WEST TARKIO CREEK
Watershed Plan
And
Environmental Impact Statement

Montgomery, Fremont and Page Counties, Iowa
Atchison County, Missouri

U.S. Department of Agriculture
Natural Resources Conservation Service

March 2006

WEST TARKIO CREEK WATERSHED
WATERSHED PLAN - ENVIRONMENTAL IMPACT STATEMENT
PAGE COUNTY, IOWA

Public Law 83-566

ABSTRACT: This document sets forth a recommended plan to construct a multi-purpose structure that provides for water supply, recreational opportunities and agricultural pollution control. The plan consists of construction of a structure creating a 1,818 acre lake in Page County; associated outdoor recreation facilities; raw water intake and water transmission lines; and sediment basins that reduce agricultural pollutants to the lake. Total estimated installation costs are $63,105,700.

PREPARED BY THE:
Cities of Clarinda and Shenandoah, Iowa
City of Tarkio, Missouri
Atchison County Soil and Water Conservation District, Missouri
Page County Soil and Water Conservation District, Iowa
USDA, Natural Resources Conservation Service

FOR ADDITIONAL INFORMATION CONTACT:
Richard Van Klaveren, State Conservationist, Natural Resources Conservation Service, 210 Walnut Street, 693 Federal Building, Des Moines, Iowa 50309, Phone: (515) 284-6655.

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Cover image:
A computer generated image of the preferred alternative multi-purpose dam, pool, and adjacent area.

Summary

Project Name
West Tarkio Creek Watershed

Counties and States
Page, Montgomery and Fremont Counties, Iowa and Atchison County, Missouri

Description of Recommended Plan
The plan consists of constructing a detention dam that will have a drainage area of 30,380 acres and have a permanent pool of 1,818 acres that will be used for water supply and water-based recreation. Basic recreation facilities are included. Thirty-nine sediment basins and one in-channel structure will be constructed upstream of the multi-purpose site in order to reduce agricultural pollution of the lake.

Authority
The project is planned under the authority of the Watershed Protection and Flood Prevention Act, Public Law 83-566, and the Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2006, PL-109-97.

Purpose and Need
The project purposes are: a) provide an adequate and safe regional water supply that includes the cities of Shenandoah and Clarinda, Iowa, b) provide water based recreation opportunities, and c) agricultural pollution control.

The needs for the project are: a) Shenandoah and Clarinda need to increase their current water supply capacity to four million gallons per day to provide for the basic health and sanitary requirements of their citizens, to maintain existing businesses and industries, and to enhance the area for economic development, b) According to studies by the Iowa Department of Natural Resources (IDNR, 2001), University of Northern Iowa Center for Social and Behavioral Research (Gonnerman et. al., 2000), and the Iowa State University Center for Agriculture and Rural Development (CARD) (Azevedo et. al., 2003) there is an unmet need for the types of outdoor recreation that would be provided by a multiple purpose reservoir in the West Tarkio Creek watershed, and c) The need for agricultural pollution control is to further protect the 1,818 acre water impoundment from runoff in the 30,380 acre watershed. This will minimize the quantity of runoff constituents like sediment and attached pollutants delivered to the impoundment.

Resource Information
Latitude and longitude: y lat 40.76 DD, x long -95.27 DD
8-digit hydrologic number: 10240005

Climate

The climate is mid-continental with warm summers and cold winters. The mean annual temperature in the summer is 74 degrees Fahrenheit while the mean temperature in the winter is 25 degrees. Average annual precipitation is 31.7 inches, with 22.9 inches occurring during the months of April through September.

Topography

The watershed is in the Southern Iowa Drift Plain landform region. This region is gently to strongly sloping and is characterized by moderately wide, slightly rounded ridges with strongly sloping side slopes and well-defined alluvial valleys.

Size of West Tarkio Creek Watershed

The watershed project area is 105,290 acres; 70,790 acres in Page, Fremont, and Montgomery Counties in southwest Iowa and 34,500 acres in Atchison County, in northwest Missouri. The recommended plan detention dam and its 30,380 acre watershed are located entirely in Page and Montgomery Counties. The acquisition area for the recommended plan is entirely within Page County, Iowa.

Land Uses in West Tarkio Creek Watershed

The 105,290 acre West Tarkio Creek watershed is primarily in agricultural uses. Land uses include; cropland 79 percent, grassland 10 percent, forestland five percent, and other land six percent.

Alternative Plans Considered

Four locations on West Tarkio Creek in Page County were investigated to determine the feasibility of a multi-purpose structure at each site using various water surface elevations. Most of the locations were dropped from further study as they would not provide the required four million gallons of water per day. Groundwater was studied initially as a water source but was dropped from further study as groundwater does not meet the objective of providing water based recreation.

Project Costs

	PL 83-566 funds		Other funds		Total	
	$	%	$	%	$	%
Construction	13,726,400	50	13,726,400	50	27,452,800	100
Engineering	1,915,400	50	1,915,400	50	3,830,800	100
Real Property Rights	14,547,600	50	14,547,500	50	29,095,100	100
Relocation	725,000	50	725,000	50	1,450,000	100
Administration	638,500	50	638,500	50	1,277,000	100
Total	31,552,900	50	31,552,800	50	63,105,700*	100

*Does not include associated costs of $500,000 for Shenandoah to upgrade water treatment plant

Project Benefits

	Average Annual Benefits $
Agricultural Water Management	1,625,400
Recreation	8,589,900
Agricultural Pollution Control	423,600

Net Beneficial Effects (NED)
$ 6,952,000 average annual

Period of Evaluation
The period of evaluation is 100 years

Project Life
The project life is 100 years.

Environmental Impacts
See Scoping Table

Major Conclusions
Alternative #6 is the National Economic Development (NED) plan and the preferred alternative. This plan meets the sponsor's objectives of developing a source of public water supply of at least four million gallons per day, providing water-based recreation facilities, and agricultural pollution control to protect the impoundment while maximizing net economic benefits. The plan consists of construction of a structure creating a 1,818 acre lake in Page County; associated outdoor recreation facilities; raw water intake and water transmission lines; and sediment basins that reduce agricultural pollutants to the lake. The sponsors will acquire 6,186 acres of agricultural land for the project

Areas of Controversy
Some landowners in and near the proposed impoundment and public acquisition area have expressed their opposition to the project. They do not want to sell their land. The sponsors are prepared to acquire the land via eminent domain if necessary.

Issues to be Resolved
None

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Purpose and Need for Action

Purpose of the Project

The purpose of the project is to provide a safe, environmentally sound, and cost-effective supply of water that provides at least four million gallons per day (mgd) for the cities of Shenandoah and Clarinda, Iowa, as well as the surrounding rural area. A second project purpose is to develop a high quality public recreation area that will fill a portion of the area's unmet demand for water-based recreation.

Need for the Project

Water Supply

Shenandoah and Clarinda need to increase their current water supply to provide for the basic health and sanitary requirements of their citizens, to maintain existing businesses and industries, and to enhance the area for economic development. Current total peak daily demand for both communities is about 2.4 mgd.

The City of Shenandoah currently uses nine shallow wells that are drilled into the alluvial valley of the East Nishnabotna River. They range in depth from 34 to 73 feet and average 44 feet deep. The total yield of the nine active wells declined from about 1,840,000 gallons per day in 1999 to 1,220,000 gallons per day in 2001, a decrease of 34 percent. Industry standards require a minimum supply capacity capable of providing the peak day demand in 24 hours with the largest well out of service for repair. Under such conditions, the current peak daily supply is about 980,000 gallons. The current peak day demand is about 1,200,000 gallons (Green, 2001), a deficit of about 220,000 gallons per day.

The City of Shenandoah invoked emergency water conservation measures in 1999, 2000, and 2001. Residents complied with the water conservation order to prevent the water supply from being overdrawn.

The City of Clarinda uses the West Nodaway River as their source of water. The current average daily demand is about 782,000 gallons per day, with peak daily demand of 1,200,000 gallons (Green, 2001). This includes water sold to the Page Rural 1 Water District, which serves customers in all rural areas of Page County and some rural areas in Fremont, Montgomery, and Taylor Counties.

The flow of the West Nodaway River at Clarinda is insufficient to meet both water supply demand and protected low flow purposes. At the Clarinda gauging station the Protected Low Flow (PLF) as set by IDNR is 15 cubic feet per second (cfs) (Bartlett and West, 2002). The Iowa Administrative Code defines Protected Low Flow as: "The protected flow is designed to protect and maintain adequate water supplies for ordinary household and livestock use; for fish and wildlife use; for recreational use; for in-stream wasteload assimilation and pollution control; for beneficial water use need in the watershed; for preservation of aesthetic values; and for other uses of a public nature".

Photo 1. West Nodaway River at Clarinda, IA, January 2006 (NRCS Photo).
The Clarinda water supply intake structure and low-head dam are shown in this photograph. City water withdrawals continue even in low flow conditions as shown.

Figure A. shows the most recent two years data (March 2004-March 2006) of seasonal flows. (USGS, 2006) In early 2006, daily minimum discharge (flows) of less than 15cfs have occurred.

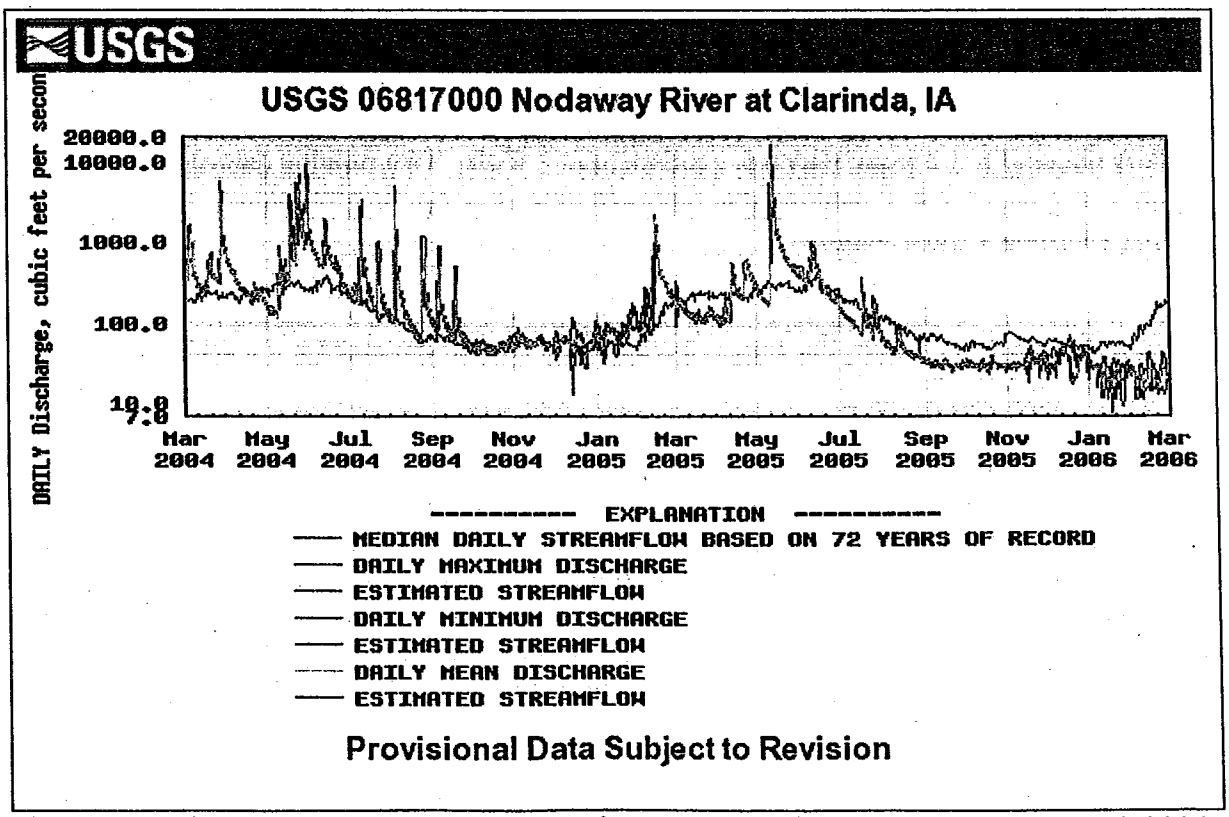

Figure A. Daily discharge of the Nodaway River at Clarinda, IA. March 2004-March 2006

During the data period of 1918 through 2000, every month of the year at some time in the past had a flow less than 15 cfs. The table below summarizes Nodaway River flows for that period of record.

Table A
Summary of historical water flow in Nodaway River at Clarinda, IA.
1918-2000

Month	Max (cfs)	Min (cfs)	Average (cfs)
January	5940	5	130
February	11500	7	312
March	16400	10	561
April	14800	8	567
May	17200	6	693
June	20000	3.8	762
July	19100	5	435
August	22200	2	233
September	25500	1	315
October	18300	6	177
November	4740	3	174
December	8440	1	138

The preceding table shows record monthly minimum flows, all of which are below the PLF of 15 cfs. United States Geological Survey (USGS) stream flow data indicate the daily flow dropped below the PLF seven percent of the time between 1918 and 2000. Clarinda's current peak daily demand is 1.2 mgd, which is equivalent to 1.8 cfs. Two months record minimum flows are less than 1.8 cfs, indicating that there are times the river is physically incapable of providing Clarinda's water supply.

In order to meet the current demands of the populations and provide a reasonable supply of water for increased commerce within the area, the cities set a goal of developing a water source capable of supplying four mgd.

Water-based Recreation
According to studies by the IDNR, University of Northern Iowa Center for Social and Behavioral Research, and CARD, there is an unmet need for the types of outdoor recreation that would be provided by a multiple purpose reservoir in the West Tarkio Creek watershed. Similar studies conducted in adjoining states by the Missouri Department of Conservation and Department of Natural Resources (MDNR, 2003), Nebraska Game and Parks Commission (NGPC, 2000), and Kansas Department of Wildlife and Parks (KDWP, 2003), revealed an overall regional deficiency in outdoor recreation opportunities.

Survey results from the *Recreational Activities & Environmental Opinions: A Statewide Survey of Adult Iowans* (2000) revealed that one-fifth (21.9 percent) of those surveyed felt that their

recreational opportunities were severely limited. The five most limited, unsuitable or inhibited recreational activities in Iowa were 1) biking on paved trails (14.7 percent), 2) power boating/water skiing (13.9 percent), 3) hiking/nature/backpacking walks (13.5 percent), 4) fishing (13.1 percent) and 5) swimming in lake/river/pond (eight percent). Similarly, the *Survey of Iowa State Park and Recreation Area Users* (2000), showed that one-third (33.2 percent) of park users would like to see more lakes for fishing. About 30 percent would like to see more overnight cabins, and one-fourth (25.4 percent) would like to see additional swimming areas; and 20.6 percent would like to see more lakes for boating activities. The 2003 Missouri Statewide Comprehensive Outdoor Recreation Plan (SCORP) cited survey results stating that more fishing opportunities was the number one facility/activity most desired by residents, with more lakes in general coming in second.

Ten common outdoor recreation activities that could be provided by a multiple-purpose reservoir and recreation area were evaluated by NRCS. The existing supply and demand for fishing, boating, hunting, developed camping, primitive camping, and water skiing within a 75 mile radius of the project area were determined. The existing supply and demand for hiking, biking, picnicking, nature study, and lake swimming within a 25 mile radius of the project area were determined. The evaluation shows an unmet need of over 10,000,000 visitor days for these ten outdoor activities exists. See Appendix D for details.

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Scope of the EIS

This project involves the development of a plan to manage, protect, and enhance water and land resources in the West Tarkio Creek Watershed. The watershed project area is 105,290 acres; 70,790 acres in Page, Montgomery, and Fremont Counties in southwest Iowa, and 34,500 acres in Atchison County, Missouri. The upper end of the watershed is five miles northeast of Red Oak, Iowa. The City of Tarkio, Missouri, is at the downstream boundary of the project area.

The original sponsors included the Page, Montgomery, and Atchison county governments, the Page, Montgomery, and Atchison county soil and water conservation districts, the City of Tarkio, Missouri, as well as the cities of Clarinda and Shenandoah, Iowa. The sponsors formed the West Tarkio Watershed Planning Committee to serve as a local decision-making body for the project. The Planning Committee is made up of representatives from the sponsoring groups plus four local watershed residents.

The sponsors' original objectives were regional water supply including the cities of Clarinda and Shenandoah, flood damage reduction for the City of Tarkio and agricultural land, water based recreation, grade stabilization of West Tarkio Creek and its tributaries, upland gully and erosion control, and agricultural pollution control.

The NRCS planning assistance is being provided under the authority of the Watershed Protection and Flood Prevention Act, Public Law 83-566 and Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2006, PL109-97. The NRCS has completed studies to determine the extent of natural resource problems and needs in accordance with the sponsors' objectives.

Preliminary studies of flood damages, grade stabilization, and upland gully and erosion damages were conducted early in the planning process.

The West Tarkio Creek floodplain contains approximately 8,400 acres. Floodwater damages crops, pastures, other agricultural facilities such as fences, farmsteads, and farm crossings, and non-agricultural facilities such as roads, bridges, and public utilities and urban residences and businesses.

Damages to cropland consist of complete or partial loss of crops due to sustained inundation and reduction of yields on areas inundated for shorter periods of time. Floodwater may delay planting and other field operations in the spring or harvest in the fall. Delayed planting or replanting may lead to the substitution of lower value crops. Pasture damages consist of reduction in quantity and quality of forage. Sustained inundation may necessitate replanting forage species. Other agricultural facilities such as fences and farm crossings may be damaged by the action of floodwaters. If farm crossings are washed out, farmers with land on both sides of a stream may have to make long detours to reach farm fields. Estimated average annual agricultural floodwater damages are about $252,000.

High flow accompanying flood events may damage transportation facilities by removal of surfacing materials, road embankment erosion, and occasionally bridges or culverts. Roads

closed by high water, erosion of embankments, or loss of bridges, necessitate rerouting of traffic. The rerouting cause delays for residents, school buses, and may delay response by emergency vehicles. Flooded roads, washed-out crossings, and delayed response by emergency vehicles all pose safety hazards for travelers and residents of the watershed. Annual damages to roads, bridges, and rerouting traffic are estimated to be $19,000.

The city of Tarkio, Missouri has experienced damages from flood events in 1993, 1995 and 1998. Following a flood event in 1993, the Federal Emergency Management Agency (FEMA) bought out some of the flood damaged houses and businesses. Three houses and 15 businesses/buildings are still subject to flooding. Estimated average annual flood damages in the city of Tarkio are approximately $7,000.

Areas voided by permanent gully erosion can suffer significant economic losses while adjacent areas experience depreciation of the land resource. Currently, an estimated 17 acres are voided and 46 acres are depreciated per year as a result of permanent gully erosion in the West Tarkio Creek watershed. Estimated average annual damage from voiding and depreciation is $2,700.

Preliminary study results indicate that damages related to the sponsors' objectives of flood damage reduction, grade stabilization, and upland gully and erosion control is not economically feasible. Other federal and state programs can be used to satisfy landowner requests for upland gully and erosion control. These three purposes were dropped from further study.

The NRCS studies indicate that the sponsors' objectives of water supply, water based recreation, and agricultural pollution control are likely to be economically feasible. Additional study for these project purposes was completed.

The original sponsors reconsidered their interest in the project considering the change in project purposes. Remaining sponsors are the cities of Clarinda and Shenandoah, Iowa, and Tarkio, Missouri; the Page County Soil and Water Conservation District, and the Atchison County Soil and Water Conservation District.

Four study sites on the main channel of West Tarkio Creek, all located in Page County Iowa, were initially identified for possible multiple-purpose reservoir sites. One study site was dropped from further consideration after it was determined that it would have more effect on public roads than other alternatives.

Studies indicated each remaining site could be developed as a multi-purpose water impoundment to provide water based recreation and water supply. Six preliminary alternatives for multiple-purpose reservoirs were developed, two alternatives at each study site. The permanent pool sizes of the six preliminary alternatives ranged from 1,100 acres to 1,818 acres.

Groundwater was investigated as a water supply source as a result of public comment. The NRCS consulted with groundwater experts from the Iowa Geological Survey Bureau of the Iowa Department of Natural Resources and the US Geological Survey. Generalized sources of groundwater were identified in the area. There was no sponsor support for an alternative plan featuring groundwater because it could not meet the water-based recreation project purpose.

Preliminary alternatives that do not meet the sponsors' objectives were removed from further study and consideration. Each alternative plan that was carried through detailed planning was compared against a no action plan as a basis to determine effects. The sponsors will select an alternative plan based on the effects, economic evaluation, and the extent that it meets their objectives. The project will include one multi-purpose reservoir for the purposes of water supply and water-based recreation. Sediment basins will be included in the planned project in order to further protect the new multiple-purpose site from agricultural pollution.

Based on public participation, sponsor and landowner objectives, NRCS policy, federal and state laws, and agency consultation, the following table, Table B - Summary of Scoping, was developed. Resource concerns listed in Table B were evaluated to analyze effects of proposed alternative actions. These evaluations are described further in the section, "Alternatives."

Table B. Summary of Scoping

Resource Concern	Relevant to the Proposed Action?		Rationale
Sponsors, Public, Agencies	**Yes**	**No**	
Flood Damages		X	Sponsor objective; Determined not to be cost effective for project action
Soil Erosion and Sedimentation	X		Sponsor objective; Essential for structure design and economic evaluation for water quality purpose
Local Economy	X		Sponsors are interested in diversifying local economy
Recreation	X		Sponsor objective; Address statewide and regional deficit
Public Water Supply	X		Sponsor objective; Provide reliable quantity of water for local needs and enhance local economy
Water Quality	X		Sponsor objective; Basic health and sanitary requirements of their citizens and enhance local economy
Century Farms	X		Identified by watershed residents
Impoundment Effects on Downstream Wells	X		Identified by watershed residents
Impoundment Effects on Stream Baseflow	X		Identified by watershed residents
NRCS Requirements			
Air Quality		X	Project not an air quality attainment area; minor fugitive dust during construction of dam
Coral Reefs		X	None present in area of project impact
Ecologically Critical Areas		X	None present in area of project impact
Environmental Justice	X		No identified Limited Resource Farmers affected; no tribal land present
Essential Fish Habitat		X	No designated essential fish habitat in project area
Fish and Wildlife Coordination	X		Tri-agency biology coordination is completed, planned project measures will provide net gain in woodland and grassland habitat
Floodplain Management		X	EAP will be developed prior to construction
Historic Cultural and Scientific Resources	X		Tribes have been consulted; no known significant historic and archaeological sites in the project area
Invasive Species	X		Potential for aquatic invasive species to become established
Migratory Birds	X		Conversion of agricultural land to wildlife areas benefits migratory birds; lake will benefit migratory waterfowl and shorebirds
National Economic Development (NED)	X		Required by Principles and Guidelines
Natural Areas		X	None exist in project area, predominantly cropland and pastureland
Parklands	X		Project will create parkland
Prime and Unique Farmland	X		Direct impact on prime farmland
Public Health and Safety	X		Project will provide a readily available water source for fire fighting
Regional Water Resource Plans		X	No current regional water resource plan is available
Riparian Areas	X		Project will inundate riparian area in multi-purpose pool area, 39 upland sediment basins will enhance downstream riparian areas
Scenic Beauty	X		Proposed action enhances visual diversity
Threatened & Endangered Species	X		No impact on federally listed species; no impact to state listed species
Waters of the US	X		Waters of the U.S. will be impacted, Sponsors will obtain Section 404 CWA permit prior to any project construction
Wetlands	X		Project will create wetlands in the upper reaches of the multi-purpose pool and in the pools of the 39 sediment retention basins
Wild and Scenic Rivers		X	None present in area of project impact

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Affected Environment

West Tarkio Creek watershed is located in Page, Fremont and Montgomery counties in southwest Iowa and Atchison County in northwest Missouri. The 8-digit Hydrologic Unit Code (HUC) is 10240005 and is identified as Missouri River/Tarkio River. West Tarkio's headwaters are located about five miles northeast of the City of Red Oak, Iowa and flows generally in a south-southwest direction through the City of Tarkio, Missouri which is also the confluence with the Tarkio River. The watershed consists of two subwatersheds, West Tarkio Creek (132 square miles), and the Middle Tarkio Creek (33 square miles). The watershed area has a total drainage area of approximately 165 square miles. See Project Map in Appendix F.

The watershed drainage area by county is:

County	Acres
Montgomery, IA	14,840
Page, IA	53,630
Fremont, IA	2,320[1]
Atchison, MO	34,500
Total	105,290

[1] Since Fremont County is 2.2 percent of the entire watershed, additional information about the county is not included in the remainder of this plan

West Tarkio Creek watershed is located within the Southern Iowa Drift Plain landform region. This region is gently to strongly sloping and is characterized by moderately wide, slightly rounded ridges with strongly sloping side slopes and well-defined alluvial valleys. Loess covers most of the upland area, although till outcrops on the lower part of the strongly sloping flanks. The native vegetation was primarily native grasses.

Upland soils consist primarily of the Marshall soil association which are well drained soils that are silty clay loam throughout. The ridge tops are loess material, while many of the side slopes are glacial till and well drained. The larger drainageways have adjacent alluvial deposits.

Most of the soils are either loess or alluvium derived. The loess soils, which were deposited by wind, are the most extensive parent material in the watershed. These soils are mostly on the uplands and benches. The loess consists of mainly silt-sized particles and is calcareous. The loess formed in Wisconsin loess, which is believed to have blown mainly from the flood plain of the Missouri River during the Wisconsin glacial period. The loess is thinner (18 feet thick) and finer textured in the eastern part of the watershed than the western part (25 feet thick). Alluvium material is sediment laid down along the major streams and narrow upland drainageways.

The climate is mid-continental with warm summers and cold winters. Average annual precipitation is 31.7 inches, with 22.9 inches occurring as rain during the months of April through September. Runoff from intense, short duration rainfalls, typical of this climate, causes erosion and produces sediment and flooding to the streams and floodplain. Average annual runoff is 6.2 inches. Snowfall averages 27 inches annually. Average frost free growing season is 164 days, from April 28th to October 9th. Mean annual temperature in the winter is 25 degrees

Fahrenheit while the mean temperature in the summer is 74 degrees. The annual free water surface evaporation rate is 42 inches.

West Tarkio Creek is classified for designated uses by IDNR as Class B(LR) (see glossary) in the 2000 and 2001 305(b) Assessment Report (IDNR, 2001). Waters designated as class "B" waters are to be protected for wildlife, fish, aquatic and semi-aquatic life, and secondary contact water uses (IDNR, 2001). The segment assesses only from the Iowa/Missouri state line to five river miles north of Highway 2 (section 9, T69N, R38W Page County) and does not include Middle Tarkio Creek which is included in the watershed. The creek partially supports its overall use and aquatic life. The 1995 biocriteria sampling assessment indicates both the fish IBI (Index of Biological Integrity) and the biological monitoring IBI as fair (IDNR, 2001). Habitat and the fish community have been diminished by historic channelization and flow extremes. In November 2005, the EPA added West Tarkio Creek to Iowa's 2004 Clean Water Act Section 303(d) list of Impaired Waters. The designated pollutant is listed as unknown. The 2004 biological communities (fish) assessment suggests impairment of aquatic life use. (EPA, 2005)

The West Tarkio stream system is ephemeral in the upper reaches and intermittent in the lower reaches with water typically present throughout the year. In late summer base flow often diminishes or ceases and the stream is reduced to a series of connected pools with little flow or no flow. Six IDNR fish survey records collected between the years of 1983 - 1999 indicate that the system supports a fishery primarily composed of minnow species. Detailed information, including species, is in Appendix E. The suckermouth minnow, an uncommon fish species in Iowa, was a minor component of the fish community.

Photo 2. West Tarkio Creek (Photo provided by Cheryl Lundgren).

No watershed specific records occur for reptiles, amphibians, or other aquatic species within West Tarkio Creek watershed. However, six species of amphibian (eastern gray treefrog, plains leopard frog, American toad, Woodhouse's toad, Blanchard's cricket frog, and smallmouth salamander) may be present in existing ponds and possibly the stream. These amphibian species have stable populations within Iowa, with the exception of the Blanchard's cricket frog and the smallmouth salamander, which are listed as having vulnerable, declining state populations. Five snake species may occur within the watershed, including the ringneck snake, brown snake, bullsnake, plains and eastern garter snakes. The bullsnake is a special concern species in Iowa and is the only reptile species within the project area with a declining population status statewide.

Ten Iowa butterfly species of conservation concern have been recorded within Page and Montgomery Counties (Appendix E). Larval food plant(s) are commonly the limiting

factor for each of these species, with the majority of these butterflies dependant upon prairie, wet meadow, savanna, or riparian woodland habitats which are nonexistent or very limited within the project area.

Appendix E contains a list of known breeding birds and a list of migratory birds found in Page and Montgomery counties. The intense agricultural land uses for the watershed have resulted in the area being populated mainly by generalist species. Small populations of ring-necked pheasant and bobwhite quail are present in the watershed. In addition, avian species such as American robin, eastern meadowlark, red-winged blackbird, red tailed hawk, American crow, blue jay, killdeer, gray catbird, barn and tree swallow, red-headed woodpecker, brown creeper, and mourning dove would be typical of the birds using the grass and woodland habitats in the project area.

Mammal species in the watershed are also primarily generalist species adapted to a highly disturbed agricultural landscape. Species found in West Tarkio include white-tail deer, raccoon, striped skunk, fox squirrel, cottontail rabbit, coyote, and various rodent species.

According to USDA soil survey data, 99.7% of the West Tarkio Watershed was historically dominated by prairie community types, while transitional woodlands occupied approximately 0.3% of the watershed and occurred in a few clustered, highly isolated locations (USDA 1978; USDA 1989). For the most part, the historic prairie vegetation has been converted to, and is functioning as, cropland or pastureland today. Most of the historically wooded areas have been cleared for agricultural production. Present day wooded areas are a result of unheeded succession along historically prairie dominated riparian corridors, and areas established to windbreaks around farmsteads. Additional wooded areas include draws and steep slope lands due to the removal of prairie maintaining ecological processes such as grazing and fire.

Although six percent of the watershed consists of hydric soils, few wetlands are present in the watershed today. Any remaining wetlands are likely small, scattered areas that occur within the banks of the stream system itself. These wetland areas occur due to channel evolution and the reestablishment of a secondary floodplain within the stream banks along certain reaches of the stream. Some artificial wetlands exist in peripheral areas of livestock ponds but there are not any identified natural wetland areas in the uplands or within the out of bank flood plain.

Communities within the watershed include Tarkio, MO (population 1,895), Westboro, MO (population 163), and Northboro, IA (population 60) according to the 2000 US Census. The economy of the watershed is predominantly agriculture.

The population trend, like many rural areas in Iowa and Missouri, is declining, with the exception of outlying metropolitan areas. Atchison County (6,300; 2004 population), Page County (16,200; 2004 population) and Montgomery County (11,400; 2004 population) lost two-five percent from 2000 to 2004. (US Census) Average annual net cash farm income in 2002 was $37,530 in Montgomery County; $31,640 in Atchison County and $22,872 in Page County (2002 Census of Agriculture). On the contrary, the nearby metropolitan areas of Omaha, NE/Council Bluffs, IA and Lincoln, NE have experienced positive net migration for several consecutive years. The City of Omaha and Douglas County have shown population increases of nine and 11.3 percent respectively between 1990 and 2000, with additional increases of four percent from 2000-2004. Similarly, the City of Lincoln and Lancaster County have increases of

17 and 17.2 percent in population in the period from 1990-2000, with additional increases of 4.5 percent posted from 2000-2004. Within Iowa, the City of Council Bluffs and Pottawattamie County showed population increases of 6.4 percent and 6.1 percent respectively from 1990-2000, with additional gains of 0.7 percent and 1.6 percent between 2000-2004 (US Census).

Average size of farms are 388 acres in Page County, 416 acres in Montgomery County and 683 acres in Atchison County with the trend toward larger and fewer farms. The predominant landuse in the watershed is cropland (79 percent) which is evenly split between corn for grain and soybeans. (See Table C below). Corn and soybeans are grown on 94 percent of the cropland acres with the remaining six percent in forages. Ten percent of the watershed is grassland. Land ownership in the watershed is primarily private.

Table C
Landuse in the West Tarkio Creek Watershed

Current Land Use Area	Iowa	Missouri	Total	% of Drainage
	(acres)			
Cropland[1)]	56,214	27,144	83,358	79%
Grassland[2)]	7,428	2,879	10,307	10%
Forest land	3,166	2,639	5,805	5%
Other[3)]	3,982	1,838	5,820	6%
Total	70,790	34,500	105,290	100%

1) approximately 94 percent is rowcrop (corn soybean) 6 percent forages
2) approximately 60 percent of grassland is pastureland, 30 percent CRP, the balance is riparian buffers and odd areas
3) includes farmsteads, roads, railroads, bicycle trails, ponds, urbanized areas

Cropland soils are typically classified as highly erodible land (HEL). Typical slope steepness ranges from 5-14 percent which can result in excess sheet and rill erosion, ephemeral erosion, and gully erosion unless adequate erosion control practices are implemented.

Table D (below) is a summary of erosion by water and sediment yield in the watershed. Gross erosion in the watershed from all sources, including sheet and rill, channel, gully and ephemeral gully erosion, is about 381,000 tons per year, or an average annual rate of 3.6 tons per acre per year. About 102,000 tons of this sediment is delivered to the Tarkio River at the City of Tarkio, Missouri. Eighty-six percent of the cropland in the drainage area is adequately treated using conservation tillage, terraces and contour farming. Nearly 50 percent of the cropland acres are terraced and an additional 24 percent is farmed on the contour. These percentages make this watershed one of the most protected watersheds in southwest Iowa due to the efforts of the on-going conservation efforts of the farmers and the soil and water conservation districts.

All three Soil and Water Conservation Districts (SWCD) have active soil conservation programs within the watershed. Page and Montgomery SWCD's have a joint grant through a state program that addresses soil erosion in the watershed above Highway 2. Page and Montgomery SWCD's prioritized their regular state cost-share monies and utilized no-interest loans provided by the State of Iowa. The USDA EQIP program prioritizes the watershed and several jobs have

been completed. Once the location of the lake has been determined by the sponsors, both SWCD's will pursue additional funding for land treatment within that watershed.

Table D
Summary of Erosion and Sediment Yield, West Tarkio Watershed.

Erosion Type & Source	*Area* (ac)	*Length* (mi)	*Erosion Rate* (t/ac/yr)	(t/mi/yr)	*Soil Loss* (t/yr)	*SDR* (%)	*Sediment Yield* (t/yr)	*Percent of Total*
Sheet & Rill Erosion	*105,290*		*3.2* [1]		*336,358*	*20*	*67,272*	*65.8*
Channel Erosion		*160*	*0.21* [1]	*142*	*22,684*	*85*	*19,281*	*18.8*
Classic Gully Erosion			*0.06* [1]		*5,841*	*85*	*4,965*	*4.9*
Ephemeral Cropland Gully Erosion			*0.16* [2]		*16,557*	*65*	*10,762*	*10.5*
TOTAL	**105,290**		**3.62**		**381,440**		**102,280**[3]	**100**

[1] Soil loss averaged out over the entire watershed.
[2] Soil loss averaged out over the entire watershed. The rate on unterraced cropland is 0.38 t/ac/yr.
[3] Sediment yield is to the Tarkio River at Tarkio MO.

There are 92 livestock operations in the Iowa portion of the watershed. There are approximately 4,100 head in 53 cow/calf herds. They tend to be smaller operations that sell the calves in the fall. These herds typically are on pasture near streams. Pastures are typically overgrazed, inviting invasive weed species resulting in poor forage quality. The cattle have direct access to the stream contributing to eroding streambanks, and manure and urine deposition into the stream. There are also 22 feeder cattle operations in the watershed with approximately 3,000 head in small lots. There are 13 hog operations in the watershed, mostly confinement, with approximately 14,200 head, typically in finishing units. This includes one large hog finishing unit, and trends indicate that additional facilities may locate in the watershed. Four sheep operations with 140 head are also in the watershed.

The City of Shenandoah currently uses nine shallow wells ranging from 34-73 feet (averaging 44 feet) drilled into the alluvial valley of the East Nishnabotna River as their source of potable water. The total capacity of the nine active wells declined from about 1,840,000 gallons per day in 1999 to 1,220,000 gallons per day in 2001, a decrease of 33 percent. Industry standards require a minimum supply capacity capable of providing the peak day demand in 24 hours with the largest well out of service for repair. Under such conditions, the current peak daily supply is about 980,000 gallons. The current peak day demand is about 1,200,000 gallons, a deficit of about 220,000 gallons per day. (Green, 2001).

The City of Clarinda uses the West Nodaway River as their source of potable water. The current average daily demand is about 782,000 gallons per day, with peak daily demand of 1.2 million

gallons (Green, 2001). This includes water sold to the Page Rural 1 Water District, which serves customers in all rural areas of Page County and some rural areas in Montgomery, and Taylor Counties.

During the data period of 1918 through 2000, the West Nodaway River had a flow less than 15 cfs every month of the year at some time in the past. As recently as the summer of 2002, the flow was less than 15 cfs. Table A summarizes Nodaway River flows for that period of record. USGS stream flow data indicate the daily flow dropped below the PLF seven percent of the time between 1918 and 2000. During these periods of low flow, Clarinda has a water supply deficit.

Most of the communities and residents in southwest Iowa rely on shallow groundwater sources because of unacceptable water quality in deeper aquifers. These problems include excessive hardness, high iron concentrations often exceed secondary drinking water standards, and sulfate concentrations from some aquifers can exceed the secondary drinking water standard. (USGS, 1992).

There are 11 water-based public recreational facilities within a 25 mile radius of the West Tarkio Watershed, and a total of 88 within a 75 mile radius, including lakes in Iowa, Missouri, Nebraska and Kansas. The recreation areas range in size from 10 acres to 1,006 acres (averaging 138 acres). These areas have a wide variety of amenities available, ranging from none to a full fledged resort. A complete assessment of the existing water-based recreational facilities within a 75 mile radius of the West Tarkio Watershed can be found in Appendix E.

The major Midwest population centers of Omaha/Council Bluffs (population 448,647, 1 hour 15 minutes travel time), and Lincoln, NE (population 232,362, 1 hour 40 minutes travel time), are within a 75 mile radius of the watershed. It is anticipated these metropolitan areas will continue to grow in population. In total, 1,281,561 people live within that 75 mile radius (U.S. Census Bureau 2003). The Omaha and Lincoln areas are of particular interest because they hold 33.2 percent of Nebraska's population, but only 2.2 percent of its recreation resources. This is an area that has unmet recreation demands, and residents of this region fuel demands for recreation not only across Nebraska but across its borders and into Iowa as well (NGPC 1995).

In addition, from a regional perspective, two other major metropolitan areas are within 150 miles- Kansas City, MO (2 hours 32 minutes travel time), and Des Moines, IA (2 hours 42 minutes travel time). All of these cities (including Omaha/Council Bluffs and Lincoln) offer international or regional commercial airline service, further enhancing the intermodal transportation structure present around West Tarkio Watershed.

Access to the nation's Interstate highway system is within easy driving distance of both Shenandoah and Clarinda. I-80 East is 50 miles north at Avoca. I-80 West is best reached by driving 25 miles west to the Highway 2/I-29 exit and then onward for 40 miles to Lincoln, NE where I-80 offers access to the West Coast. The same route (only turning north on I-29) provides a route to South Dakota, North Dakota and Canada. For southbound traffic to I-29 South, the entrance ramp at Craig, MO is 40 minutes away, eventually leading to Kansas City 95 miles beyond. I-35 between Kansas City and Des Moines is 90 minutes east of the project. Two lane highways, Iowa 2 and US 34 (east/west) and US 71/59 (north/south) are immediately accessible for local travel and hard surface access to the project area. (See map in Appendix C)

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Alternatives

General

Alternatives were studied that addressed the project purposes identified by the Sponsors. The Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G) were used to evaluate alternatives consistent with NRCS policy. The broad objective of P&G is to maximize national economic development while protecting the nation's environment.

Planning and installation of this project is authorized under the authority of the Watershed Protection and Flood Prevention Act, Public Law 83-566 and the Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2006, PL 109-97. Authorized project purposes are agricultural water management – rural water supply; agricultural pollution control; and public recreation. Policy and procedures used are contained in the NRCS National Watershed Manual and the NRCS National Watershed Program Handbook.

This Plan-Environmental Impact Statement (EIS) was formulated to solve water supply and recreation needs identified by local residents and sponsors in the watershed. These problems include excessive hardness, high iron concentrations often exceed secondary drinking water standards, and sulfate concentrations from some aquifers can exceed the secondary drinking water standard. (USGS, 1992). In addition, economic growth is also limited because industrial, commercial and residential development will create significantly more demand for water than the current sources can provide.

Formulation Process

The formulation process was used to identify alternatives that meet the following criteria that would:

1. be economically feasible,
2. provide a water supply capacity of at least four million gallons per day (mgd),
3. provide water-based outdoor recreation,
4. protect the water quality of the planned water supply.

Formulation proceeded with an inventory of potential reservoir sites on West Tarkio Creek because the watershed is large enough to meet the projected minimum demand, and because of its proximity to the water treatment plant near Shenandoah. Sites were selected that would provide a reservoir large enough to meet the sponsors water supply needs. Both surface water and groundwater were studied as potential sources of water.

Surface water storage sites at four locations (Sites 1-4) were identified. See Map in Appendix C for locations.

The sponsors wanted to develop alternatives that would reflect PL-566 maximum limits of 25,000 acre/feet in a single structure site. In addition, the sponsors wanted to maximize the water yield potential at each site. Subsequently, two alternatives were developed at each site. Only one alternative was developed at site 4 because the drainage area was too large to stay below the 25,000 acre/feet program limit.

Alternatives that met program limits for sites 1, 2, and 3 are described by the site number with no modifier (e.g. Site 3). Sites 1, 2, and 3 were then evaluated for the maximum water storage that could reasonably be expected to be sustained by the drainage area. These alternatives are described by adding the modifier "Max" to the respective site number (e.g. Site 3 Max). The maximum ratio of drainage area to pool area was determined to be 17 to 1.

Two sources of groundwater were considered in order to develop alternatives. Constructing additional wells in the East Nishnabotna River alluvium near Shenandoah was studied. Groundwater resources are also available in the Fremont Channel, a buried bedrock valley that includes part of Fremont County and the southwest corner of Page County. The spatial distribution and extent of the sand and gravel deposits of the Fremont Channel are poorly understood. Excessive hardness and both high iron and sulfate concentrations often exceeding secondary drinking water standards are problematic in deep aquifers like the Fremont Channel (USGS, 1992). In order to determine the feasibility of the Fremont Channel, a geophysical study would be required to delineate the area of buried sand and gravel deposits, followed by test drilling to confirm the results and evaluate potential well yields and groundwater quality. The sponsors were not willing to carry out these additional studies. Because the East Nishnabotna alluvium is a known groundwater source, it was determined to be the most feasible source of groundwater and the Fremont Channel was dropped from further consideration.

The Nodaway River, Clarinda's current water source, was not studied as a supplemental water source for any of the alternatives considered. As described earlier, the river is frequently incapable of maintaining the State of Iowa's PLF.

The public asked that sponsors study blending surface and groundwater sources for water supply. The existing water treatment plant in Shenandoah currently has the capability to treat surface water but needs to add turbidity and organic overload meters to meet federal and state standards.

Alternatives Considered but Eliminated From Detailed Study

Alternative 1

Alternative 1 is the smallest reservoir studied at Site 1, the most upstream location in the study area. The ratio of drainage area to pool area is 18 to 1. The average daily demand supported by this structure under drought conditions is 2.6 mgd. This is 1.4 mgd short of the sponsors' objective of at least 4.0 mgd. The existing water supply, the nine active wells located in the alluvial valley of the East Nishnabotna River, could be used to supplement this demand. However, under drought conditions they have a capacity of just under 1.0 mgd with the largest well out of service as prescribed by industry standards. Under these conditions there would still be a deficit of 0.4 mgd. This alternative did not meet the sponsors' water supply objective and was dropped from further study.

Alternative 2

Alternative 2 was developed as the largest structure at Site 1 that would be supported by the drainage area. The ratio of drainage area to pool area is 17 to 1. The average daily demand under drought conditions supported by this structure is 3.2 mgd. This is 0.8 mgd short of the sponsors' objective of at least 4.0 mgd. The existing water supply, the nine active wells located

in the alluvial valley of the East Nishnabotna River, could be used to supplement this demand. Under drought conditions they have a capacity of just under 1.0 mgd with the largest well out of service as prescribed by industry standards. This could be adequate during short term periods of drought. However, the total capacity of the existing nine active wells declined from about 1.84 mgd in 1999 to 1.22 mgd in 2001, a decrease of 33 percent (Green, 2001). Therefore the desired long-term water yield may not be sustainable. This alternative did not meet the sponsors' water supply objective and was dropped from further study.

Alternative 3

Alternative 3 is the smallest reservoir studied at Site 2, an intermediate location between Site 1 and Highway 2 that provides suitable topography for a structure. The ratio of drainage area to pool area is 23 to 1. The average daily demand supported by this structure under drought conditions is 2.0 mgd. This is 2.0 mgd short of the sponsors' objective of at least 4.0 mgd. The existing water supply, the nine active wells located in the alluvial valley of the East Nishnabotna River, could be used to supplement this demand. However, under drought conditions they have a capacity of just under 1.0 mgd with the largest well out of service as prescribed by industry standards. Under these conditions there would still be a deficit of 1.0 mgd. This alternative did not meet the sponsors' water supply objective and was dropped from further study.

Alternative 5

Alternative 5 is the smallest reservoir studied at Site 3, the site nearest to Highway 2 that is still upstream of the highway. The ratio of drainage area to pool area is 28 to 1. The average daily demand supported by this structure is 1.7 mgd. This is 2.3 mgd short of the sponsors' objective of at least 4.0 mgd. The existing water supply, the nine active wells located in the alluvial valley of the East Nishnabotna River, could be used to supplement this demand. However, under drought conditions they have a capacity of just under 1.0 mgd with the largest well out of service as prescribed by industry standards. Under these conditions there would still be a deficit of 1.3 mgd. This alternative did not meet the sponsors' water supply objective and was dropped from further study.

Alternative 7

Site 4 was developed as the most downstream site within the project and is located south of Iowa Highway 2. Alternative 7 was developed at Site 4 with a drainage area to pool area ratio of 18:1. The average daily demand supported by this structure is 7.4 mgd, which meets the projected demand. The 2,200 surface acre pool inundates Iowa Highway 2, and would require the highway to be rerouted, closed, or a bridge installed across the permanent and flood pools. This highway is a major transportation artery through southern Iowa. In addition, this site would be subject to a greater risk of contamination due to the highway's proximity. This alternative was dropped from further study because it was not acceptable to flood or close Iowa Highway 2. It is not feasible to otherwise modify the highway when alternative sites that met the water supply objective were present.

Alternative 8

The City of Shenandoah currently draws water from several wells located in the alluvium of the East Nishnabotna River valley. The installation of new larger-diameter vertical wells and/or radial collector wells could provide significant additional groundwater resources to the community. In theory, larger diameter vertical wells could provide well yields of 0.65 mgd,

while radial wells could have potential yields of more than 3 mgd. These potential yields have not been confirmed through drilling test wells. These wells would tap into the same aquifer currently used by Shenandoah. The total capacity of the existing nine active wells declined from

about 1.84 mgd in January of 1999 to 1.22 mgd in January of 2001, a decrease of 33 percent. Therefore the desired long-term water yield may not be sustainable.

In addition to the concerns about reliability, groundwater does not provide a source of water-based recreation. This alternative did not meet the sponsors' objective and was dropped from further study.

Description of Alternatives

Three alternatives were developed in detail, evaluated during planning, and are described in this section. These alternatives include;

- No Action Alternative (Future Without Project). This required alternative is used as the basis for comparison between alternatives studied in detail to predict environmental and other consequences.
- Alternative 4 (Site 2 Max)
- Alternative 6 (Site 3 Max)

No Action Alternative:

Under this alternative the cities of Shenandoah and Clarinda would continue to draw on their existing sources of water. Residential, commercial, and industrial development may be hindered since the existing sources are near maximum withdrawal. During periods of drought, residents of both communities may experience water shortages affecting the availability of drinking water and impacting sanitary conditions. In the absence of a large reservoir, the county and its communities will not gain any economic or quality of life benefits that a water-based recreational area would provide.

Alternative 4

Alternative 4 was initially developed as the largest structure at Site 2 based on the ratio of drainage area to pool area of 17:1. The final location of the site was moved upstream to accommodate the design of the auxiliary spillway resulting in a drainage area to pool area of 18.6:1. The total project installation cost of this alternative is $59,253,500.

The following structural components are proposed for this alternative;

- One multi-purpose detention dam and reservoir
- One raw water intake and transmission lines
- 34 single-purpose sediment basins
- One public recreation area
- One public wildlife management area

One multi-purpose detention dam with 25,220 acres of drainage area and 1,347 acres of permanent pool would be constructed for water supply and recreation. The dam at Site 2 consists of an earthfill dam, a reinforced concrete principal spillway, and a vegetated auxiliary spillway. The auxiliary spillway area is 70 acres while the dam area covers 20 acres. This alternative meets the sponsors' goal of an average daily demand of 4.0 mgd. County Highways

J28 and J20, and two county roads are flooded by the permanent pool. County Highway M56 and one county road are below the top of dam, but above the permanent pool level.

One raw water intake structure and raw water transmission lines to Clarinda and Shenandoah are included in the water supply purpose.

Thirty-four single-purpose sediment basins (2.4 acre to 39.2 acre sediment pools and 38 acre to 17,965 acre drainage areas) located upstream and near the permanent pool of Site 2 are included to maintain water quality for both water supply and recreation needs.

One sediment basin is located in the West Tarkio Creek channel near the upper end of the permanent pool. This basin has a compacted earthfill core with a top elevation one foot below the permanent pool and is designed to provide an effective sediment trap. The earthfill core is covered with two feet of loose rock riprap to prevent erosion of the earthfill from wave action when the reservoir is full and from runoff when the reservoir is low. The top of the riprap is set one foot above the permanent pool and may be used as a low level crossing.

The remaining 33 sediment basins are compacted earthfill dams with principal spillways comprised of corrugated metal pipes. The design sediment storage for these structures is 100 years, matching the design life of Site 2. Some structures will support permanent pools while others have drainage areas too small to support a permanent pool.

This alternative will permanently convert 5,152 acres of agricultural land to a water supply reservoir and public recreation area. An estimated 25 building locations are impacted by this alternative. Of this estimate, 14 locations have occupied dwellings that would need to be acquired and relocated or demolished. An additional 11 unoccupied building locations would have to be acquired and relocated or demolished.

Site 2 Max and the associated public recreation area total 5,152 acres, which includes a permanent pool of 1,347 acres. A 296 acre developed recreation area managed by the sponsors will be located near the west central portion of the reservoir. Planned amenities and facilities include 162 modern camping and RV sites, 20 housekeeping cabins, a lodge, a marina, day use areas, a concrete three lane boat ramp, an accessible fishing pier, and a swimming beach. Connections to the Wabash Trace Recreational Trail, which is the longest single contiguous recreation trail in Iowa (64 miles), will add additional opportunities for bicyclists, equestrians, cross-country skiers, runners, and walkers.

A 55 acre site has been identified for potential destination park development at Site 2 Max. The proposed site is located centrally on the eastern shore of the lake, directly opposite the developed recreation area.

Three thousand three hundred sixty four acres will be managed as a public wildlife area. Existing cropland and pastureland will be converted to a mixture of new woody cover, native warm season grasses and forbs, and food plots. The creation of new wildlife habitat on this area will provide the mitigation necessary to replace the loss of terrestrial wildlife habitat due to creation of the reservoir. Major in-lake improvements to Site 2 will be installed prior to construction. These improvements will consist of submerged islands, rock reefs, and a structure on the upstream end of the permanent pool which will decrease sediment and turbidity in the

lake. Riprapping of the shoreline will protect exposed points and windward shores in the lower portion of the lake, reducing bank erosion. These improvements will provide enhanced fishery quality for Site 2. Numerous fishing jetties and three boat ramps will be added to improve fisher access to the resource.

Table E
Acreage allocations within acquisition area (5,152 acres total)
Site 2 (Alternative 4) West Tarkio Watershed.

Area Description	Acres
Dam	20
Auxiliary Spillway	70
Permanent Pool	1,347
Developed Recreation Area	296
Includes campgrounds, main boat ramp,	
cabins, picnic facilities, beach	
Possible Destination Park Location	55
Upland Recreation Area	3,364
Includes remaining upland acres beyond	
the developed recreation area, used for	
mitigation purposes, hunting, bird watching	
and nature study. Also includes remaining	
three boat ramp accesses.	
Total:	**5,152**

Site 2 Max would provide an estimated average annual benefit of $1,762,500 related to water supply. Recreation would provide an estimated 187,400 visitor days per year for an average annual benefit of $6,368,600. The thirty-four sediment basins would provide an estimated average annual benefit of $316,000 by further protecting the water quality of the reservoir and enhancing recreation benefits.

ALTERNATIVE 4, Site 2
Estimated Installation Costs*

Item	Number	Total (dollars)
Multi-purpose Dam	1	35,217,500
Water Intake Structure	1	2,384,800
Raw Water Transmission Lines	123,200 ft.	13,691,000
Sediment Basins	33	2,744,200
In-Channel Sediment Basin	1	130,600
Recreation Facilities	NA	5,055,400
	GRAND TOTAL	59,253,500

*Does not include associated costs of $500,000 for Shenandoah to upgrade water treatment plant

Average Annual Costs*

Item	Installation	OM&R**	Total
	----------(dollars)----------		
Multi-purpose Dam	1,817,200	15,000	1,832,200
Water Intake Structure	123,100	59,600	182,700
Raw Water Transmission Lines	706,400	171,100	877,500
Sediment Basins	143,100	59,300	202,400
In-Channel Sediment Basin	6,700	2,200	8,900
Recreation Facilities	260,900	95,200	356,100
GRAND TOTALS	3,057,400	402,400	3,459,800

*Does not include associated costs of $500,000 for Shenandoah to upgrade water treatment plant

* *Operation, Maintenance, and Replacement

Benefits
Average Annual Benefits: $8,447,100
Benefit/Cost Ratio: 2.4:1.0

Alternative 6
Alternative 6 was developed as the largest structure at Site 3 based on the ratio of drainage area to pool area of 17:1. The total project installation cost of this alternative is $63,105,700.

The following structural components are proposed for this alternative;

- One multi-purpose detention dam and reservoir
- One raw water intake and transmission lines
- 40 single-purpose sediment basins
- One public recreation area
- One public wildlife management area

One multi-purpose detention dam with 30,380 acres of drainage area and 1,818 acres of permanent pool would be constructed for water supply and recreation. The dam at Site 3 consists of an earthfill dam, a reinforced concrete principal spillway, and a vegetated auxiliary spillway. The auxiliary spillway area is 49 acres while the dam area covers 18 acres. County Highways J32 and J28, and three county roads upstream of the site are flooded by the permanent pool. County Highway J20 and two other county roads are below the top of dam. Refer to Project Map, Appendix F, for approximate structure location.

This alternative meets the sponsors' goal of an average daily demand of 4.0 mgd. One raw water intake structure and two raw water transmission lines are included for the water supply purpose.

Forty single-purpose sediment basins (2.7 acre to 19.7 acre permanent pools and 45 acre to 22,850 acre drainage areas) located upstream and adjacent to the permanent pool are included to enhance water quality for both water supply and recreation needs. Refer to Project Map, Appendix F, for approximate structure locations.

One sediment basin is located in the West Tarkio Creek channel near the upper end of the permanent pool. This basin has a compacted earthfill core with a top elevation one foot below the permanent pool and is designed to provide an effective sediment trap. The earthfill core is covered with two feet of loose rock riprap to prevent erosion of the earthfill from wave action when the reservoir is full and from runoff when the reservoir is low. The top of the riprap is set one foot above the permanent pool of Site 3 and may be used as a low level crossing.

The remaining 39 sediment basins are compacted earthfill dams with principal spillways comprised of corrugated metal pipes. The design sediment storage for these structures is 100 years matching the design life of Site 3. Some structures will support permanent pools while others have drainage areas too small to support a permanent pool.

The installation of Site 3 will permanently change 6,186 acres of agricultural land to a water supply reservoir and recreation area. An estimated 29 building locations are impacted by this alternative. Of this estimate, 16 locations have occupied dwellings that would need to be acquired and relocated or demolished. An additional 13 unoccupied building locations would have to be acquired and relocated or demolished.

The public recreation area will cover a total of 6,186 acres, with a permanent pool of 1,818 acres. A 457 acre developed recreation area managed by the sponsors will be located near the west central portion of the reservoir. Planned amenities and facilities include 162 modern camping and recreational vehicle (RV) sites, 20 housekeeping cabins, a lodge, a marina, day use areas, a concrete four lane boat ramp, an accessible fishing pier, and a swimming beach. Connections to the Wabash Trace Recreational Trail, which is the longest single contiguous recreation trail in Iowa (64 miles) will add additional opportunities for bicyclists, equestrians, cross-country skiers, runners and walkers.

Further north along the western shore, 65 acres will be set aside for potential future development of a destination park/resort facility under management by the City of Shenandoah.

The remaining 3,779 acres will be managed by the sponsors as a public wildlife area. Existing cropland and pastureland will be converted to a mixture of new woody cover, native warm season grasses and forbs, and food plots. The creation of new wildlife habitat on this area will provide the mitigation necessary to replace the loss of terrestrial wildlife habitat due to creation of the reservoir. Major in-lake improvements to Site 3 Max will be installed prior to construction. These improvements will consist of submerged islands, rock reefs, and a structure on the upstream end of the permanent pool which will decrease sediment and turbidity in the lake. Riprapping of the shoreline will protect exposed points and windward shores in the lower portion of the lake, reducing bank erosion. These improvements will provide enhanced fishery quality. Numerous fishing jetties and four boat ramps are planned to improve fisher access to the resource.

Table F
Acreage allocations within acquisition area (6,186 acres total)
Site 3 (Alternative 6) West Tarkio Watershed.

Area Description	Acres
Dam	18
Auxiliary Spillway	49
Permanent Pool	1,818
Developed Recreation Area	457
Includes campgrounds, main boat ramp,	
cabins, picnic facilities, beach	
Possible Destination Park Location	65
Upland Recreation Area	3,779
Includes remaining upland acres beyond	
the developed recreation area, used for	
mitigation purposes, hunting, bird watching	
and nature study. Also includes remaining	
three boat ramp accesses.	
Total:	**6,186**

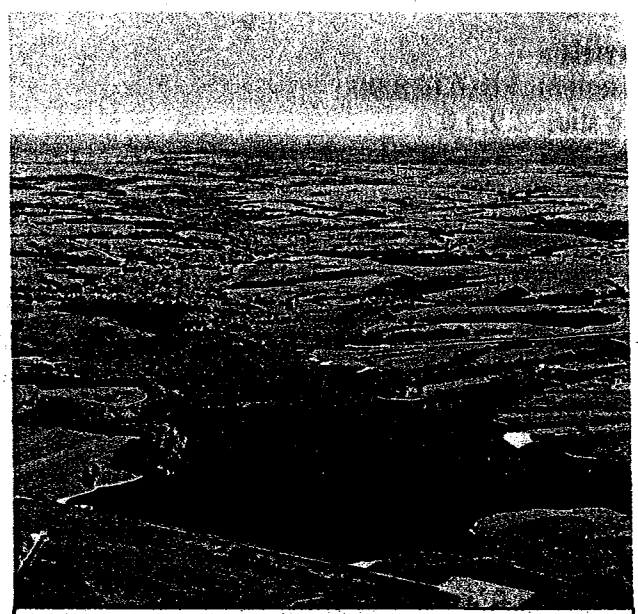

Photo 3. Lake Sugema, a lake formed as part of the Indian Creek-Van Buren Watershed Project in Van Buren County, Iowa. The site provides recreation, water supply, and boosts the local economy.

Site 3 would provide an estimated average annual benefit of $1,625,400 related to water supply. Recreation would provide an estimated 251,800 visitor days per year for an average annual benefit of $8,589,900. The forty sediment basins would provide an estimated average annual benefit of $423,600 by further protecting the water quality of the reservoir and enhancing recreation benefits.

ALTERNATIVE 6, Site 3
Estimated Installation Costs*

Item	Number	Total (dollars)
Multi-purpose Dam	1	38,366,600
Water Intake Structure	1	2,384,800
Raw Water Transmission Lines	118,100 ft.	13,275,100
Sediment Basins	39	3,145,900
In-Channel Sediment Basin	1	71,000
Recreation Facilities	NA	5,862,300
	GRAND TOTAL	63,105,700

*Does not include associated costs of $500,000 for Shenandoah to upgrade water treatment plant

Average Annual Costs*

Item	Installation	OM&R**	Total
	----------(dollars)----------		
Multi-purpose Dam	1,979,600	13,800	1,993,400
Water Intake Structure	123,100	59,600	182,700
Raw Water Transmission Lines	685,000	166,000	851,000
Sediment Basins	162,300	67,500	229,800
In-Channel Sediment Basin	15,900	1,200	4,900
Recreation Facilities	302,500	110,400	412,900
GRAND TOTALS	3,256,200	418,500	3,686,900

*Does not include associated costs of $500,000 for Shenandoah to upgrade water treatment plant
** Operation, Maintenance, and Replacement

Benefits
Average Annual Benefits: $10,638,900
Benefit/Cost Ratio: 2.9:1.0

Hazard Potential

No Action Alternative
This alternative does not change the existing hazard potential. The current hazard potential due to flooding is low. The results of the flood study of West Tarkio Creek down to Tarkio, Missouri revealed that the 100 year storm event remained within the channel banks except within the town of Tarkio and even then the extent of flooding was not major.

Alternative 4
Storage to the auxiliary spillway of Site 2 is about 37,900 acre-feet. The effective height of the structure is about 52 feet. The top of dam was set by routing the freeboard hydrograph with the 24 hour, probable maximum precipitation (PMP) of 33.0 inches. A sudden failure of the dam would impact homes, roads, bridges, power lines, crop fields, fences, and forest land downstream of the site.

County Road J32 and Highway 2 are located about 1.25 miles and 4.5 miles downstream, respectively, from Site 2. Both would be in the breach inundation area and would be overtopped with a risk of loss of life as well as potential for damage to the bridges and road embankments. Numerous other houses are located in the floodplain downstream of Highway 2 that could

potentially be impacted. Due to the existing infrastructure, this site has been planned as a high hazard dam.

Three possible modes of failure were evaluated: seismic, static and hydrologic. Iowa is in seismic zone 1, which means there is very low probability of an earthquake causing dam failure. A seismic assessment is not required for dams in zone 1.

Static failures are characterized by seepage, foundation geology inadequacies, or principal spillway deterioration. Seepage affects include piping of embankment materials, unstable slopes, accelerated surface erosion and accelerated growth of detrimental vegetation such as trees. While all these effects may be observed in Western Iowa, piping is the most likely to lead to a sudden failure of a dam.

A hydrologic failure is caused by dam overtopping. Dam overtopping may result from storms that exceed the original design storm, plugging of the principal and/or auxiliary spillways, or by sedimentation. An overtopping failure due to an extreme storm event has a very low probability of occurrence. Sedimentation can increase the possibility of overtopping because accumulating sediment increasingly displaces flood storage. Auxiliary spillway flows and overtopping flows have occurred in Iowa as a result of all three. However, sudden failure of the embankments happens rarely.

According to the Iowa State Dam Safety Officer, the most likely mode of failure is a piping failure. This would be the type of failure modeled in a breach analysis of Site 2. The structure would be installed with a drainage system that would intercept foundation seepage and seepage through the embankment reducing the chance of a piping failure.

Alternative 6

Storage to the auxiliary spillway of Site 3 is about 56,700 acre-feet. The effective height of the structure is about 62 feet. The top of dam was set by routing the freeboard hydrograph with the 24 hour, probable maximum precipitation of 33.0 inches. A sudden failure of the dam would impact homes, roads, bridges, power lines, crop fields, fences, and forest land downstream of the site.

Between Site 3 and Highway 2 there are homes that potentially could be in the breach inundation area. Highway 2 is located about one mile downstream from Site 3 and would be in the breach inundation area. Highway 2 would be overtopped by a sudden breach of the dam with a risk of loss of life as well as potential for damage to the bridge and road embankment. Numerous other houses are located in the floodplain downstream of Highway 2 that could potentially be impacted. Due to the existing infrastructure, this site has been planned as a high hazard dam.

Three possible modes of failure were evaluated: seismic, static and hydrologic. Iowa is in seismic zone 1, which means there is very low probability of an earthquake causing dam failure. A seismic assessment is not required for dams in zone 1.

Static failures are characterized by seepage, foundation geology inadequacies, or principal spillway deterioration. Seepage affects include piping of embankment materials, unstable slopes, accelerated surface erosion and accelerated growth of detrimental vegetation such as trees.

While all these affects may be observed in Western Iowa, piping is the most likely to lead to a sudden failure of a dam.

A hydrologic failure is caused by dam overtopping. Dam overtopping may result from storms that exceed the original design storm, plugging of the principal and/or auxiliary spillways, or by sedimentation. An overtopping failure due to an extreme storm event has a very low probability of occurrence. Sedimentation can increase the possibility of overtopping because accumulating sediment increasingly displaces flood storage. Auxiliary spillway flows and overtopping flows have occurred in Iowa as a result of all three. However, sudden failure of the embankments happens rarely.

According to the Iowa State Dam Safety Officer, the most likely failure is a piping failure. This would be the type of failure modeled in the breach analysis of Site 3. The structure would be installed with a drainage system that would intercept both foundation seepage and seepage through the embankment reducing the chance of a piping failure.

A high hazard dam requires an Emergency Action Plan (EAP). The sponsors will be required to develop the EAP prior to construction of the dam.

Table G summarizes each alternative considered. Major items used in the decision process are included. Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G) requires the alternative plan with the greatest net economic benefit consistent with protecting the Nation's environment (the NED plan) is to be selected unless the Secretary of a department or agency head grants an exception when there is some overriding reason for selecting another alternative.

Table G

Summary and Comparison of Candidate Plans

EFFECTS	WITHOUT PROJECT	ALTERNATIVE 4	ALTERNATIVE 6 (NED & Recommended)
MEASURES Structural		One (Site 2, max) multi-purpose water supply and recreation dam; one (Site IC-2) in-channel sediment basin; 33 sediment basins.	One (Site 3, max) multi-purpose water supply and recreation dam; one (Site IC-1) in-channel sediment basin; 39 sediment basins.
PROJECT INVESTMENT Structural Measures	$0	$59,253,500	$63,105,700
National Economic Development (NED) Account			
Beneficial, Annual		$8,447,100	$10,638,900
Adverse, Annual		$3,459,800	$3,686,900
Net beneficial		$4,987,300	$6,952,000
Environmental Quality (EQ) Account			
Environmental Justice	No Effect	Increased water supply and recreational opportunities for all persons.	Increased water supply and recreational opportunities for all persons.
Fish and Wildlife Coordination	No Effect	The permanent pool will convert 1,347 acres from terrestrial habitat to aquatic habitat. A total of 3,364 acres will be managed for wildlife habitat.	The permanent pool will convert 1,818 acres from terrestrial habitat to aquatic habitat. A total of 3,779 acres will be managed for wildlife habitat.
Impoundment Effects on Downstream Wells	No Effect	A mounding effect in the watertable in the periphery of the impoundment is expected to recharge groundwater downstream from the dam.	A mounding effect in the watertable in the periphery of the impoundment is expected to recharge groundwater downstream from the dam.
Impoundment Effects on Stream Baseflow	No Effect	A mounding effect in the watertable in the periphery of the impoundment is expected to increase baseflow downstream from the dam.	A mounding effect in the watertable in the periphery of the impoundment is expected to increase baseflow downstream from the dam.
Invasive Species	Invasive species adaptable to cropland and grassland areas can become established.	Invasive species adaptable to aquatic environments may become established.	Invasive species adaptable to aquatic environments may become established.
Migratory Birds	Limited use by migratory birds	The lake and upland wildlife areas will provide increased habitat benefiting many species of migratory birds.	The lake and upland wildlife areas will provide increased habitat benefiting many species of migratory birds.
Riparian Areas	Limited riparian areas exist along West Tarkio Creek and major tributaries.	Increased areas along 22.7 miles of shoreline.	Increased areas along 25.4 miles of shoreline.
Scenic Beauty	Project area is dominated by intensive rowcrop agriculture, marked by large fields and little, if any, native vegetation.	Impoundment, recreation area, and managed wildlife area will provide a variety of scenic landscapes.	Impoundment, recreation area, and managed wildlife area will provide a variety of scenic landscapes.
Threatened and Endangered Species	There are no federally listed T&E species in the watershed. Records indicate that no habitat for state listed T&E species exists in the watershed.	No impacts to any federal or state listed species.	No impacts to any federal or state listed species.

Table G

Summary and Comparison of Candidate Plans

EFFECTS	WITHOUT PROJECT	ALTERNATIVE 4	ALTERNATIVE 6 (NED & Recommended)
Water Quality	West Tarkio Creek is impacted by agricultural landuses in the watershed. The creek is on the Iowa 303(d) list of impaired waters. The designated pollutant is listed as unknown.	Project measures will reduce sediment delivery to the creek. Agricultural nutrients will be reduced with ongoing and planned efforts in the Page SWCD.	Project measures will reduce sediment delivery to the creek. Agricultural nutrients will be reduced with ongoing and planned efforts in the Page SWCD.
Waters of the US	West Tarkio Creek is a jurisdictional water of the US and is subject to the CWA of 1972.	Any modifications to the stream and associated wetlands are subject to the CWA of 1972. Project will convert 10.9 miles of stream to flat water habitat.	Any modifications to the stream and associated wetlands are subject to the CWA of 1972. Project will convert 10.1 miles of stream to flat water habitat.
Wetlands	Few wetlands are present in the watershed.	Some wetland areas will be created in the upper reaches of the permanent pool and the 33 upland sediment basin pools.	Some wetland areas will be created in the upper reaches of the permanent pool and the 39 upland sediment basin pools.
Other Social Effects (OSE) Account			
Historic Cultural and Scientific Resources	Cultural resources are anticipated to continue to degrade under the effects of erosion and human disturbance.	Construction will likely affect historic and prehistoric cultural resources. This will be a federal undertaking and the NRCS will identify, evaluate, and mitigate any significant cultural resources present.	Construction will likely affect historic and prehistoric cultural resources. This will be a federal undertaking and the NRCS will identify, evaluate, and mitigate any significant cultural resources present.
Local Economy	A shortage of future water supply and the limited water-based recreational opportunities limit economic growth in Page, Fremont and adjacent Counties.	A regional water supply is established for the area, including the cities of Shenandoah and Clarinda. Regional water-based recreational opportunities are developed for the enhancement of the local economy.	A regional water supply is established for the area, including the cities of Shenandoah and Clarinda. Regional water-based recreational opportunities are developed for the enhancement of the local economy.
Parklands	There are 88 water-based recreational developments providing a total of 943,441 user days of outdoor recreation within a 75 mile radius of the project area.	A multi-purpose recreation site would provide 5,152 acres of public recreation including a 1,347 acre lake open to fishing, boating, camping, picnicking, hiking and hunting, and many other activities.	A multi-purpose recreation site would provide 6,186 acres of public recreation including a 1,818 acre lake open to fishing, boating, camping, picnicking, hiking and hunting, and many others activities
Prime and Unique Farmland	Soils defined as prime farmland are cropped and grazed. There are no soil mapping units classified as unique in the watershed.	The 5,152 acres of land in the acquisition area being developed as a park, pool, dam, and auxiliary spillway will change current agland use to non-agricultural use on 2,819 acres of soils that are classified as prime farmland. Of 2,819 acres of prime farmland, 2,312 acres are currently cropped.	The 6,186 acres of land in the acquisition area being developed as a park, pool, dam, and auxiliary spillway will change current agland use to non-agricultural use on 3,163 acres of soils that are classified as prime farmland. Of 3,163 acres of prime farmland, 2,636 acres are currently cropped.
Public Water Supply	Water supply inadequacies exist.	Meets the sponsors' goal of an average daily demand of 4.0 mgd.	Meets the sponsors' goal of an average daily demand of 4.0 mgd.
Recreation	There are 88 water-based recreational facilities within a 75 mile radius of the project area serving a population of 1.2 million people.	The 5,152 acres public recreation area will provide 187,400 annual user days of water-based recreation.	The 6,186 acre public recreation area will provide 251,800 annual user days of water-based recreation.

Table G

Summary and Comparison of Candidate Plans

EFFECTS	WITHOUT PROJECT	ALTERNATIVE 4	ALTERNATIVE 6 (NED & Recommended)
Regional Economic Development (RED) Account			
Total Adverse Effects		$40,030,200	$43,066,100
Total Beneficial Effects		$35,443,600	$44,262,400
Net beneficial		$(4,586,600)	$ 1,196,300

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Environmental Consequences

Based on public participation, sponsor objectives, NRCS policy, federal and state laws, and agency consultation, resource concerns were identified and placed in the Summary of Scoping Table B. The resource concerns shown in Table B as relevant to the proposed action are described further in this section. Each of the proposed alternatives was analyzed to determine its effects on those identified concerns.

Soil Erosion and Sedimentation

Existing Conditions:	Sheet and rill erosion rates in the entire watershed averages 3.2 tons/ac/year. Approximately 85.9 percent of the watershed to Tarkio, MO, is at or below "T". Ephemeral and classic gully erosion rates combined average 0.22 tons/ac/year. Stream channel erosion rates average 142 tons/mile or 0.21 tons/ac/year. The sediment yield to the Tarkio River at Tarkio, MO is 102,280 tons/year.
No Action:	All types of erosion and sedimentation remain the same as existing conditions.
Alternative 4:	Sheet and rill erosion rates in the Site 2 watershed average 3.7 tons/ac/year. Approximately 85.7 percent of the watershed is at or below "T". Ephemeral and classic gully erosion rates combined average 0.23 tons/ac/year. Sediment yield to the dam at Site 2 is estimated at 32,453 tons/year without sediment basins. The estimated trap efficiency is 97 percent. The overall reduction of sediment delivered just downstream of Site 2 without sediment basins is 31,480 tons/year. The planned 33 upland sediment basins will collect sediment from 5,184 acres, or 20.6 percent of the watershed. Sediment yield to Site 2 is reduced from 32,453 tons/year to 25,782 tons/year. The planned in-channel sediment basin collects sediment from 17,920 acres, or 70 percent of the watershed, and will prevent 944 tons/year from reaching the main body of the reservoir.
Alternative 6:	Sheet and rill erosion rates in the Site 3 watershed averages 3.5 tons/ac/year. Approximately 86.4 percent of the watershed is at or below "T". Ephemeral and classic gully erosion rates combined average 0.21 tons/ac/year. Sediment yield to the dam at Site 3 is estimated at 36,795 tons/year without sediment basins. The estimated trap efficiency is 97

percent. The overall reduction of sediment delivered just downstream of Site 3 without sediment basins is 35,691 tons/year.

The planned 39 upland sediment basins will collect sediment from 5,296 acres, or 17.4 percent of the watershed. Sediment yield to Site 3 is reduced from 36,795 tons/year to 30,380 tons/year. 6415 T/YR REDUCTION OR 165 T/YR/STR.

The planned in-channel sediment basin collects sediment from 22,848 acres, or 75 percent of the watershed, and will prevent 925 tons/year from reaching the main body of the reservoir.

Local Economy

Existing Conditions:	A shortage of future water supply and the limited water-based recreational opportunities limit economic growth in Page and Fremont Counties.
No Action:	Same as existing conditions.
Alternative 4:	A regional water supply is established for the area, including the cities of Shenandoah and Clarinda. Regional water-based recreational opportunities are developed for the enhancement of the local economy. Approximately 4,328 acres cropland, 48 acres CRP, and 32 acres of filter strips will be converted to recreation land. In addition, 744 acres of non cropped areas will be converted to recreation land.
Alternative 6:	A regional water supply is established for the area, including the cities of Shenandoah and Clarinda. Regional water-based recreational opportunities are developed for the enhancement of the local economy. Approximately 4,685 acres cropland, 335 acres CRP, and 86 acres of filter strips will be converted to recreation land. In addition, 1,080 acres of non cropped areas will be converted to recreation land.

Recreation

Existing Conditions:	There are 88 water-based recreational facilities within in a 75 mile radius of the project area serving a population of 1.2 million people.
No Action:	The demand for water-based recreational opportunities will increase as the population grows.
Alternative 4:	A 5,152 acre public recreation area including a 1,347 acre lake will provide 187,400 annual user days of water-based recreation.
Alternative 6:	A 6,186 acre public recreation area including a 1,347 acre lake will provide 251,800 annual user days of water-based recreation.

Public Water Supply

Existing Conditions:	Water supply inadequacies exist.
No Action:	Water supply inadequacies continue and become more extreme.
Alternative 4:	Meets the sponsors' goal of an average daily demand of 4.0 mgd.
Alternative 6:	Meets the sponsors' goal of an average daily demand of 4.0 mgd.

Water Quality

Existing Conditions:	West Tarkio Creek is impacted by agricultural landuses in the watershed. The creek is on the Iowa 303(d) list of impaired waters. The designated pollutant is listed as unknown.
No Action:	Changing regulatory nutrient and sediment criteria could require additional crop nutrient management and sediment control measures.
Alternative 4:	Sediment control basins will trap sediment and phosphorus attached to the sediment. These Best Management Practices (BMP) will enhance water-based recreation activities an average annual value of $316,000. Conventional drinking water treatment methods will be used to produce an adequate supply of high quality water for public consumption.
Alternative 6:	Sediment control basins will trap sediment and phosphorus attached to the sediment. These BMPs will enhance water-based recreation activities by an average annual value of $423,600. Conventional drinking water treatment methods will be used to produce an adequate supply of high quality water for public consumption.

Century Farms

Existing Conditions:	There are 30 Century Farms in the Iowa portion of the watershed.
No Action:	Same as existing conditions.
Alternative 4:	No Century Farms are located in the proposed public acquisition area.
Alternative 6:	Three Century Farms are located in the proposed public acquisition area.

Impoundment Effects on Downstream Wells

Existing Conditions:	Shallow, alluvial private wells are located in the project area. The wells are subject to moderate fluctuations during periods of drought.
No Action:	Same as existing conditions.

Alternative 4: There are four wells on the alluvial floodplain of West Tarkio Creek within four miles downstream of Site 2 that may be negatively impacted during the filling of the structure. Reservoirs can cause a permanent rise in the water table in the periphery of the reservoir, this is called a mounding effect. The reservoir is expected to act as a recharge source for groundwater at the structure site and increase base flow in the downstream system. After the permanent pool has been established, base flow downstream of the dam will continue to be dependent upon rainfall and runoff events. These private, alluvial wells will continue to be subject to moderate fluctuations during periods of drought.

Alternative 6: There is one well on the alluvial floodplain of West Tarkio Creek within four miles downstream of Site 3 that may be negatively impacted during the filling of the structure. Reservoirs can cause a permanent rise in the water table in the periphery of the reservoir, this is called a mounding effect. The reservoir is expected to act as a recharge source for groundwater at the structure site and increase base flow in the downstream system. After the permanent pool has been established, base flow downstream of the dam will continue to be dependent upon rainfall and runoff events. These private, alluvial wells will continue to be subject to moderate fluctuations during periods of drought.

Impoundment Effects on Stream Baseflow:

Existing Conditions: Base flow is affected by climatic patterns and varies seasonally.

No Action: Same as existing conditions.

Alternative 4: The base flow will be less than existing conditions during construction of the dam and filling of the permanent pool. Reservoirs can cause a permanent rise in the water table in the periphery of the reservoir, this is called a mounding effect. The reservoir is expected to act as a recharge source for groundwater at the structure site and increase base flow in the downstream system. Once the permanent pool has been established, there will be flow through the principal spillway, adding to the base flow. The long-term base flow downstream of the dam will depend on rainfall events within the watershed. Sources of base flow downstream of the dam will remain unaltered from their existing condition.

Seepage flow from the structure drains is also expected to contribute to base flow. Experience with dams in western Iowa has shown that some steady seepage flow beneath the dam can be anticipated, though the quantity of flow can be difficult to predict. The drainage system will be designed to intercept seepage flow

that would adversely impact the dam and safely outlet the flow into West Tarkio Creek immediately downstream of the dam.

Alternative 6: The base flow will be less than existing conditions during construction of the dam and filling of the permanent pool. Reservoirs can cause a permanent rise in the water table in the periphery of the reservoir, this is called a mounding effect. The reservoir is expected to act as a recharge source for groundwater at the structure site and increase base flow in the downstream system. Once the permanent pool has been established, there will be flow through the principal spillway, adding to the base flow. The long-term base flow downstream of the dam will depend on rainfall events within the watershed. Sources of base flow downstream of the dam will remain unaltered from their present condition.

Seepage flow from the structure drains is also expected to contribute to base flow. Experience with dams in western Iowa has shown that some steady seepage flow beneath the dam can be anticipated, though the quantity of flow can be difficult to predict. The drainage system will be designed to intercept seepage flow that would adversely impact the dam and safely outlet the flow into West Tarkio Creek immediately downstream of the dam.

Threatened & Endangered Species

Existing Conditions: There are no federally listed Threatened or Endangered Species present in Page and Montgomery Counties. State listed Endangered Species in Page and Montgomery Counties, Iowa are the barn owl *(Tyto alba)*. State listed Threatened Species are; southern bog lemming (*Synaptomy's cooperi),* long-eared owl *(Asio otus)*, and false hellebore *(Veratrum woodii)*. The Edward's hairstreak (*Satyruim edwardsii)* is listed as a species of special concern in Page County. Records indicate that no habitat for these State Species exists in the watershed.

No Action: Same as existing conditions.

Alternative 4: There will be no impacts to any listed species.

Alternative 6: There will be no impacts to any listed species.

Environmental Justice

Existing Conditions: There are no known minority residents in the project area. No tribes are present in the project area. No producers within the project area have identified themselves as limited income producers.

No Action: Same as existing conditions

Alternative 4:	Increased water supply and recreational opportunities for all persons.
Alternative 6:	Increased water supply and recreational opportunities for all persons.

Essential Fish Habitat

Existing Conditions:	No essential fish habitat located in the project area.
No Action:	No essential fish habitat located in the project area.
Alternative 4:	No essential fish habitat located in the project area.
Alternative 6:	No essential fish habitat located in the project area.

Fish and Wildlife/ Fish and Wildlife Coordination

Existing Conditions:

Most of the land in the project area is used for production of corn and soybeans. The grassland in the watershed is cool season, monotypic stands of smooth brome grass, Kentucky bluegrass, or tall fescue. These grasslands are intensely grazed through the growing season and provide limited value for nesting or winter cover. Woody habitat areas are limited to small tracts along the stream, wooded draws, fencerows, and a few scattered upland patches of trees.

West Tarkio Creek is an intermittent stream system that supports a generalist minnow fishery.

No Action:

Same as existing conditions.

Alternative 4:

Terrestrial impacts - The permanent pool will inundate 1,347 acres. This change will displace wildlife from using 84 acres of woodland habitat (includes bottomland, upland, draws and fence lines), 145 acres of cool season and 16 acres of warm season grassland habitat, and 1,102 acres of cropland/altered land.

The dam and auxiliary spillway will impact a total of 90 acres; six acres of cool season grassland habitat, and 84 acres of cropland/altered land.

The flood pool will temporarily inundate up to 580 additional acres. This will periodically interrupt wildlife usage on 10 acres of woodland, 10 acres of warm season and 84 acres of cool season grassland, and 476 acres of cropland/altered land.

The 33 upland sediment basins will impact 3 acres of woodland, 1 acre of shrubland, 5 acres of warm season and 43 acres of cool season grasslands and 148 acres of cropland.

Construction of the lake, developed recreation areas, and the 33 upland sediment basin will result in a loss of 61 habitat units (HU) of woodland habitat and 115 HU of grassland habitat.

This alternative establishes 3,364 acres that will be managed for wildlife habitat. This includes both the upland area and the land that is in the flood pool. This area will convert cropland to a mixture of tree and shrub cover, warm and cool season grass cover, and food plots. The management area will be designed to provide more than the 61 HU of woody cover and 115 HU of grassy cover being lost to project measures. This will result in a net gain of woodland and grassland habitat. Since the wildlife areas will produce a net gain in habitat units, no formal mitigation will be required.

Aquatic impacts – The construction of the permanent pool will convert 10.9 miles of ephemeral and intermittent stream to a flat water fishery. The flood pool will impact an additional 2.8 miles of stream. The 33 upland sediment basins will be constructed on drainage ways. The project will disrupt continuity of the stream system and isolate the upper reaches of the West Tarkio system from the lower reaches. It will allow the native fish, both game stocked in the lake and minnow species to move up stream when water conditions permit and the pool will provide a refuge for the existing fish species to utilize when low water conditions necessitate moving downstream.

Wetland impacts – Minor areas of wetlands exist along the toe slopes and stream benches within the channel of West Tarkio Creek. The construction of the 39 acre shallow in-lake sediment basin at the upper end of the permanent pool will fill with sediment within a few years and then through the life of the project this sediment basin will function as an emergent wetland. The storage area of the 33 upland sediment basins will also form wetlands.

Alternative 6:

Terrestrial impacts - The permanent pool will inundate 1,818 acres. This will impact 114 acres of woodland habitat (includes bottomland, upland, draws and fence lines), 354 acres of cool season and 30 acres of warm season grassland habitat and 1,320 acres of cropland/altered land.

The dam and auxiliary spillway will impact a total of 67 acres, 40 acres of grassland and 6 acres of woodland habitat, and 21 acres of cropland/altered land.

The flood pool will temporarily inundate up to a maximum of 781 additional acres. This will periodically interrupt wildlife usage on 35 acres of woodland, 197 acres of cool season and 18 acres of warm season grassland, and 531 acres of cropland/altered land.

The 39 upland sediment basins will impact 3 acres of woodland, 2 acre of shrubland, 7 acres of warm season and 58 acres of cool season grasslands and 157 acres of cropland.

Construction of the lake, developed recreation areas, and the 39 upland sediment basin will result in a loss of 125 habitat units (HU) of woodland habitat and 262 HU of grassland habitat.

This alternative establishes 3,779 acres that will be managed for wildlife habitat. This includes both the upland area and the land that is in the flood pool. This area will convert cropland to a mixture of tree and shrub cover, warm and cool season grass cover, and food plots. The management area will be designed to provide more than the 125 HU of woody cover and 262 HU of grassy cover being lost to project measures. This will result in a net gain of woodland and grassland habitat. Since the wildlife areas will produce a net gain in habitat units, no formal mitigation will be required.

Aquatic impacts – The construction of the permanent pool will convert 10.1 miles of ephemeral and intermittent stream to a flat water fishery. The flood pool will impact an additional 3.4 miles of stream. The project will disrupt continuity of the stream system and isolate the upper reaches of the West Tarkio system from the lower reaches. It will allow species stocked in the lake to move up stream when water conditions permit and the pool will provide a refuge for the existing fish species to utilize when low water conditions necessitate moving downstream.

Wetland impacts – Minor areas of wetlands exist along the toe slopes and stream benches within the channel of West Tarkio Creek. The construction of the 45 acre shallow in-lake sediment basin at the upper end of the permanent pool will fill with sediment within a few years and then through the life of the project this sediment basin will function as an emergent wetland. The storage area of the 39 upland sediment basins will also form wetlands.

Historic, Cultural and Scientific Resources

Existing Conditions:	No federal undertaking, therefore no federal compliance procedures are necessary. Cultural resources are anticipated to continue to degrade under the effects of erosion and human disturbance.
No Action:	Same as existing conditions.
Alternative 4:	Construction will likely effect historic and prehistoric cultural resources. This will be a federal undertaking and the NRCS will identify, evaluate, and mitigate any significant cultural resources present.

Alternative 6:	The APE is 540 acres, 9 percent of the project area requiring deep survey, in addition 520 acres, 8 percent, requires a shallow survey. Construction will likely effect historic and prehistoric cultural resources. This will be a federal undertaking and the NRCS will identify, evaluate, and mitigate any significant cultural resources present.

Invasive Species

Existing Conditions:	Invasive species adaptable to cropland and grassed areas, such as leafy spurge, musk thistle, and red cedar can become established.
No Action:	Same as existing conditions.
Alternative 4:	Same as existing conditions. In addition, invasive species adaptable to aquatic environments such as purple loosestrife, Eurasian milfoil, and zebra mussel may become established.
Alternative 6:	Same as existing conditions. In addition, invasive species adaptable to aquatic environments such as purple loosestrife, Eurasian milfoil, and zebra mussel may become established.

Migratory Birds

Existing Conditions:	The watershed is intensively cropped and grazed. Small patches of woody habitat offer some limited value to migratory passerines and other bird groups for resting and feeding. Overgrazed pasture offers limited habitat for migrating grassland birds. Lack of wetlands and other open water areas provide limited habitat for water dependent species. Nesting and brood rearing habitat for migratory bird species is very limited.
No Action:	Same as existing conditions.
Alternative 4:	The lake and upland wildlife areas will provide increased habitat benefiting many species of migratory birds. The 1,347 acre lake will provide habitat for loafing, resting and feeding that currently does not exist for migrating waterfowl and other water dependent birds. The conversion of cropland and pastureland to 3,364 acres of wildlife areas will provide new grass and woodland habitat for terrestrial birds to feed and rest during spring and fall migrations. This new habitat will also provide nesting and brood rearing habitat for the species of migratory birds that nest in the area.
Alternative 6:	The lake and upland wildlife areas will provide increased habitat benefiting many species of migratory birds. The 1,818 acre lake will provide habitat for loafing, resting and feeding that currently does not exist for migrating waterfowl and other water dependent birds. The conversion of cropland and pastureland to 3,779 acres of wildlife areas will provide new grass and woodland habitat for terrestrial birds to feed and rest during spring and fall migrations.

This new habitat will also provide nesting and brood rearing habitat for the species of migratory birds that nest in the area.

National Economic Development

Existing Conditions:	Not Applicable
No Action:	Not Applicable
Alternative 4:	$8,447,100 Beneficial, Annual $3,459,800 Adverse, Annual $4,987,300 Net Beneficial
Alternative 6:	$10,638,900 Beneficial, Annual $3,686,900 Adverse, Annual $6,952,000 Net Beneficial

Parklands

Existing Conditions:	There are 88 water-based recreational developments providing a total of 943,441 user days of outdoor recreation within a 75 mile radius of the project area. They vary in size from 10 – 1,006 surface acres (averaging 138 acres) and with amenities provided ranging from primitive access to a full fledged modern resort. An overall regional demand of 10,277,304 user days of additional outdoor recreational opportunities exists.
No Action:	Same as existing conditions.
Alternative 4:	A multi-purpose recreation site would provide 5,152 acres of public recreation including a 1,347 acre lake open to fishing, boating, camping, picnicking, hiking and hunting and many other outdoor activities.
Alternative 6:	A multi-purpose recreation site would provide 6,186 acres of public recreation including a 1,818 acre lake open to fishing, boating, camping, picnicking, hiking and hunting and many other outdoor activities.

Prime and Unique Farmland

Existing Conditions:	Soils of Prime Farmland are currently being cropped and grazed. There are no soils classified as unique farmland.
No Action:	Same as existing conditions.
Alternative 4:	The 5,152 acres of land in the acquisition area being developed as a park, pool, dam, and auxiliary spillway will change current agland use to non-agricultural use on 2,819 acres of soils that are classified as prime farmland. Of 2,819 acres of prime farmland, 2,312 acres are currently cropped.

Alternative 6:	The 6,186 acres of land in the acquisition area being developed as a park, pool, dam, and auxiliary spillway will change current agland use to non-agricultural use on 3,163 acres of soils that are classified as prime farmland. Of 3,163 acres of prime farmland, 2,636 acres are currently cropped.

Public Health & Safety

Existing Conditions:	Water supply is inadequate so support basic health and sanitary requirements. Inadequate water supplies requires the rural fire departments to drive into town to refill tanker trucks when fighting a fire.
No Action:	Water supply is inadequate so support basic health and sanitary requirements. As people continue to build rural residences, more private property will be at greater risk due to inadequate water sources for fire fighting.
Alternative 4:	The reservoir will provide a safe and reliable water supply for basic human needs of hygiene and drinking water. Serves as a readily available water source for fighting fires in the surrounding rural areas. There is an increased risk for water-based recreation related injuries.
Alternative 6:	The reservoir will provide a safe and reliable water supply for basic human needs of hygiene and drinking water. The reservoir will provide a readily available water source for fighting fires in the surrounding rural areas. There is an increased risk for water-based recreation related injuries.

Riparian Areas

Existing Conditions:	Currently the 8,402 acres riparian area habitat of West Tarkio Creek consist of 6,344 acres of cropland, 1,264 acres grass and trees, 538 acres grassland 56 acres woodland and 200 acres of buildings, roads, and other non cropped areas.
No action:	The riparian area land use will be the same as existing conditions.
Alternative 4:	The pool area will reduce the riparian area habitat by 605 acres cropland, 146 acres grass and trees, 70 acres grassland, 2 acres of woodland and 11 acres of buildings, roads and other non cropped areas.
Alternative 6:	The pool area will reduce the riparian area habitat by 725 acres cropland, 184 acres grass and trees, 75 acres grassland, 4 acres of woodland and 19 acres of buildings, roads and other non cropped areas.

Scenic Beauty

Existing Conditions: The West Tarkio Creek watershed is dominated by intensive row crop agriculture marked by large fields and little, if any, native vegetation. The topography is typical southwestern Iowa rolling hills, with a few scattered scrub trees occasionally occurring in the drainages.

No Action: Same as existing conditions.

Alternative 4: Creation of a large reservoir provides a focal point on the landscape which will be further enhanced by shade tree plantings in and around the park area and wildlife habitat plantings in the uplands. The numerous ridges overlooking the reservoir will increase opportunities for wildlife watching, photography and nature appreciation in the region.

Alternative 6: Creation of a large reservoir provides a focal point on the landscape which will be further enhanced by shade tree plantings in and around the park area and wildlife habitat plantings in the uplands. The numerous ridges overlooking the reservoir will increase opportunities for wildlife watching, photography and nature appreciation in the region.

Waters of the US

Existing Conditions: Jurisdictional Waters of the US include West Tarkio Creek. Any modifications to the stream and associated wetlands are subject to provisions of the Clean Water Act (1972).

No Action: Same as existing conditions.

Alternative 4: Jurisdictional Waters of the US include West Tarkio Creek. Any modifications to the stream and associated wetlands are subject to provisions of the Clean Water Act (1972). Modifications include placing fill in 600 linear feet of West Tarkio Creek from the construction of the dam. Inundation by the permanent pool would permanently convert 10.9 miles of ephemeral and intermittent stream to flat water. The flood pool would temporarily inundate up to 2.8 miles of West Tarkio Creek and its tributaries upstream of the permanent pool.

The 33 upland sediment control basins will primarily be constructed on second or third order tributaries to West Tarkio Creek. These basins are planned to prevent sediments from gully erosion and upland sheet and rill erosion form being delivered to the lake.

Fish stocked in the lake would be free to move upstream from the lake. This will provide opportunities for native species to move into the upper reaches of the stream. These species are typically

not found in the upstream reaches due to the size, depth, and intermittent flows of the system.

Alternative 6: Jurisdictional Waters of the US include West Tarkio Creek. Any modifications to the stream and associated wetlands are subject to provisions of the Clean Water Act (1972). Modifications include placing fill in 590 linear feet of West Tarkio Creek from the construction of the dam. Inundation by the permanent pool would permanently convert 10.1 miles of ephemeral and intermittent stream to flat water. The flood pool would temporarily inundate up to 3.4 miles of West Tarkio Creek and its tributaries upstream of the permanent pool.

The 39 upland sediment control basins will primarily be constructed on second or third order tributaries to West Tarkio Creek. These basins are planned to prevent sediments from gully erosion and upland sheet and rill erosion from being delivered to the lake.

Fish stocked in the lake would be free to move upstream from the lake. This will provide opportunities for native species to move into the upper reaches of the stream. These species are typically not found in the upstream reaches due to the size, depth, and intermittent flows of the system.

Wetlands

Existing Conditions: Few wetlands are present in the watershed. Minor areas of wetlands may exist along the toe slopes and stream benches within the channel of West Tarkio Creek. Some artificial wetlands exist in peripheral areas of livestock ponds but there are not any identified wetland areas outside of the stream banks in the flood plain or uplands.

No Action: Same as existing conditions

Alternative 4: The construction of the 39 acre shallow in-channel sediment basin at the upper end of the permanent pool will fill with sediment within a few years and then through the life of the project this sediment basin will function as an emergent wetland. The 33 upland sediment basins will also form small emergent wetlands within the project area.

Alternative 6: The construction of the 45 acre shallow in-channel sediment basin at the upper end of the permanent pool will fill with sediment within a few years and then through the life of the project this sediment basin will function as an emergent wetland. The 39 upland sediment basins will also form small emergent wetlands within the project area.

Cumulative Environmental Impacts:

The National Environmental Policy Act (NEPA) carries the mandate to analyze the cumulative impacts of federal actions (Council on Environmental Quality, 1997). The NRCS-Iowa procedure for cumulative impact analysis was used. This process is interdisciplinary and utilizes the concept of scoping, two key elements of agency compliance with NEPA. Members of the interdisciplinary planning team (IDT) completed the "Checklist for Identifying the Cumulative Environmental Impacts of Projects" for Alternatives 4 and 6. The completed checklists are found in Appendix D.

This checklist was adapted from "Questionnaire Checklist for Cumulative Impacts" (Canter and Kamath, 1995). The checklist identifies 106 different areas of potential environmental and socioeconomic concerns that the project could effect. The IDT answered either "Yes", "Maybe", or "No" to each of the 106 potential concerns based on their collective knowledge of the project area and the proposed project alternatives. Each concern with either a Yes or Maybe answer was then listed in the Cumulative Impacts Matrix. The concerns the IDT identified as having no impact from the project alternative being evaluated were considered "scoped out" of further cumulative impact analysis.

The Cumulative Impacts Matrix was adapted from "Considering the Cumulative Effects of NRCS Activities" (NRCS, 2003). For those concerns that were entered into the matrix, the IDT assigned qualitative ratings on a seven item scale ranging from low adverse impact through no net effect to strong beneficial effect in each of six categories. The Cumulative Impacts Matrix combines impacts from installation of the alternative current conditions within the project area (past actions) no project action (other present actions) to display future condition impacts with the project as well as cumulative impacts. The complete Cumulative Impacts Matrices for Alternatives 4 and 6 follow.

The table below is the symbol key for the Cumulative Impacts Matrices:

O = no effect	* = low adverse effect	** = moderate adverse effect	*** = high adverse effect	+ = low beneficial effect	++ = moderate beneficial effect	+++ = high beneficial effect

Cumulative Impacts Matrix - Alternative 4 - West Tarkio Watershed

a. Potential Impacts	b. Proposed Action[1]	c. Future Condition From Proposed Action	d. Past Actions[2]	e. Other Present Actions[3]	f. Future Condition (c+e)	g. Cumulative Impacts (b+f)
PHYSICAL ENVIRONMENT						
LANDFORM						
Deposition (sedimentation, precipitation)	*	+	**	+	++	+ Reduced sediment deposited downstream
Impact to land classified as prime or unique farmland	**	**	o	o	**	*** Conversion of 2,819 acres of prime farmland to reservoir, recreation area, dam and spillway
Change existing topography (ground contours, shorelines, river banks)	**	+	*	+	++	o Reduces amount of eroding streambank; Creates 22.7 miles of shoreline
Changes in hydrology (water table, gradient, infiltration)	*	+++	***	+	+++	++ Reduces stream peaks downstream of reservoir, extends length of time stream flows
AIR						
Impact on air quality due to gases, particulates and fugitive dust	*	+	*	o	+	+ Increase of 3,364 acres of perennial vegetation in lieu of annually cropped land reduces particulates & dust; carbon sequestration increase reduces greenhouse gases
WATER						
Changes in quality and quantity of surface drinking water	+	+++	**	+	+++	+++ Provides 4.0 mgd of high quality drinking water
Alter flows due to construction	**	++	**	+	+++	+ Reduces stream peaks downstream of reservoir, extends length of time stream flows
Eutrophication	*	+	*	+	+	o Sediment basins and Site 2 reduce amount of nutrients reaching downstream areas
Increase in temperature and turbidity due to impoundment	**	*	**	+	o	* Slight increase in water temperatures due to impoundment
Destruction of streams	*	*	**	o	*	* Convert 10.9 miles of stream to reservoir

Cumulative Impacts Matrix – Alternative 4 – West Tarkio Watershed

a. Potential Impacts	b. Proposed Action[1]	c. Future Condition From Proposed Action	d. Past Actions[2]	e. Other Present Actions[3]	f. Future Condition (c+e)	g. Cumulative Impacts (b+f)
WATER (continued)						
Considerable effects on conventional water quality parameters (DO, pH, turbidity, nutrients, etc.)	*	++	**	+	++	+ Downstream water quality improved due to reduced sediment and nutrient loads
Impact to recharge area or recharge rate	*	+	**	+	+	+ Increased ground water recharge due to increased infiltration
Impact on or construction in a wetland or floodplain	*	++	*	o	++	+ Shallow water areas in project structures create wetland areas
Impact on fisheries	*	+++	**	+	+++	++ Increase in diversity of fish species; increase in sport fishing days
NOISE						
Increase existing noise levels	*	**	o	o	**	*** Increase in traffic and crowd noise
BIOLOGICAL ENVIRONMENT						
FLORA						
Change in diversity or productivity of vegetation	*	+++	***	+	+++	+++ Substantial increase in plant diversity
Impact to riparian habitat	*	++	***	+	++	+ Improved plant diversity provides improved habitat
Introduce new plant species into area	++	+++	**	+	+++	+++ Reintroduction of native grasses and forbs in lieu of corn-soybean monoculture
Create a barrier to the normal replenishment of existing species	**	*	**	+	*	* Dam will stop upstream migration of minnows and other fish
Reduce acreage or create damage to any agricultural crop	**	*	+++	+	*	* About six percent of land acreage in watershed converted to other uses

Cumulative Impacts Matrix – Alternative 4 – West Tarkio Watershed

a. Potential Impacts	b. Proposed Action[1]	c. Future Condition From Proposed Action	d. Past Actions[2]	e. Other Present Actions[3]	f. Future Condition (c+e)	g. Cumulative Impacts (b+f)
FAUNA						
Effect to land animals, benthic organisms, insects, and microfauna	*	+++	**	+	+++	+++ 5,152 acres of low diversity habitat converted to other uses. 3,364 acres of greater diversity of vegetation and 1,347 acres of water created thus improving conditions for these creatures.
Attraction, entrapment, or impingement of animal life	*	+	**	+	+	+ Improved habitat conditions will result in increased animal populations of many species.
Impact to existing fish, wild-life habitat, and nesting areas	**	+++	***	+	+++	+++ Improved habitat conditions will result in increased animal populations of many species.
Introduction of new species of animals into the area	o	++	**	o	++	++ Improved habitat conditions will result in increased animal populations and more species.
Create a barrier to the migration or movement of animals or fish	*	+	+	o	+	+ Site 2 will stop upstream migration of minnows and other fish
Cause emigration resulting in human-wildlife interaction problems	*	o	**	+	+	+ More intensive land use increases human-wildlife encounters.
Effect to food chain	+	++	***	+	++	++ Increase in habitat types results in more complex food chain with greater stability.
LANDUSE						
Substantially altering existing land use of area	***	***	++	+	**	*** 5,152 acres of farms converted to water, recreation areas, and wildlife habitat
Impact to wetlands	*	++	***	+	++	++ Project structures will create a net increase of wetland habitat
RECREATION						
Impact to hunting, fishing, picnicking, & holiday resorts	++	+++	**	o	+++	+++ Increase of 187,400 visitor days of these and related activities

Cumulative Impacts Matrix – Alternative 4 – West Tarkio Watershed

a. Potential Impacts	b. Proposed Action[1]	c. Future Condition From Proposed Action	d. Past Actions[2]	e. Other Present Actions[3]	f. Future Condition (c+e)	g. Cumulative Impacts (b+f)
AESTHETICS						
Impact to scenic views and vistas	+	+++	*	+	+++	+++ Water and wildlife habitat area provides visual diversity in area dominated by row crops
Impact to landscape design	+	+++	**	+	+++	+++ Water and wildlife habitat area provides visual diversity in area dominated by row crops
Impact to parklands and reserves	++	+++	***	o	+++	+++ Increase of 5,152 acres of parks and wildlife habitat
ARCHAEOLOGICAL SITES						
Impact to or destruction of historical, archaeological, cultural, and paleontological sites or objects	*	+	*	+	+	+ Farmsteads > 50 years old will be removed; archaeological sites will be protected by permanent vegetation
HEALTH AND SAFETY						
Health hazard or potential health hazard	*	*	*	o	*	* Greater number of people exposed to less risky (than farming) activities
Exposure of people to potential health hazard	*	**	*	o	*	* Greater number of people exposed to less risky (than farming) activities
CULTURAL PATTERNS						
Change existing cultural patterns (life style)	*	+	*	+	+	o Small town and rural life styles will be retained
NEED FOR NEW OR ALTERED LOCAL SERVICES IN ANY OF THE FOLLOWING AREAS						
Child care	o	+	*	o	+	+ Increase in local economy will result in maintaining more young families in area
Police	o	*	*	o	*	* Increase in recreational visitors may result in need for additional police

Cumulative Impacts Matrix – Alternative 4 – West Tarkio Watershed

a. Potential Impacts	b. Proposed Action[1]	c. Future Condition From Proposed Action	d. Past Actions[2]	e. Other Present Actions[3]	f. Future Condition (c+e)	g. Cumulative Impacts (b+f)
NEED FOR NEW OR ALTERED LOCAL SERVICES IN ANY OF THE FOLLOWING AREAS - continued						
Fire protection	o	*	o	o	*	* Roads closed by lake will result in increased travel patterns for fire responders
Education	o	+	*	o	+	+ Increase in local economy will result in maintaining more young families in area
Churches	o	+	*	o	+	+ Increase in local economy will result in maintaining more people in area
NEED FOR NEW OR ALTERATIONS TO THE FOLLOWING PUBLIC UTILITES						
Electricity	o	+	o	o	+	+ Increase in local economy will result in increased demand for electricity in area
Natural gas	o	+	o	o	+	+ Increase in local economy will result in increased demand for natural gas in area
Potable water	o	+	*	+	+	+ More reliable water supply will improve local economy
Wastewater treatment	o	+	o	o	+	+ More people remaining in area will increase demand
Stormwater control	*	+	o	o	+	+ Increase in permanent vegetation and water detention sites will reduce stormwater runoff
Solid waste collection and disposal	*	*	+	o	*	* More people remaining in area will increase demand
Communications systems	*	o	o	o	o	* Site 2 will require modification or rerouting of some utilities
Transmission pipelines	*	o	o	o	o	* Site 2 will require modification or rerouting of some utilities

Cumulative Impacts Matrix – Alternative 4 – West Tarkio Watershed

a. Potential Impacts	b. Proposed Action[1]	c. Future Condition From Proposed Action	d. Past Actions[2]	e. Other Present Actions[3]	f. Future Condition (c+e)	g. Cumulative Impacts (b+f)
POPULATION						
Alteration of location or distribution of human populations in area	*	*	*	o	*	* Rural residents at 14 locations will be displaced
Change to demographic characteristics in the area	o	++	*	o	+	+ Increase in local economy will result in maintaining more young families in area
ECONOMIC						
Effect on local or regional economy	+	++	*	+	++	++ More reliable water supply will improve local economy
Changes in per capita income	o	+	*	o	+	+ More reliable water supply will improve local economy
Changes in the standard of living	o	+	*	o	+	+ More reliable water supply will improve local economy
Employment	+	+	*	o	+	++ Project will create almost 300 direct jobs (one time occurrence) during construction and about 140 direct long-term jobs; loss of about 15 agricultural jobs
TRANSPORTATION						
Change to existing railroad, road, waterway and/or air traffic	*	*	o	o	*	* It is anticipated the county will close at least four rural roads
Increase in movement	*	*	o	o	*	* Increase in traffic due to recreational visitors
Increase in accident and traffic hazards	*	*	o	o	*	* Increase in traffic due to recreational visitors will likely result in more accidents
Effect to transportation network	o	*	o	o	*	* Increase in traffic due to recreational visitors will likely result in additional operation and maintenance of some county roads in project area

Cumulative Impacts Matrix – Alternative 4 – West Tarkio Watershed

a. Potential Impacts	b. Proposed Action[1]	c. Future Condition From Proposed Action	d. Past Actions[2]	e. Other Present Actions[3]	f. Future Condition (c+e)	g. Cumulative Impacts (b+f)
TRANSPORTATION (continued)						
Construction of new roads	o	+	o	o	+	+ About 1.5 miles of new road will be constructed within recreation area. The county may construct or upgrade additional roads
Change in existing patterns of movement of persons and materials	*	**	o	o	**	** It is anticipated the county will close at least four rural roads
ENERGY						
Substantial use of fuel or energy	*	*	*	o	*	* Fuel used for construction, recreational use will increase. Fuel used for agriculture will decrease.

Symbol Key: o - net no effect	* = low adverse effect	** = moderate adverse effect	*** = high adverse effect	+ = beneficial effect	++ = moderate beneficial effect	+++ = high beneficial effect

[1] Proposed Action-Alternative 4 Site 2 Max plus sediment control structures

[2] Past Actions - 5152 acres of intensively farmed agricultural land with high rates of participation in federal farm programs; warm water stream highly modified by straightening, in-stream grade control structures, and sedimentation; city water supplies from ground water and from Nishnabotna River.

[3] Other Present Actions-EQIP, CSP, State Programs, CRP, Ag Commodity Programs, EPA water quality programs

Cumulative Impacts Matrix - Alternative 6 - West Tarkio Watershed

a. Potential Impacts	b. Proposed Action[1]	c. Future Condition From Proposed Action	d. Past Actions[2]	e. Other Present Actions[3]	f. Future Condition (c+e)	g. Cumulative Impacts (b+f)
PHYSICAL ENVIRONMENT						
LANDFORM						
Deposition (sedimentation, precipitation)	*	+	**	+	++	+ Reduced sediment deposited downstream
Impact to land classified as prime or unique farmland	**	**	o	o	**	*** Conversion of 3,163 acres of prime farmland to reservoir, recreation area, dam and spillway
Change existing topography (ground contours, shorelines, river banks)	**	+	*	+	++	o Reduces amount of eroding streambank; Creates 25.4 miles of shoreline
Changes in hydrology (water table, gradient, infiltration)	*	+++	***	+	+++	++ Reduces stream peaks downstream of reservoir, extends length of time stream flows
AIR						
Impact on air quality due to gases, particulates and fugitive dust	*	+	*	o	+	+ Increase of 3,779 acres of perennial vegetation in lieu of annually cropped land reduces particulates & dust; carbon sequestration increase reduces greenhouse gases
WATER						
Changes in quality and quantity of surface drinking water	+	+++	**	+	+++	+++ provides 4.0 mgd of high quality drinking water
Alter flows due to construction	**	++	**	+	+++	+ Reduces stream peaks downstream of reservoir, extends length of time stream flows
Eutrophication	*	+	*	+	+	o Sediment trapping structures and Site 3 reduce amount of nutrients reaching downstream areas

Cumulative Impacts Matrix - Alternative 6 - West Tarkio Watershed

a. Potential Impacts	b. Proposed Action[1]	c. Future Condition From Proposed Action	d. Past Actions[2]	e. Other Present Actions[3]	f. Future Condition (c+e)	g. Cumulative Impacts (b+f)
WATER (continued)						
Increase in temperature and turbidity due to impoundment	**	*	**	+	o	* Slight increase in water temperatures due to impoundment
Destruction of streams	*	*	**	o	*	* Inundation of 1.5 miles of stream by reservoir
Considerable effects on conventional water quality parameters (DO, pH, turbidity, nutrients, etc.)	*	++	**	+	++	+ Downstream water quality improved due to reduced sediment and nutrient loads
Impact to recharge area or recharge rate	*	+	**	+	+	+ Increased ground water recharge due to increased infiltration, in and near impoundment
Impact on or construction in a wetland or floodplain	*	++	*	o	++	+ Shallow water areas in project structures will result in creation of wetland areas
Impact on fisheries	*	+++	**	+	+++	++ Increase in diversity of fish species; increase in sport fishing days
NOISE						
Increase existing noise levels	*	**	o	o	**	*** Increase in traffic and crowd noise
BIOLOGICAL ENVIRONMENT						
FLORA						
Change in diversity or productivity of vegetation	*	+++	***	+	+++	+++ Substantial increase in plant diversity
Impact to riparian habitat	*	++	***	+	++	+ Improved plant diversity provides improved habitat
Introduce new plant species into area	++	+++	**	+	+++	+++ Reintroduction of native grasses and forbs in lieu of corn-soybean monoculture

Cumulative Impacts Matrix – Alternative 6 – West Tarkio Watershed

a. Potential Impacts	b. Proposed Action[1]	c. Future Condition From Proposed Action	d. Past Actions[2]	e. Other Present Actions[3]	f. Future Condition (c+e)	g. Cumulative Impacts (b+f)
FLORA (continued)						
Create a barrier to the normal replenishment of existing species	**	*	**	+	*	* Dam will stop upstream migration of minnows and other fish
Reduce acreage or create damage to any agricultural crop	**	*	+++	+	*	* About 5% of land acreage in watershed converted to other use
FAUNA						
Effect to land animals, benthic organisms, insects, and microfauna	*	+++	**	+	+++	+++ 5,597 acres of low diversity habitat converted to 3,779 acres of greater diversity of vegetation and 1,818 acres of water, thus improving conditions for these creatures.
Attraction, entrapment, or impingement of animal life	*	+	**	+	+	+ Improved habitat conditions will result in increased animal populations of many species.
Impact to existing fish, wild-life habitat, and nesting areas	**	+++	***	+	+++	+++ Improved habitat conditions will result in increased animal populations of many species.
Introduction of new species of animals into the area	o	++	**	o	++	++ Improved habitat conditions will result in increased animal populations and more species.
Create a barrier to the migration or movement of animals or fish	*	+	+	o	+	+ Site 3 will stop upstream migration of minnows and other fish
Cause emigration resulting in human-wildlife interaction problems	*	o	**	+	+	+ More intensive land use increases human-wildlife encounters.

Cumulative Impacts Matrix - Alternative 6 - West Tarkio Watershed

a. Potential Impacts	b. Proposed Action[1]	c. Future Condition From Proposed Action	d. Past Actions[2]	e. Other Present Actions[3]	f. Future Condition (c+e)	g. Cumulative Impacts (b+f)
FAUNA -continued						
Affect to food chain	+	++	***	+	++	++ Increase in habitat types results in more complex food chain with greater stability.
LANDUSE						
Substantially altering existing land use of area	***	***	++	+	**	*** 6,186 acres of farms converted to water, recreation areas, and wildlife habitat
Impact to wetlands	*	++	***	+	++	++ Project structures will create a net increase of wetland habitat
RECREATION						
Impact to hunting, fishing, picnicking, & holiday resorts	++	+++	**	o	+++	+++ Increase in 251,800 visitor days of these activities
AESTHETICS						
Impact to scenic views and vistas	+	+++	*	+	+++	+++ Water and wildlife habitat area provides visual diversity in area dominated by row crops
Impact to landscape design	+	+++	**	+	+++	+++ Water and wildlife habitat area provides visual diversity in area dominated by row crops
Impact to parklands and reserves	++	+++	***	o	+++	+++ Increase of 6,186 acres of parks and wildlife habitat
ARCHAEOLOGICAL SITES						
Impact to or destruction of historical, archaeological, cultural, and paleontological sites or objects	*	+	*	+	+	+ Farmsteads > 50 years old will be removed; archaeological sites will be protected by permanent vegetation

Cumulative Impacts Matrix – Alternative 6 – West Tarkio Watershed

a. Potential Impacts	b. Proposed Action[1]	c. Future Condition From Proposed Action	d. Past Actions[2]	e. Other Present Actions[3]	f. Future Condition (c+e)	g. Cumulative Impacts (b+f)
HEALTH AND SAFETY						
Health hazard or potential health hazard	*	*	*	o	*	* Greater number of people exposed to less risky (than farming) activities
Exposure of people to potential health hazard	*	**	*	o	*	* Greater number of people exposed to less risky (than farming) activities
CULTURAL PATTERNS						
Change existing cultural patterns (life style)	*	+	*	+	+	o Small town and rural life styles will be retained
NEED FOR NEW OR ALTERED LOCAL SERVICES IN ANY OF THE FOLLOWING AREAS						
Child care	o	+	*	o	+	+ Increase in local economy will result in maintaining more young families in area
Police	o	*	*	o	*	* Increase in recreational visitors may result in need for additional police
Fire protection	o	*	o	o	*	* Roads closed by lake will result in increased travel patterns for fire responders
Education	o	+	*	o	+	+ Increase in local economy will result in maintaining more young families in area
Churches	o	+	*	o	+	+ Increase in local economy will result in maintaining more people in area

Cumulative Impacts Matrix – Alternative 6 – West Tarkio Watershed

a. Potential Impacts	b. Proposed Action[1]	c. Future Condition From Proposed Action	d. Past Actions[2]	e. Other Present Actions[3]	f. Future Condition (c+e)	g. Cumulative Impacts (b+f)
NEED FOR NEW OR ALTERATIONS TO THE FOLLOWING PUBLIC UTILITES						
Electricity	o	+	o	o	+	+ Increase in local economy will result in increased demand for electricity in area
Natural gas	o	+	o	o	+	+ Increase in local economy will result in increased demand for natural gas in area
Potable water	o	+	*	+	+	+ More reliable water supply will improve local economy
Wastewater treatment	o	+	o	o	+	+ More people remaining in area will increase demand
Stormwater control	*	+	o	o	+	+ Increase in permanent vegetation and water detention sites will reduce stormwater runoff
Solid waste collection and disposal	*	*	+	o	*	* More people remaining in area will increase demand
Communications systems	*	o	o	o	o	* Site 3 will require modification or rerouting of some utilities
Transmission pipelines	*	o	o	o	o	* Site 3 will require modification or rerouting of some utilities
POPULATION						
Alteration of location or distribution of human populations in area	*	*	*	o	*	* Rural residents at 16 locations will be displaced
Change to demographic characteristics in the area	o	++	*	o	+	+ Increase in local economy will result in maintaining more young families in area

Cumulative Impacts Matrix - Alternative 6 - West Tarkio Watershed

a. Potential Impacts	b. Proposed Action[1]	c. Future Condition From Proposed Action	d. Past Actions[2]	e. Other Present Actions[3]	f. Future Condition (c+e)	g. Cumulative Impacts (b+f)
ECONOMIC						
Effect on local or regional economy	+	++	*	+	++	++ More reliable water supply will improve local economy
Changes in per capita income	o	+	*	o	+	+ More reliable water supply will improve local economy
Changes in the standard of living	o	+	*	o	+	+ More reliable water supply will improve local economy
Employment	+	+	*	o	+	++ Project will create almost 300 direct jobs (one time occurrence) during construction and about 140 direct long-term jobs; loss of about 15 agricultural jobs
TRANSPORTATION						
Change to existing railroad, road, waterway and/or air traffic	*	*	o	o	*	* It is anticipated the county will close at least five rural roads
Increase in movement	*	*	o	o	*	* Increase in traffic due to recreational visitors
Increase in accident and traffic hazards	*	*	o	o	*	* Increase in traffic due to recreational visitors will likely result in more accidents
Effect to transportation network	o	*	o	o	*	* Increase in traffic due to recreational visitors will likely result in additional operation and maintenance of some county roads in project area
Construction of new roads	o	+	o	o	+	+ New roads will be constructed within recreation area
Change in existing patterns of movement of persons and materials	*	**	o	o	**	** It is anticipated the county will close at least five rural roads

Cumulative Impacts Matrix – Alternative 6 – West Tarkio Watershed

a. Potential Impacts	b. Proposed Action[1]	c. Future Condition From Proposed Action	d. Past Actions[2]	e. Other Present Actions[3]	f. Future Condition (c+e)	g. Cumulative Impacts (b+f)
ENERGY						
Substantial use of fuel or energy	*	*	*	o	*	* Fuel used for construction, recreational use will increase. Fuel used for agriculture will decrease.

Symbol Key: o - net no effect	* = low adverse effect	** = moderate adverse effect	*** = high adverse effect	+ = beneficial effect	++ = moderate beneficial effect	+++ = high beneficial effect

[1] Proposed Action - Alternative 4-Site 3 plus sediment control structures

[2] Past Actions - 5100 acres of intensively farmed agricultural land with high rates of participation in federal farm programs; warm water stream highly modified by straightening, in-stream grade control structures, and sedimentation; city water supplies from ground water and from Nishnabotna River.

[3] Other Present Actions - EQIP, CSP, State Programs, CRP, Ag Commodity Programs, EPA water quality programs

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Consultation and Public Participation

A letter dated January 15, 2002 requesting project planning assistance from NRCS Iowa was signed by eight local municipal and county government officials. The NRCS authorized planning assistance near the end of 2002.

A public forum was conducted on November 4, 2002 by local municipal and county officials to discuss a possible lake project. The forum was held in Clarinda and was attended by nearly 1,000 people with the majority expressing support. The Page County Board of Supervisors acknowledged receiving letters favoring the project by a 10:1 ratio.

The sponsors formed the West Tarkio Watershed Planning Committee in 2003 to serve as an advisory body for the project. The Planning Committee is made up of representatives from the sponsoring groups plus four local watershed residents. The West Tarkio Planning Committee has held 15 meetings from March 2003 to January 2006. All have been conducted in accordance with the Iowa Open Meetings Law. The public was notified of each meeting and invited to attend and participate. Typically, 10-15 members of the public attend these meetings. One or more members of the NRCS staff were at each of these meetings to answer questions and receive comments.

The West Tarkio Planning Committee held open house meetings to discuss the planning process and plan development. Two open house informational meetings were held in Shenandoah, Iowa on August 19, 2003, to initiate the planning process and obtain public input. Numerous displays related to the West Tarkio planning process were used. Members of the public were encouraged to visit with NRCS specialists on specific topics. These meetings were publicized in local media through the use of news releases and on the NRCS Iowa website. A total of 79 people attended the sessions. Attendees were given an opportunity to complete a public opinion questionnaire and a recreation planning assessment. Forty- two public opinion questionnaires and 22 recreation planning surveys were submitted to the NRCS planning staff.

Three issues were identified by the public and were added to the Environmental Evaluation. Century Farms, impoundment effects on downstream wells, and impoundment effects on baseflow were added to Table B. In addition, the public requested that groundwater sources be studied as an alternative to surface water impoundments and that a combination of groundwater and surface water sources be evaluated.

State and federal agencies, private organizations, and local individuals were invited to a scoping meeting on February 17, 2004. Resource Concerns listed in Table B are the result of the scoping meeting. More than 80 people attended the session and were given a chance to speak and complete a Scoping Meeting Study Information worksheet. Six individuals presented oral statements at the meeting and six worksheets were completed and later returned. A copy of this worksheet is in Appendix E.

Some landowners in and near the impoundment study areas expressed their opposition to the project. Concerns expressed included: potential loss of land ownership; sediment accumulation

in the constructed impoundment; and impacts to the local economy as farmland is converted to project uses. Other individuals expressed support for the project purposes of water supply and recreation. NRCS planning staff presented summaries of on-going and proposed technical studies. A summary of the scoping meeting is included in Appendix E.

In early 2004, an advisory group was organized to gather additional input from project sponsors and interested persons or organizations related to the recreation or fish and wildlife purposes of the West Tarkio Watershed project. Members of the group represented diverse organizations including some of the project sponsors, professionals in outdoor recreation management, and local non-governmental organizations.

Five working sessions were held between May 2004 and June 2005. Topics discussed included, but were not limited to: types of facilities and amenities to be included in the recreation plan, design layout of those facilities, partnership and funding opportunities, covenants and zoning for water quality protection, public/private development scenarios, and a potential destination park location. Suggestions from the group played a key role in finalizing the recreation plan design and layout. At the request of the sponsors, NRCS provided technical information on a variety of topics to facilitate their decision making process.

There were 33 direct contacts with the NRCS Iowa planning staff and other NRCS officials outside of scheduled project meetings or local sponsor meetings. These contacts were usually emails, meetings, faxes or phone calls and were typically comments or questions about specific aspects of the project. The NRCS staff responded to these contacts as appropriate.

A Notice of Intent (NOI) to prepare an Environmental Impact Statement was published in the Federal Register on April 20, 2005. The NOI was also posted at the Iowa NRCS web site and was the subject of a press release.

Appendix E; Supporting Information, contains the Southwest Iowa Water Improvement Project Chronology of Events prepared by the City of Shenandoah in July 2003.

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Provisions of the Preferred Alternative

Rationale for the Plan Selection

Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G) requires the alternative plan with the greatest net economic benefit consistent with protecting the Nation's environment (the NED plan) is to be selected unless the Secretary of a department or agency head grants an exception when there is some overriding reason for selecting another alternative.

The evaluation of the three alternatives indicates that Alternative 6 is the NED plan. The primary objectives of the sponsors are to develop a safe and reliable regional water supply and water-based recreation opportunities while maximizing net economic benefits. The sponsors also selected Alternative 6 as the Preferred Alternative as it best meets their objectives.

Measures to be Installed

Structural Measures

The structural measures included in this project are required to provide an adequate water supply for the cities of Shenandoah and Clarinda, rural water for the surrounding area, water-based recreational development, and agricultural pollution control .

Tables 1-6 in Appendix A provide additional information on the preferred alternative.

The following is a discussion of structural components for Alternative 6, the Preferred Alternative.

Multi-purpose Dam

The multi-purpose dam at Site 3 will be an earthfill embankment with planned storage for sediment, recreation, and water supply. Site 3 will have a reinforced concrete principal spillway and a vegetated auxiliary spillway. Storage volume is provided for 100 years of sediment accumulation. Water will be stored in this area until displaced with accumulated sediment.

Sediment storage provided by Site 3 is as shown in Table 3, Appendix D. Storage of 19,961 acre-feet will be provided for water supply. Storage volume for recreation and fish and wildlife purposes is 9,856 acre-feet. Surface area at the principal spillway crest will be 1,818 acres. The surface area of the floodwater retarding pool will be 2,599 acres providing 23,765 acre-feet of temporary flood water storage.

The area to be cleared includes the foundation area of the dam and outlet channel area, the auxiliary spillway, the waste area, the intake structure, and the alternate borrow area. Stumps will be grubbed from most of the clearing area except for the waste area. Trees will be cut flush with the ground in the waste area but stumps will not be removed.

Geologic investigation of the site has not been completed at this time since landrights have not been obtained. Shallow borings in the floodplain within 1.5 miles of the site were predominantly

fine grained soils to depths of 20 to 25 feet. These soils are typically loess derived alluvium. At this point it is anticipated that the foundation will consist of compressible fine grained soils which are bounded by glacial till at an unknown depth. The foundation material is presumed to be low in permeability but foundation drains will likely be needed to reduce pore water pressure and intercept any seepage flowing beneath the embankment that might contribute to saturation and uplift at the toe of the dam. It is anticipated that removal of all the compressible material will be cost prohibitive. Slope stability and settlement issues will be addressed by methods other than removal of compressible material. Some stream channel cleanout will be necessary to remove post-settlement alluvium and to slope the channel banks to a stable slope of 2:1 or flatter. A core trench five feet deep with 2:1 side slopes is anticipated for investigation of the foundation soils.

The embankment will be rolled earthfill comprised of relatively homogeneous fine grained soil. Because the foundation material likely consists of compressible material, settlement plates and piezometer wells may be required to monitor foundation and embankment settlement as well as pore water pressure. A granular drainage diaphragm and filter will control seepage around the principal spillway.

The primary borrow source for the dam will be the auxiliary spillway which is located in the hill at the left end of the dam. Suitable borrow material will likely be present in the pool area and on adjacent hills.

The principal spillway consists of a single-stage , reinforced concrete baffle inlet, a reinforced concrete box conduit (6.5' x 6.5'), and a Saint Anthony Falls (SAF) outlet (see Figure B). A minimum of one gated drawdown pipe will extend from the riser into the reservoir. This pipe will be set at or below the level of 50 percent of the permanent storage. The drawdown can be used to lower the water elevation as necessary for operation and maintenance for fish management.

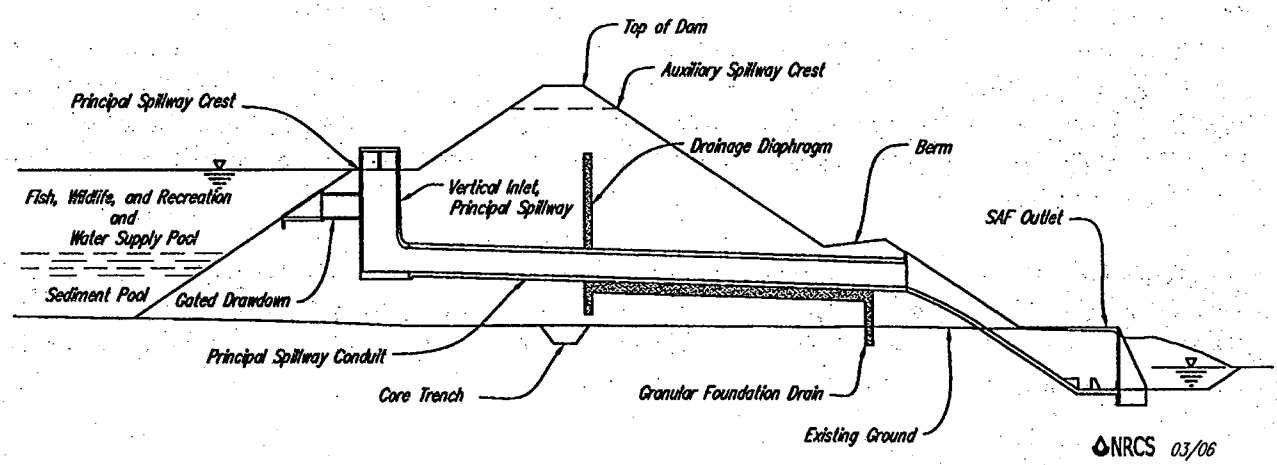

Figure B.

The 100 year- 24 hour rainfall of 6.9 inches is controlled by the principal spillway. The retarding storage associated with this storm event is 8,874 acre-feet.

The auxiliary spillway is a vegetated spillway to be constructed into the hill east of the dam. The entire auxiliary spillway bottom will be in excavation and will be the primary source of borrow material for the embankment. The auxiliary spillway bottom width is 640 feet and is divided into four channels each 160 feet wide. The channels are separated by three dikes of an additional 60 feet of total width each. The total bottom width of the auxiliary spillway is 820 feet.

The design life of the dam and associated appurtenances is 100 years. The sediment storage is apportioned with 80 percent submerged and 20 percent aerated. The volume of storage below crest reserved for sediment storage is 2,644 acre-feet. The volume of storage above crest reserved for sediment is 496 acre-feet. Sediment storage of 1.24 inches is provided for in the design of the reservoir and dam.

Water Supply Components

To convey untreated water, two water lines will be constructed from Site 3; one to the City of Shenandoah and one to the City of Clarinda. Each city will treat its own water. Shenandoah will be using its current treatment plant while Clarinda plans on constructing a new treatment plant.

The water supply intake tower will be a reinforced concrete structure installed to withdraw lake water from three different pool levels. Withdrawing from three levels enables the sponsors to control water quality through selection and mixing of raw water for treatment and distribution.

Single Purpose In-Channel Sediment Basin

One in-channel structure (numbered IC-1) is planned in the upper reaches of the reservoir and has a drainage area of 22,848 acres, which is 75 percent of the watershed. The function of this structure is to trap 97 percent of the sediment delivered to the reservoir from the main channel in the upper reaches. The purpose is to extend the period of higher quality and depth of water in the main reservoir. This structure consists of a compacted earthfill core armored with loose rock riprap two feet thick. The top of the earthfill core is set one foot below the permanent pool elevation of Site 3. The top of the loose rock riprap is set one foot above the permanent pool (see Figure C). This configuration was selected to avoid the necessity of a large and expensive conduit. As a result, the structure can function during base flow by allowing flow through the riprap. During storm events the structure will be inundated by the reservoir allowing large flows to pass over the top.

The estimated sediment life of the in-channel sediment basin is approximately seven years. Because the structure was designed to function without a large principal spillway, its top elevation is limited by the permanent pool elevation of Site 3. Consequently, the sediment life of the in-channel structure is limited to about seven years.

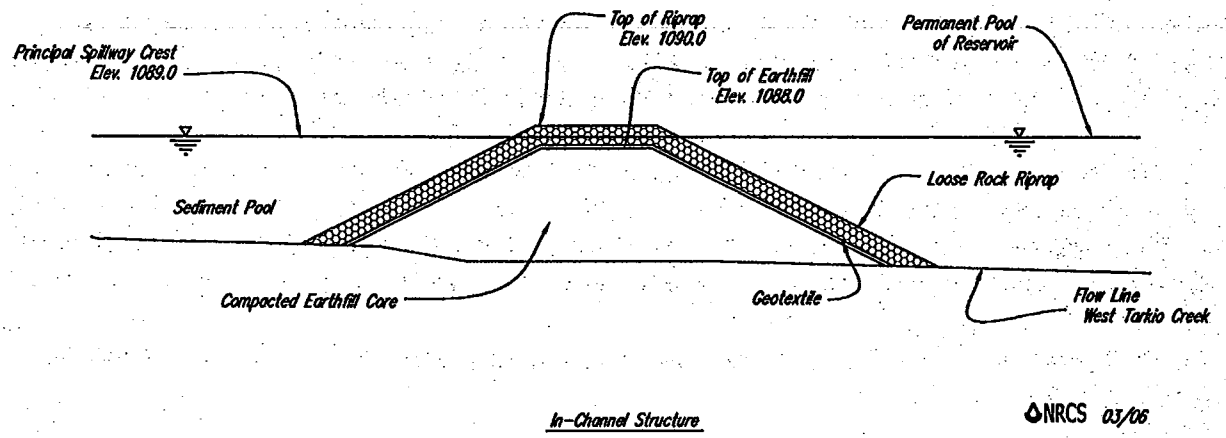

Figure C.

Single Purpose Sediment Basins

Thirty-nine sediment basins have been planned around and just upstream of the reservoir for the purpose of agricultural pollution control. The structure drainage areas range from 45 acres to 459 acres (Appendix A, Table 3). The structures have drainage areas totaling 5,296 acres which is 17.4 percent of the watershed. See Map in Appendix C. These structures are designed using Iowa Standard 350, Sediment Basin, from Section IV of the NRCS Field Office Technical Guide, and have a sediment storage life of 100 years. The dams and spillways of most sites will be designed using Iowa Standard 378, Pond (also from Section IV). A few sites will be designed using Technical Release 60, "Earth Dams and Reservoirs", NRCS, Conservation Engineering Division.

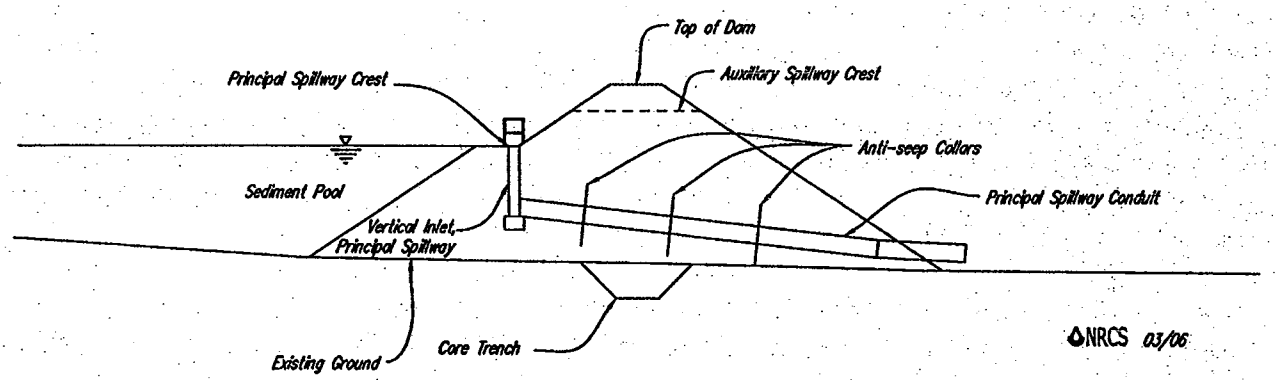

Figure D.

Cost estimates of the 39 sites were developed using six sample sites. The drainage areas of the 39 sites range from 45 acres to 459 acres. Each site therefore falls into one of three categories listed in the Iowa Pond Standard for determining the minimum spillway capacity for storage type structures. Each successive category is based on an increasing range of drainage area and the applicable categories are; "20-80 acres", "80-250 acres", and "All Others". Two sites, one on

the low end of the range and one on the high end of the range, matching each category were sampled to represent all the sites in that category. Data for the six individual sites is displayed in Appendix A, Table 3. Cumulative data for all 39 sites are also displayed in Table 3.

Little or no clearing will be necessary for many of the sites. A few sites will require some significant clearing. Any trees located within and around the foundation area of the dam will be cleared and grubbed. Some trees located in the pool area outside the foundation area may be cut flush with the ground if a permanent pool is anticipated but clearing will be kept to a minimum.

As many trees as possible will be left standing within these pools to furnish additional fish and wildlife habitat.

The need for seepage control on most sites is expected to be low. Typical seepage control will consist of three or four anti-seep collars that are 60 inch by 60 inch or 72 inch by 72 inch. A few of the larger sites will require drainage diaphragms as well as foundation and abutment drains.

The embankments will be rolled earthfill comprised of relatively homogeneous fine grained soil. The fill height of most of the dams will be below 25 feet. Standard side slopes of 3:1, and a top width of 12 feet should be adequate. Most sites will require a 10 foot level berm the length of the dam due to the potential pool size. A few sites will require vegetative sloping berms. Slope stability and settlement are not expected to be outside of normal parameters for western Iowa.

These small sites are located in upland valleys where the soils range from alluvium in the bottom to loess on the higher slopes. Sufficient borrow for the smaller dams will be found in the sediment pool area. Larger dams will require some hill borrow in addition to borrow from the sediment pool. General knowledge of the soils indicates that borrow will consist primarily of loess and loess derived alluvium.

All the upland sediment basins have been designed with principal spillways consisting of corrugated metal pipe (see Figure D). The principal spillway storm ranges from the 5 year-24 hour storm (approximately 4.2 inches) to the 10 year-24 hour storm (approximately 4.9 inches). Site 38 is a road structure which potentially falls under TR-60 criteria. This structure would likely be designed without an auxiliary spillway. In that case, the principal spillway and top of dam will be designed for the freeboard storm, a 10.0 inch rainfall in 24 hours. Two other sites have been identified as potential road structures. These should be small enough that they may be designed according to the pond standard.

Vertical inlets were used in the design to allow for drawdown pipes where desired for management of the pool levels. Barrel sizes range from 12 inch to 30 inch diameter. Some sites located downstream of crop fields may require a larger pipe to reduce drawdown time so that crop damage from flooding will be minimal.

Auxiliary spillways will be vegetated spillways designed for either the 25 year-24 hour storm (approximately 5.7 inches) or the 50 year- 24 hour storm, depending on fill height and drainage area.

The design life of the sediment storage was based on a 100 year period. Trap efficiency was assumed to be 100%. Most sites do not have active gullies and the delivery rate of sediment off the drainage area ranged from 50 to 90 percent. Sediment storage was based on an apportionment of 80 percent below crest and 20 percent above crest. The sediment volume of all 39 sites averaged 2.24 inches. The principal spillway components are expected to achieve a 50 year life using polymer coated pipe and cathodic protection. The cost of one complete replacement of the principal spillway and appurtenances was factored into the operation, maintenance and replacement cost.

All the single-purpose sediment basins have been classified as low hazard. During a site visit to 28 of the 39 upland sediment basins, no sites were identified as having potential for a higher hazard rating. Downstream conditions for the remaining 11 sites were checked using aerial photos. None of these sites appeared to warrant a higher hazard classification. None of the upland sediment basins are in series.

Wildlife Management Area

The 3,779 acre wildlife area will be established to provide for public recreational wildlife opportunities and wildlife habitat. This wildlife area will provide the necessary mitigation to replace wildlife habitat lost due to the installation of the multi purpose permanent pool, flood pool, and developed recreational areas. The wildlife area will be composed both of existing woody cover and new native deciduous woody cover, and new native grass and forb cover, improved existing herbaceous areas, and food plots. In order to provide sufficient mitigation to replaces losses of woody and herbaceous wildlife habitat values, a minimum of 125 habitat units of tree and shrub planting for replacement of lost woody wildlife cover and 262 habitat units of native grass and forbs to replace lost herbaceous wildlife cover will be required.

Agricultural Pollution Control

Table H below is a summary of land use in the drainage area of Alternative 6 and includes erosion rates for terraced and unterraced cropland as well as drainage protected by the basins that are included in this plan.

Table H
Landuse and Erosion rates in Drainage Area of Alternative 6.

Erosion Type & Source	*Area* (ac)	*Basin* (ac)	*Non Basin* (ac)	*Erosion Rate* basin (t/ac/yr)	*Erosion Rate* non basin (t/ac/yr)
Sheet & Rill Erosion	*30,380.0*	*5,178.8*	*25,201.2*	*4.20*	*3.53*
Pasture	998.0	197.8	800.2	0.8	0.5
Grassland	176.0	23.0	153.0	0.1	0.1
Woodland & Corridors	1,153.0	123.4	1,029.6	0.1	0.1
CRP	380.0	39.4	340.6	0.1	0.1
Farmsteads	773.0	123.3	649.7	2.0	2.0
Unterraced Cropland	14,268.0	2,777.1	11,490.9	6.2	4.8
Terraced Cropland	11,673.0	1,765.7	9,907.3	2.3	3.2
Other	959.0	129.1	829.9	0.2	0.2
total	30,380.0	5,178.8	25,201.2		

Alternative 6 (Site 3) Land use and erosion rates for watershed including the 39 basins.

The sample unit study concluded that when considering all land uses, soil loss on 86 percent of the drainage area is at acceptable soil loss, "T" which is generally 5 tons/acre/year) or less. Soil loss data from the sample units show that 84 percent of cropland is less than or equal to "T".

The purpose of agricultural pollution control is to further protect the 1,818 acre water impoundment from runoff in the 30,380 acre watershed. The 17:1 ratio between watershed area and impoundment surface area will inherently protect water quality. This relationship will minimize the quantity of runoff constituents like sediment and attached pollutants delivered to the impoundment and yet yield adequate runoff to support all planned water uses.

Erosion is adequately controlled on 86.4 percent of the watershed. Almost 50 percent of the cropland is terraced and an additional 24 percent is farmed on the contour. Currently there is a watershed based project funded by the state of Iowa, US EPA, and USDA . This project is focused on landowners voluntarily implementing additional erosion and sediment control practices.

The sponsors will acquire a total of 6,186 acres including and adjacent to the impoundment that will be developed for public recreational uses, wildlife habitat and open spaces. It will provide a buffer from private land uses. The acquisition area is in compliance with Iowa DNR public water supply regulations which requires; "an owner of the water supply system shall submit proof of legal control through ownership, lease, easement, or other similar means, of continuous land for a distance of 400 feet from the shoreline at maximum water level. (Note: maximum water level has been interpreted by Iowa DNR as the principal spillway elevation.) "Legal control shall be for the life of the impoundment and shall control location of sources of contamination within the 400 foot distance". (State of Iowa Administrative Code).

Other planned measures to further protect the impoundment include sediment basins and a preemptive water quality protection project. The objective of these initiatives is to improve and

protect water quality to reduce water supply treatment costs, maximize recreational quality, and enhance fish and wildlife habitat.

A preemptive voluntary water quality project will be initiated under the leadership of the Page SWCD after the recommended plan is approved prior to, and during the construction of the impoundment. The water quality project will allow landowners to focus on managing crop and livestock production to reduce sediment and other runoff constituents to the impoundment. Areas of emphasis will include nutrient and pest management, buffers adjacent to drainageways, constructed and restored wetlands, as well as additional measures to control sediment. The SWCD will seek funding from state and federal sources including USDA and EPA, in addition to other sources.

Permits and Compliance

A Federal Clean Water Act, (CWA) Section 404, permit for the project will be required prior to project construction. A required component of the Section 404 permit is a review by the IDNR for the State Section 401 Water Quality Certification. Construction and water storage permits are required prior to initiation of the project as set forth under Iowa Administrative Code 567. Under a 1987 amendment to the Federal CWA, a National Pollutant Discharge Elimination System (NPDES) permit from the IDNR will also be required prior to the start of construction. Sponsors are responsible for obtaining all necessary permits.

Costs

All costs are for the purposes of water supply and recreation. See Appendix A, Tables 1 and 2 for details. Construction costs for labor, equipment, and materials are the engineer's estimate which includes an allowance for contingencies. The estimates were made by applying appropriate unit costs to detailed quantity estimates. Unit costs, based on the most recent contract bid schedules and actual construction costs of similar projects in Iowa, were adjusted to the 2005 average price level. Cost allowances for contingencies of 5 percent are included to offset unknown conditions which may appear during construction.

Engineering services costs include the direct cost of design surveys, investigations, design, preparation of drawings and specifications for project measures, and construction inspection. Engineering services costs were estimated at 15 percent of the construction cost.

Project administration costs are associated with the installation of project measures, including the cost of contract administration, government representative, obtaining permits, relocation assistance advisory services, and administrative functions connected with relocation payments. The NRCS and the Sponsors will pay the administrative costs each incurs. Project administration cost has been estimated at 5 percent of the construction cost.

Operation, Maintenance, and Repair (OM&R) is the cost of materials, equipment, services, and facilities needed to operate the project, and make repairs and replacements necessary to maintain project measures in sound operating condition during the evaluated life of the project. Included are costs of repairs, replacements, or additions and an appropriate charge for inspection, engineering, supervision, and general overhead. Costs for OM&R will be paid from local funds.

Landrights costs include all expenditures made to acquire land or easements for construction of the dam, permanent pool, temporary pool to the top of dam, raw water intake structure, raw water pipeline, and recreational areas. Values were estimated by the NRCS with concurrence by the Sponsors. Local sponsors are responsible for obtaining landrights.

The sponsors will comply with all of the policies and procedures of the Uniform Relocation Assistance and Real Property Acquisition Act (42 U.S.C. 4601 et. Seq. as implemented by 7 C.F.R. Part 21) for real property acquisition and relocation. Relocation payments are applicable to a displaced person, business or farm operation.

Project Installation

The estimated total project installation cost of Site 3 is $63,105,700. The Public Law 83-566 (P.L.-566) share of this cost is $31,552,900, and the other (nonfederal) share, is $31,552,800 (Table 1). The watershed agreement shows actual cost-sharing rates between P.L.-566 and other funds. All project costs reflect a December 2005 price base.

Installation costs include expenditures for construction, engineering services, project administration, landrights, and relocation. These costs are allocated to purposes for which the dam is designed. For Site 3, these purposes are agricultural water management, recreation and agricultural pollution control.

Construction costs are based on current costs for similar work, including a 5 percent contingency allowance. Total construction costs (dam, recreation facilities, water intake, and transmission line) are $27,452,800, of which $13,726,500 will be borne by P.L.-566 and $13,726,300 by other funds.

Engineering services include the cost of engineers, geologists, archaeologists, and technicians for design and layout of the structure. Engineering costs also include investigations, preparation of plans and specifications for the structure, and inspection during construction. Total engineering services are $3,830,800, of which $1,915,300 are P.L.-566 costs and $1,915,500 are paid for by other funds.

Project administration costs include contract administration, relocation assistance advisory services, and other items. Total project administration costs are $1,277,000, of which $638,600 will be borne by P.L.-566 and $638,400 by other funds.

Landrights costs for Site 3 include the value of land and buildings covered by the dam, sediment pool, beneficial pool, and recreation and wildlife areas; plus costs for such items as appraisals, legal fees, and access roads. These costs total $29,095,100, of which $14,547,500 will be borne by P.L.-566 and $14,547,600 by other funds.

Relocation payments are estimated to be $1,450,000, of which $725,000 will be borne by PL-566 funds and $725,000 will be borne by other funds.

Table 2 shows the estimated cost distribution, and Table 2A shows the estimated cost allocation and cost-sharing by purpose between P.L.-566 and other funds for Site 3.

Financing Project Installation

The sponsors will finance their share of costs by utilizing local sources of revenue, loans, grants and state appropriations.

Federal assistance will be provided under authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress 68 Stat. 666), as amended, and the Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2006, PL-109-97. Federal assistance in carrying out this Plan is contingent on appropriation of funds for that purpose and securing land rights and permits for installation of Site 3.

The sponsors will provide land rights. The City of Shenandoah has power of eminent domain and agrees to use it, if needed, to acquire land rights for Site 3. Construction and water storage permits required by Iowa law will be acquired by the sponsors.

Installation including construction of the dam, archeological mitigation, intake structure, untreated water line, and recreation facilities will be by contracts awarded and administered by NRCS and the sponsors.

Contracts for engineering services for the design of the multiple purpose dam, intake structure, untreated water line, and recreation facilities will be by contracts awarded and administered by NRCS and the sponsors.

Sponsors will obtain their funding for Operation, Maintenance, and Replacement (OM&R) of the works of improvement from general revenues, water sales, cabin rentals and concessionaire fees.

Operation, Maintenance, and Replacement

The amount for OM&R, estimated to be $418,500 annually, is the cost of materials, equipment, services, and facilities needed to operate the project, and make repairs and replacements necessary to maintain project measures in sound operating condition during the evaluated life of the project. Included are costs of repairs, replacements, or additions and an appropriate charge for inspection, engineering, supervision, and general overhead. Costs for OM&R will be paid from local funds. Sponsoring local organizations will be responsible for OM&R which occurs in their area.

Total benefits to be derived from installation of structures cannot be realized unless they are operated, maintained, and replaced to serve the full purpose for which they are installed.

OM&R consist of routine and recurring needs such as:

1. Replacing soil moved by erosion and burrowing animals on earthfills and auxiliary spillways.
2. Re-establishing vegetative cover on earthfills, emergency spillways, and borrow areas.
3. Removing debris accumulations in sediment and retarding pools.
4. Keeping trash racks in proper working order and free of trash and debris.
5. Replacing or repairing damaged or depleted principal spillways.
6. Keeping water control gates in working order.
7. Removing undesirable vegetation from earthfills and auxiliary spillways.

8. Repairing or replacing damaged sections of fence around embankments, pools, and livestock exclusion areas.
9. Landscape maintenance of developed recreation area (mowing, tree pruning and staking, etc.)
10. Maintenance and replacement of site furnishings as needed (shelters, picnic tables, camping pads, restroom facilities)
11. Grading and/or adding rock to graveled parking areas, access roads and camping pads
12. Litter removal and waste collection

OM&R work will generally be accomplished by mechanical means such as mowing, seeding, planting, and earthmoving. Undesirable vegetation will be controlled by mechanical methods. However, to prevent the resprouting of brush or trees that have been cut down, spot application of herbicide may be needed.

Sponsors' Responsibility/Costs

The sponsors will be responsible for OM&R on all components of structural measures upon completion of construction, and approval by the sponsors and the NRCS. The sponsors will be responsible for vegetative cover two years after completion and acceptance of construction. This is the normal period allowed for establishment of vegetation. The sponsors' liability extends throughout the life of the measure or practice, until the measure or practice is modified to remove potential risk of loss of life and property, or as may be required by federal, state, and local laws.

The annual cost of OM&R for multi-purpose dam Site 3, recreational facilities, and water supply components (water intake structure and transmission lines) is estimated to be $349,800. The cities of Shenandoah and Clarinda will be responsible for the operation and maintenance of the dam, appurtenances, and water intake facilities. They will be responsible for all replacement items relative to the dam, intake structure, raw water main, and recreational facilities when the need arises.

The annual cost of OM&R for in-channel sediment basin Site IC-1 is estimated to be $1,200. The sponsors will be responsible for operation and maintenance of the dam, which is topped with loose rock riprap, its approaches, and any necessary safety signage.

The annual cost of OM&R for the 39 small sediment basins is $64,400 which includes $3,100 for replacement of the polymer-coated corrugated metal pipe in each dam at the midpoint of the project life. The sponsors will be responsible for operation and maintenance of the dam, which is topped with loose rock riprap, its approaches, and any necessary safety signage.

A specific OM&R agreement will be completed for each structural measure prior to signing a landrights, relocation, project agreement, or long-term contract. Agreements will provide for inspections, reports, and procedures necessary for the performance of OM&R items. The agreements will include specific provisions for retention, use, and disposal of property acquired or improved with PL-566 financial assistance.

Inspections are necessary to ensure that the installed project measures are safe and functioning properly. Inspections shall accomplish the following; assess performance of the practice, determine compliance with the OM&R Plan, assess the adequacy of previous OM&R activities, identify OM&R needs, identify conditions that may threaten life and property, identify any

changed conditions that may affect the hazard classification, and develop a schedule to address OM&R needs.

The sponsors are responsible for making inspections which will be made annually for the life of a practice or as specified in the OM&R agreement. Special, annual, and formal inspections shall be performed by personnel trained in conducting the inspections. The NRCS shall assure that sufficient information is provided to the sponsors to enable them to complete inspections. If requested by the sponsor, the NRCS may; participate in inspections, provide training to ensure that the sponsor understands inspection techniques and the importance of completing corrective action, and provide technical assistance to address specific OM&R needs. Inspections shall be conducted according to the NRCS National Operation and Maintenance Manual.

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List of Preparers

Name	Present Title	Years	Degree	Subject	Prior Experience	Years
David Beck	Planning Leader	6	BS MPA	Wildlife Biology Public Management	Area Conservationist Biologist District Conservationist Soil Conservationist	15 6 2 1
Kevin McCall	District Conservationist	16	BS	Farm Operations	District Conservationist Soil Conservationist	4 3
Tom Burkhiser	District Conservationist	20	BS	Agri-business	District Conservationist Soil Conservationist	7 1
Laurel Foreman	Hydrologist	14	BS	Watershed Hydrology	Hydrologic Technician	5
Kathy Woida	Geologist	12	BA BS PhD	English Geology Geology		
Alan Lauver	Economist	13	BS	Agricultural Business	Ohio EPA Liaison Soil Conservationist	2 3
Mark Lindflott	Biologist	21	BS	Animal Ecology	District Conservationist Soil Conservationist	2 2
Roger Link	Water Quality Specialist	17	BS	Agronomy	Soil Conservationist – Planning Staff District Conservationist	11 10
Jennifer Anderson-Cruz	Biologist	3	BS	Environmental Science	Naturalist – Putnam Center Watershed Coordinator Wildlife Technician	2 2 1
Steven Manternach	Resource Conservationist	4	BS	Agronomy	District Conservationist Soil Conservationist	25 2
Christina Murphy	Civil Engineer	2	BS MS	Biological Engineering Biological Engineering	Agricultural Engineer	2
Mark McCurdy	Planning Engineer	2	BS	Agricultural Engineering	Agricultural Engineer Agricultural Research Service Technician	16 1
Tom Oswald	Resource Conservationist	6	BS	Agronomy	IDNR Nonpoint Liaison Area Agronomist District Conservationist Soil Conservationist Soil Conservation Technician Engineering Draftsman	7 2 10 2 4 3
John Paulin	Landscape Architect	5	BS BLA MLA	Fisheries & Wildlife Biology Landscape Architecture Landscape Architecture		
James Phillips	GIS Specialist	1	BS	General Studies	Geospatial Data Technician Civil Engineering Technician Soil Conservation Aide	2 16 1
Richard Rogers	Archeologist	20	BA MA PhD	Anthropology Anthropology Anthropology	Archeologist	12
Lee White	State Construction Engineer	16	BS	Ag. Engineering	Civil Engineer	18
Jill Clothier	Secretary	1		Business Interpreter, Signing	Business Operations Mgr Patient Accounts Advisor Bookkeeping Supervisor Interpreter NCIC Operator	4 4 5 5 5

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Distribution List

First Name	Last Name	Job Title	Company/Agency	City/State
Laura	Belin	President	1000 Friends of Iowa	Des Moines, IA
Roger	Still	Executive Director	Audubon Missouri	Columbia, MO
Elaine	Farwell		Clarinda Chamber of Commerce	Clarinda, IA
		Director	Clarinda Economic Development	Clarinda, IA
Randy	Pullen		Clarinda Parks and Recreation Department	Clarinda, IA
Ewell	Lawson		Commission on Intergovernmental Cooperation	Jefferson City, MO
Steve	McCann	Iowa Department of Economic Development	Community Development Intergovernmental Review System	Des Moines, IA
Deb	Ryun	Executive Director	Conservation Districts of Iowa	Chariton, IA
Ken	Tow	Director	Division of Soil Conservation Iowa Department of Agriculture and Land Stewardship	Des Moines, IA
Rick	Robinson	Director	Environmental Affairs, Farm Bureau	West Des Moines, IA
Ken	Barr	Chief	Environmental Analysis Section, United States Army Corps of Engineers	Rock Island, IL
Joseph	Cothern	NEPA Team Leader	Environmental Services Division; Environmental Protection Agency Region 7	Kansas City, KS
Derryl	McLaren	State Executive Director	Farm Service Agency	Des Moines, IA
Dick	Hainje	Regional Director	Federal Emergency Management Agency	Kansas City, MO
Rich	Weist	United States Department of Agriculture	Forest Service, NE State and Private Forester	St. Paul, MN
Macie	Houston	Regional Director	HUD-Kansas City Regional Office	Kansas City, KS
Karl	Jungbluth	President	Iowa Audubon	Des Moines, IA
Jane	Clark	Chair	Iowa Chapter, Sierra Club	Des Moines, IA
Jeff	Joens	Management Executive Officer	Iowa Department of Natural Resources	Des Moines, IA
Mike	McGhee	Lakes Coordinator	Iowa Department of Natural Resources	Des Moines, IA
Mike	Brandrup	Division Administrator, Division of Conservation and Recreation	Iowa Department of Natural Resources	Des Moines, IA
Jeffrey R.	Vonk	Director	Iowa Department of Natural Resources	Des Moines, IA
Carl	Priebe	Biologist	Iowa Department of Natural Resources	Sidney, IA
Rich	Leopold	Executive Director	Iowa Environmental Council	Des Moines, IA
John	Whitaker	President	Iowa Farmers Union	Ames, IA
Mark	Ackelson	Director	Iowa Natural Heritage Foundation	Des Moines, IA
Max	Proctor	Chairman	Iowa Watersheds	Bloomfield, IA
Emily	Eide	Executive Director	Iowa Watersheds	Des Moines, IA
Joe	Wilkinson	President	Iowa Wildlife Federation	Des Moines, IA
Joe	Barnes		Izaak Walton League Sierra Club, Ozark Chapter	Moberly, MO

First Name	Last Name	Job Title	Company/Agency	City/State
Seth	Davis	President	Izaak Walton League of America-Iowa Division	Marshalltown, IA
Gary	Brown	Chairman	Locust Creek Watershed District	Newtown, MO
Peter	Hofherr	Director	Missouri Department of Agriculture	Jefferson City, MO
Diane	Epperson	Senior Policy Coordinator	Missouri Department of Conservation	Jefferson City, MO
John	Hoskins	Director	Missouri Department of Conservation	Jefferson City, MO
Steve	Eder	Fisheries Administrator	Missouri Department of Conservation DELETE???	Jefferson City, MO
Gregory	Steinhoff	Director	Missouri Department of Economic Development	Jefferson City, MO
Doyle	Childers	Director	Missouri Department of Natural Resources (5 copies, they will distribute)	Jefferson City, MO
Mark	Kross	Design/Eng Div	Missouri Department of Transportation	Jefferson City, MO
Elizabeth	Brown	Chairperson	Missouri Soil & Water Districts Commission	Fayette, MO
Richard	Price	Director	Montgomery County Conservation Board	Red Oak, IA
Mike	Carlson	Chair	Montgomery County Farm Bureau	Emerson, IA
Fred	Bruce	President	Montgomery County Pheasants Forever	Red Oak, IA
Gene	Danekas	State Statistician	National Agricultural Statistics Service	Columbia, MO
		Legislative Representative	National Wildlife Federation	Washington D.C.
		Director	Natural Resources Defense Council, Inc.	Washington D.C.
Bruce	Hensley		North Central Missouri Electric Cooperative	Milan, MO
Mike	Majeski	Hydrologist	Northeastern Area, S&PF, USDA/Forest Service	St. Paul, MN
Kevin	Gowing		Page 1 Rural Water	Clarinda, IA
Charlie	Stevens		Page County Conservation Board	Clarinda, IA
Dave	Rydberg		Page County Farm Bureau	Clarinda, IA
Stanley	Johnson		Page County Pheasants Forever	Villisca, IA
Steve	Wichman		Pheasants Forever	Clarinda, IA
James	Wooley	Field Representative	Pheasants Forever	Chariton, IA
Charlie	Fowler	Presiding Commissioner	Putnam County Commissioner	Unionville, MO
Dennis	Fechtling	Chairman	Putnam County SWCD	Novinger, MO
Angie	Timblin	Executive Director	Red Oak Chamber of Commerce	Red Oak, IA
		Director	Red Oak Industrial Foundation	Red Oak, IA
James	Gulliford	Director	Region 7, United States Environmental Protection Agency	Kansas City, KS
Neal	Johnson	United States Army Corps of Engineers	Rock Island District	Rock Island, IL
Greg	Connell		Shenandoah Chamber & Industry Association	Shenandoah, IA
Mike	Laughlin		Shenandoah Parks and Recreation	Shenandoah, IA
Bill	Danforth	President	Southwest Iowa Nature Trails, Incorporated	Shenandoah, IA
Jerry	Uhlmann	Director	State Emergency Management Agency	Jefferson City, MO
Douglas W.	Jones	Archaeologist	State Historic Preservation Office, Community Programs Bureau	Des Moines, IA
Matthew	Blunt	Governor	State of Missouri	Jefferson City, MO
John	Sellers, Jr.	Chairperson	State Soil Conservation Committee	Corydon, IA
Chris	May	Presiding Commissioner	Sullivan County Commissioner	Humphreys, MO

First Name	Last Name	Job Title	Company/Agency	City/State
Larry	Stephenson	Chairman	Sullivan County SWCD	Green City, MO
Leslie	Spraggins	Director	The Nature Conservancy	Des Moines, IA
H. Lewis	von Schweinsberg		The Nature Conservancy	St. Louis, MO
Shannon	Ramsey	President/Chief Executive Officer	Trees Forever	Marion, IA
Jeffrey A.	Bedey	District Engineer	United States Army Corps of Engineers	Omaha, NE
Duane P.	Gapinski	District Engineer	United States Army Corps of Engineers	Rock Island, IL
Donald R.	Curtis	District Engineer	United States Army Corps of Engineers	Kansas City, MO
		Director, Ecology and Conservation Office	United States Department of Commerce, NOAA	Washington D.C.
		Director	United States Department of the Interior, Office of Environmental Policy & Compliance	Washington D.C.
		Coordinator, Water Resources	United States Department of Transportation, U.S. Coast Guard G-MPSI	Washington D.C.
		Director, Office of Federal Activities	United States Environmental Protection Agency	Washington D.C.
		Regional Administrator, Region VII	United States Environmental Protection Agency	Kansas City, KS
Charles	Scott	Field Supervisor	United States Fish & Wildlife Service	Columbia, MO
Richard	Nelson	Supervisor	United States Fish and Wildlife Service	Rock Island, IL
James R.	Munson	Private Lands Coordinator	United States Fish and Wildlife Service, Iowa Private Lands Office	Prairie City, IA
Sam	Graves		United States House of Representatives	Washington D.C.
Kathy	Chinn	Missouri State Representative	United States House of Representatives	Jefferson City, MO
Brian	Munzlinger	Missouri State Representative	United States House of Representatives	Jefferson City, MO
Bob	Behnen	Missouri State Representative	United States House of Representatives	Jefferson City, MO
John	Quinn	Missouri State Representative	United States House of Representatives	Jefferson City, MO
Therese	Sander	Missouri State Representative	United States House of Representatives	Jefferson City, MO
James	Whorton	Missouri State Representative	United States House of Representatives	Jefferson City, MO
Jim	Talent		United States Senate	Washington D.C.
Christopher	Bond		United States Senate	Washington D.C.
John	Cauthorn	Missouri State Senator	United States Senate	Jefferson City, MO
David	Klindt	Missouri State Senator	United States Senate	Jefferson City, MO
Bill	Stouffer	Missouri State Senator	United States Senate	Jefferson City, MO
Bob	Broz	Water Quality Specialist	University Outreach & Extension	Columbia, MO
Mike	Majeski	Hydrologist	USDA - FS Northeastern Area, S&PF	St. Paul, MN
Tim	Kelley	State Executive Director	USDA/Farm Service Agency	Columbia, MO
Karen	Brinkman	Area Conservationist	USDA-NRCS	Palmyra, MO
Stuart	Lawson	District Conservationist	USDA-NRCS, Sullivan County Field Office	Milan, MO
Merlin	Bartz	Regional Assistant Chief - Central	USDA/NRCS - NHQ	Washington D.C.
Thomas	Christensen	Deputy Chief - Programs	USDA/NRCS - NHQ	Washington D.C.
		Director	USDA Office of Advocacy and Enterprise	Washington D.C.

First Name	Last Name	Job Title	Company/Agency	City/State
Greg	Branum	State Director	USDA/Rural Development	Columbia, MO
Dennis	Alt	Supervisor	Water Supply Section, Water Quality Bureau Iowa Department of Natural Resources	Des Moines, IA
Steve	Johnson		Whitetails Unlimited	Shenandoah, IA
John	Rasmussen	Montgomery County Engineer		Red Oak, IA
Jim	Christensen	Page County Engineer		Clarinda, IA
Steve	Guthrie	Water Department Head		Clarinda, IA
Donald	Rolf			Shenandoah, IA
Brian	Walker			Essex, IA
Cheryl	Lundgren			Essex, IA
Marlin	Logan			Westboro, IA
Steve	Mainquist			Red Oak, IA
Curtis	Hedrick			Tarkio, IA
Robert	Allen			Red Oak, IA
Marvin	Southard			Tarkio, MO
Robert	Anderson			Clarinda, IA
Joel	Bashaw			Shenandoah, IA
Bo	Harris			Shenandoah, IA
Randy Wenstrand	Wenstrand			Essex, IA
Glen	Benskin			Red Oak, IA
Sam	Graves			Tarkio, MO
Steve	Guthrie			Clarinda, IA
Jan	Christensen			Shenandoah, IA

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Glossary

Alluvium A general term for all eroded material deposited or in transit by streams, including gravel, sand, silt, clay, and all variations and mixtures of these.

Area of Potential Effect (APE) The area where there is a potential for a significant cultural resource site to be present and where disturbance from the project will have the potential to damage those factors that make any such sites significant.

Average Annual Benefits The difference between the without-project average annual damages and the with-project average annual damages.

Average Annual Costs The initial cost amortized to an annual cost plus the necessary operation, maintenance, and replacement cost.

Base Flow The sustained or fair-weather discharge which persists after storm runoff has been depleted. It is usually derived from groundwater discharge but need not be continuous flow.

Breach A rapid failure of a dam caused by overtopping flows, earthquake, or internal erosion of fill material. Once started by one of the above mechanisms, the stored water behind the dam is suddenly released.

Breach Inundation Area The area of land that would be flooded in the event of a catastrophic dam failure.

Century Farm The Century Farms Program has been conducted by the Iowa Department of Agriculture and Land Stewardship in conjunction with the Iowa Farm Bureau Federation since 1976. Farms eligible for the Century Farm designation must have 100 years of consecutive ownership by the same family on at least 40 acres. The present owner must be related to the person who owned the land 100 years ago. Century Farms are not afforded any special recognition or protection by federal or state cultural resource laws or regulations.

Class B(LR) Stream Classification Limited resource warm water is the designated use as found in the Iowa Water Quality Standards, Chapter 61. It is defined as "Waters in which flow or other physical characteristics limit the ability of the water body to maintain a balanced warm water community. Such waters support only populations composed of species able to survive and reproduce in a wide

	range of physical and chemical conditions, and are not generally harvested for human consumption.
Clean Water Act	The CWA of 1972 established the basic structure for regulating discharges of pollutants into the waters of the United States. It gave EPA the authority to implement pollution control programs. The CWA also continued requirements to set water quality standards for all contaminants in surface waters. It made it unlawful to discharge any pollutant from a point source into navigable waters, unless a permit was obtained.
Dam	An artificial barrier together with any associated spillways and appurtenant works that impound or divert water. (TR60)
Depreciated Area	Areas that have suffered a loss of value and decreased monetary returns because of soil erosion, or because they have become inaccessible due to active gullies.
Emergency Action Plan (EAP)	An outline of procedures to minimize risks to downstream life and property when the integrity of a dam or similar structure may be in jeopardy
Environmental Assessment (EA)	A document that briefly provides sufficient evidence and analysis for determining whether to prepare an environmental impact statement (EIS).
Environmental Impact Statement (EIS)	A document detailing the environmental impact of a proposed law, construction project, or other major action that may significantly affect the quality of the environment
Environmental Justice	The fair treatment and meaningful involvement of all people regardless of race, color, national origin or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies.
Ephemeral Cropland Gully	Concentrated flow erosion occurring on cropland. The soil erosion pattern can be eliminated by tillage operations, but returns in approximately the same location following a runoff event.
Erosion (Gully)	The erosion process whereby water concentrates in narrow channels and cuts into the soil to depths ranging from a few feet to as much as 60 feet. Cannot be obliterated by ordinary tillage.
Erosion (Rill)	Erosion process, in which numerous small channels are formed by runoff water, occurs mainly on recently cultivated soil and

	is intermediate between sheet and ephemeral cropland gully erosion.
Erosion (Sheet)	The removal of a fairly uniform layer of soil from the land surface by runoff water. There is no development of conspicuous water channels.
Flood Plain	Level land adjacent to a channel subject to overflow flooding. Generally referenced as the 100-year flood plain (see "Frequency").
Flood Pool	Floodwater storage in a reservoir. In a floodwater retarding reservoir, the temporary storage between the crests of the principal and auxiliary spillways. (National Engineering Handbook Series, Technology, Part 630, Chapter 4)
Free Water Surface Evaporation	Evaporation from a thin film of water having no appreciable heat storage. FWS evaporation closely represents the potential evaporation from adequately watered natural surfaces such as vegetation and soil. (NOAA Technical Report NWS 33, "Evaporation Atlas for the Contiguous 48 United States", June 1982)
Frequency	An expression of measure of how often a hydrologic event, such as precipitation or a flood, of a given size or magnitude should, on average, be equaled or exceeded. Example: 10 Yr. – A hydrologic event having a 10 percent chance of occurring in any given year. 100 Yr. – a hydrologic event having a 1 percent chance of occurring in any given year.
Geosam	A long-term systematic collection and retention of earth science data maintained by the Iowa Geologic Survey Bureau.
Gross (total) Erosion	Erosion within a drainage area resulting from all sources (sheet, rill, ephemeral and permanent gully, streambank, scour, etc.).
Habitat Units	Habitat Units are a term used for a quantification of wildlife habitat. The term is a function of both quality and quantity of habitat. Quality of habitat is measured by analyzing how well the habitat meets the life requirements of the species being analyzed. Species specific models are used to rate the quality of habitat on a scale of 0.0 to 1.0, with a rating of 1.0 being optimal habitat conditions for the species. The quality score is termed the HSI for the species (Habitat Suitability Index). The

	quality score is then multiplied by the acres of habitat with that score to obtain the quantity of habitat units for the species.
Hazard Classification	A system that categorizes dams according to the degree of adverse incremental consequences of a failure or improper operation of the dam. NRCS classifies dams as "low", "significant", or "high", formerly hazard class a, b, or c, respectively. Low hazard dams are located in rural or agricultural areas where failure may damage farm buildings, agricultural land or township and country roads. Significant dams are located in predominantly rural or agricultural areas where failure may damage isolated homes, main highways, or minor railroads or cause interruption of use or service of relatively important public utilities. High hazard dams are located where failure may cause loss of life, serious damage to homes, industrial and commercial buildings, important public utilities, main highways, or railroads.
Maintenance	The recurring activities necessary to retain or restore a practice in a safe and functioning condition, including the management of vegetation, the repair or replacement of failed components, the prevention or treatment of deterioration, and the repair of damages caused by flooding or vandalism.
Maximum Allowable Soil Loss	Also known as 'T' and is expressed in tons/acre/year. 'T' typically ranges from 3-5 tons and it determined by numerous factors including; soil characteristics, economics, and climate.
Multiple-purpose Dams	Dams designed to serve more than one purpose. They may include storage for rural water, floodwater, recreation, fish and wildlife development, irrigation, etc.
NED Plan (National Economic Development Plan)	A plan that reasonably maximizes net national economic development benefits.
Operation	Administration, management, and performance of non-maintenance activities necessary to keep a practice safe and functioning throughout its evaluated life. This includes such items as periodic inspections, reports, and other needed labor.
Permanent Pool	The area upstream of a dam which is designed to be inundated with water at all times. This is the reservoir area under normal circumstances. The permanent pool elevation is set by the lowest un-gated opening in the principal spillway inlet.

Prime Farmland	Prime Farmland as defined by USDA, is land that is best suited to food, feed, forage, fiber, and oil seed crops. It may be cropland, pasture, woodland or other land, but is not urban and built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce economically a sustained high yield of crops. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in least damage to the environment.
Principles and Guidelines (P&G)	Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. These guidelines establish standards and procedures for use by Federal agencies in formulating and evaluating alternative plans for water and related land resources implementation studies.
Protected Low Flow	Designated protected flows of streams are defined in the Iowa Administrative Code: Flow designed to protect and maintain adequate water supplies for ordinary household and livestock use; for fish and wildlife use; for in-stream wasteload assimilation and pollution control; for beneficial water use needs in the watershed; for preservation of aesthetic values; and for other uses of a public nature. Protected low flow is expressed in cubic feet per second (CFS) at a stream location.
Replacement	Planned periodic replacement of facilities, parts of project measures, or complete project measures.
Sediment Delivery Ratio	The proportion of sediment yield to gross erosion. This value is normally expressed as a percentage.
Sediment Yield	That portion of the gross (total) erosion that is actually delivered to a specified location (i.e., watershed outlet, stream channel, etc.). Gross erosion less the sediment that is deposited prior to reaching the point of concern.
Site	The location or vicinity of a dam including the appurtenant works, impounded water and adjacent floodwater storage area.
Stormwater Flooding	A flood that causes a stream to overflow its' normal banks as a result of a rainfall event.
Structural Measures	Project works of improvement such as dams, levees, diversions, channels, or other constructed devices, installed and maintained for flood prevention, drainage, irrigation, recreation, fish and wildlife, municipal and industrial water

	supply, water quality management, or other agricultural water management purposes. Structural measures ordinarily require group action for their installation, always require group benefits, are not usually included in individual farm or ranch conservation plans, and are installed, operated, and maintained by a project sponsor.
Species of Special Concern	These are species of animals or plants that are not yet listed as either Threatened or Endangered but are species whose numbers are declining.
Threatened & Endangered Species	These are species of animals or plants that have been officially listed by either the federal or state governments as being in danger of extinction without special protection. These species are protected by federal or state law respectively. The laws protect the species themselves from harm. In addition, their habitat is protected from modifications that would be harmful to the species survival.
Tri-agency Team	Tri-Agency Team is a group of biologists from the US Fish and Wildlife Service, the state fish and game agencies, and the NRCS. Under the Fish and Wildlife Coordination Act this team of biologists is responsible for analyzing impacts to both T&E Species and fish and wildlife habitat from the proposed project.
User Day	One person using the recreation facilities for any amount of time for one defined activity translates to a user day. Used interchangeably with the term "visitor day".
Voiding	The destruction of land by gully erosion. The productive capacity of these "voided areas" is essentially destroyed and restoration or productivity is, for the most part, not economically feasible.
Watershed	The land area above a point on a drainageway with surface drainage to that point. Synonymous with drainage area.
Works of Improvement	Conservation practices installed, such as dams, to achieve project purposes including flood prevention and gully stabilization.

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Appendices

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Table 6	Comparison of NED Benefits and Costs

Appendix B – Comments and Responses

Letters and oral comments received on the draft plan.

Appendix C – Support Maps

Surface Water Supply and Recreation Study Sites
Recreational Development Map
Project Area Regional Connections Map
Breach Inundation Map
Sediment Basin Map

Appendix D – Investigations and Analyses Report

Information that supports the formulation, evaluation, and conclusions of the watershed plan. This appendix is presented by each discipline. Each report contains its own references.

Appendix E – Supporting Information

Tables, project history and chronology

Appendix F – Project Map

Shows location of important project measures and the location and extent of important watershed conditions that will be affected by the works of improvement to be installed.

Appendix A – Tables 1-6

Table 1, Estimated Installation Cost
West Tarkio Creek Watershed, Iowa
(Dollars)[1]

Installation Cost Item	Unit	Number	Estimated cost (dollars)[1] P.L.-566 Funds *Nonfederal Land* NRCS	Estimated cost (dollars)[1] Other Funds *Nonfederal Land*	TOTAL
STRUCTURAL MEASURE					
Multiple-Purpose Dam	no.	1	29,944,400	29,944,300	59,888,700
Sediment Basins	no.	39	1,572,900	1,573,000	3,145,900
In-Channel Sediment Basin	no.	1	35,500	35,500	71,000
TOTAL PROJECT			31,552,800	31,552,800	63,105,600

1-Price Base December 2005 January 2006

Does not include associated costs of $500,000 for Shenandoah to upgrade water treatment plant.

Table 2, Estimated Cost Distribution - Structural measures
(West Tarkio Creek Watershed), (Iowa)
(Dollars)[1]

	Installation Cost - Public Law 83-566						Installation Cost - Other Funds						Total Installation Cost
	Const.	Engr. Services	Real Property Rights	Reloc. Payments	Project Admin.	Total PL 566	Const.	Engr. Services	Real Property Rights	Reloc. Payments	Project Admin.	Total	
Structural Measures													
Multiple-Purpose Dam	3,809,000 [2]	427,700	14,079,000	725,000	142,600	19,183,300	3,808,900[2]	427,800	14,079,000	725,000	142,600	19,183,300	38,366,600
Recreation Facilities	2,442,600	366,400	0	0	122,200	2,931,200	2,442,600	366,400	0	0	122,100	2,931,100	5,862,300
Water Intake Structure	993,600	149,100	0	0	49,700	1,192,400	993,700	149,000	0	0	49,700	1,192,400	2,384,800
Raw Water Lines	5,531,300	829,700	0	0	276,500	6,637,500	5,531,300	829,700	0	0	276,600	6,637,600	13,275,100
Sediment Basins	920,300	138,100	468,600	0	46,000	1,573,000	920,400	138,000	468,500	0	46,000	1,572,900	3,145,900
In-Channel Sed. Basin	29,600	4,400	0	0	1,500	35,500	29,500	4,500	0	0	1,500	35,500	71,000
Subtotal	**13,726,400**	**1,915,400**	**14,547,600**	**725,000**	**638,500**	**31,552,900**	**13,726,400**	**1,915,400**	**14,547,500**	**725,000**	**638,500**	**31,552,800**	**63,105,700**
GRAND TOTAL	**13,726,400**	**1,915,400**	**14,547,600**	**725,000**	**638,500**	**31,552,900**	**13,726,400**	**1,915,400**	**14,547,500**	**725,000**	**638,500**	**31,552,800**	**63,105,700**

January 2006

1- Price Base December 2005

Does not include associated costs of $500,000 for Shenandoah to upgrade water treatment plant.

2- Includes $642,450 of Public Law 83-566 funds and $642,450 of other funds for woody and herbaceous planting of 4,283 acres. Also includes $314,900 of Public Law 83-566 funds and $314,900 of other funds ($629,800 total) for cultural resource protection and mitigation measures.

Table 2a. Cost Allocation and Cost-sharing Summary - Structural Measures (West Tarkio Creek Watershed), (Iowa) (Dollars)[1]

	Cost-Allocation Purpose			Cost-Sharing Public Law 83-566			Cost-Sharing Other		
	Agric. Water Mgmnt.	Recreation	Total	Agric. Water Mgmnt.	Recreation	Total	Agric. Water Mgmnt.	Recreation	Total
Multiple-Purpose Dam									
Construction[2]	3,808,900	3,809,000	7,617,900	1,904,500	1,904,500	3,809,000	1,904,400	1,904,500	3,808,900
Engineering Services	427,800	427,700	855,500	213,900	213,800	427,700	213,900	213,900	427,800
Relocation	725,000	725,000	1,450,000	362,500	362,500	725,000	362,500	362,500	725,000
Real Property Rights									
Land Acquisition	8,969,700	8,969,700	17,939,400	4,484,900	4,484,800	8,969,700	4,484,800	4,484,900	8,969,700
Buildings	1,470,000	1,470,000	2,940,000	735,000	735,000	1,470,000	735,000	735,000	1,470,000
Legal Fees	67,500	67,500	135,000	33,700	33,800	67,500	33,800	33,700	67,500
Road and utility modifications	3,364,800	3,364,800	6,729,600	1,682,400	1,682,400	3,364,800	1,682,400	1,682,400	3,364,800
Perimeter Fencing	207,000	207,000	414,000	103,500	103,500	207,000	103,500	103,500	207,000
Project Administration	142,600	142,600	285,200	71,300	71,300	142,600	71,300	71,300	142,600
Subtotal	19,183,300	19,183,300	38,366,600	9,591,700	9,591,600	19,183,300	9,591,600	9,591,700	19,183,300
Recreational Facilities									
Construction - Basic Facilities	0	4,885,200	4,885,200	0	2,442,600	2,442,600	0	2,442,600	2,442,600
Engineering Services	0	732,800	732,800	0	366,400	366,400	0	366,400	366,400
Project Administration	0	244,300	244,300	0	122,200	122,200	0	122,100	122,100
Subtotal	0	5,862,300	5,862,300	0	2,931,200	2,931,200	0	2,931,100	2,931,100
Water Intake Structure									
Construction	1,987,300	0	1,987,300	993,600	0	993,600	993,700	0	993,700
Engineering Services	298,100	0	298,100	149,100	0	149,100	149,000	0	149,000
Project Administration	99,400	0	99,400	49,700	0	49,700	49,700	0	49,700
Subtotal	2,384,800	0	2,384,800	1,192,400	0	1,192,400	1,192,400	0	1,192,400
Raw Water Lines									
Construction	11,062,600	0	11,062,600	5,531,300	0	5,531,300	5,531,300	0	5,531,300
Engineering Services	1,659,400	0	1,659,400	829,700	0	829,700	829,700	0	829,700
Project Administration	553,100	0	553,100	276,500	0	276,500	276,600	0	276,600
Subtotal	13,275,100	0	13,275,100	6,637,500	0	6,637,500	6,637,600	0	6,637,600
Sediment Basins									
Construction	1,840,700	0	1,840,700	920,300	0	920,300	920,400	0	920,400
Engineering Services	276,100	0	276,100	138,100	0	138,100	138,000	0	138,000
Real Property Rights	937,100	0	937,100	468,600	0	468,600	468,500	0	468,500
Project Administration	92,000	0	92,000	46,000	0	46,000	46,000	0	46,000
Subtotal	3,145,900	0	3,145,900	1,573,000	0	1,573,000	1,572,900	0	1,572,900
In-Channel Sediment Basins									
Construction	59,100	0	59,100	29,600	0	29,600	29,500	0	29,500
Engineering Services	8,900	0	8,900	4,400	0	4,400	4,500	0	4,500
Project Administration	3,000	0	3,000	1,500	0	1,500	1,500	0	1,500
Subtotal	71,000	0	71,000	35,500	0	35,500	35,500	0	35,500
TOTAL	**38,060,100**	**25,045,600**	**63,105,700**	**19,030,100**	**12,522,800**	**31,552,900**	**19,030,000**	**12,522,800**	**31,552,800**

1- Price Base December 2005

Does not include associated costs of $500,000 for Shenandoah to upgrade water treatment plant.

2- Includes $1,284,900 for 4,283 acres of woody and herbaceous planting, and $629,800 for cultural resources.

January 2006

Table 2b. Recreational Facilities - Estimated Construction Costs

(West Tarkio Creek Watershed), (Iowa)

(Dollars)[1/]

Item	Unit	Number[2]	Cost	Total Construction Cost
Developed Recreation Area				
Entrance road, concrete	each	1	Lump Sum	$460,500
Parking lot, 75 vehicle w/trailer, concrete and triple lane concrete boat ramp	each	1	Lump Sum	$201,500
Fishing pier, disabled accessible	each	1	Lump Sum	$161,200
Campsites				
Modern RV (sewer, water, electric)	each	28	$5,200	$145,600
Modern tent (electric)	each	134	$1,750	$234,500
Restroom Facilities w/flush toilets, showers, disabled accessible	each	2	$293,590	$587,180
Cabins	each	20	$23,030	$460,600
Shelters 24x36	each	4	$13,820	$55,280
Picnic Tables	each	202	$580	$117,160
Grills				
In-ground w/fire ring	each	162	$90	$14,580
Upright	each	8	$120	$960
Waste Treatment Lagoon	each	1	Lump Sum	$36,400
Overflow parking, 40 units, gravel	each	1	Lump Sum	$26,100
Secondary Boat Ramp Access #1				
Double lane ramp, access road and 20 unit parking lot, gravel	each	1	$115,140	$115,140
Trash receptacles	each	1	$500	$500
SST (Sweet Smelling Toilet)	each	1	$10,940	$10,940
Secondary Boat Ramp Access #2				
Double lane ramp, access road and 20 unit parking lot, gravel	each	1	$115,140	$115,140
Trash receptacles	each	1	$500	$500
SST (Sweet Smelling Toilet)	each	1	$10,940	$10,940
Secondary Boat Ramp Access #3				
Single lane ramp, access road and 20 unit parking lot, gravel	each	1	Lump Sum	$57,600
Marina/Beach Area				
Restroom Facilities w/flush toilets, showers, concession, disabled accessible	each	1	Lump Sum	$293,600
Beach 300x75	SF	22,500	$0.50	$11,250
Shelters 10X12	each	3	$1,960	$5,880
Picnic Tables	each	12	$580	$6,960
Parking Lot, 30 units, concrete	each	1	Lump Sum	$69,100
Fishing Jetties	each	18	$17,270	$310,860
Riprap Shoreline	feet	64,000	$14	$896,000
Underwater Fish Structures				
Rock piles on roadways	each	1	Lump Sum	$28,800
Rock covered mounds	each	3	$17,270	$51,810
Earthen mounds	each	7	$9,060	$63,420
Spawning area	each	1	Lump Sum	$23,000
Waterfowl Nesting Islands	each	4	$7,200	$28,800
Site Cleanup	each	1	Lump Sum	$28,800
			Subtotal	**$ 4,630,600**
			Contingencies, 5% (except entrance road, 10%)	**$254,600**
			Total Construction Costs	**$ 4,885,200**

1 - Price Base December 2005 January 2006

2 - Estimated quantity subject to variations at time of detailed design

Table 3

Structural Data – Dams with Planned Storage Capacity
West Tarkio Creek Watershed, Iowa

Item	Unit	Site 3	IC-1[5/]
Class of Structure		c	a
Seismic Zone		1	1
Uncontrolled Drainage Area	Sq. Mi.	47.5	35.7
Controlled Drainage Area	Sq. Mi.	0.0	0.0
Total Drainage Area	Sq. Mi.	47.5	35.7
Runoff Curve No. (1-day) (AMC II)		74	---
Time of Concentration (T_c)	Hours	13.1	---
Elevations			
Top Dam	Feet	1108.0	1090.0
Auxiliary Spillway Crest	Feet	1100.0	---
Principal Spillway Crest	Feet	1089.0	---
Elevation Crest Drawdown Inlet [1/]	Feet	1078.0	---
Auxiliary Spillway Type		Vegetated	---
Auxiliary Spillway Bottom Width	Feet	640	---
Auxiliary Spillway Exit Slope	Percent	4.2	---
Maximum Height of Dam	Feet	73	12
Volume of Fill	Cu. Yd.	983,079	1,279
Total Capacity [2/]	Acre-Feet	56,722	70.8
Sediment Submerged	Acre-Feet	2,644) 3140	1.2 70.8
Sediment Aerated	Acre-Feet	496)	ws1 ---
Beneficial Use, Fish/Wildlife/Rec.	Acre-Feet	9,856	---
Beneficial Use, Water Supply	Acre-Feet	19,961	---
Floodwater Retarding	Acre-Feet	23,765	---
Between Drawdown and PS	Acre-Feet	16,262	---
Surface area			
Sediment Pool	Acres	373	19.7
Beneficial Use Pool, Fish/Wildlife/Rec.	Acres	980	---
Beneficial Use Pool, Water Supply	Acres	1,818	---
Floodwater Retarding Pool [3/]	Acres	2,599	---
Principal spillway design			
Rainfall Volume (1-day)	Inches	6.9	---
Rainfall Volume (10-day)	Inches	11.5	---
Runoff Volume (10-day)	Inches	5.69	---
Capacity of Low Stage (max.)	CFS	---	---
Capacity of High Stage (max.)	CFS	1,530	---
Dimensions of Conduit	Feet	6.5' x 6.5'	---
Type of Conduit		R/C Box	None
Frequency Operation-Auxiliary Spillway	% chance	.02	---
Auxiliary Spillway Hydrograph			
Rainfall Volume [4/]	Inches	9.39	---
Runoff Volume	Inches	6.19	---
Storm Duration	Hours	6	---
Velocity of Flow (V_e)	FPS	0.0	---
Max. Reservoir Water Surface Elev.	Feet	1096.4	---
Item	**Unit**	**Site 3**	**IC-1[5/]**

Freeboard Hydrograph			
Rainfall Volume 4/	Inches	28.43	---
Runoff Volume	Inches	24.61	---
Storm Duration	Hours	24	---
Max. Reservoir Water Surface Elev.	Feet	1107.3	1107.3
Discharge Per Ft of Width (Q_e/b)	Ac-Ft/Ft	44.6	---
Capacity Equivalents			
Sediment Volume	Inches	1.24	.05
Floodwater Retarding Volume	Inches	9.40	0.0
Fish/Wildlife/Recreation	Inches	3.90	---
Water Supply	Inches	7.89	---

1/ This crest is the gated drawdown at the 50% level of the permanent storage as required by IDNR (Technical Bulletin 16)
2/ Total storage to the crest of the auxiliary spillway
3/ Surface area at the auxiliary spillway crest
4/ Precipitation represented indicate values with areal correction.
5/ This is an in-channel structure armored on top and slopes with loose rock riprap. Structure designed to flood out from Site 3 during storm events. Small storm events will likely not cause the structure to be flooded out, but head differential from upstream to downstream will not be more than one foot and the downstream face of the structure will be armored with loose rock riprap.

Table 3

Structural Data – Dams with Planned Storage Capacity
West Tarkio Creek Watershed, Iowa

	Unit	SAMPLE SEDIMENT BASINS			
		Site 72	Site 75	Site 54	Site 46
Class of Structure		a	a	a	a
Seismic Zone		1	1	1	1
Uncontrolled Drainage Area	Acres	45	76	100	229
Total Drainage Area	Acres	45	76	100	229
Runoff Curve No. (1-day) (AMC II)		75	75	75	75
Time of Concentration (T_c)	Hours	.53	.58	.65	1.03
Elevations					
Top of Dam	Feet	1149.5	1123.0	1115.0	1130.0
Auxiliary Spillway Crest	Feet	1147.5	1121.0	1113.0	1128.0
Principal Spillway Crest	Feet	1145.5	1119.0	1110.0	1124.0
Auxiliary Spillway Type		Vegetated	Vegetated	Vegetated	Vegetated
Auxiliary Spillway Bottom Width	Feet	12	12	12	24
Auxiliary Spillway Exit Slope Range	Percent	1-12	1-12	1-12	1-12
Maximum Height of Dam	Feet	14.1	20.8	13.8	20.4
Volume of Fill	Cu. Yd.	11,172	21,675	10,659	25,689
Total Capacity 6/	Acre-Feet	13.2	37.0	36.2	67.1
Sediment Submerged 7/	Acre-Feet	8.3	26.1	16.8	31.3
Sediment Aerated	Acre-Feet	1.5	4.2	2.9	5.5
Floodwater Retarding	Acre-Feet	3.4	6.7	16.5	30.3
Surface Area					
Sediment Pool	Acres	2.1	4.9	5.2	6.9
Floodwater Retarding Pool	Acres	2.7	6.1	7.7	11.1
Principal Spillway Design					
Rainfall Volume (24 hr)	Inches	4.2 (5 yr)	4.2 (5 yr)	4.9 (10 yr)	4.9 (10 yr)
Runoff Volume	Inches	1.82	1.82	2.36	2.36
Principal Spillway Capacity (max.)	CFS	6.5	7.3	6.2	40.3
Dimensions of Conduit	Inches	12	12	12	24
Type of Conduit		CMP	CMP	CMP	CMP
Auxiliary Spillway Design					
Frequency of Operation	% Chance	4	4	4	4
Auxiliary Spillway Hydrograph					
Rainfall Volume (25 yr/24 hr)	Inches	5.7	5.7	5.7	5.7
Runoff Volume	Inches	3.0	3.0	3.0	3.0
Velocity of Flow (V_a)	CFS	2.0	2.0	2.0	2.0
Max. Water Surface Elevation	Feet	1148.2	1121.6	1113.1	1128.1
Capacity Equivalents					
Sediment Volume	Inches	2.61	4.78	2.36	1.93
Floodwater Retarding Volume	Inches	0.91	1.06	1.98	1.59

6/ Total storage to the crest of the auxiliary spillway
7/ Sediment storage based on 100 year Design Life.

Structural Data – Dams with Planned Storage Capacity
West Tarkio Creek Watershed, Iowa

	Unit	SAMPLE SEDIMENT BASINS		33 Additional Sites	Total
		Site 43	Site 38		
Class of Structure		a	a	a	a
Seismic Zone		1	1	1	1
Uncontrolled Drainage Area	Acres	339	459	4,678	5,926
Total Drainage Area	Acres	339	459	4,678	5,926
Runoff Curve No. (1-day) (AMC II)		75	75	---	---
Time of Concentration (T_c)	Hours	1.27	1.35	---	---
Elevations					
Top of Dam	Feet	1137.0	1152.0	---	---
Auxiliary Spillway Crest	Feet	1134.0	---	---	---
Principal Spillway Crest	Feet	1130.0	1145.5	---	---
Auxiliary Spillway Type		Vegetated	None[8/]	---	---
Auxiliary Spillway Bottom Width	Feet	24	---	---	---
Auxiliary Spillway Exit Slope Range	Percent	1 - 12	---	---	---
Maximum Height of Dam	Feet	18.1	23.2	---	---
Volume of Fill	Cu. Yd.	27,858	4	---	---
Total Capacity [6/]	Acre-Feet	118.9	263.0	---	---
Sediment Submerged[7/]	Acre-Feet	59.0	89.3	702.5	933.3
Sediment Aerated	Acre-Feet	10.4	15.9	130.4	170.8
Floodwater Retarding	Acre-Feet	49.5	157.8	---	---
Surface Area					
Sediment Pool	Acres	11.7	18.2	36.0	85.0
Floodwater Retarding Pool	Acres	18.5	29.8	---	---
Principal Spillway Design					
Rainfall Volume (24 hr)	Inches	5.7 (25 yr)	10.0 (FBH)	---	---
Runoff Volume	Inches	3.02	6.87	---	---
Principal Spillway Capacity (max.)	CFS	63.7	68.5	---	---
Dimensions of Conduit	Inches	30	30	---	---
Type of Conduit		CMP	CMP	---	---
Auxiliary Spillway Design					
Frequency of Operation	% Chance	2	---	---	---
Auxiliary Spillway Hydrograph					
Rainfall Volume (24 hr)	Inches	6.4	---	---	---
Runoff Volume	Inches	3.6	---	---	---
Velocity of Flow (V_a)	CFS	2.0	---	---	---
Max. Water Surface Elevation	Feet	1134.4	---	---	---
Capacity Equivalents					
Sediment Volume	Inches	2.46	2.75	2.14	2.24
Floodwater Retarding Volume	Inches	1.75	4.12	---	---

8/ Road structure designed without an auxiliary spillway.

Table 4, Estimated Average Annual NED Costs (West Tarkio Creek Watershed), (Iowa) (Dollars)[1]

Evaluation Unit	Project outlays		
	Amortization of Installation Cost	Operation Maintenance and Replacement Cost	Total
STRUCTURAL			
Multiple-Purpose Dam	$3,090,200	$349,800	$3,440,000
Sediment Basins	$162,300	$67,500	$229,800
In-Channel Sediment Basin	$15,900	$1,200	$17,100
Subtotal	$3,268,400	$418,500	$3,686,900
TOTAL	**$3,268,400**	**$418,500**	**$3,686,900**

1 - Price Base December 2005, Discounted at 5.125% interest rate for 100 years January 2006
Does not include associated costs of $500,000 for Shenandoah to upgrade water treatment plant.
2 - Includes $110,400 for operation, maintenance, and replacement for recreation development.

Table 6, Comparison of NED Benefits and Costs (West Tarkio Creek Watershed), (Iowa) (Dollars)[1]

Evaluation Unit	Recreation	Agricultural Water Management	Agricultural Pollution Control	Average Annual Benefits	Average Annual Costs[2]	Benefit/ Cost Ratio
Multiple-purpose Dam	8,589,900	1,625,400	0	10,215,300	3,440,000	3.0:1.0
Sediment Basins and In-Channel Sediment Basin	0	0	342,000	342,000	246,900	1.4:1.0
Subtotal	**8,589,900**	**1,625,400**	**342,000**	**10,557,300**	**3,686,900**	**2.9:1.0**
TOTAL	**8,589,900**	**1,625,400**	**342,000**	**10,557,300**	**3,686,900**	**2.9:1.0**

1- Price base: December 2005, discount rate 5.125 percent for 100 years. January 2006
Does not include associated costs of $500,000 for Shenandoah to upgrade water treatment plant.
Total average annual equivalent benefits are $7,834,600 and total average annual equivalent costs are $3,044,100 for an average annual equivalent benefit-cost ratio of 2.6:1.0.
2- From Table 4

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Appendix B – Comments and Responses

Appendix B will contain the letters and oral comments received on the draft plan

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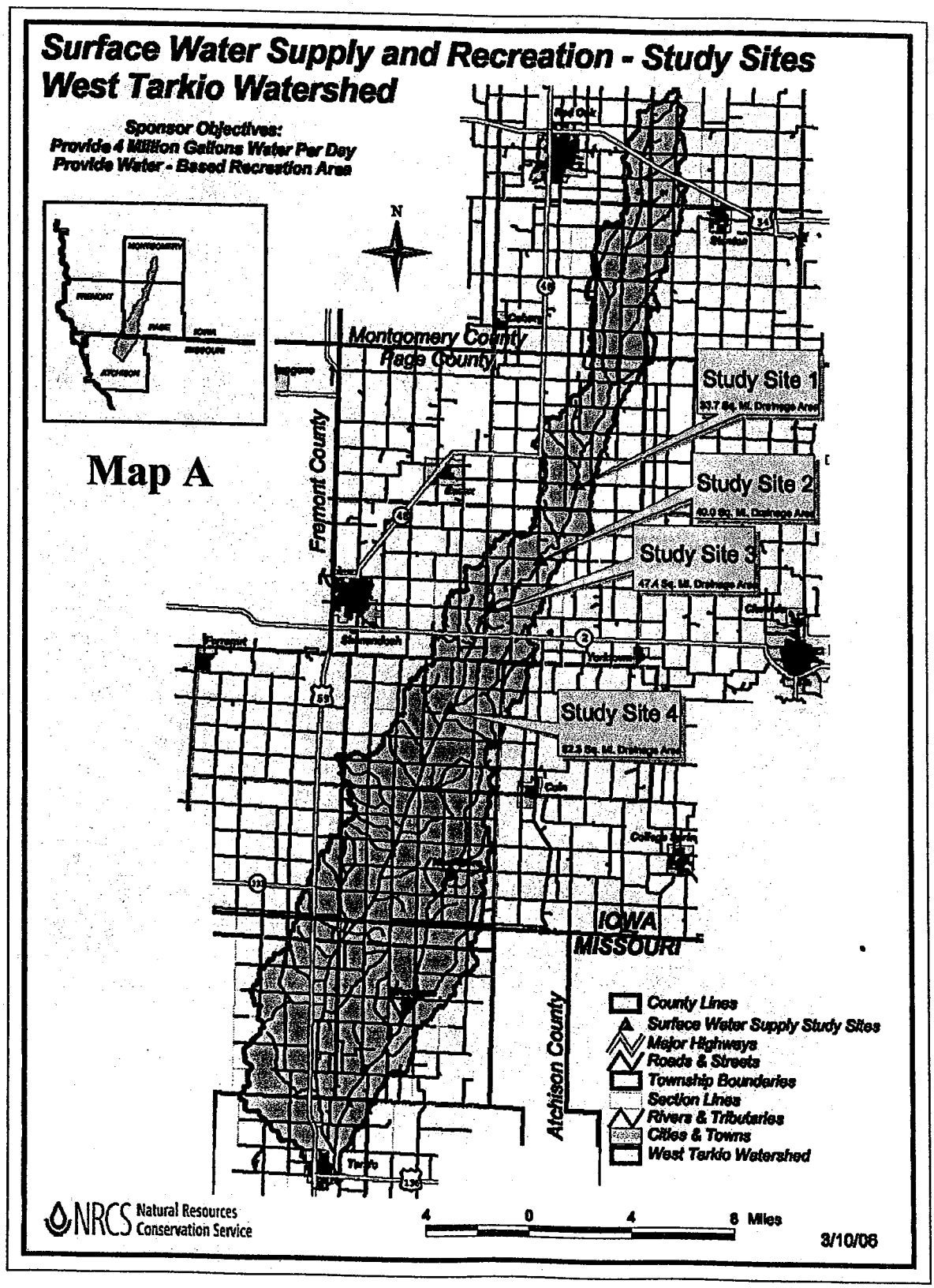
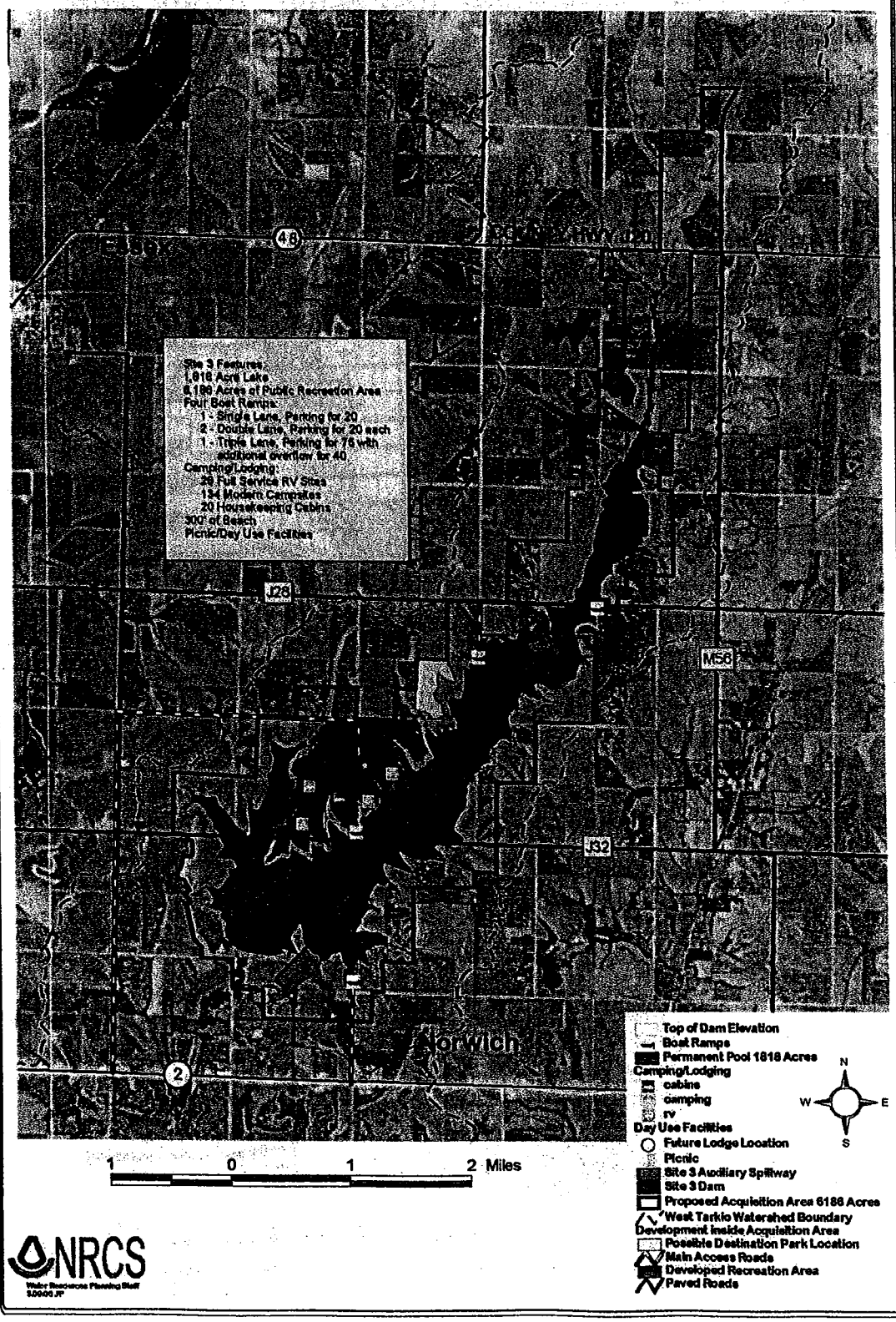
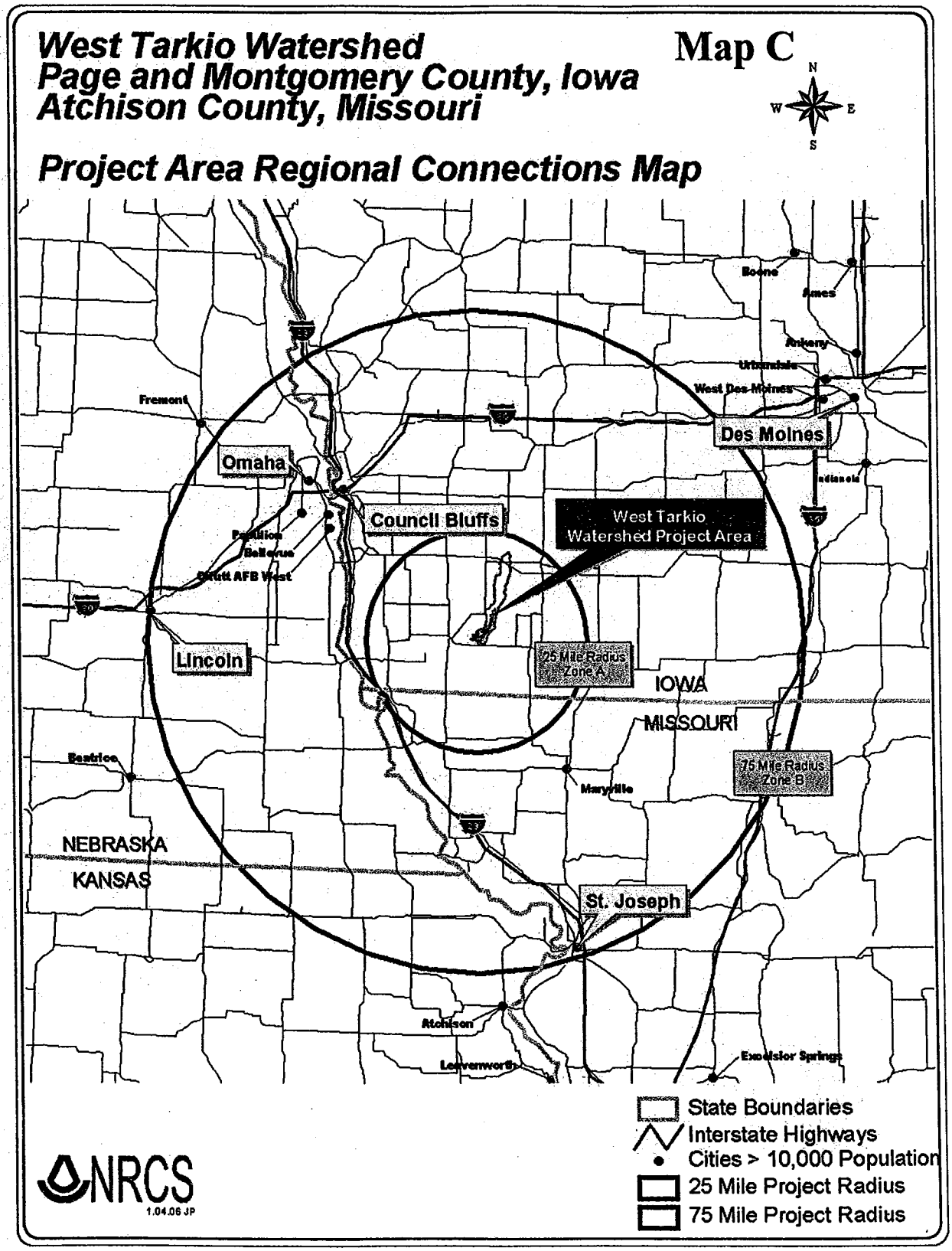
Appendix C – Support Maps

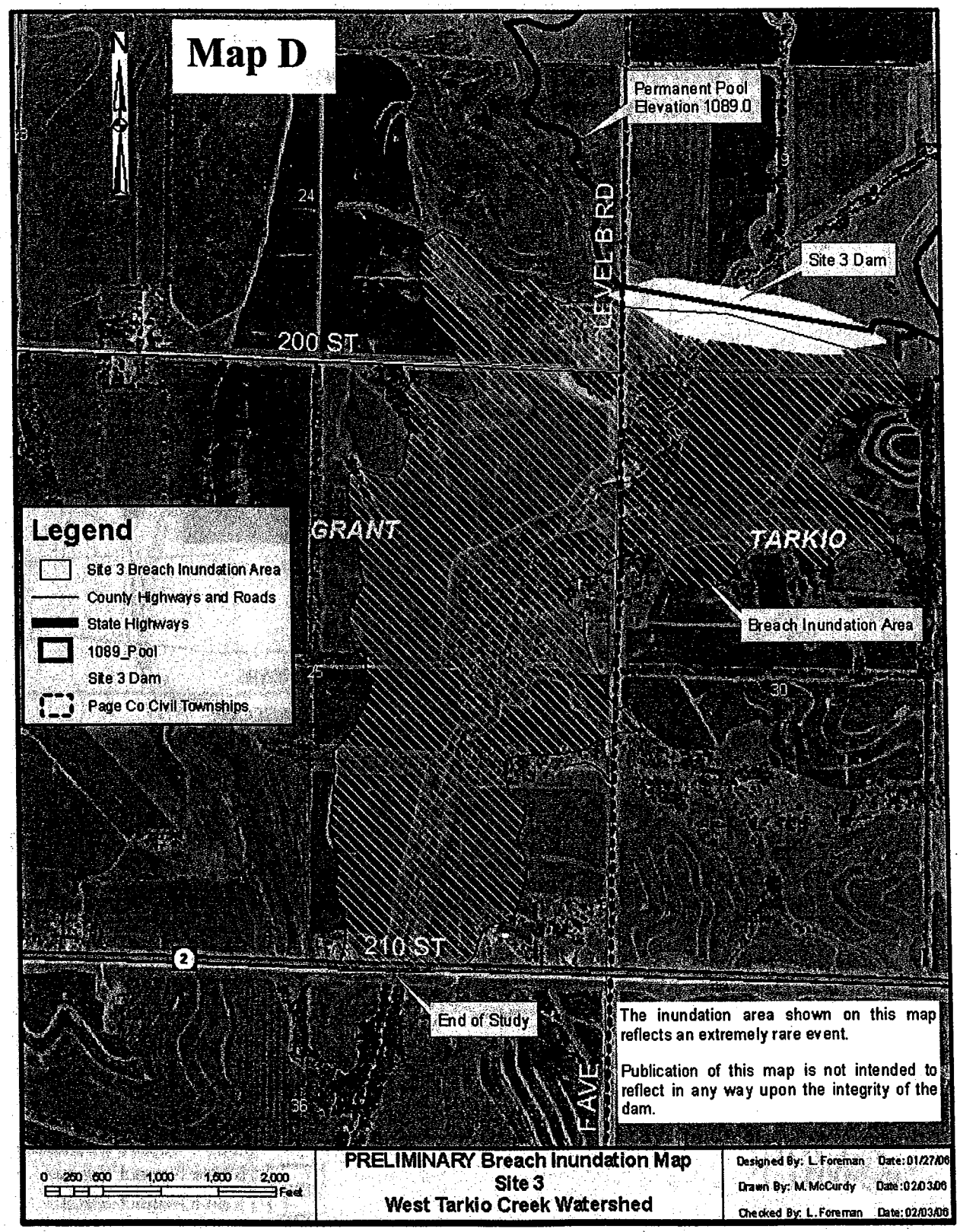


Site 3 West Tarkio Reservoir Recreational Development Map

Map B

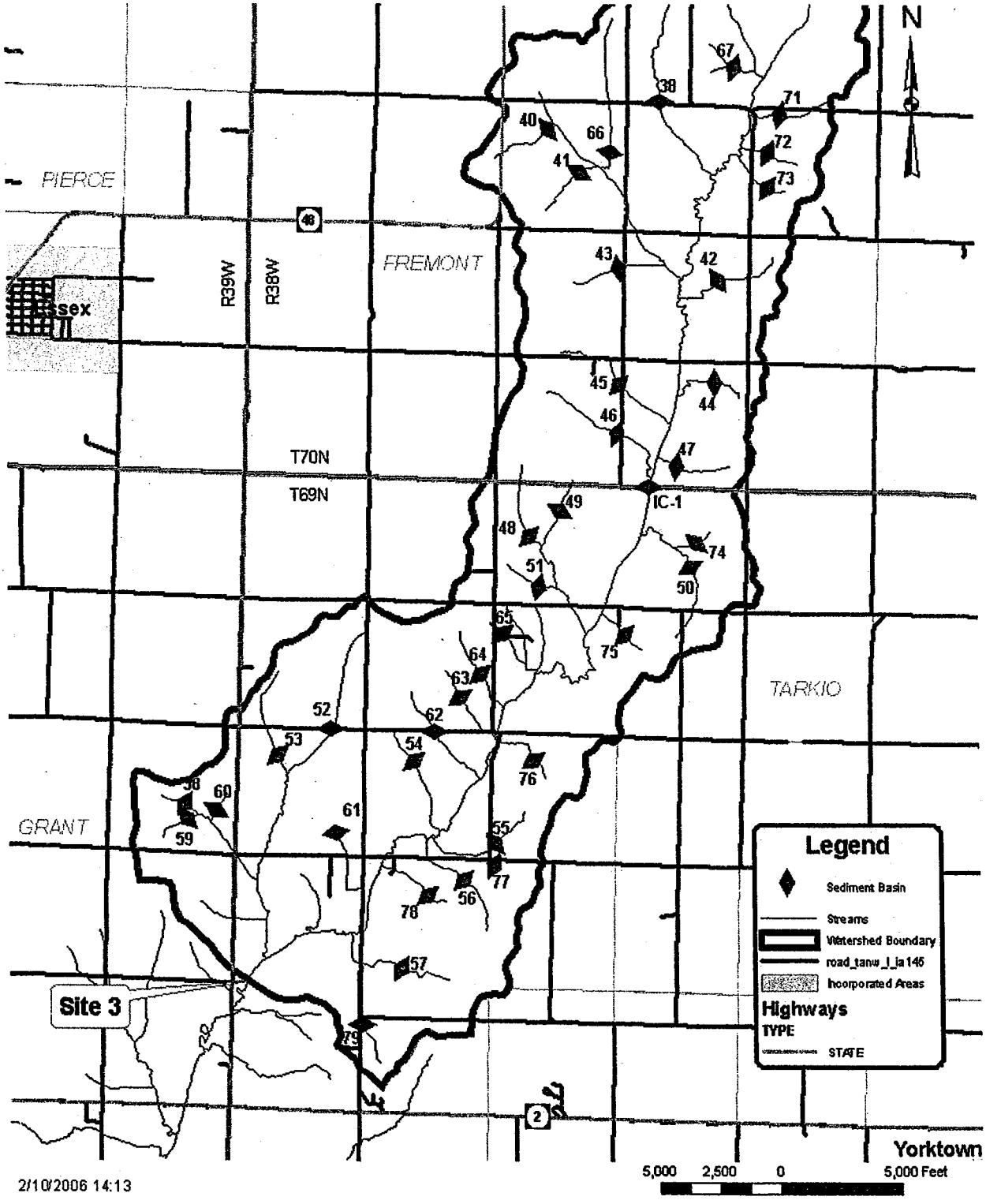



West Tarkio Watershed
Page and Montgomery County, Iowa
Atchison County, Missouri
Map C
Project Area Regional Connections Map
N
W
E
S
Boone
Ames
Ankeny
Urbandale
West Des Moines
Des Moines
Fremont
Omaha
Council Bluffs
West Tarkio
Watershed Project Area
Papillion
Bellevue
Offutt AFB West
Lincoln
25 Mile Radius
Zone A
IOWA
MISSOURI
75 Mile Radius
Zone B
Beatrice
Maryville
NEBRASKA
KANSAS
St. Joseph
Atchison
Leavenworth
Excelsior Springs
NRCS
1.04.06 JP
State Boundaries
Interstate Highways
Cities > 10,000 Population
25 Mile Project Radius
75 Mile Project Radius


Map D
N
Permanent Pool Elevation 1089.0
Site 3 Dam
LEVEL B RD
200 ST
GRANT
TARKIO
Breach Inundation Area
210 ST
End of Study
FAVE
24
25
30
36
Legend
Site 3 Breach Inundation Area
County Highways and Roads
State Highways
1089_Pool
Site 3 Dam
Page Co Civil Townships
The inundation area shown on this map reflects an extremely rare event.
Publication of this map is not intended to reflect in any way upon the integrity of the dam.
0 250 500 1,000 1,500 2,000 Feet
PRELIMINARY Breach Inundation Map
Site 3
West Tarkio Creek Watershed
Designed By: L. Foreman Date: 01/27/06
Drawn By: M. McCurdy Date: 02/03/06
Checked By: L. Foreman Date: 02/03/06

West Tarkio Creek Watershed Sediment Basin Map

Map E



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Appendix D – Investigation and Analysis Report

Recreation Evaluation of the Mulitple-purpose Reservoir for the West Tarkio Creek Watershed, Montgomery, Page, and Fremont Counties, Iowa and Atchison County, Missouri

The evaluation of recreation benefits for water resources planning is guided by the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (henceforth referred to as P&G), which outlines three methodologies for calculating recreation benefits. The Unit Day Valuation method is used in this study due to time constraints and a lack of site specific visitor data for utilizing the other methodologies. Due to the amount of research that has been conducted since P&G was published in 1983, the U.S. Forest Service has released a meta analysis that updates the user day values from P&G (Rosenberger and Loomis, 2001). In order to provide the most accurate estimate of recreation benefits, the meta analysis user day values are used to refine User Day Valuation estimates.

According to studies conducted by the Iowa Department of Natural Resources (IDNR), University of Northern Iowa Center for Social and Behavioral Research, and the Iowa State University Center for Agriculture and Rural Development (CARD) there is an unmet need for the types of outdoor recreation that would be provided by a multiple-purpose reservoir in the West Tarkio Creek Watershed. Similar studies conducted in adjoining states by the Missouri Department of Conservation and Department of Natural Resources (MDNR, 2003), Nebraska Game and Parks Commission (NGPC, 1991, 2000), and Kansas Department of Wildlife and Parks (KDWP, 2003) revealed an overall regional deficiency in outdoor recreation opportunities.

Survey results from the *Recreational Activities & Environmental Opinions: A Statewide Survey of Adult Iowans* (2000) revealed that one-fifth (21.9 percent) of those surveyed felt that their recreational opportunities were severely limited. The five most limited, unsuitable or inhibited recreational activities in Iowa were 1) biking on paved trails (14.7 percent), 2) power boating/water skiing (13.9 percent), 3) hiking/nature/backpacking/walks (13.5 percent), 4) fishing (13.1 percent) and 5) swimming in lake/river/pond (8 percent). Similarly, the *Survey of Iowa State Park and Recreation Area Users* (2000), showed that one-third (33.2 percent) of park users would like to see more lakes for fishing. About 30 percent would like to see more overnight cabins, and one-fourth (25.4 percent) would like to see additional swimming areas, and 20.6 percent would like more lakes for boating activities. The 2003 Missouri Statewide Comprehensive Outdoor Recreation Plan (SCORP) cited survey results stating that more fishing opportunities was the number one facility/activity most desired by residents, with more lakes in general coming in second.

Since the inception of P&G in the early 1980's, some new trends have developed regarding the distance people are willing to travel for outdoor recreation opportunities. Early assessments used a 15 mile radius for day use activities (scenic drives, picnicking, nature walks/study) and a 25 mile radius for more intensive activities (fishing, hunting, camping, boating etc.). While 40.9 percent of Iowans cite nearness to home as the major factor behind the frequency with which they visit Iowa parks, the majority of those surveyed (61.9 percent) stated they would travel 3-5 hours to visit a destination park (CSBB, 2000). Given an average travel speed of 48 mph, which translates into 144-240 miles trip distance, one way. A reservoir at either Site 2 (1,347 acres) or Site 3 (1,818

acres) in the West Tarkio Watershed will be the largest public water body within a 100 mile radius of Shenandoah and Clarinda and will likely be a major recreation draw for the urban population centers of Omaha/Council Bluffs and Des Moines. There are over 2.5 million people living in that 100 mile radius, and as previously mentioned, this four state region is currently deficient in outdoor recreational opportunities. However, for analysis purposes we will confine the population base for day use activities (hiking, biking, picnicking, bird watching/nature study, swimming) to a 25 mile radius. For the more intensive activities (fishing, boating, hunting, camping, water skiing), analyses will be conducted utilizing the population and current supply of recreational facilities within a 75 mile radius of the proposed reservoir locations. Recreation benefits for both Site 2 and Site 3 will be calculated for comparison of alternatives purposes. In the end, only one reservoir location will be selected for construction.

The methodology for estimating recreation benefits for a multiple-purpose reservoir in the West Tarkio Creek Watershed follows five steps:

1. Calculate recreation demand in annual user days
2. Calculate existing recreation supply in annual user days
3. Compare the results of steps 1 and 2 to determine any unmet recreation needs
4. Calculate recreation supply of proposed reservoir in annual user days
5. Apply user day values to calculate average annual monetary benefits

Step 1. Calculate Recreation Demand in Annual User Days

As stated in the previous section, the user draw for day use activities shall be 25 miles, and 75 miles used for more intensive recreational pursuits. There are 43,554 people that live within 25 miles of the proposed reservoir locations (highlighted in Table 1), and 1,281,561 within a 75 mile radius (2003 Census estimates).

Table 1. 2003 Population by county within 25 and 75 miles of the proposed West Tarkio Reservoir.

COUNTY	STATE	2003 75 Mile Radius Population	2003 25 Mile Radius Population
Shelby	IA	12,181	
Shelby	IA	12,583	
Audubon	IA	6,038	
Guthrie	IA	3,894	
Cass	IA	88,406	
Cass	IA	14,317	
Adair	IA	7,922	
Mills	IA	22,341	
Mills	IA	14,911	3,529
Adams	IA	11,289	10,397
Adams	IA	4,370	
Union	IA	11,928	
Clarke	IA	1,707	
Page	IA	7,866	7,034
Page	IA	16,348	16,348
Taylor	IA	6,791	1,230
Decatur	IA	5,420	
Decatur	IA	3,586	
Nodaway	MO	6,283	3,024
Worth	MO	21,737	1,734
Worth	MO	2,270	
Gentry	MO	6,744	
Gentry	MO	6,566	
Daviess	MO	176	
DeKalb	MO	2,090	
Andrew	MO	16,806	
Buchanan	MO	67,749	
Holt	MO	5,148	
Doniphan	KS	8,059	
Brown	KS	7,680	
Nemaha	KS	4,635	
Marshall	KS	17	
Richardson	NE	9,006	
Pawnee	NE	2,837	
Nemaha	NE	7,137	
Johnson	NE	4,430	
Gage	NE	1,826	

COUNTY	STATE	2003 75 Mile Radius Population	2003 25 Mile Radius Population
Cass	NE	17,3568	
Otoe	NE	15,504	
Cass	NE	25,235	
Sarpy	NE	132,526	
Saunders	NE	7,31	
Douglas	NE	476,66	
Washington	NE	17,20	
Dodge	NE	117	
TOTAL 25 Mi. Radius:			**43,554**
TOTAL 75Mi. Radius:		**1,281,561**	

Recreation trends and participation rates are very similar across the board for Iowa, Missouri, Nebraska and Kansas. The 1991 Missouri SCORP provides a comprehensive analysis of participation rates and frequency of activity. These data will be combined with the population information contained in Table 1 to determine the annual user days demanded by the relevant population for the main recreation activities planned for at the proposed reservoir. This calculation shows that there are 11,778,745 annual user days of recreation demanded. Table 2 shows the participation rates and user days used to calculate the annual user days demanded by recreation activity.

Table 2. Recreation demand calculations for 25 and 75 mile radius surrounding the proposed West Tarkio Reservoir.

Activity	Percent Participation	Total Participation	User Days	Annual User Days Demanded
75 MILE RADIUS				
Fishing	0.522	668,975	8.1	5,418,697
All Boating (incl. canoeing)	0.554	709,985	5.0	3,549,925
Hunting	0.239	306,293	3.7	1,133,284
Dev. Camping	0.27	346,021	2.2	761,246
Prim. Camping	0.144	184,545	0.6	110,727
Water Skiing	0.161	206,331	1.3	268,230
				11,242,109
25 MILE RADIUS				
Hiking	0.27	11,760	3.4	39,984
Biking	0.218	9,495	6.8	64,566
Picnicking	0.631	27,483	4.8	131,918
Bird Watching/Nature Study	0.223	9,713	5.3	51,479
Swimming	0.521	22,692	11.4	258,689
				546,636
TOTAL:				**11,788,745**

Step 2. Calculate Existing Recreation Supply in Annual User Days

There are 11 water-based recreation facilities within the 25 mile radius of the proposed reservoir, and a total of 88 within 75 miles. The facilities range in size from as little as 10 acres to as large as 1,006 acres, with a wide variety of amenities ranging from no developed facilities to a full fledged resort available. Since the recreation opportunities vary among facilities and the demand for different recreation activities varies, it is important to break down the analysis to assess the user days supplied for each activity at each facility. This provides a more complete assessment of the current supply of each recreation activity in the region versus the demand for each recreation activity.

Uhlig (1980) provides a methodology for calculating annual user days by dividing the maximum daily design capacity of the facility times a Sunday use factor (0.0231). The daily design capacity is determined by using a relationship between the size of the lake and the number of parking spaces available (the number of parking spaces equals the acres of lake times 0.4). From this relationship it is assumed there are four people per car and each space is used twice per day (Table 3). Lakes highlighted in yellow are within 25 miles of the proposed West Tarkio reservoir Sites 2 and 3.

Table 3. Existing supply of water based recreation within 75 mile radius of the proposed West Tarkio Reservoir

LAKE	STATE	ACRES	USER DAYS
Papio Lake	NE	31	4,294
Glenn Cunningham	NE	390	54,026
Standing Bear	NE	135	18,701
Carter	NE	300	41,558
Zorinsky	NE	255	35,325
Two Rivers	NE	320	44,329
Wehrspann Lake	NE	245	33,939
Memphis Lake	NE	45	6,234
Schilling Lake	NE	25	3,463
Louisville Lake	NE	40	5,541
Oak Lake	NE	47	6,511
Holmes Lake	NE	100	13,853
Wagon Train	NE	315	43,636
Stage Coach Lake	NE	195	27,013
Hedgefield Lake	NE	44	6,095
Wilson Creek Lake	NE	38	5,264
Mayberry Lake	NE	25	3,463
Burchard Lake	NE	150	20,779
Verdon Lake	NE	45	6,234
Sabetha City Lake	KS	100	13,853
Pony Creek Lake	KS	171	23,688
Brown St. Fishing Lake	KS	62	8,589
Mission Lake	KS	154	21,333
Atchison St. Fishing Lake	KS	66	9,143
LAKES	**STATE**	**ACRES**	**USER DAYS**

Browning Oxbow	KS	100	13,853
Bilby Ranch Lake	MO	110	15,238
Nodaway Co. Comm.	MO	73	10,113
Mozingo Lake	MO	1,006	139,359
Worth Co. Comm. Lake	MO	20	2,771
Buffalo Bill Lake	MO	45	6,234
Pony Express Lake	MO	240	33,247
Harrison Co. Reservoir	MO	280	38,788
North Bethany Reservoir	MO	72	9,974
Old Bethany Reservoir	MO	16	2,216
Big Lake	MO	315	43,636
Savannah City Reservoir	MO	23	3,186
King Lake	MO	186	25,766
Happy Holler	MO	67	9,281
Willow Brook Lake	MO	100	13,853
Limpp Community Lake	MO	29	4,017
Afton Reservoir	IA	18	2,494
Anita	IA	182	25,212
Arrowhead	IA	18	2,494
Bartlett	IA	22	3,048
Binder	IA	70	9,697
Blockton Reservoir	IA	70	9,697
Cold Springs	IA	16	2,216
Corning Reservoir	IA	13	1,801
Criss Cove	IA	10	1,385
Desoto Bend	IA	811	112,346
East Lenox	IA	35	4,848
Farm Creek	IA	10	1,385
Fogle	IA	44	6,095
Fulsom	IA	45	6,234
Greenfield	IA	48	6,649
Green Valley	IA	365	50,563
Hacklebarney East	IA	10	1,385
Icaria	IA	665	92,121
Keg Creek	IA	52	7,203
Littlefield	IA	70	9,697
Loch Ayr	IA	78	10,805
Manawa	IA	772	106,944
Manteno	IA	15	2,078
McPaul A	IA	10	1,385
McPaul B	IA	28	3,879
Meadow	IA	42	5,818
Mile Hill	IA	14	1,939
Morman Trail	IA	35	4,848
Mt. Ayr Reservoir	IA	12	1,662
Nodaway	IA	25	3,463
Orient	IA	16	2,216
LAKES	**STATE**	**ACRES**	**USER DAYS**

Percival	IA	20	2,771
Pierce Creek	IA	28	3,879
Pacific Junction	IA	15	2,078
Prairie Rose	IA	201	27,844
Ross Area	IA	12	1,662
Scott A	IA	16	2,216
Summit	IA	250	34,632
Thayer	IA	12	1,662
Three Mile	IA	880	121,905
Three Fires	IA	95	13,160
Twelve Mile	IA	640	88,658
Viking Lake	IA	137	18,978
Walnut Creek	IA	60	8,312
West Lenox	IA	10	1,385
Willow Lake	IA	26	3,602
Wilson Lake	IA	17	2,355
Windmill	IA	22	3,048

To determine the annual user days supplied by each recreation activity the total annual user days for each facility are proportionally distributed between the activities available at that facility. The proportions are determined using the Missouri 1991 SCORP information on user days per activity. Table 4 shows the distribution of annual user days per activity supplied by all the recreation facilities.

Table 4. Existing supply of recreational opportunities by activity at water based recreational facilities within 75 miles of the proposed West Tarkio Reservoir.

ACTIVITY	ANNUAL USER DAYS
75 Mile Radius Evaluation	
Fishing	478,650
All Boating (incl. canoeing)	259,222
Hunting	109,026
Developed Camping	49,671
Primitive Camping	10,410
Water Skiing	18,032
	925,011
25 Mile Radius Evaluation	
Hiking	2,181
Biking	0
Picnicking	3,705
Bird Watching/Nature Study	7,163
Swimming	5,382
	18,431
Total Supply (User Days) =	**943,442**

Step 3. Compare Steps 1 and 2 to Determine Any Unmet Recreation Needs

Before quantifying the recreational opportunities that the proposed reservoir will supply, it is important to determine that the recreation demand is not currently met by the existing recreation facilities in the region. Step 1 determined that the annual user day demand for recreation is 11,220,745. Step 2 determined that the current annual user day supply for recreation is 943,441 annual user days. Since the proposed reservoir will provide a variety of recreation activities, this analysis is taken one step further in order to ensure that there is demand for those specific activities. Table 5 shows that each of the proposed recreation activities do have unmet demand that the proposed reservoir will be able to address.

Table 5. Unmet regional recreation demand.

ACTIVITY	Supply	Demand	Unmet Demand
75 Mile Radius Evaluation			
Fishing	478,650	5,418,697	4,940,047
All Boating (incl. canoeing)	259,222	3,549,925	3,290,703
Hunting	109,026	1,133,284	1,024,258
Developed Camping	49,671	761,246	711,575
Primitive Camping	10,410	110,727	100,317
Water Skiing	18,032	268,230	250,198
25 Mile Radius Evaluation			
Hiking	2,181	39,984	37,803
Biking	0	64,566	64,566
Picnicking	3,705	131,918	128,213
Bird Watching/Nature Study	7,163	51,479	44,316
Swimming	5,382	258,689	253,307
TOTALS:	**943,442**	**11,788,745**	**10,845,303**

Step 4. Calculate Recreation Supply of Proposed Reservoir

The previous steps show that there is an unmet demand for recreation in the area surrounding a proposed reservoir in the West Tarkio Creek Watershed. Utilizing the relationships developed by Uhlig (1980) as used in Step 2 to calculate the existing supply of recreational opportunities, the proposed West Tarkio reservoir Site 3 would provide 251,775 annual user days of outdoor recreational activities.

1,818 acre reservoir x 0.4 = 727 parking spaces
727 spaces x 4 people/car x 2 cars/space/day = 5,816 people per day
5,816 people per day = maximum daily design capacity
Daily design capacity / Sunday use factor (0.0231) = 251,775 Annual User Days

The supply of 251,775 user days by the proposed reservoir is proportioned to the various recreation activities the proposed reservoir will provide by the same methodology in Step 2 (Table 6).

Table 6. Recreational opportunities provided by West Tarkio Site 3 (Alternative 6).

ACTIVITY	USER DAYS	PROPORTION	ANNUAL USER DAYS
Fishing	8.1	0.483	121,607
All Boating (incl. canoeing)	5	0.266	66,972
Hunting	3.7	0.101	25,429
Developed Camping	2.2	0.068	17,121
Primitive Camping	0.6	0.01	2,518
Water Skiing	1.3	0.024	6,043
Hiking	3.4	0.003	755
Biking	6.8	0.006	1,511
Picnicking	4.8	0.012	3,021
Bird Watching/Nature Study	5.3	0.004	1,007
Swimming	11.4	0.023	5,791
User Days Supplied by West Tarkio Site 3			**251,775**

Similarly, the slightly smaller Site 2 would provide 186,666 annual user days of outdoor recreational opportunities:

1,347 acre reservoir x 0.4 = 539 parking spaces
539 spaces x 4 people/car x 2 cars/space/day = 4,312 people per day
4,312 people per day = maximum daily design capacity
Daily design capacity / Sunday use factor (0.0231) = 186,666.6 Annual User Days

The supply of 186,666 user days by the proposed reservoir is proportioned to the various recreation activities the proposed reservoir will provide by the same methodology in Step 2 (Table 7).

Table 7. Recreational opportunities provided by West Tarkio Site 2 (Alternative 4).

ACTIVITY	USER DAYS	PROPORTION	ANNUAL USER DAYS
Fishing	8.1	0.483	90,160
All Boating (incl. canoeing)	5	0.266	49,653
Hunting	3.7	0.101	18,853
Developed Camping	2.2	0.068	12,693
Primitive Camping	0.6	0.01	1,867
Water Skiing	1.3	0.024	4,480
Hiking	3.4	0.003	560
Biking	6.8	0.006	1,120
Picnicking	4.8	0.012	2,240
Bird Watching/Nature Study	5.3	0.004	747
Swimming	11.4	0.023	4,293
User Days Supplied by West Tarkio Site 2			**186,666**

Step 5. Apply User Day Values to Calculate Average Annual Monetary Benefits

In 2001, the U.S. Forest Service released a meta analysis of recreation literature that spans 1967-1998. The analysis covers 21 different recreation activities. There are 163 different studies referenced providing 760 benefit measures (Rosenberger and Loomis, 2001). This analysis provides the most complete and updated resource for applying benefits to user day values. For this analysis the benefit transfer of applicable user day values from the meta analysis is used to calculate the monetary recreation benefits of the proposed reservoir.

Using the benefit transfer method, the average annual recreation benefits of the proposed reservoir at Site 3 are $8,872,427. Similarly, the proposed reservoir at Site 2 provides $6,578,022 in average annual recreation benefits. Each activity is assigned a user day value transferred from the meta analysis specific to that activity. Those specific and unique values are then multiplied by the annual user days the proposed reservoir will supply from Step 4 to get the total monetary benefit per activity (Tables 8 and 9).

Table 8. Monetary valuation of recreation benefits provided by West Tarkio Site 3 (Alternative 6).

ACTIVITY	ANNUAL USER DAYS	USER DAY VALUE	MONETARY BENEFIT
Fishing	121,607	$38.37	$4,666,061
All Boating (incl. canoeing)	66,972	$30.34	$2,031,930
Hunting	25,429	$38.37	$975,711
Developed Camping	17,121	$32.79	$561,398
Primitive Camping	2,518	$32.79	$82,565
Water Skiing	6,043	$24.32	$146,966
Hiking	755	$37.52	$28,328
Biking	1,511	$56.20	$84,918
Picnicking	3,021	$34.43	$104,013
Bird Watching/Nature Study	1,007	$38.37	$38,639
Swimming	5,791	$26.23	$151,898
TOTAL			**$8,872,427**

Table 9. Monetary valuation of recreation benefits provided by West Tarkio Site 2 (Alternative 4).

ACTIVITY	ANNUAL USER DAYS	USER DAY VALUE	MONETARY BENEFIT
Fishing	90,160	$38.37	$3,459,439
All Boating (incl. canoeing)	49,653	$30.34	$1,506,472
Hunting	18,853	$38.37	$723,390
Developed Camping	12,693	$32.79	$416,203
Primitive Camping	1,867	$32.79	$61,219
Water Skiing	4,480	$24.32	$108,954
Hiking	560	$37.52	$21,011
Biking	1,120	$56.20	$62,944
Picnicking	2,240	$34.43	$77,123
Bird Watching/Nature Study	747	$38.37	$28,662
Swimming	4,293	$26.23	$112,605
TOTAL:			**$6,578,022**

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Procedure Used for Evaluating Cumulative Environmental Impacts

The National Environmental Policy Act (NEPA) carries the mandate to analyze the cumulative impacts of federal actions (Council on Environmental Quality, 1997). The objective of cumulative impacts analysis is to make sure proposed actions account for the broadest range of consequences possible. The analysis will often involve assumptions and uncertainties. It should be conducted with techniques appropriate for the scope of the project and with the best data available.

The NRCS-Iowa procedure for cumulative impact analysis was used during planning the West Tarkio Creek Watershed Project. This process is interdisciplinary and utilizes the concept of scoping, two key elements of agency compliance with NEPA. Members of the interdisciplinary planning team (IDT) completed the "Checklist for Identifying the Cumulative Environmental Impacts of Projects" for the alternatives selected for detailed study, Alternatives 4 and 6. The completed checklists are included in this appendix.

This checklist was adapted from "Questionnaire Checklist for Cumulative Impacts" (Canter and Kamath, 1995) by NRCS-Iowa. The checklist identifies 106 different areas of potential environmental and socioeconomic concerns that the project could have effects on. The IDT answered either Yes, Maybe, or No to each of the 106 potential concerns based on their collective knowledge of the project area and the proposed project alternatives. Each concern with either a Yes or Maybe answer was then listed in the Cumulative Impacts Matrix. The concerns that the IDT identified as having no impact from the project alternative being evaluated were considered "scoped out" of further cumulative impact analysis.

The Cumulative Impacts Matrix was adapted from "Considering the Cumulative Effects of NRCS Activities" (NRCS, 2003). For those concerns that were entered into the matrix, the IDT assigned qualitative ratings on a seven item scale ranging from low adverse effect through no net effect to strong beneficial effect in each of six categories. The Cumulative Impacts Matrix combines impacts from installation of the alternative, current conditions within the project area (past actions), and no project action (other present actions) to display future condition impacts with the project as well as cumulative impacts. The complete Cumulative Impacts Matrices for Alternatives 4 and 6 are in the Environmental Consequences section of the main document.

Cumulative impacts were only evaluated for the alternatives studied in detail. Impacts from the no action alternative are integral to the cumulative impact analysis of likely alternatives. Those impacts are shown in the Cumulative Impacts Matrix for each alternative as "Other Present Actions". A separate cumulative impact analysis for the no action alternative was determined to be unnecessary using the NRCS-Iowa system.

A key part of the process is how the IDT defines the various categories of impacts on the matrix. For this project, they are defined as follows:

Proposed Action- The planned project activity over the construction period of the alternative being evaluated. For example, Alternative 6 is the construction of an 1,818 acre mulitple-purpose reservoir, 457 acre developed public recreation area, 65 acre destination park, 3,779 acres of public wildlife management area, and 67 acres of dam and auxiliary spillway. It also includes 39 sediment basins and one in-channel sediment basin constructed for the purpose of improving water quality in the reservoir. Construction period is estimated to be five years.

Future Condition From Proposed Action- Following actual construction, the conditions during the rest of the project evaluation period, estimated as years five to 100 of the project.

Past Actions- Past actions are essentially the existing conditions within the project area. It includes land use, typical land management activities, and past actions with lasting effects on the environment. For example, Alternative 6 is 6,186 acres in row crop agriculture; 90 percent rate of participation in federal farm programs by farmers in the watershed; warm water stream that is highly modified by straightening, down cutting, and in-stream grade stabilization structures; city water supplies from ground water and from the Nishnabotna River.

Other Present Actions- This is equivalent to the "no action" portion of the Environmental Consequences section of the watershed plan and EIS. This includes other federal and state programs and regulations that have major influences on landowners' decisions for land use and management within the project area. This includes the availability to farm owners and operators of the Environmental Quality Incentives Program (EQIP), Conservation Security Program (CSP), Conservation Reserve Program (CRP), State of Iowa conservation cost-sharing programs, IDNR regulations of confined animal operations, and agricultural commodity programs administered by the Farm Services Agency.

Future Condition- Determined by combining the impacts of the Future Condition from Proposed Action with the impacts from Other Present Actions. The IDT determined qualitative values using the seven item scale.

Cumulative Impacts- The IDT determined qualitative values by combining the impacts from the Proposed Action with the impacts of the Future Condition.

Alternative 4 West Tarkio Watershed

Checklist for Identifying Cumulative Environmental Impacts

	Will the Project Result in:			
Environmental Category	**Yes**	**Maybe**	**No**	**Comments**
PHYSICAL ENVIRONMENT				
Landform:				
• fractures on geologic strata?			√	
• landslides and land subsidence?			√	
• seismic activity?			√	
• compacting and settling?			√	
• deposition (sedimentation, precipitation)?	√			
• erosion of soils due to increased wind, floods, removal of vegetation?			√	
• impact to unique physical features (due to destruction, modification, or covering)?			√	
• impact to land classified as prime or unique farmland?	√			
• change existing topography (ground contours, shorelines, river banks)?	√			
• extensive use of existing mineral resources (mining, oil and gas)?			√	
• disposal of construction debris?	√			some brush clearing; removal of building sites
• excessive fields and radiation (magnetic fields electromagnetic radiation)?			√	
• changes in hydrology (water table, gradient, infiltration)?	√			
Air/Climate:				
• impact on air quality due to gases, particulates and fugitive dust?	√			
• air pollutant emissions that will exceed federal or state standards or cause deterioration of ambient air quality?			√	
• objectionable odors?			√	
• changes in climate due to alteration in humidity, air movement or temperature?			√	
• emissions of hazardous air pollutants (VOCs, SOCs, and other toxins regulated under the Clean Air Act?			√	
• acid rain?			√	
Water:				
• changes in the quality and quantity of surface drinking water?	√			
• discharge of wastewater to potable drinking water systems?			√	
• alter flows due to construction?	√			
• increase tendency to flooding?			√	
• salinate water bodies?			√	
• unsightly appearance of water bodies?			√	
• eutrophication?		√		
• increase in temperature and turbidity due to impoundment?	√			

Alternative 4 West Tarkio Watershed
Checklist for Identifying Cumulative Environmental Impacts

	Will the Project Result in:			
Environmental Category	**Yes**	**Maybe**	**No**	**Comments**
Water (continued):				
• destruction of streams?	√			
• considerable effects on conventional water quality parameters (that is, DO, fecal coliforms, pH, BOD_5, NO_3, PO_4, temperature deviation, turbidity, total solids)?	√			
• alter the rate or direction of ground water flow?		√		
• introduce pollutants to ground water due to land application of wastes?			√	
• contamination of public water supplies?			√	
• impact to recharge area or recharge rate?		√		
• make ground water vulnerable to contamination (due to wells, boreholes, cracks, etc.)?			√	
• impact on or construction in a wetland or flood plain?	√			
• thawing snow, ice, and permafrost?			√	
• impact to a wellhead protection zone?			√	
• impact on fisheries?	√			
Solid waste:				
• generation of significant solid waste?			√	
• impact existing landfill capacity?			√	
Noise:				
• increase existing noise levels?		√		
• expose people or wildlife to excessive noise?			√	
• vibrations?			√	
Hazardous waste:				
• generation, transport, storage, or disposal of regulated hazardous wastes?			√	
BIOLOGICAL ENVIRONMENT				
Flora:				
• change to the diversity or productivity of vegetation (namely trees, shrubs, grass, crops, microflora, and aquatic plants?	√			
• impact to riparian habitat?	√			
• impact to rare or endangered plant species?			√	
• introduce new plant species into the area, create a barrier to the normal replenishment of existing species?	√			
• reduce acreage or create damage to any agricultural crop?	√			
• impact forests?			√	
Fauna:				
• reduce the habitat or numbers of unique, rare, or endangered species of birds or animals?			√	

Alternative 4 West Tarkio Watershed
Checklist for Identifying Cumulative Environmental Impacts

	Will the Project Result in:			
Environmental Category	**Yes**	**Maybe**	**No**	**Comments**
Fauna (continued):				
• effect to land animals, benthic organisms, insects, and microfauna?	√			
• attraction, entrapment or impingement of animal life?	√			
• impact to existing fish, wildlife habitat, and nesting areas?	√			
• introduction of new species of animals into an area, create a barrier to the migration or movement of animals or fish?	√			
• cause emigration resulting in human-wildlife interaction problems?		√		
• effect to food chain?		√		
SOCIOECONOMIC ENVIRONMENT				
Land Use:				
• substantially altering existing land use of an area?	√			
• impact to wilderness qualities and open-space qualities?			√	
• impact to or destruction of wetlands?	√			
• impact to Special Management Areas (SMAs)?			√	
Recreation:				
• impact to hunting, fishing, boating, swimming, camping and hiking, picnicking and holiday resorts?	√			
Aesthetics:				
• impact to scenic views and vistas?	√			
• impact to landscape design?	√			
• impact to unique physical features?			√	
• impact to parklands and reserves?	√			create
• impact to monuments?			√	
• presence of misfits (out of place)?			√	
Archaeological sites:				
• impact to or destruction of historical, archaeological, cultural and paleontological sites or objects?	√			Farmsteads > 50 years old within acquisition area
Health and safety:				
• health hazard or potential health hazard?		√		increased risk of drowning
• exposure of people to potential health hazards?	√			
• risk of accidents due to explosion, release of oil, radioactive materials, toxic substances, etc.?			√	
Cultural patterns:				
• change existing cultural patterns (or life style)?	√			
Local services: Need for new or altered services in any of the following areas -				

Alternative 4 West Tarkio Watershed
Checklist for Identifying Cumulative Environmental Impacts

	Will the Project Result in:			
Environmental Category	**Yes**	**Maybe**	**No**	**Comments**
Local services (continued):				
• health care?			√	
• police?	√			additional needed
• fire protection?	√			closed roads may increase response time
• education?		√		retention of younger people in area
• churches?		√		
• child care?		√		retention of younger people in area
• other services?			√	
Public utilities:				
Need for new or alterations to following utilities:				
• electricity?	√			
• natural gas?	√			
• potable water?	√			
• wastewater treatment and disposal?	√			
• stormwater control?	√			construction of dam
• solid waste collection and disposal?	√			reduce dumping in gullies
• communications systems?	√			
• transmission pipelines?	√			raw water lines to treatment facilities
• other utilities?				
Population:				
• alteration of location or distribution of human populations in the area?	√			
• change to demographic characteristics in area?		√		
• change to housing and household?			√	
Economic:				
• effect on local or regional economy?	√			
• changes in per capita income?		√		
• changes in the standard of living?		√		
• employment?		√		
Transportation:				
• change to existing rail, road, waterway and/or air traffic?	√			some local road closures
• increase in movement?	√			holiday, weekend
• increase in accident and traffic hazards?		√		
• effect to transportation network?	√			possible paving of some existing gravel roads
• construction of new roads?	√			new roads within acquisition area
• change in existing patterns of movement of persons and materials?		√		
Natural resources:				
• deplete natural resources?			√	
• destruction of natural resources?			√	
Energy:				
• substantial use of fuel or energy?	√			construction, recreational vehicles, boats
• increase in demand for existing sources of energy?			√	increase by recreational uses offset by decrease in agricultural use

Notes: Due consideration has to be given to the time and space scales. The projects may have short-term or long-term impacts, and the geographical extent of the impacts may be either in the vicinity of the project or considerable distances away.

Checklist for Identifying Cumulative Environmental Impacts

Environmental Category	Will the Project Result in: Yes	Maybe	No	Comments
PHYSICAL ENVIRONMENT				
Landform:				
• fractures on geologic strata?			√	
• landslides and land subsidence?			√	
• seismic activity?			√	
• compacting and settling?			√	
• deposition (sedimentation, precipitation)?	√			
• erosion of soils due to increased wind, floods, removal of vegetation?			√	
• impact to unique physical features (due to destruction, modification, or covering)?			√	
• impact to land classified as prime or unique farmland?	√			
• change existing topography (ground contours, shorelines, river banks)?	√			
• extensive use of existing mineral resources (mining, oil and gas)?			√	
• disposal of construction debris?	√			some brush clearing; removal of building sites
• excessive fields and radiation (magnetic fields electromagnetic radiation)?			√	
• changes in hydrology (water table, gradient, infiltration)?	√			
Air/Climate:				
• impact on air quality due to gases, particulates and fugitive dust?	√			
• air pollutant emissions that will exceed federal or state standards or cause deterioration of ambient air quality?			√	
• objectionable odors?			√	
• changes in climate due to alteration in humidity, air movement or temperature?			√	
• emissions of hazardous air pollutants (VOCs, SOCs, and other toxins regulated under the Clean Air Act?			√	
• acid rain?			√	
Water:				
• changes in the quality and quantity of surface drinking water?	√			
• discharge of wastewater to potable drinking water systems?			√	
• alter flows due to construction?	√			
• increase tendency to flooding?			√	
• salinate water bodies?			√	
• unsightly appearance of water bodies?			√	
• eutrophication?		√		
• increase in temperature and turbidity due to impoundment?	√			
• destruction of streams?	√			

Alternative 6 West Tarkio Watershed
Checklist for Identifying Cumulative Environmental Impacts

Environmental Category	Will the Project Result in: Yes	Maybe	No	Comments
Water (continued):				
• considerable effects on conventional water quality parameters (that is, DO, fecal coliforms, pH, BOD_5, NO_3, PO_4, temperature deviation, turbidity, total solids)?	√			
• alter the rate or direction of ground water flow?		√		
• introduce pollutants to ground water due to land application of wastes?			√	
• contamination of public water supplies?			√	
• impact to recharge area or recharge rate?		√		
• make ground water vulnerable to contamination (due to wells, boreholes, cracks, etc.)?			√	
• impact on or construction in a wetland or flood plain?	√			
• thawing snow, ice, and permafrost?			√	
• impact to a wellhead protection zone?			√	
• impact on fisheries?	√			
Solid waste:				
• generation of significant solid waste?			√	
• impact existing landfill capacity?			√	
Noise:				
• increase existing noise levels?		√		
• expose people or wildlife to excessive noise?			√	
• vibrations?			√	
Hazardous waste:				
• generation, transport, storage, or disposal of regulated hazardous wastes?			√	
BIOLOGICAL ENVIRONMENT				
Flora:				
• change to the diversity or productivity of vegetation (namely trees, shrubs, grass, crops, microflora, and aquatic plants?	√			
• impact to riparian habitat?	√			
• impact to rare or endangered plant species?			√	
• introduce new plant species into the area, create a barrier to the normal replenishment of existing species?	√			
• reduce acreage or create damage to any agricultural crop?	√			
• impact forests?			√	
Fauna:				
• reduce the habitat or numbers of unique, rare, or endangered species of birds or animals?			√	
• effect to land animals, benthic organisms, insects, and microfauna?	√			

Alternative 6 West Tarkio Watershed
Checklist for Identifying Cumulative Environmental Impacts

Environmental Category	Will the Project Result in: Yes	Maybe	No	Comments
Fauna (continued)				
• attraction, entrapment or impingement of animal life?	√			
• impact to existing fish, wildlife habitat, and nesting areas?	√			
• introduction of new species of animals into an area, create a barrier to the migration or movement of animals or fish?	√			
• cause emigration resulting in human-wildlife interaction problems?		√		
• effect to food chain?		√		
SOCIOECONOMIC ENVIRONMENT				
Land Use:				
• substantially altering existing land use of an area?	√			
• impact to wilderness qualities and open-space qualities?			√	
• impact to or destruction of wetlands?	√			
• impact to Special Management Areas (SMAs)?			√	
Recreation:				
• impact to hunting, fishing, boating, swimming, camping and hiking, picnicking and holiday resorts?	√			
Aesthetics:				
• impact to scenic views and vistas?	√			
• impact to landscape design?	√			
• impact to unique physical features?			√	
• impact to parklands and reserves?	√			create
• impact to monuments?			√	
• presence of misfits (out of place)?			√	
Archaeological sites:				
• impact to or destruction of historical, archaeological, cultural and paleontological sites or objects?	√			Farmsteads > 50 years old within acquisition area
Health and safety:				
• health hazard or potential health hazard?		√		increased risk of drowning
• exposure of people to potential health hazards?	√			
• risk of accidents due to explosion, release of oil, radioactive materials, toxic substances, etc.?			√	
Cultural patterns:				
• change existing cultural patterns (or life style)?	√			
Local services:				
Need for new or altered services in any of the following areas -				
• health care?			√	
• police?	√			additional needed

Alternative 6 West Tarkio Watershed
Checklist for Identifying Cumulative Environmental Impacts

Environmental Category	Will the Project Result in: Yes	Maybe	No	Comments
Local services (continued):				
• fire protection?	√			closed roads may increase response time
• education?		√		retention of younger people in area
• churches?		√		
• child care?		√		retention of younger people in area
• other services?			√	
Public utilities:				
Need for a new or alterations to the following utilities:				
• electricity?	√			
• natural gas?	√			
• potable water?	√			
• wastewater treatment and disposal?	√			
• stormwater control?	√			construction of dam
• solid waste collection and disposal?	√			reduce dumping in gullies
• communications systems?	√			
• transmission pipelines?	√			raw water lines to treatment facilities
• other utilities?				
Population:				
• alteration of location or distribution of human populations in the area?	√			
• change to demographic characteristics in the area?		√		
• change to housing and household?			√	
Economic:				
• effect on local or regional economy?	√			
• changes in per capita income?		√		
• changes in the standard of living?		√		
• employment?		√		
Transportation:				
• change to existing rail, road, waterway and/or air traffic?	√			some local road closures
• increase in movement?	√			holiday, weekend
• increase in accident and traffic hazards?		√		
• effect to transportation network?	√			possible paving of some existing gravel roads
• construction of new roads?	√			new roads within acquisition area
• change in existing patterns of movement of men and materials?		√		
Natural resources:				
• deplete natural resources?			√	
• destruction of natural resources?			√	
Energy:				
• substantial use of fuel or energy?	√			construction, recreational vehicles, boats
• increase in demand for existing sources of energy?			√	increase by recreational uses offset by decrease in agricultural use

Notes: Due consideration has to be given to the time and space scales. The projects may have short-term or long-term impacts, and the geographical extent of the impacts may be either in the vicinity of the project or considerable distances away.

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Council on Environmental Quality (CEQ). 1991. *Considering Cumulative Effects Under the National Environmental Policy Act.* Washington, D.C.

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Economics

Flood Damages

Average annual damages for crop and pasture, other agriculture, and road and bridges were estimated based on landowner interviews and values from other watershed studies. Average annual flood damages in the city of Tarkio, Missouri were estimated utilizing a spreadsheet version of the urban floodwater damage economic evaluation (URB1) computer program. The program requires data on damage factors, by flood depth, for buildings and contents. Interviews of owners of the potentially damaged properties were conducted to gather data.

Streambank and Gully Erosion Damages

The annual extent of voided and depreciated land was determined by geologic investigation and other similar watershed studies. On-site damages were estimated based on values from another watershed study that utilized the net-income method. This method develops crop budgets for each crop and weights the values to arrive at a net-income per composite acre.

Agricultural Water Management

Benefits were computed using the evaluation procedure in Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G), section 2.2.12.

Annual benefits of a water supply are generally equal to the annual cost of the most likely alternative of providing the water. However, the alternative cost of providing a water supply for smaller communities (population of 10,000 or less) may be extremely expensive on a per capita basis because these communities lack the efficiencies of large-scale development. In this case the annual benefit may be considered equal to the cost of the separable water supply facilities plus an appropriate share of the remaining joint cost of the project.

The annual separable cost related to water supply, plus an appropriate share of the joint cost for the Site 2 is $1,762,500 and $1,625,400 for Site 3. Therefore, the estimated average annual benefit for the water supply of Site 2 is $1,762,500 and $1,625,400 for Site 3.

Recreation Benefits

The Benefit Transfer method was used to evaluate recreation benefits. A national average value by recreation activity was obtained from "Benefit Transfer of Outdoor Recreation Use Values: A Technical Document Supporting the Forest Service Strategic Plan", Randall S. Rosenberger and John B. Loomis (2001). This document is supported by a database of 700 recreation valuation studies.

Agricultural Pollution Control

Sedimentation of reservoirs is the main aging process because they are effective at trapping suspended solids. The deposition of solids decreases lake storage capacity and smothers fish spawning sites and affects the diversity and abundance of many kinds of aquatic life. In addition to reducing lake volume, suspended solids make the water turbid, and lakes located where

colloidal clays are abundant may have persisitent muddy water conditions long after a given runoff event. The decreased lake volume and turbidity decreases water-based recreation use over time.

Conservation practices, such as terraces and no-till, can reduce the amount of sediment entering a reservoir. Due to very active soil conservation programs in Page and Montgomery counties, the watershed above either Site 2 or 3 is at or below "T" for over 85% of the watershed. Even with much of the watershed protected by conservation practices, there would still be over 33,000 tons per year and 37,000 tons per year delivered to Site 2 and 3, respectively. Further reductions in sediment delivered to a reservoir can be achieved through the installation of sediment basins near and around the reservoir.

By restoring some of their lakes (Lake Ahquabi, Pine Lake, Nine Eagles Lake and Slip Bluff Lake), IDNR has demonstrated the correlation between high water quality and recreation use. The lakes mentioned above had experienced significant sedimentation over the years and IDNR was able to reduce current sedimentation by 50 percent or more. This resulted in the lakes use to either double or increase three-fold.

Since the watersheds for Site 2 and 3 have a high measure of conservation practices, it is assumed that the remaining sediment entering either site would reduce recreation use for fishing, boating, water skiing and swimming by 10 percent by the end of the project life. It is also assumed that the remaining sediment would need to be reduced by 20-25 percent to capture back half of the 10 percent declining recreation usage.

SITE 2 – AGRICULTURAL POLLUTION CONTROL ANALYSIS

Recreation activities most impacted by degraded water quality:

Activity	Annual User Days	User Day Value	Average Annual Value
Fishing	90,200	$ 36.06	$ 3,252,600
Boating	49,700	$ 30.34	$ 1,507,900
Water Skiing	4,500	$ 24.32	$ 109,400
Swimming	4,300	$ 26.23	$ 112,800
		Total	$ 4,982,700

(Assume a 5 year construction period)

Recreation declines 10% percent by year 105: ($4,982,700 x 90%) =	$ 4,235,300
Net decline from year 5 to year 105 ($4,982,700 - $4,235,300) =	$ 747,400
Average decline over 100 years: ($747,400/100) =	$ 7,500
Present value of decreasing annuity, 100 yrs: ($7,500 x 1573.06422) =	$ 11,798,000
Present value of 1, 5 years hence: ($11,798,000 x 0.77888) =	$ 9,189,200
Average annual recreation value decline: ($9,189,200 x 0.0516) =	$ 474,100

With installation of 34 sediment basins

Recreation declines 5% by year 105: ($4,982,700 x 95%) =	$ 4,733,600
Net decline from year 5 to year 105: ($4,982,700 - $4,733,600) =	$ 249,100
Average decline over 100 years: ($249,100/100) =	$ 2,500
Present value of decreasing annuity, 100 yrs: ($2500 x 1573.06422) =	$ 3,932,700
Present value of 1, 5 years hence: ($3,932,700 x 0.77888) =	$ 3,063,100
Average annual recreation value decline: ($3,063,100 x 0.0516) =	$ 158,100
Average annual benefits: ($474,100 - $158,100) =	$ 316,000

SITE 3 – AGRICULTURAL POLLUTION CONTROL ANALYSIS

Recreation activities most impacted by degraded water quality:

Activity	Annual User Days	User Day Value	Average Annual Value
Fishing	121,600	$ 36.06	$ 4,384,900
Boating	67,000	$ 30.34	$ 2,032,800
Water Skiing	6,100	$ 24.32	$ 148,400
Swimming	5,800	$ 26.23	$ 152,100
		Total	$ 6,718,200

(Assume a 5 year construction period)

Recreation declines 10% percent by year 105: ($6,718,200 x 90%) =	$ 5,712,500
Net decline from year 5 to year 105 ($6,718,200- $5,712,500) =	$ 1,007,700
Average decline over 100 years: ($1,007,700/100) =	$ 10,100
Present value of decreasing annuity, 100 yrs: ($10,100 x 1573.06422) =	$ 15,887,900
Present value of 1, 5 years hence: ($15,887,900 x 0.77888) =	$ 12,374,800
Average annual recreation value decline: ($12,374,800 x 0.0516) =	$ 638,500

With installation of 40 sediment basins

Recreation declines 5% by year 105: ($6,718,200 x 95%) =	$ 6,382,300
Net decline from year 5 to year 105: ($6,718,200 - $6,382,300) =	$ 335,900
Average decline over 100 years: ($335,900/100) =	$ 3,400
Present value of decreasing annuity, 100 yrs: ($3400 x 1573.06422) =	$ 5,348,400
Present value of 1, 5 years hence: ($5,348,400 x 0.77888) =	$ 4,165,800
Average annual recreation value decline: ($4,165,800 x 0.0516) =	$ 241,900
Average annual benefits: ($638,500 - $214,900) =	$ 423,600

Regional Economic Development Methodology

Economic Evaluation of Benefits and Costs

Article I. Establishing the reservoir represents a public investment in natural resources that will generate a variety of environmental and economic benefits and costs. The analysis of these benefits and costs is referred to as economic impact analysis. Economic impact analysis is an assessment of change in overall economic activity as a result of some change in one or several economic activities (MIG, 2004). This study evaluates and compares the economic impacts of two potential multiple-purpose reservoirs, referred to in this document as Site 2 and Site 3, for the West Tarkio Creek reservoir project using the IMPLAN (Impact Analysis for Planning) model. IMPLAN is a non-survey-based input-output model developed by the US Forest Service in 1993. IMPLAN is used for input-output analysis of any county or combination of counties in the U.S, and is designed to estimate changes in total economic output, total value added to the economy and employment for impacts in up to 509 economic sectors.

The IMPLAN economic impact model for the reservoir measures both the benefits and costs of the project. Benefits are increases in regional economic activity. Costs are decreases in regional economic activity and direct local cost expenditures related to the reservoir. Economic activity is measured in terms of dollars (value added and output) and jobs (employment). Value added is a monetary measure of employee compensation, proprietary income, other property type income and indirect business taxes generated (or lost) due to the impact. Output is a monetary measure of total industry production generated (or lost) due to the impact. Employment is measured in jobs gained (or lost) due to the impact. In the reservoir model, the impacts are modeled as either long term and short term impacts according to whether the impact will continue throughout the life of the project (long term) or whether the impact will occur during the construction phases of the project only (short term).

Page and Fremont Counties is the region of impact modeled. Benefits from either Site 2 or Site 3 accrue due to the construction activities related to construction of a dam and its associated sediment basins, water supply structures (raw water intake structure and transmission lines), land acquisition, and recreation facilities. Benefits also accrue due to operation and maintenance activities, and the public's participation in recreation activities. Table 1 summarizes the impact and whether the impact is modeled as a short term or long term impact.

Table 1: Regional Benefits of Site 2 or Site 3

Impact	Life of Impact
Dam & Sediment Basins Construction	Short Term
Water Supply Construction (raw water intake and transmission lines)	Short Term
Dam & Sediment Basins Operation and Maintenance	Long Term
Water Supply Operation and Maintenance	Long Term
Land Acquisition	Short Term
Recreation Facilities Construction	Short Term
Recreation Facilities Operation and Maintenance	Long Term
Recreation Activities	Long Term

The region's costs of installing either Site 2 or Site 3 are lost agricultural production for lands that will be inundated and included as part of the project acquisition area. The region will also lose local property tax revenue from those same properties. The local sponsors of the reservoir project are responsible for a portion of the cost of property acquisition, infrastructure, construction cost of the reservoir and sediment basins and all of the operation and maintenance costs. Table 2 summarizes the cost impacts and whether they are modeled as a short term or long term impact.

Table 2: Regional Costs of Site 2 or Site 3

Impact	Life of Impact
Lost Agriculture	Long Term
Lost Property Tax Revenue	Long Term
Local Property Acquisition and Infrastructure	Short Term
Local Construction Cost	Short Term
Operation and Maintenance	Long Term

Tables 1 and 2 provide the general framework for modeling the regional impacts of Site 2 and Site 3. The magnitude of the impacts and the economic sectors where the impact occurs in the model is described below.

Value of Impacts and Sectors Modeled

The impacts of the benefits and costs of Site 2 and Site 3 are modeled as shocks (dollars coming into or out of the economy) to the regional economy in a specified sector of the economy. IMPLAN delineates 509 sectors linked to NAICS (North American Industry Classification Scheme) and Bureau of Economic Analysis (BEA) commodity classifications (MIG, 2004).

Benefits

Dam construction represents the actual physical construction and earthmoving associated with constructing a dam. The estimated cost of dam and sediment basins construction for Site 2 is $17,831,500 and $17,978,400 for Site 3. These costs are modeled as a shock to IMPLAN sector 39, highway, street, bridge, tunnel construction. Water supply construction is the construction of the raw water intake structure and transmission lines that will provide water supply from Site 2 or Site 3 to the treatment plants. The estimated costs of water supply construction for Site 2 is

$16,075,900 and $15,659,900 for Site 3 and are modeled as shocks to IMPLAN sector 40, water, sewer and pipeline construction. Dam and sediment basins operation and maintenance is the continuous maintenance needs that will accrue over the life of the dam and sediment basins. This includes activities such as mowing and brush control on the dam and sediment basins to replacement and repair of pipes and structures associated with the structures. The estimated capitalized[1] cost of dam and sediment basins operation and maintenance for Site 2 is $1,482,600 and $1,599,000 for Site 3 and is modeled as a shock to IMPLAN sector 44, maintenance and repair of highway, street, bridge and tunnel construction.

Recreation facilities construction is the construction of facilities needed to enhance recreation opportunities such as parking lots, boat ramps, fishing piers and jetties, campsites, cabins, picnic shelters, beach, and underwater fish structures. The estimated cost of recreation construction for Site 2 is $5,055,500 and $5,862,300 for Site 3 and is modeled as a shock to IMPLAN sector 41, other new construction. The estimated capitalized cost of recreation facilities operation and maintenance is $1,845,000 for Site 2 and $2,139,600 for Site 3 and is modeled as a shock to IMPLAN sector 45, other maintenance and repair construction. Recreation activities represent the benefits of having recreation available to the public and the monetary value of that recreation to the public. The estimated capitalized recreation benefit for Site 2 is $123,426,400 and $166,476,200 for Site 3 and is modeled as a shock to IMPLAN sector 478, other amusement, gambling, and recreation industry.

[1] Operation and maintenance costs are generated in average annual terms for planning. A project life of 100 years and 5.125% discount rate (the 2006 Federal Rate for Water Resources Projects) is used to convert average annual values to a capitalized value to model in IMPLAN.

Table 3a: Benefits, Value and IMPLAN Sector for Site 2

Impact	Value	IMPLAN Sector
Dam & Sediment Basins Construction	$17,831,500	39- Highway, street, bridge, tunnel construction
Water Supply Construction	$16,075,900	40- Water, sewer, pipeline construction
Dam & Sediment Basins Operation and Maintenance	$1,482,600	44- Maintenance and repair of highway, street, bridge, tunnel
Water Supply Operation and Maintenance	$4,471,100	45- Other maintenance and repair
Land Acquisition	$18,918,300	431- Real Estate
Recreation Facilities Construction	$5,055,500	41- Other new construction
Recreation Facilities Operation and Maintenance	$1,845,000	45- Other maintenance and repair
Recreation Activities	$123,426,400	478- Other amusement, gambling, recreation industry

Table 3b: Benefits, Value and IMPLAN Sector for Site 3

Impact	Value	IMPLAN Sector
Dam & Sediment Basins Construction	$17,978,400	39- Highway, street, bridge, tunnel construction
Water Supply Construction	$15,659,900	40- Water, sewer, pipeline construction
Dam & Sediment Basins Operation and Maintenance	$1,599,000	44- Maintenance and repair of highway, street, bridge, tunnel
Water Supply Operation and Maintenance	$4,372,300	45- Other maintenance and repair
Land Acquisition	$22,464,400	431- Real Estate
Recreation Facilities Construction	$5,862,300	41- Other new construction
Recreation Facilities Operation and Maintenance	$2,139,600	45- Other maintenance and repair
Recreation Activities	$166,476,200	478- Other amusement, gambling, recreation industry

Costs

Lost agriculture represents the land currently in agricultural production that will be removed from production in order to construct either Site 2 or Site 3. The regional costs of lost agricultural production represent lands in corn and soybeans. The estimated capitalized value of lost agricultural production for Site 2 is $28,138,500 ($15,519,900 for corn and $12,618,600 for soybeans) and $33,138,600 ($18,293,200 for corn and $14,845,400 for soybeans) for Site 3 and is modeled as shocks to the following IMPLAN sectors: sector 2, grain farming for corn and sector 1, oilseed farming for soybeans.

Lost property tax revenue represents the revenue the local economy will lose as a result of the reservoir. Lost property taxes impact schools, health department, county and townships. The estimated capitalized cost of lost property tax revenue for Site 2 is $1,503,900 ($922,500 for schools and area college, $44,600 for Health Department, and $536,800 for county and townships) and for Site 3 is $1,872,200 ($1,139,600 for schools and area college, $65,900 for Health Department, and $666,700 for county and townships) (Page County Assessors Office, 2005) and is modeled as a shock to the following IMPLAN sectors: sector 503, state and local education; sector 470, social assistance; and sector 499, other state and local government enterprises.

The local sponsor is responsible for half of the cost of property acquisition. The estimated local property acquisition cost for Site 2 is $9,459,200 and $11,232,200 for Site 3. The local sponsor is also responsible for half of the cost of the reservoir, sediment basins, recreation facilities and water supply construction. The estimated local construction cost for Site 2 is $19,481,400 and $19,750,300 for Site 3. The local sponsor is also responsible for all of the operation and maintenance costs. The estimated capitalized operation and maintenance costs for the dam and sediment basins, water supply infrastructure, and recreation facilities for Site 2 are $1,482,600, $4,471,100 and $1,845,000 respectively and for Site 3 they are $1,599,000, $4,372,300, and $2,139,600 respectively. These costs are included in the analysis as direct costs. Table 4a summarizes the cost, value of the impact and IMPLAN sector for Site 2 and Table 4b summarizes the cost, value of the impact and IMPLAN sector for Site 3.

Table 4a: Costs, Value and IMPLAN Sector for Site 2

Impact	Value	IMPLAN Sector
Lost Agriculture Production		
Corn	$15,519,900	2- Grain farming
Soybeans	$12,618,600	1- Oilseed farming
Lost Property Tax Revenue		
Schools and Area Colleges	$922,500	503- State and Local Education
Health Department	$44,600	470- Social assistance
County and Townships	$536,800	499- Other state and local government enterprises
Local Property Acquisition	$9,459,200	Direct cost
Local Construction Cost	$19,481,400	Direct cost
Operation and Maintenance, Dam & Sediment Basins	$1,482,600	Direct cost
Operation and Maintenance, Water Supply	$4,471,100	Direct cost
Operation and Maintenance, Recreation Facilities	$1,845,000	Direct cost

Table 4b: Costs, Value and IMPLAN Sector for Site 3

Impact	Value	IMPLAN Sector
Lost Agriculture Production		
Corn	$18,293,200	2- Grain farming
Soybeans	$14,845,400	1- Oilseed farming
Lost Property Tax Revenue		
Schools & Area Colleges	$1,139,600	503- State and Local Education
Health Department	$65,900	470- Social assistance
County and townships	$666,700	499- Other state and local government enterprises
Local Property Acquisition	$11,232,200	Direct cost
Local Construction Cost	$19,750,300	Direct cost
Operation and Maintenance, Dam & Sediment Basins	$1,599,000	Direct cost
Operation and Maintenance, Water Supply	$4,372,300	Direct cost
Operation and Maintenance, Recreation Facilities	$2,139,600	Direct cost

Results and Discussion

As described above, the impacts of the benefits and costs of the reservoir are modeled as shocks to the regional economy that is initiated in a specified sector of the economy. These are the inputs of the IMPLAN model. The output represents what impact that input has as it influences all sectors of the economy. Outputs of the model can be analyzed on a sector basis or as an aggregate total impact. For the purposes of this model, the aggregate total impacts are presented in terms of the value added to the economy and the jobs generated.

Benefits

The aggregated benefits from dam and sediment basins construction, recreation facilities construction, and water supply construction, land acquisition, recreation activities, and all operation and maintenance activities generate for Site 2 and 3, $35,443,639 and $44,262,433 in value added to the regional economy respectively. Total employment generated during the life of the project for Site 2 and 3 is 1,179.8 and 1,459.1 jobs to the region respectively.

Costs

The local sponsors are responsible for half of the property acquisition and construction costs for an aggregated cost for Site 2 of $28,940,600 and $30,982,500 for Site 3. The local sponsors are responsible for all the costs of operation and maintenance of the project at an aggregated capitalized cost for Site 2 of $7,798,700 and $8,110,900 for Site 3.

The lost value added associated with lost agricultural production and lost property taxes are for Site 2 are $3,290,942 and $3,972,732 for Site 3 during the life of the project. The lost employment, during the life of the project, related to lost agricultural production and lost property taxes for Site 2 is 100.1 jobs and 120.9 jobs for Site 3.

The total cost for Site 2 (direct costs plus lost value added) is $39,951,810 with a loss of 100.1 jobs. The total cost for Site 3 (direct costs plus lost value added) is $43,066,132 with a loss of 100.1 jobs.

Conclusion

Over the 100 year life of the project, site 2 provides negative net regional benefits of $(4,586,603), while site 3 provides positive net regional benefits of $1,196,301 over the 100 year project life. Table 5a summarizes total costs, benefits and net benefits during the project life for Site 2 and Table 5b summarizes total costs, benefits and net benefits during the project life for Site 3.

Table 5a: Average Annual Costs, Benefits and Net Benefits for Site 2

Total Regional Costs	$40,030,242
Total Regional Benefits	$35,443,639
Net Regional Benefits	$(4,586,603)

Table 5b: Average Annual Costs, Benefits and Net Benefits for Site 3

Total Regional Costs	$43,066,132
Total Regional Benefits	$44,262,433
Net Regional Benefits	$1,196,301

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Biology

After scoping meetings were held for the project, NRCS consulted with biologists from U.S. Fish and Wildlife Service, Iowa Department of Natural Resources, and Missouri Department of Conservation to ascertain what potential issues needed to be addressed for Threatened and Endangered Species, fishery and other aquatic species, and terrestrial wildlife habitat for the proposed project.

Consultation on Endangered Species determined that no Federally listed or Iowa or Missouri State listed T&E species are present in the areas being impacted by the proposed reservoir, public recreation areas, or ancillary structures.

The IDNR has conducted several fishery surveys of the West Tarkio Creek system. The fishery is composed mainly of generalist minnow species which are tolerant of moderately degraded habitat conditions. The stream has been placed on Iowa's Impaired Waters list due to degraded habitat conditions for the fishery. Installation of the multipurpose reservoir will convert several miles of a flashy, warm water lotic habitat to a high quality warm water lentic system. The dam will effectively divide the stream into two sections and block upstream movement of fish from the lower portions of West Tarkio to its headwaters. Both native game species and existing minnow species in the stream system will be able to move upstream from the reservoir into the headwaters areas of West Tarkio and the same fish will also be able to move downstream from the reservoir.

The project is forecasted to benefit downstream habitat by maintaining a more stable flow regime, will reduce stream incision, and reduce sedimentation and turbidity downstream of the reservoir.

The tri-agency biology team used an Iowa version of the US Fish and Wildlife Service Habitat Evaluation Procedures (HEP) to assess habitat impacts. The HEP is a process where quality of habitat for any species is computed using a habitat model specific to the species. The model looks at all life stage needs of the selected species and produces a quality value for the species known as the Habitat Suitability Index (HSI). The HSI ranges from 0.0 to 1.0, where 1.0 represents optimal habitat conditions for the species. The HSI is then multiplied by the acres of habitat available which produce a quantitative value for the habitat conditions. This is termed Habitat Units (HU).

Wildlife habitat is fragmented, with almost all of the land in the watershed devoted to corn and soybean crop production or introduced grasses that are heavily grazed. The team decided that losses of any remaining areas of woodland cover would have the potential to be significant to wildlife. The loss of grassland cover, while less significant, was also deemed to be an important consideration in the analysis of project impacts. Loss of cropland acres was not considered to be significant.

The tri-agency team used Habitat Suitability Index (HSI) models for seven terrestrial species to quantify impacts to woodland and grassland wildlife habitat from installation of the lake, recreation areas, and wildlife habitat development areas. The team selected the following species which were representative of the wildlife using woody cover in this watershed: white-tailed deer, bobwhite quail, fox squirrel, red tailed hawk, ring-necked pheasant, black capped chickadee, red-headed woodpecker. The following species were selected as representative of species using the grassland cover in the watershed: white-tailed deer, ring-necked pheasant, and bobwhite quail.

The team divided the woody habitat into three subclasses: scrub-shrub mixed woody cover, linear tree cover such as draws and fence lines, and non-linear (block), larger patches of trees. Representative samples of each cover type were analyzed with the seven species models. An average HSI value for each species was computed for each of the three cover types. These average HSI values were multiplied by the acreage of each of the three cover classes to compute the amount of Habitat Units (HU) impacted by the project for each species and habitat type. The woody cover HU impacts for each species were aggregated to produce one quantity of HU impacts for woody cover as a class.

The lost HU quantities were then used to plan the types and quantities of woodland habitat that would be installed on the wildlife management area. Mitigation for any negative woodland habitat impacts will be obtained through directing the installation, layout, and arrangement of the practices on the wildlife management area.

Three HSI species models were used to measure grassland impacts. The grassland habitat was divided into two subclasses based on the intensity of grazing. Grassland impacts were then analyzed in a similar manner to the woodland analysis described above. This analysis was also used in planning the development of the wildlife arrangement area to ensure adequate replacement of all lost HU.

The following table summarizes the average HSI values for each habitat type by species analyzed.

WOODLAND HABITAT

Species	Scrub/Shrub	Block	Linear
White-tail Deer	0.60	0.53	0.42
Bobwhite Quail	0.61	0.71	0.71
Fox Squirrel	0.31	0.24	0.16
Red-tailed Hawk	0.62	0.62	0.53
Pheasant	0.31	0.46	0.46
BC Chickadee	N/A	0.80	N/A
RH Woodpecker	0.62	0.73	0.53

GRASSLAND HABITAT

Species	Heavy Use	Moderately Heavy Use

White-tail Deer	0.10	0.10
Bobwhite Quail	0.29	0.38
Ring-necked Pheasant	0.10	0.10

The following are the quantities of Habitat Units (HU) that would be lost due to the installation of the Alternative 4 reservoir, developed recreation areas, and ancillary structures. The numbers of HU are a combined total of losses for the various subcategories of habitat lost under each general heading in the table.

Species	Woodland Cover	Grassland Cover
White-tail Deer	42 HU	31 HU
Bobwhite Quail	54 HU	115 HU
Fox Squirrel	19 HU	N/A
Red-tailed Hawk	48 HU	N/A
Pheasant	35 HU	31 HU
BC Chickadee	57 HU	N/A
RH Woodpecker	56 HU	N/A

The following are the quantities of Habitat Units (HU) that would be lost due to the installation of the Alternative 6 reservoir, developed recreation areas, and ancillary structures. The numbers

of HU are a combined total of losses for the various subcategories of habitat lost under each general heading in the table.

Species	Woodland Cover	Grassland Cover
White-tail Deer	85 HU	70 HU
Bobwhite Quail	112 HU	262 HU
Fox Squirrel	40 HU	N/A
Red-tailed Hawk	99 HU	N/A
Pheasant	72 HU	70 HU
BC Chickadee	118 HU	N/A
RH Woodpecker	115 HU	N/A

Wildlife habitat mitigation will consist of replacing 118 HU of woody cover and 262 HU of grassland cover.

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Hydrology and Hydraulics

Traditional methods were used to determine stage-discharge and flow-frequency for future without-project condition and for future with-project alternatives tested.

Stream Hydraulics
Water surface profiles were developed using the US Army Corps of Engineers HEC-RAS computer program. Cross-section surveys at 49 valley and channel locations were used to represent that evaluation reaches. Ten-foot contour interval topography was useful for stage-storage and cross-section data at structure sites.

Hydraulic characteristics were measured from quadrangle sheets and photographs taken in the field. Manning's "n" was evaluated using National Engineering Handbook, Section 5, Supplement B, techniques.

Rainfall- Runoff- Peak Flows
National Weather Service Technical Paper 40 was the source for rainfall depth-frequency data. Hydraulic Runoff Curve Numbers were computed based upon soils, land use, and treatment practices. Times of concentration for local drainage areas were based on the travel time method.

Watershed Hydrology Model Project Formulation – Hydrology (TR-20) was used to compute flow frequency – discharge – flood elevation data for seven floods ranging from a one percent event (100-year), to the average one time per year event. Results of present condition TR-20 modeling were consistent with regional analysis flow-frequency guidelines provided by the U.S. Geological Survey.

Flooding in West and Middle Tarkio Creeks
Flood damages were studied as part of the sponsor objective. For the West Tarkio Creek, out-of-bank flooding occurs statistically once per year in the upper one-third of the watershed. These flood flows are flashy in nature and return to within bank in a fairly short period of time. The central portion of the drainage area has a statistical probability of out-of-bank flooding of four percent each year, as the channel is wider and deeper in this area. The upper portion of the lower one-third of the drainage area has an annual probability of out-of-bank flooding of 20 percent. The lower portion of the lower one-third of the drainage area has annual probability of out-of-bank flows between 20 percent and 100 percent. This is consistent with landowner interviews. As in the upper portion of the watershed, these frequent floods return to within bank in a short period of time, thus causing little damage to crops in the flood plain.

For the Middle Tarkio Creek, out-of-bank flooding occurs on an annual basis 10 percent of the time, statistically, in the upper one-third of the tributaries watershed. The central portion of the tributary has greater capacity and therefore has a four percent chance in any year of out-of-bank flows. Approximately two miles upstream of the confluence with the West Tarkio Creek, the Middle Tarkio Creek has less capacity, with an annual chance of out-of-bank flooding of 25 percent, statistically.

Flooding in Tarkio, Missouri

The City of Tarkio, Missouri has several buildings within the flood plain of the West Tarkio Creek. Many of the buildings are used for storage. After the flood of 1993, most of the residences were removed from the 100-year flood plain. One residence remains in the flood plain, but does not get flooded from the statistical 100-year (one percent) flood. Not every structure was mapped for this study. Some structures which are small and not obviously being used, were left out of the study, as their presence was not thought to raise the water surfaces studied. The buildings large enough to affect the water surfaces were mapped, including several storage buildings, the lumber yard and its storage buildings, an old depot, some barns, sheds, silos, grain elevators, and a repair shop. Flooding of all these structures does not begin until the statistical 25-year (four percent) flood, where a total of five structures flood. The 50-year event (two percent) floods 10 structures, and the 100-year event (one percent) floods 15 structures.

Water Supply

The future municipal water supply demand for the project was determined with input from the project sponsors. The monthly municipal water supply demand with additional volume for fish, wildlife, and recreation, were inputs to a computer program called Technical Release 19, Reservoir Operation. TR-19 is a water balance program which uses rainfall and runoff as "pluses" to the equation, and seepage, evaporation, and water supply demand as "minus" to the equation. Each site alternative was evaluated for its suitability to supply the needed water during two periods of drought in Iowa. These two periods, 1950-1959 and 1966-1990, had available data for input to TR-19.

Breach Analysis

A breach analysis was conducted on the site in Alternative 6 using the National Weather Service's BREACH program. The BREACH program is a physically based model which predicts the breach characteristics (size, time of formation) of the discharge hydrograph resulting from a breached earthen dam. A piping failure was modeled as it is more common statistically than an overtopping failure. The breach outflow determined from BREACH was then input into TR-20 for flood routing downstream. The results of the breach analysis show that Iowa Highway 2 would overtop in the unlikely event of a breach, thereby raising the hazard classification of this structure to high hazard.

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Engineering Design and Cost Estimates

Aerial photographs and USGS topographic maps were studied to select potential multipurpose dam sites and the single-purpose sediment basin sites. Other information and criteria used in selection of sites included drainage area to pool area ratio, land treatment, highways, and major utilities.

Four potential multipurpose dam sites were identified in the West Tarkio Creek Watershed project area. Field investigations of these sites were made with members of the interdisciplinary team to evaluate the physical conditions, abutment conditions, habitat, cultural resource considerations, and land cover complexes. The interdisciplinary team consisted of a biologist, geologist, resource conservationists, hydrologist, representatives from the Iowa Department of Natural Resources, and the U.S. Fish and Wildlife Service. This group traveled to the field to evaluate each of the selected study sites.

Formulation of the multiple-purpose dam at Site 3 included water supply and recreation for the City of Clarinda, the City of Shenandoah, and Page County.

Planning design for the dam at Site 3 is based on aerial survey provided by Howard R. Green Company and the USGS DEM (digital elevation model). The aerial survey was flown in March 2001 at 10,000 feet with a photography scale of 1:20,000 (Mark Duben, P.E., Howard R. Green Company). The estimated accuracy of the contours that could be developed from this survey is five feet. While the aerial survey covered much of the reservoir area, coverage did not extend far enough upstream to fully develop storage data from this survey for Site 3. For this reason the aerial survey was used to refine the earthwork quantities of the site design as well as the auxiliary spillway layout.

The USGS DEM was used to develop the storage data for the Reservoir Operation program, Technical Release 19, and the Water Resource Site Analysis software (SITES) which performed the flood routings at Site 3. The points of the USGS DEM are at a spacing of 30 meters and were used to develop 10 foot contours.

The principal spillway selected in the preliminary flood routings consisted of a D x 3D baffle riser and a 72" circular pipe barrel. The auxiliary spillway was set at the minimum elevation as determined by the principal spillway hydrograph (PSH) with a 400 foot bottom width and 3:1 side slopes. Geologic data was not available and this was a preliminary routing so an integrity analysis was not done at this time.

As the process of analyzing the structure cost at Site 3 was refined from the Preliminary Engineering Report written by Howard R. Green (September 2001) the flood routings were revisited to determine if it would be of value to do an integrity analysis even if the soil profile had to be approximated. Site specific geology could not yet be obtained because landrights had not been acquired at this time.

Given the size of the peak flows from the stability design hydrograph (SDH) and freeboard hydrograph (FBH) it appeared that the configuration of the principal spillway, auxiliary spillway crest and size, and dam height as established in the Howard R. Green report might be inadequate.

Therefore the soil survey and general knowledge of the area formed the basis for constructing the soil profile. The geologist provided estimated material parameters for SITES input. The principal spillway hydrograph (PSH) set the minimum auxiliary spillway crest at elevation 1093.97. The stability and freeboard storms were initially routed with the auxiliary spillway crest at 1094.0 and the level section breached with passage of the FBH.

The auxiliary spillway crest was raised and the size increased incrementally until a stable auxiliary spillway configuration was achieved. During the process of refining the auxiliary spillway layout it also became necessary to increase the principal spillway size from a 72" circular barrel to a 6.5' x 6.5' box conduit to reduce the flow handled by the auxiliary spillway.

Auxiliary spillway integrity was not the only factor in determining the final configuration used in the cost estimate. Achieving a reasonable balance between excavation and earthfill was an objective because a large imbalance could lead to a significant and unnecessary increase in cost. Shrinkage then was another factor that affected the dam and spillway configuration. Shrinkage of the material in the auxiliary spillway was assumed to be about 35 percent. In order to maintain a reasonable earthwork balance further adjustments were made to the auxiliary spillway crest and size. These iterations resulted in an auxiliary spillway crest that was raised about six feet to elevation 1100.0 and the bottom width was increased to 640 feet. The dam had to be moved a short distance upstream as well so that the auxiliary spillway outflow would not get directed at the toe of the dam. Part of the effect of these changes was that the maximum elevation from routing the SDH was 1096.38, or 3.68 feet below the design auxiliary spillway crest. Therefore there is no flow through the auxiliary spillway from the SDH.

The earthwork quantities were estimated using digital terrain surface modeling from the aerial survey. Basic assumptions about the embankment layout include 3:1 front and back slopes, a 30 foot sloping front berm, a single sloping back berm with an equivalent horizontal width of 40 feet, and a top width of 22 feet. The typical stream channel cleanout cross section had a bottom width of about 24 feet, average depth below channel bottom of five feet, and 2:1 side slopes. The typical core trench cross section had a 12 foot bottom width, five foot depth, and 1.5:1 side slopes.

Surface models for these work items, as well as the auxiliary spillway channel, were developed to make improved estimates of quantities. An attempt to refine these quantities further by working out minor details closer to a design level was not made at this stage.

Quantities of materials associated with the reinforced concrete spillway were approximated using preliminary hydraulics and similar spillway designs.

Because of time constraints, the extent of the cost analysis for most of the water supply components was limited to updating costs listed in the Howard R. Green report using a construction cost index. The raw water transmission line cost was estimated using a recommended unit price from SIRWA (Southern Iowa Rural Water Association). The estimated quantity was based on an arbitrary placement of the intake structure upstream of the dam and the assumption that the lines will generally follow county and state right-of-way.

The estimated quantity of the perimeter fencing was based on the assumption that new fencing would be installed along the entire landrights boundary. This should be a conservative estimate since much of the boundary will fall on existing property line fences.

Seventy-nine potential sediment basin sites were identified using the aerial photographs and USGS topographic maps. A field investigation of 28 sites was conducted by a hydrologist, planning engineer, and resource conservationist. This group of sites was selected as representative of the range of drainage areas, channel conditions, sediment loading, and site topography that would occur in all the potential sediment basin sites.

The 39 upland sediment basins will be designed in accordance with the Sediment Basin Standard (350) and shall meet or exceed the criteria in the Pond Standard (378) or Technical Release 60, whichever applies. Most of the site routings will be completed using HydroYardage, a small structure flood routing program designed for structures meeting 378 criteria.

Cost estimates for these structures were based on 13 sites sampled from the original 79 sites. Individual site designs were completed for the sample sites using the USGS DEM and HydroYardage. An itemized cost estimate was then completed for the thirteen sample sites which were chosen to represent three different drainage area ranges, 20-80 acres, 80-250 acres, and over 250 acres. Cost curves were then plotted from the itemized cost estimates in an Excel spreadsheet with drainage area as the independent variable and cost the dependent variable. The spreadsheet was used to generate a second order polynomial best fit equation for each of these three lines. The final step was to compute estimated costs by applying one of the three derived equations that fit each of the 39 sites based on drainage area.

Important assumptions made in the site design include a 100 year sediment design life, polymer coated pipe with cathodic protection, 3:1 slopes on the embankments, and vertical intakes for drawdown capability for small sites and improved hydraulics for larger sites.

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Erosion Calculation Methodology

Sheet and Rill Erosion

Sixty-eight randomly selected quarter section sampling units representing 10.1 percent of the watershed were used for this study. Color infrared photos flown in April 2002 for Page and Montgomery Counties and April 2003 for Atchison County were used in ArcView to determine land use boundaries, locate conservation practices, and serve as a base map.

Studies of sheet and rill erosion were completed using RUSLE2. RUSLE2 version 1.15.4.0 (February 11, 2004) requires inputs of; location, climate, soils, crops grown, tillage systems used, length and steepness of slope, and conservation practices. The management and conservation practices, typical slope length and steepness, and default crop yields were obtained from NRCS field office staff in Montgomery and Page counties in Iowa and Atchison County in Missouri. Predominant soil types were selected from the digital soil survey maps. RUSLE2 soil loss was determined for each field in the sample units using all the above information.

ArcView version 3.3 was used to develop the quarter section sampling grid, locate and measure field acres, determine predominant soil types for soil loss calculations, and for storing RUSLE2 results.

An ArcView attributes table was developed for the sample units and used to develop Table D.

Table D. Summary of Erosion and Sediment Yield, West Tarkio Watershed.

Erosion Type & Source	*Area* (ac)	*Length* (mi)	*Erosion Rate* (t/ac/yr)	(t/mi/yr)	*Soil Loss* (t/yr)	*SDR* (percent)	*Sediment Yield* (t/yr)	*Percent of Total*
Sheet & Rill Erosion	*105,290*		*3.2* [1]		336,358	*20*	*67,272*	*65.8*
Pasture	5,841		0.9		5,257			
Grassland	958		0.3		287			
Forest land & Corridors	6,458		0.5		3,229			
CRP	2,855		0.1		286			
Farmsteads	2,297		0.2		460			
Non-terraced Cropland	42,096		4.3		181,013			
Terraced Cropland	41,262		3.5		144,417			
Other	3,523		0.4		1409			
Channel Erosion		*160*	*0.21* [1]	*142*	*22,684*	*85*	*19,281*	*18.8*
Classic Gully Erosion			*0.06* [1]		*5,841*	*85*	*4,965*	*4.9*
Ephemeral Cropland Gully Erosion			*0.16* [2]		*16,557*	*65*	*10,762*	*10.5*
TOTAL	**105,290**		**3.62**		**381,440**		**102,280**[3]	**100**

[1] Soil loss averaged out over the entire watershed.
[2] Soil loss averaged out over the entire watershed. The rate on unterraced cropland is 0.38 t/ac/yr.
[3] Sediment yield is to the Tarkio River at Tarkio MO.

Acreage Determination:

The following Land Use Summary Table represents the land use that was taken from digitized land use layers in ArcView. The land use acres have been rounded to the nearest acre and the totals rounded to the nearest ten acres. This table was used to determine acres in Table C "Land Use in the West Tarkio Drainage Area" and Table D "Summary of Erosion and Sediment Yield, West Tarkio Watershed"

Land Use Summary Table

LAND USE	Page Co.	Mont. Co.	Frem. Co.	Iowa	Atch. Co.	Watershed
CRP	1,911	33	112	2,056	799	2855
filter strip	592	51	0	643	10	653
alfalfa	1,062	376	187	1,625	413	2,038
bike trail	79	0	0	79	0	79
cemetery	5	0	0	5	7	12
cropland	38,634	12,465	1,385	52,484	25,832	78,316
cropland (grass)	1,933	125	47	2,105	899	3,004
ditch corridor	1,342	116	79	1,537	1,534	3,071
farmstead/acreage	1,281	425	80	1,786	511	2,297
grass/trees	397	26	0	423	192	615
grassland	819	57	20	896	49	945
pastureland	3,089	418	323	3,830	2,011	5,841
pond	44	5	2	51	63	114
road/railroad	1,383	546	85	2,014	782	2,796
stream corridor	866	189	0	1,055	411	1,466
urban	47	0	0	47	392	439
woodland	146	5	0	151	502	653
grassed waterway	0	3	0	3	10	13
golf course	0	0	0	0	83	83
TOTAL	53,630	14,840	2,320	70,790	34,500	105,290

The land use categories in Table C include Cropland, Grassland, Forest Land, and Other. The following shows how acres were taken from the Land Use Summary Table above and combined into the categories.

Cropland Acres

Land Use	Iowa	Missouri	Total
Cropland	52,484	25,832	78,316
Cropland (grass)	2,105	899	3,004
Alfalfa	1,625	413	2.038
Total	56,214	27,144	83,358

Grassland Acres

Land Use	Iowa	Missouri	Total
Grassland	896	49	945
CRP	2,056	799	2,855
Pastureland	3,830	2,011	5,841
Grassed Waterway	3	10	13
Filter Strip	643	10	653
Total	7,428	2,879	10,307

Forest Land Acres

Land Use	Iowa	Missouri	Total
Ditch corridor	1,537	1,534	3,071
Stream corridor	1,055	411	1,466
Forest Land	151	502	653
Grass/trees	423	192	615
Total	3,166	2,639	5,805

Other Acres

Land Use	Iowa	Missouri	Total
Farmstead/acreage	1,786	511	2,297
Road/railroad	2,014	782	2,796
Urban	47	392	439
Golf Course	0	83	83
Pond	51	63	114
Bike Trail	79	0	79
Cemetery	5	7	12
Total	3,982	1,838	5,820

Table D

The acres for Table D were determined by combining land use categories from the Land Use Summary Table in the following way:

Terraced cropland and non-terraced cropland

The watershed cropland, cropland (grass), and alfalfa acres were added together to get cropland acres (83,358). Cropland acres were multiplied by 49.5 percent to get the terraced cropland acres (41,262.2). Terraced acres were rounded to the nearest acre and subtracted from the total cropland acres to get non-terraced cropland acres (42,096). The percentage of cropland terraced was determined from the quarter section sample unit study.

Pastureland, Farmstead/acreage, CRP

The watershed acres were taken directly from the table above.

Grassland

The watershed acres for grassland and grassed waterways were added together.

Forest land & corridors

The watershed acres for ditch corridor, stream corridor, woodland, grass/trees, and filter strips were added together.

Other

The watershed acres for roads/railroads, urban, golf course, pond, bike trail, and cemetery were added together.

Erosion Calculation for Sediment Control Basins

Since RUSLE2 input values and resulting soil loss were not known for each field in the basin drainage areas, the following method was used to determine soil loss for the drainage areas of the planned sediment control basins.

Land use of the entire watershed was digitized in ArcView using the color infrared (CIR) photos and 2002 digital land cover data from IDNR. Terraced areas in the drainage area upstream from Highway 2 were also digitized based on the terrace information that was provided by the NRCS field offices. This was the only area of the watershed where the terraced areas were delineated because of the locations of Sites 1, 2, and 3.

Land use and terraced areas were delineated using the basin drainage areas. Soil types were also delineated from the digital soil survey using the basin drainage areas. Soils and land use and conservation practices were intersected together resulting in a table where soil map units could be sorted out by land use and conservation practice.

A weighted soil loss for each soil map unit was determined using the land use, management and conservation practice, found in the quarter section sample units located in the watershed upstream of Highway 2.

The weighted soil loss was then assigned to each corresponding soil map unit in the basin drainage areas by conservation practice and land use. Soil map units that were found in the basin drainage areas but not in the sample units were assigned a soil loss using soils map units that had similar erodibility factors and crop yields. Soil loss was then summarized for each basin by conservation practice and land use. Thirty-nine basins are proposed for Alternative 6.

Ephemeral Gullies

Ephemeral gullies were identified on non-terraced cropland areas on the sample quarter sections. Gullies were delineated as lines on the 2002 CIR in ArcView. The predominant soil for each gully was entered into the attribute table. The top width of the gully was selected as four feet and the bottom width was estimated as one foot and the depth was estimated to be 0.3 ft. The bulk density of the predominant soil for each gully was entered. Bulk density ranged from 81.1-96.7 lbs per cubic foot and averaged 85.1 lbs per cubic foot. Ephemeral erosion was estimated at an annual rate.

The following formula from Section I of the Iowa Field Office Technical Guide was used:

$$\frac{(A+B) \times C \times D \times E}{2 \times 2000 \times H}$$

Where A = top width
B = bottom width
C = depth
D = length
E = soil unit weight (bulk density)
H = number of years (used 1 for annual rate)

Average width and depth were determined on field visits to five percent of the quarter section in November 2003.

Prime Farmland Determination Methods

The land use data was developed for the drainage area upstream of Highway 2 and the digital soils data were delineated using the acquisition area boundaries for Alternatives 4 and 6. Land use did not include farmsteads, roads, railroads, built-up or urban areas, or water areas. Soils were determined to be drained and protected from flooding. Land use and soils tables were then intersected and prime farmland soils were sorted by land use categories, cropland, grassland, and woodland. Prime Farmland was also determined for the pool areas, top of dam areas, toe of dam, and auxiliary spillway.

West Tarkio Flood Plain Land Use

The following table shows land use in the flood plain along the main channel of West Tarkio Creek

Table 1

Land Use	Montgomery	Page	Atchison	**Total**
Cropland	600.6	3160.5	2582.8	6343.9
Grass/trees[1]	122.1	794.5	347.3	1263.9
Grassland[2]	36.0	207.0	12.1	255.1
Pastureland	117.4	161.0	5.1	283.5
Other[3]	21.2	105.5	72.9	199.6
Forest land	0.0	22.4	33.9	56.3
Total	897.3	4450.9	3054.1	8402.3

The following table shows the land use in the flood plain along the main channel of West Tarkio Creek that will be covered by the permanent pools.

Table 2

Land Use	Alternative 4 Site 2	Alternative 6 Site 3
Cropland	604.4	725.6
Grass/trees[1]	146.4	184.5
Grassland[2]	14.4	74.5
Pastureland	55.5	0.0
Other[3]	11.4	18.5
Forest land	1.9	4.1
Total	834.0	1007.2

[1] Includes stream and ditch corridors (including stream channel) and odd areas
[2] Includes CRP, and filter strips
[3] Includes farmstead, roads, railroads, bike paths, ponds, and urban areas

Methodology

The flood plain data was created by selecting the flood plain soil map units in Montgomery, Page and Atchison counties that are within the West Tarkio Creek Watershed boundary. This soil data was edited to include only the soils along the main channel of West Tarkio Creek. The flood plain soil map units for each county were joined together to form one flood plain area for each county. These flood plains were then overlain on a USGS topographic map. The USGS map

was used to adjust the boundaries of the flood plain areas so that the boundary of each of the areas fell between the channel and the next higher contour interval (10 feet). These flood plain areas were then used to delineate land use from the land use layers. The results of this operation are shown in Table 1, above. The permanent pool areas for Alternative 6 and Alternative 4 were used to delineate land use (Table 2 above).

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Geology

Streambank Erosion

Streambank erosion of second, third, fourth and fifth-order stream reaches was estimated using the "direct volume" method, developed by the Soil Conservation Service (1983). Lowest order streams are the minor tributaries and highest order streams are the main trunk reaches. They were delineated on topographic maps according to the method of Horton (1945). A total of 14.5 stream miles were assessed on foot, representing nine percent of the total stream miles in the West Tarkio Watershed. Included were 6.1 miles (eight percent) of second-order, 4.1 miles (17 percent) of third-order, 1.8 miles (nine percent) of fourth-order, and 2.5 miles (six percent) of fifth-order channels.

The "direct volume" method is a field procedure based on the following equation:

$$\text{Erosion (t/mi/yr)} = \frac{\text{eroding area (ft}^2\text{/mi) x lateral recession rate (ft/yr) x density (lb/ft}^3\text{)}}{\text{2000 lb/ton}}$$

The eroding area of both banks was derived by multiplying eroding bank height by length of eroding bank. The annual lateral recession rate--i.e., the thickness of soil or geologic material eroded from a bank surface in an average year--was determined by observing such features as bare banks, vegetative overhang, associated rills and gullies, exposed tree roots, slumps and slips, fallen trees, and washouts. The average erosion rate obtained for each stream order was multiplied by the total number of stream miles for that stream order to obtain the total soil loss from streambank erosion in tons per year.

Classic Gully Erosion

The team also used the direct volume method to assess classic gullies in the watershed, i.e., deep cuts radiating off channels that are formed by the headcutting action of concentrated flow of runoff water. In this case, however, the "eroding area" factor in the equation was derived by multiplying the average gully depth by the length of the eroding gully arc extending downstream from the headcut.

Sediment Delivery

The sediment yield of a watershed represents only a fraction of the soil eroded within the watershed upstream of the point of measurement. The average annual sediment yield, divided by the estimated average annual soil loss due to erosion, is the watershed's overall sediment delivery ratio (SDR).

Sediment delivery ratios vary from one watershed to another, depending on the particle size distribution of the soils; the size, shape and topography of the basin (small, narrow, or steep watersheds have relatively higher SDR's); channel density; the extent of temporary storage in channels and on flood plains; deposition in wetlands and water bodies, etc. SDR's also vary depending upon the erosion source, i.e., sheet and rill, channel, and gully erosion. They are generally highest for channel erosion. SDR's were estimated by the NRCS Geologist on the basis of the "Erosion and Sediment Delivery Procedure" found in Section I of the Iowa Field Office Technical Guide, and on five years of experience assessing sediment delivery in Iowa

watersheds. The Iowa FOTG procedure was developed in the late 1990's. It is a modification of a standard method long used by NRCS to evaluate SDR's. The modified version incorporates Iowa soil properties along with the standard composite drainage area curve produced by Roehl (1962) from numerous published reports relating SDR's to drainage area for various regions in the United States.

Erosion in West Tarkio Watershed

Table D is a summary of erosion and sediment yield in the watershed. Gross erosion in the watershed from all sources, including sheet and rill, channel, gully and ephemeral gully erosion, is on the order of 380,000 tons per year, or an average annual rate of 3.6 tons per acre. As discussed later under "Sediment Delivery," less than 100,000 tons of this eroded soil finds its way to the Tarkio River.

Sheet and Rill Erosion

Nearly 80 percent of the watershed is in cropland. Approximately 95 percent of the cropland is cropped to continuous row crop mainly corn and soybeans. Almost 50 percent of the cropland has been terraced; another 24 percent is being farmed on the contour. These conservation practices combined with conservation tillage and no-till results in an average sheet and rill erosion rate of four ton/acre/year. When cropland is combined with other land uses in the watershed the sheet and rill erosion rate drops to 3.2 ton /acre /year. Sheet and rill erosion accounts for about 340,000 tons of soil loss per year, or nearly 90 percent of the total soil loss in the watershed.

Ephemeral Gully Erosion

Soil loss from this erosion source is relatively low compared to many agricultural watersheds in Iowa. Ephemeral gullies account for approximately 16,500 tons of soil loss per year, or about four percent of the total soil loss in the West Tarkio watershed. Most of this occurs on unterraced cropland, where the average annual rate is about 0.4 tons per acre.

Stream bank Erosion

The average annual stream bank erosion rate in the West Tarkio watershed is estimated to be 142 tons/mile. The annual soil loss from stream bank erosion is about 23,000 tons, which is roughly six percent of the total soil loss from all erosion sources in the watershed. Averaged out over the entire watershed, it amounts to an annual rate of 0.2 tons per acre.

As in most Iowa watersheds, the rate of soil loss from stream bank erosion in the West Tarkio watershed increases as channel order increases. Rates are highest in the fifth-order reaches, at 300 tons per mile per year, and lowest in second-order reaches, at 60 tons per mile per year. This is largely due to the greater bank heights of the larger channels. In addition, bank recession rates are also generally greater on the higher order channels. Of the second-order channels that were assessed, 13 percent are receding at a moderate or severe rate, i.e., 0.06 – 0.5 ft/yr. This increases to 21 percent of third-order channels, 34 percent of fourth-order channels, and 43 percent of fifth-order channels. (Recession rates of 0.01-0.05 ft/yr are considered slight; 0.06-0.2 ft/yr is moderate; 0.3-0.5 ft/yr is severe; and >0.5 ft/yr is very severe.)

When examined more closely, the data indicate a significant difference in channel erosion rates between the portion of the watershed above County Road J-52 ("Coin Road") and the portion below J-52. On the main stem (fifth-order) channel, 64 percent of the sampled reaches above this line are undergoing moderate or severe bank recession, but only 16 percent of the sampled reaches below the line are experiencing these rates. The average annual rate of soil loss from the main channel above the dividing line is about 470 tons per mile, compared to only 100 tons per mile below. Much of the reason for this pronounced difference in soil loss is the fact that below J-52 a significant portion of the total bank surface has typically healed over and was therefore not included in the direct-volume calculation. (For example, a 25-ft bank with only the upper 8 feet in an eroding condition was recorded as an 8-ft tall bank.)

Second- and third-order channels in the West Tarkio watershed exhibit the opposite trend, although the differences above and below J-52 are not as pronounced. On second-order reaches, the average annual soil loss rate is 35 tons per mile above and 81 tons per mile below J-52. On third-order reaches, the rates are 66 tons per mile above and 176 tons per mile below this line. Fourth-order reaches, which occur mainly on the trunk stream of the Middle Tarkio tributary, do not exhibit a clear difference above and below the dividing line.

This pattern of different erosion rates in the upper and lower parts of the watershed is discussed under "Recent Evolution of the West Tarkio Drainage System."

Classic Gully Erosion

The annual soil loss from classic gully erosion is about 6,000 tons, which is less than 2 percent of the total soil loss from all erosion sources in the watershed. Averaged out over the entire watershed, this amounts to an annual rate of less than 0.1 ton per acre.

Classic gullies advance headward from channel walls where flowing water concentrates. They generally indicate high runoff rates on adjacent lands, and are most common where cattle graze right up to banks or where an effective riparian buffer is absent. In the West Tarkio watershed, significant gullying is present in two places. One is on the main stem channel in Page County above County Road J-52, where an average of 160 tons of soil is lost to gullying every year along each mile of the West Tarkio Creek. The other location is on the Middle Tarkio (a fourth-order channel) below J-52, also in Page County, where soil loss due to classic gullies amounts to 300 tons per year for each mile of stream. Classic gully erosion appears to be relatively minor elsewhere in the watershed.

Sediment Delivery in West Tarkio Watershed

For the watershed as a whole, a sediment delivery ratio (SDR) of 20 percent was determined for the sheet and rill portion of the total soil loss. It was estimated that 85 percent of the soil from streambank and classic gully erosion and 65 percent of the soil from ephemeral gully erosion is delivered downstream. This amounts to roughly 102,000 tons of sediment per year. Based on the grain-size distribution of the soils in the watershed and on estimated SDR's for fines (clay plus silt), sand, and gravel, the delivered sediment consists of roughly 95 percent fines and 5 percent sand. Gravel makes up less than 0.5 percent of the sediment.

A discussion of sediment delivery from the watershed must consider both the sediment that drops out in the downstream reaches of West Tarkio Creek and the sediment that reaches the main Tarkio River.

In-Stream Sedimentation in West Tarkio Creek

Most of the in-channel sedimentation occurs in the lower reaches of the West Tarkio main-stem channel in the zone of aggradation, which now extends upstream from Missouri into Iowa. Based on several 2003 channel cross-section surveys, a net amount of approximately 1.7 million cubic feet of sediment has accumulated since 1976 in the zone of aggradation between the Iowa-Missouri state line and County Road J-52 in southern Page County. Sediment samples collected there in 2004 show that, on average, these deposits consist of 5 percent gravel, 70 percent sand, 15 percent silt, and 10 percent clay, with an average unit weight of 115 pcf. In-channel sedimentation in Page County therefore amounts to about 3,700 tons per year, or less than 4 percent of the sediment derived from the watershed annually. Some aggradation is still occurring on the main-stem channel in Missouri as well, but this amount could not be quantified because we do not know the baseline elevation of the streambed at the time degradation ceased and aggradation began sometime during the past 25 years. If we assume in-channel deposition in Atchison County at a rate similar to that in Page County, we can safely assume that at least 90,000 tons of sediment per year remain entrained in the fluvial system and are delivered downstream to the main Tarkio River.

Sediment Delivery Downstream to the Tarkio River

In addition to sediment delivered to the Tarkio River annually from the four erosion sources discussed above—sheet and rill, ephemeral gully, classic gully and *streambank*—an attempt was made to quantify the amount of sediment that entered the Tarkio River in the recent past as a result of channel incision, or erosion of the West Tarkio *streambed*. Between 1976 and 2003, 24 miles of the streambed in Page County incised an average of 13 feet over an average width of 20 feet, yielding about 50,000 tons of soil per year. This raises the total amount of sediment that reached the Tarkio River to at least 140,000 tons per year between 1976 and 2003. Based on the watershed soils, this material consisted of approximately 3 percent fine sand, 56 percent silt, and 41 percent clay. Much of it undoubtedly made its way downstream to the Missouri River and the Gulf of Mexico.

Current rates of downcutting have not been determined and no attempt was made to quantify the amount of sediment currently being derived from incision of the channel bed.

Relative Contributions of Sediment Sources

As shown in **Table D**, sheet and rill erosion and ephemeral gully erosion combined are responsible for 76 percent of the total sediment delivered from the watershed annually (not including streambed erosion). Streambank erosion accounts for about 19 percent and classic gully erosion contributes 5 percent. At least 45 percent of the sediment, nearly 47,000 tons, originates on unterraced cropland. This latter conclusion is based on the average SDR estimate of 20 percent for sheet and rill erosion used for the watershed as a whole.

Recent Evolution of the West Tarkio Drainage System

Introduction

The erosion and sedimentation data presented above can be better understood in the context of a channel evolution model (CEM), which describes the adjustments a channel experiences—both spatially and temporally—as it responds to changes. Through these adjustments, the channel attempts to re-establish equilibrium among the variables of shape, velocity, discharge, sediment and slope. A CEM can also help predict future upstream or downstream changes in stream morphology. Schumm et al.'s (1984) five-stage model and the six-stage model of Simon (1989) are both widely accepted for channels with cohesive banks (Natural Resources Conservation Service, 1998). Simon's model was used because it had been used in previous work in the watershed sponsored by the Iowa Department of Transportation, which is described later in this report.

The differences between bank recession rates on West Tarkio Creek and its tributaries above and below County Road J-52 are a direct consequence of the evolutionary development of the drainage system, particularly over the past century. During this time, the river has responded to natural conditions and events, and to dramatic human-induced changes in its dimensions, flow regime, and watershed.

Historical Background

Between 1917 and 1923, the main stem channel between West Tarkio, Missouri and Highway 2 in Page County, Iowa was straightened and modified to an average depth of 10 feet. Average channel dimensions increased steadily over the next half century, and in 1976 the width of the main stem channel was measured at 110 feet at three locations in Atchison County. It appears that West Tarkio Creek underwent degradation similar to that of nearby Little Tarkio Creek, which had also been channelized. Piest et al. (1977) documented an average two- to fourfold increase in width and depth during this same time period for Little Tarkio Creek.

On the basis of a 1963 field survey, Yetter (Soil Conservation Service, unpublished) calculated annual soil loss from just channel erosion on the main stem of West Tarkio Creek to be on the order of 131,000 tons between 1939 and 1963, which averages out to roughly 3,000 tons per mile. (For comparison, in the present study rates on the worst reaches of the river were found to be approximately 1,500 tons per mile.)

Piest et al. (1977) compiled a streambed profile (blue line on) of West Tarkio Creek from existing records, which showed that the West Tarkio channel was still actively incising some 50 years after it was straightened. The worst degradation was occurring in the 9-mile stretch north of the Missouri-Iowa state boundary in Page County, where more than seven feet of downcutting had already occurred between 1921 and 1976 (Piest et al., 1976). In 1976, the channel gradient in this reach was approximately 0.001, nearly twice the gradient it had in stable reaches just above its confluence with the Tarkio River. This relatively steep slope contributed to continuing channel incisement.

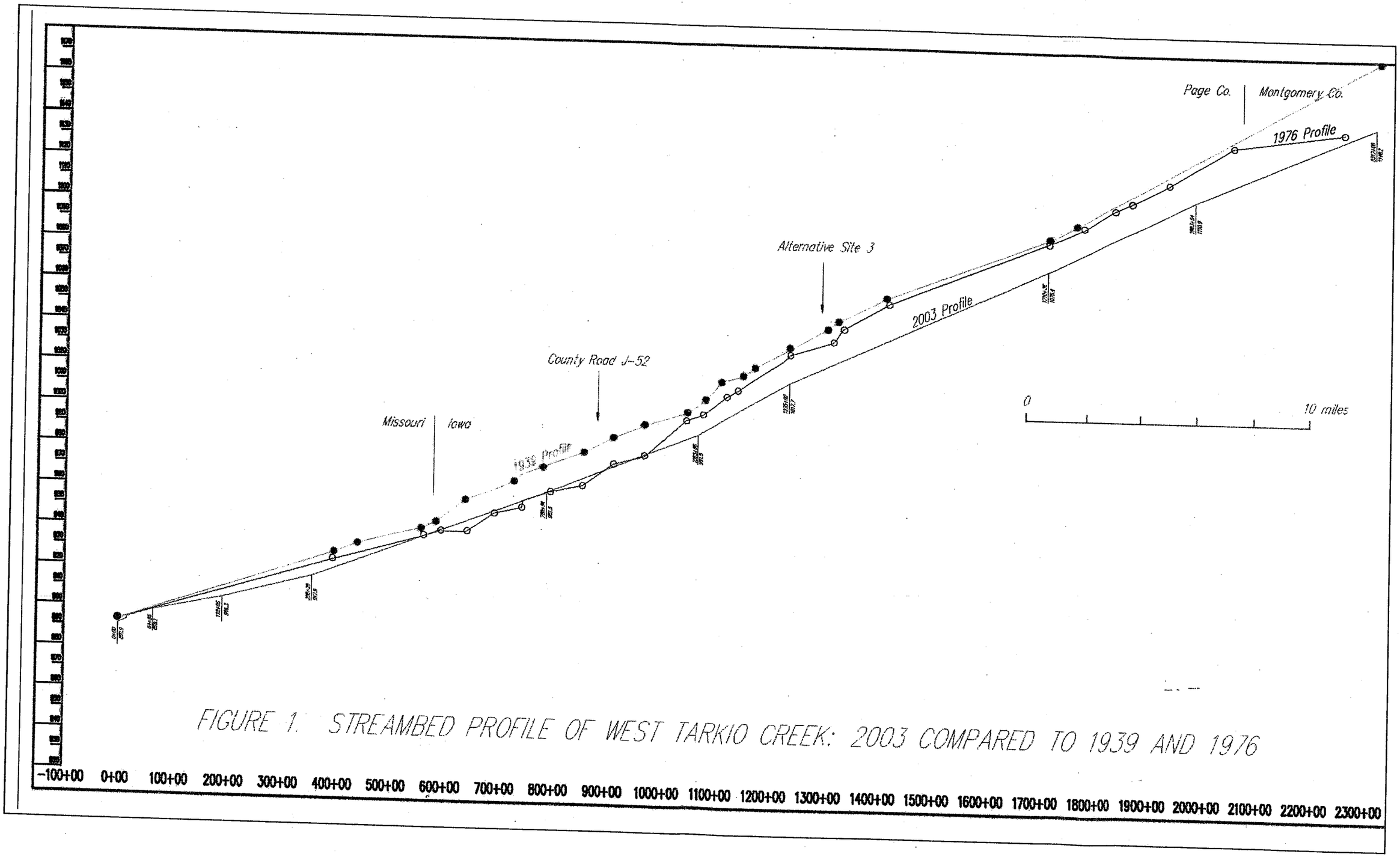

FIGURE 1. STREAMBED PROFILE OF WEST TARKIO CREEK: 2003 COMPARED TO 1939 AND 1976

The 1976 data and descriptions of West Tarkio Creek indicate that aggradation (Simon's Stage V) was limited at the time to the larger Tarkio River just below the confluence. The channel bed of the West Tarkio was relatively stable for a few miles upstream of the confluence. Beginning a few miles below the state boundary and continuing headward almost to the Page-Montgomery county line, the channel was degrading. The data suggest that the channel was undergoing widening as well as continued downcutting (Stage IV) in southern Page County, but in the northern half of the county erosion was primarily in the form of downcutting (Stage III).

Main Stem Conditions in 1993-94

In the summer of 1993, West Tarkio Creek experienced historic flows. In 1993 and 1994, the Iowa Department of Transportation sponsored a low altitude, continuous aerial reconnaissance of several western Iowa streams, including the main channel of West Tarkio Creek in Montgomery and Page Counties, which was conducted by the Hungry Canyons Alliance. The helicopter video footage shows nearly continuous raw steep banks along both sides of the main channel in Page County. As described in "Stream Stabilization in Western Iowa" (NRCS, 1994), all but about three miles of channel in Page County were classified as Stage IV in Simon's channel evolution model, i.e., actively widening. In Montgomery County, the main channel was classified as Stage III, with the major erosion process being downcutting. Several low nickpoints or riffles indicating downcutting were visible on the channel bed in both counties in the video footage. Aggradation did not extend up into Page County, but probably was present in much of Atchison County, which was not flown.

In the mid-1990's, at least 13 in-stream grade-control structures were installed in West Tarkio Creek in Page County, sponsored by the Emergency Watershed Program and the Hungry Canyons Alliance. A total of 38 feet of elevation was removed from the channel grade of the main stem by these structures.

Main Stem Conditions in 2002-03

In 2002, the Hungry Canyons Alliance again flew an aerial reconnaissance of West Tarkio Creek and other streams in western Iowa. In 2003, NRCS conducted the streambank erosion assessment and the channel cross-section surveys described in the Hydrology section of this report. Together, these three sources of information give a fairly clear picture of channel conditions and the evolution of the drainage system to the present time.

The 2003 survey data suggest that the width of the main stem channel in Missouri has not changed significantly since 1976. Channel cross-sections taken in 2003 in Atchison County at Survey Stations 192 and 357 both indicate a top channel width of 110 feet , which is identical to the 1976 measurements taken within a few hundred feet of these points. Historical measurements are not available for the channel width in Page County. However, evidence for continued downcutting in 1976 and active bank recession in 1993-94 (see above), as well as anecdotal evidence from local land users, supports the conclusion that the West Tarkio has widened dramatically in Page County since 1976. An undetermined but significant amount of bank recession occurred in the mid-nineties in response to the channel incision caused by flood flows in 1993. Today the channel has widened to 150 feet in places in southern Page County. It narrows to a width of about 40 feet in the northern part of Page county and into Montgomery County.

A comparison of bed elevations from Piest et al. (1977) with a streambed profile constructed from the 2003 survey elevations indicates that most of the West Tarkio channel bed in Missouri is now 1-5 feet lower in elevation than in 1976. Because the river is aggrading farther upstream in southern Page County, it is probable that this drop in bed elevation actually reflects two phases—early downcutting, followed by aggradation in the past several years.

The zone of *aggradation*—Simon's Stage V—now extends upstream approximately 17 miles above the West Tarkio Creek-Tarkio River confluence. It appears from the projected 2003 streambed profile that the channel has aggraded as much as 4-5 feet since 1976 between the state boundary and C.R. J-52 (about 6 miles north of the state boundary).

The channel *degradation* stage has also moved upstream. Nine miles north of the state line (Station 1065), the streambed has downcut nine feet since 1976. At two Page County survey locations—12.4 miles (Station 1235) and 21.4 miles (Station 1710) north of the state line—at least 13 feet of downcutting have occurred since 1976. Channel widening by bank erosion has been the natural consequence of the channel incision. Currently, accelerated bank erosion (Stage IV) starts just north of C.R. J-52, as documented by the erosion assessment. In the northern three-quarters of Page County, channel degradation at present appears to consist mainly of bank erosion processes, but some minor downcutting may be continuing as well. The 2003 streambed profile indicates a slope of 0.0016 on a 3-mile stretch of the main-stem channel between Stations 1063 and 1235. This is 2-3 times greater than the stream gradient in Atchison County and 1.6 times greater than the slope in southern Page County. It suggests the likelihood of continued downcutting in far northern Page County as well as in Montgomery County. The 2004 video footage shows that downcutting already extends roughly 4-5 miles north of the Page-Montgomery county line.

Discussion

The West Tarkio drainage system is a good illustration of the spatial and temporal progression of stages in a channel evolution model. The available data presented above clearly indicate a headward progression of the evolutionary stages of Simon's (1989) model. Since 1975, the main-stem channel in northern Atchison County and southern Page County (below J-52) has progressed beyond the final degradation processes of Stage IV and into Stage V, or aggradation. Also since 1975, the channel in central Page County has progressed from Stage III, when it was severely downcutting, into Stage IV, in which bank erosion processes are dominant. In Montgomery County, the main stem channel is still downcutting.

The channel evolution model also describes adjustments to change by the tributaries in a drainage system. Although no tributaries of West Tarkio Creek were surveyed in the 2003 survey, the lower reaches of two tributaries in southern Page County were filmed in the 2002 aerial reconnaissance, and 12 miles of second-, third-, and fourth-order tributaries throughout the watershed were walked during the streambank erosion assessment. As described in the "Erosion and Sediment Delivery" section of this report, the data show a clear difference in erosion rates between tributaries in the lower third and those in the upper two-thirds of the watershed. Tributaries in the lower third exhibit soil loss rates that are two to three times greater than, and bank recession rates that are nearly double, those in the upper two-thirds of the watershed. These findings are commensurate with a basic principle of fluvial geomorphology, which predicts the

spatial progression of degradation—and consequent aggradation—headward into smaller and smaller tributaries as the downcutting advances up the main-stem channel.
The headcut will advance upstream until it meets a resistant soil layer, the drainage area becomes too small to generate erosive runoff, or the slope flattens to the point that the stream cannot generate enough energy to downcut (Natural Resources Conservation Service, 1998). The evidence from this study indicates that the downcutting (Stage III) initiated by channel straightening roughly 85 years ago is not finished in the upper half of the main-stem channel or in its tributaries. Horizontal degradation (Stage IV) is not finished in the middle section of the watershed, and has only just begun in the upper tributaries.

One limitation of a channel evolution model is that it has difficulty predicting simultaneous adjustments by the stream to multiple changes. At the same time that the West Tarkio drainage system is still adjusting to channelization that occurred nearly a century ago, it is also responding to more incremental changes, including changes in runoff due to climatic fluctuations, widespread land-use changes, and local degradation of riparian habitat.

Nevertheless, the model does provide a general basis for planning stabilization and restoration practices that are appropriate to the stage of channel evolution existing at different locations in the drainage network. For instance, grade control will only be effective in the part of the drainage system undergoing downcutting (Stage III), and should be required before time and money are spent on bank stabilization on those reaches. On the other hand, where incised channels are in the initial stages of widening (early Stage IV), it is best to accommodate that process as much as possible to allow the channel to move toward equilibrium conditions on its own. Such banks are subject to deep-seated slope failure and are not good candidates for either bank armoring or "soft" bioengineering practices. They can benefit, however, from bank shaping to reduce the hazard of slope failure. Conversely, a channel that has progressed well into Stage IV may be a good candidate for bank stabilization such as durable toe protection or soil bioengineering, particularly if the adjacent land is of high value or priority. Stage V channels are already tending toward renewed stability and improving their riparian corridors can accelerate that process.

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Cultural Resources Survey

Different surveys, one for historic structures in the dam area, one for archeological sites in the dam area, one for the proposed raw water lines, one for agricultural pollution prevention measures, and one for road and utility relocations will be done.

Historic Structure Survey of the Acquisition Area
NRCS has checked for historic structures by searching atlases and plat maps at the State Historical Society of Iowa (Anderson 1920, Andreas 1875, Anonymous 1902, and Anonymous 1904). The attached map shows locations of structures or structure sites more than 50 years old (Figure 10). The sponsors plan to demolish all standing structures in the acquisition limit because of liability and safety reasons. In situations where a house is demolished, a basement may need to be filled in. Borrow to fill in basements will be obtained by some or all of three alternatives. Alternative 1 is the use of borrow from areas previously surveyed for cultural resources. Alternative 2 is the use of roadside ditch sediment removed by ditch clean-out. Alternative 3 will be the survey of new borrow areas by field office personnel as their locations are determined in a manner consistent with the State Level Agreement with the State Historic Preservation Officer. For alternatives 1 and 3, survey will ensure that borrow removal will not impact cultural resources. Alternative 2 will involve PSA and will not affect cultural resources. NRCS intends to fully document all structures over 50 years of age as mitigation. Some of the locations identified in the literature search are now archeological sites and will be treated as such. The "Iowa Historic Bridge Inventory" shows no listings for this area.

Survey of Prehistoric Resources of the Dam Area
This dam will affect an area containing deposits that potentially have cultural resources that could be significant. A check of the state archeological data base did not indicate the presence of known cultural resources. We expect, however, that prehistoric cultural resources will be discovered when the area is surveyed.

Presented below is a description of what will be surveyed, and how it will be surveyed. A portion of this description is based on geological drilling done in the watershed to enhance the soils data already available for cultural resource analysis (Figures 1-10).

The Area of Potential Effect (APE) will be surveyed (Figure 1). This is the area where there is a potential for a significant site to be present and where disturbance from the project will have the potential to damage those factors that make any such sites significant. Within the APE there will be two levels of survey. One is a shallow survey consisting of pedestrian survey and shovel testing. The other will be a deep survey consisting of trenching or coring.

The APE was developed using certain criteria. The following areas were excluded from the APE.

1. Glacial drift (diamicton) that is cultivated will be excluded from archeological survey (Figure 2). The diamicton is Pre-Illinoian. These deposits are older than the known human occupation of Iowa. Where the surface of the deposits has been disturbed by cultivation there is no chance of undisturbed archeological sites being present.

2. Post Settlement Alluvium (PSA) will be excluded from archeological survey when the PSA is deeper than the project ground disturbance (Figure 3). Where the depth of disturbance is greater than the depth of PSA, the affected area beneath the PSA will be surveyed. The depth of PSA on the Colo-Judson soils (11B) ranges from 1 ½ feet to 2 feet on fans, and valley toe slopes, but is absent or spotty on tributary valley trains. Colo silt loam with overwash (133+) has approximately 1.5 feet of PSA. PSA is 1.5 feet deep in some areas of Kenebec soils (212), but is absent from others. Should NRCS delineate the PSA in tributary valley trains, or Kenebec soils, then such delineated areas will be excluded from survey if deeper than the ground disturbance. Deep construction disturbance and wave action areas will be considered to be areas of disturbance greater than the depth of PSA, and may require archeological survey.

3. Hydric soils will be excluded from survey unless the project disturbance is deeper than the hydric deposit (unless there are surface indications of an historic dump site). This is because a hydric soil is an unlikely place for a prehistoric camp site, or an historic structure. Areas not listed as hydric soils, but known to have hydric inclusions suggest that large areas of unmapped hydric soils are present. If such hydric soil inclusions are delineated during the study, they will not be surveyed for cultural resources consistent with other hydric soils. The hydric soils are Colo silt loam with over wash (133+), Colo silty clay loam (133), and Zook silty clay loam (54). Soils with hydric inclusions include Colo-Judson silty clay loam 2-5% slope (11B), Kenebec silt loam 0-2% slope (212), and Nodaway silt loam 0-2% slope (220). Deep construction disturbance and wave action areas will be considered to be areas of disturbance greater than the depth of hydric deposits, and may require archeological survey. Hydric areas outside areas of disturbance will not be surveyed. See Figure 4.

4. Slopes greater than nine percent are excluded from survey unless they are associated with flint outcrops, rock shelters, or benches (Figure 5).

5. Access routes, if previously driven over by tractors, will not be surveyed unless the access routes have to be bulldozed in. Tractors put more pressure per square inch (psi) than construction equipment.

The following will be surveyed unless excluded by the above factors;

6. Loess that will be disturbed will be surveyed for archeological sites (Figure 6). This is because loess on the edge of a major stream valley may have reworked Holocene loess deposits that could bury archeological sites. Disturbed loess areas will be excluded from archeological survey where slopes are greater than nine percent.

7. Holocene alluvium and local alluvium (colluvium) have the potential to have surface and buried archeological sites. Such deposits will be excluded from survey if it involves shallow disturbance and has either PSA and/or hydric soils present. Otherwise, such deposits will be surveyed if disturbed. See Figure 7.

8. Areas of potential wave damage on the normal pool shore line will be surveyed (Figure 8). The normal pool is large and wave action could be a problem. Areas of wave damage encompass the level of the normal pool to ten feet above. The NRCS assumes that wave damage

may exceed the depth of Colo-Judson PSA on the colluvial apron so that it will require deep archeological survey. Archeological survey will exclude areas of potential wave damage where cultivated glacial drift, or slopes greater than nine percent are present. At the upper end of the normal pool where the sediment basin will be, the fetch is so short that this area is excluded from being an area of potential wave damage. During the time required for the normal pool to be filled with water, there would be a short period when the area of the normal pool (as opposed to its rim) would be subject to wave action damage. It is likely that any potential wave action damage would be considerably less than at the rim of the normal pool. NRCS will do a shallow survey on all deposits in the pool that are not shielded by PSA or hydric deposits or are not in deposits of cultivated glacial drift or slopes greater than 9 percent.

9. Anticipated areas of significant ground disturbance due to construction will be surveyed unless excluded by certain factors (Figure 9). This will include consideration of such improvements as borrow areas, the core trench, auxiliary spillway, roads, parking lots, pumping station, pipelines, and recreation facilities. Factors that would exclude areas from shallow disturbances from archeological survey would include cultivated glacial drift, slopes greater than nine percent, hydric soils, and PSA. Factors that would exclude areas of deep disturbance from archeological survey would include cultivated glacial drift and slopes greater than nine percent.

The APE for archeological sites is shown in Figure 1. The APE consists of those areas that have the potential for a significant archeological cultural resource, and will be disturbed by the project in a manner that would damage aspects of a cultural resource that contribute to its significance. This figure is based on comparing the factors illustrated by the other GIS data layers. It represents areas of loess, alluvium and local alluvium, wave damage, and project ground disturbance that aren't excluded from archeological survey by the factors mentioned above. This figure shows which areas are anticipated to need shallow surveys and which will need deeper surveys.

Raw Water Lines Survey

This project includes raw water lines running from the dam to treatment plants at Shenandoah and Clarinda. The water lines will be laid as much as possible into existing roadside ditches. There will be a 20 inch line installed with a wheeled trencher cutting approximately a 24 inch wide trench. The lines will be installed approximately four to five feet below the bottom of the road ditch. When stream channels are encountered, installation will involve a boring machine that would install the line approximately 10 feet below the stream channel bottom.

The exact location and extent of the water lines have not yet been determined. Consequently, a detailed description of the APE (as was done with the dam) cannot be made at this time.

An historic structure survey will not be necessary for the water lines because they will be in road ditches or tunneled under such things as stream channels and roads. These areas are not likely to have historic structures.

The archeological survey will use principles similar to those identified for the dam to evaluate the APE. Much of the area to be surveyed is in the uplands (distant from a major stream valley). Loess in such areas will be unlikely to have an accumulation of reworked Holocene loess and

therefore little chance of buried cultural resources in the road ditches. Such areas will be excluded from survey. Most of the survey will be in previously disturbed road ditches. In situations where utilities have already been buried in the ditch, disturbance of any buried cultural resources will be assumed, and that length of the ditch will not be surveyed.

Agricultural Pollution Prevention

Thirty-nine sediment basins are planned for the drainages that empty into the lake. These are small structures and their precise location will depend on factors that have not yet been determined. As the precise locations are established these will be surveyed as field office undertakings by the NRCS. These structures are within the level of field office investigation discussed in the State Level Agreement with the Iowa State Historic Preservation Officer.

Road and Utility Relocations

Some roads and the accompanying utilities will be abandoned due to construction of the dam. Additional roads are not planned; however, certain existing gravel roads may be black topped to facilitate rerouted traffic and some interrupted utilities rerouted along the black topped roads. Should utilities be rerouted along ditches that have not already been disturbed by existing utilities, then they will be surveyed in the same manner as the raw water lines.

This represents the NRCS plan to deal with cultural resources on this project.

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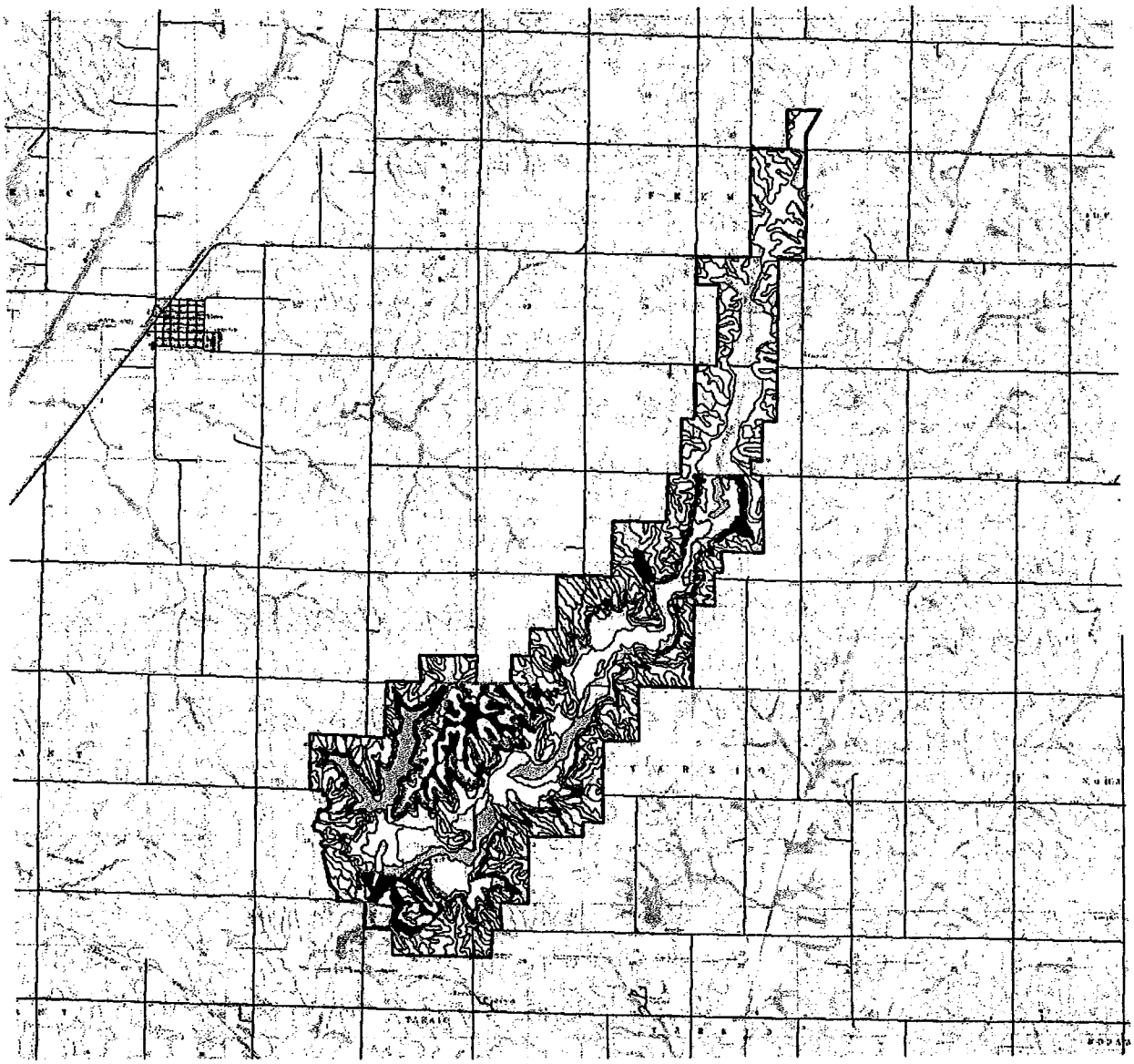
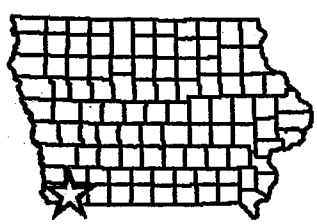
West Tarkio Creek Watershed
Site 3 Archeological Assessment

Figure 1. Area of Potential Effect (APE)*



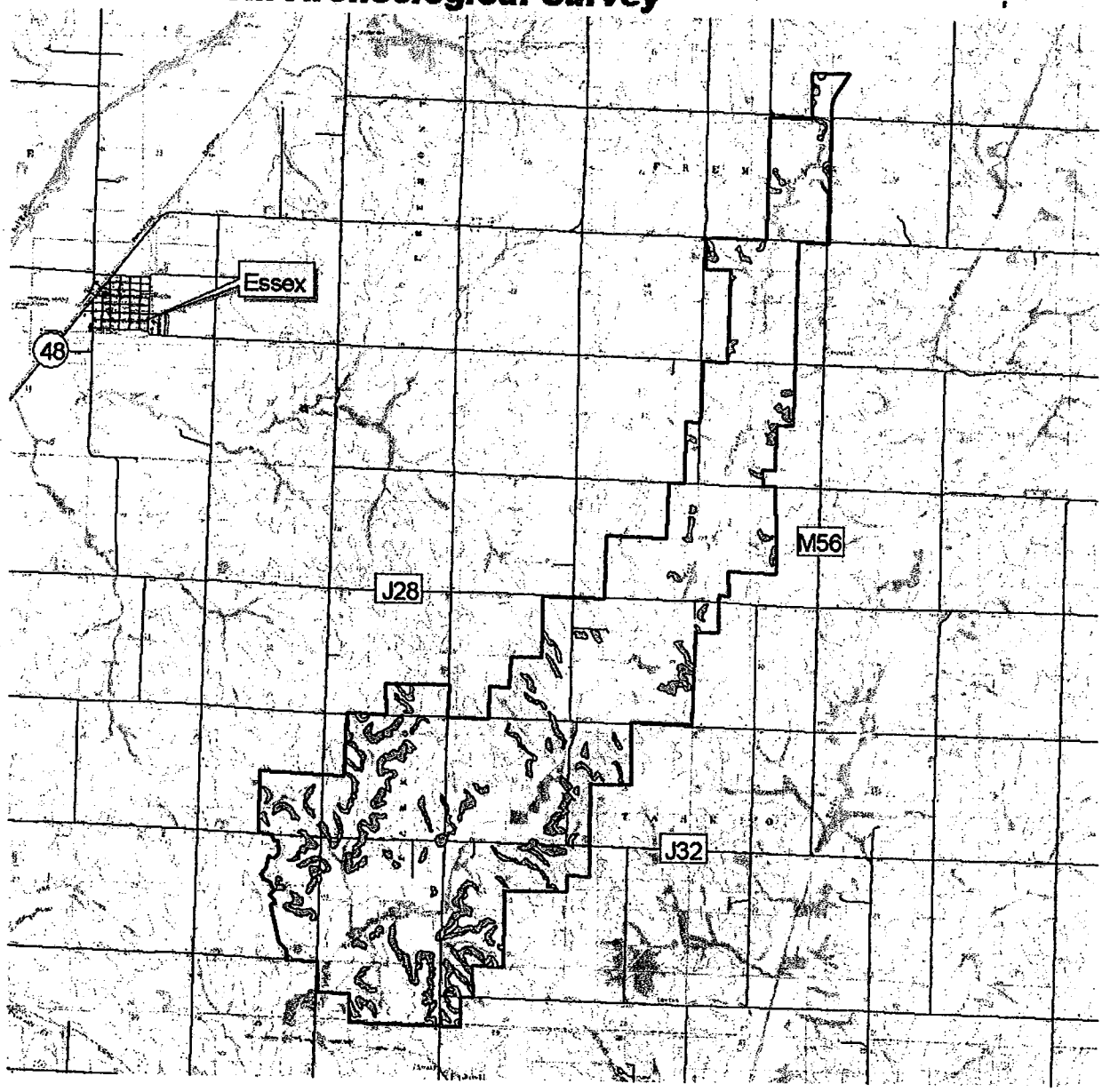


Area of Potential Effect (APE): Area that will need to be surveyed when there is potential for a significant site to be present and where disturbance from the project will have the potential to damage those factors that make any such sites significant.

West Tarkio Creek Watershed
Site 3 Archeological Assessment

NRCS
1/24/06 JP

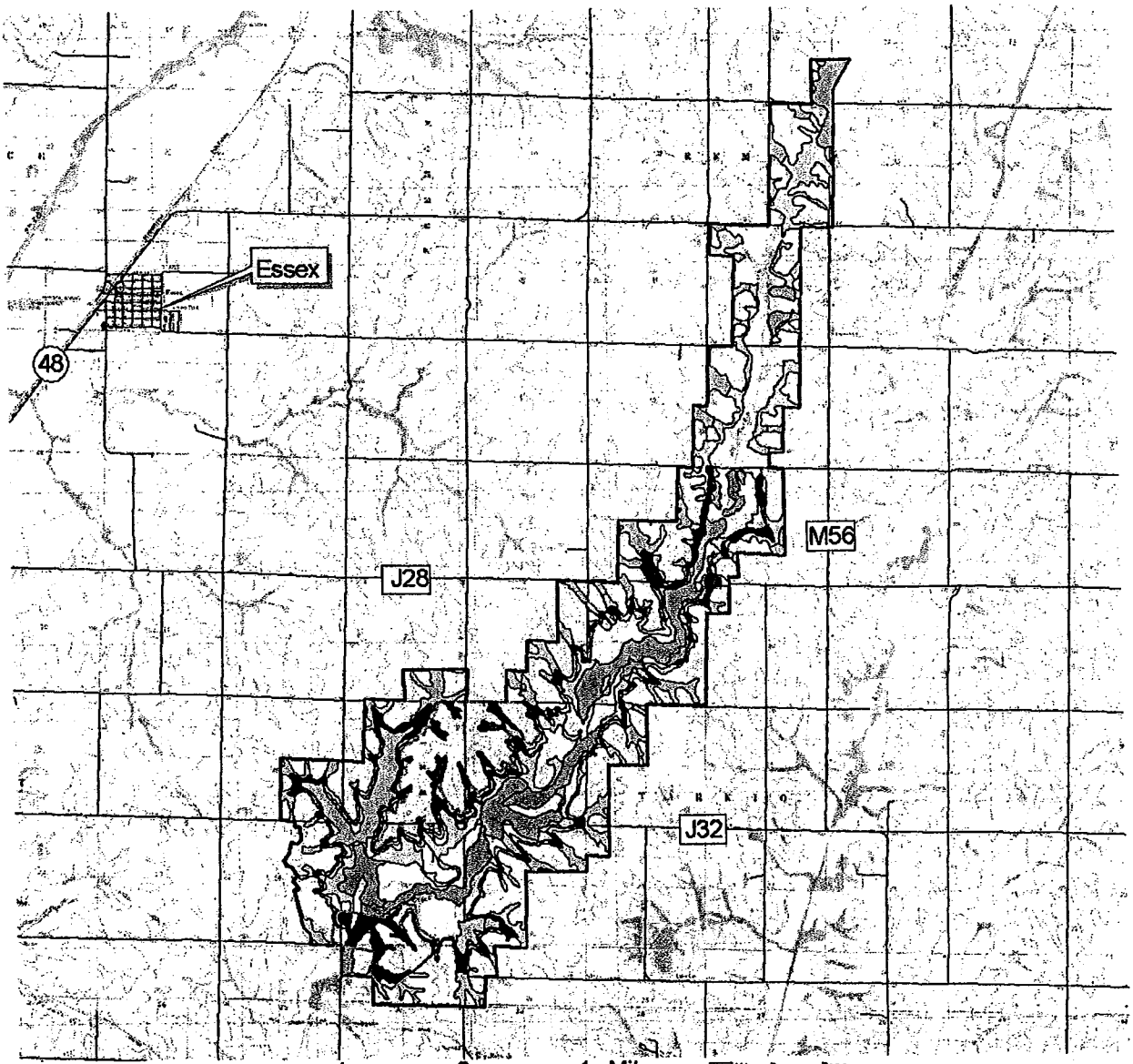
Figure 2. Cultivated Glacial Drift (Diamicton) Excluded From Archeological Survey

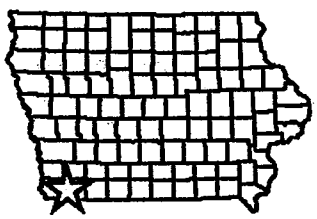


West Tarkio Creek Watershed
Site 3 Archeological Assessment

NRCS
1/26/06 JP

Figure 3. Post Settlement Alluvium (PSA) Excluded From Archeological Survey*



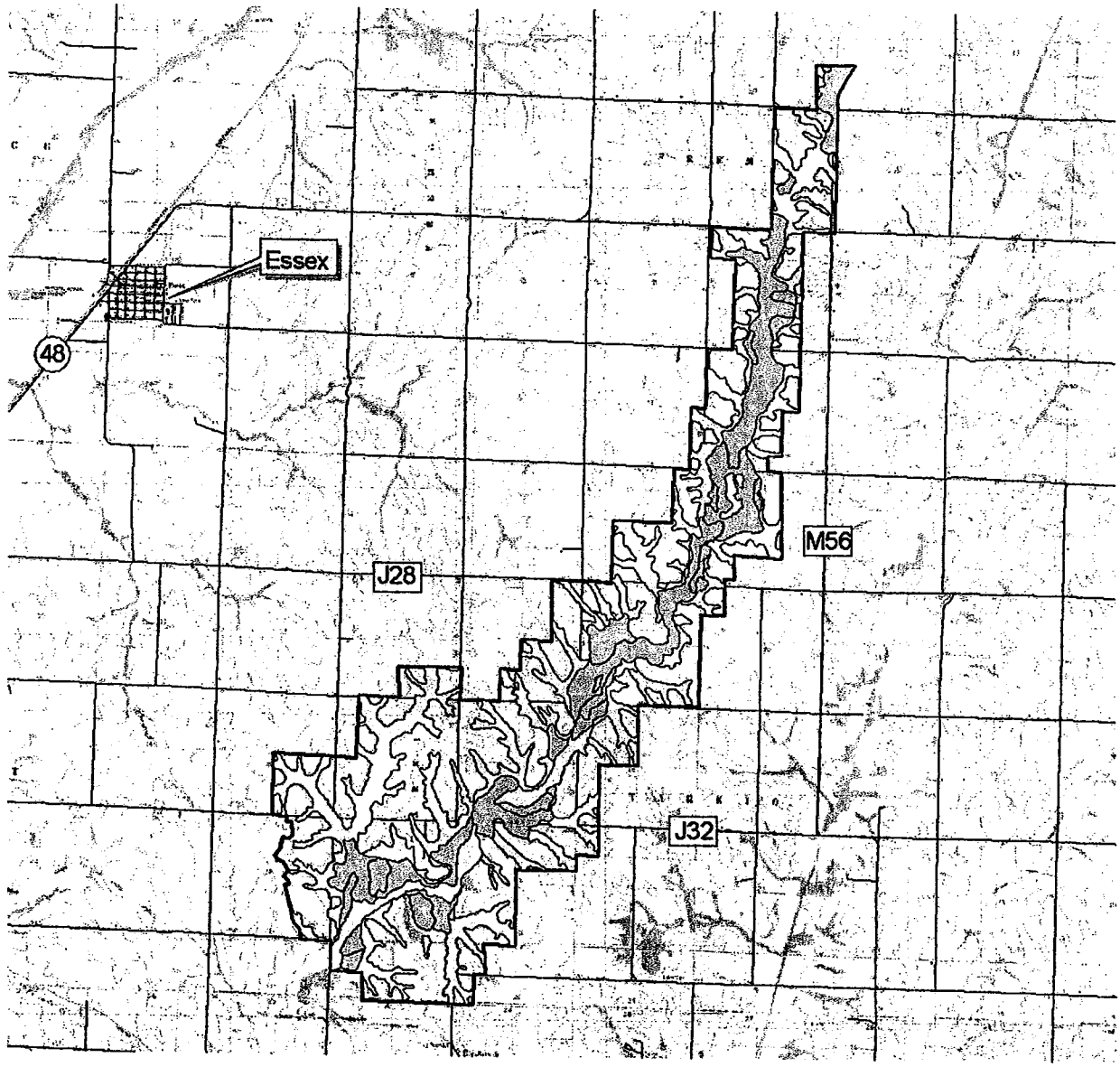


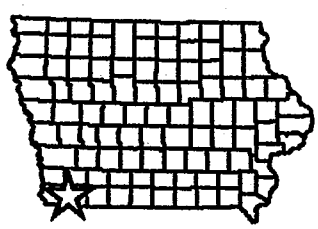
*This area will be excluded from archeological survey if the PSA is deeper than ground disturbance. Deep construction disturbance and wave action areas will be considered to be project disturbances greater than the depth of PSA and will be surveyed.

West Tarkio Creek Watershed
Site 3 Archeological Assessment

NRCS
1/24/06 JP

Figure 4. Hydric Soils Excluded From Archeological Survey*





1 0 1 2 Miles

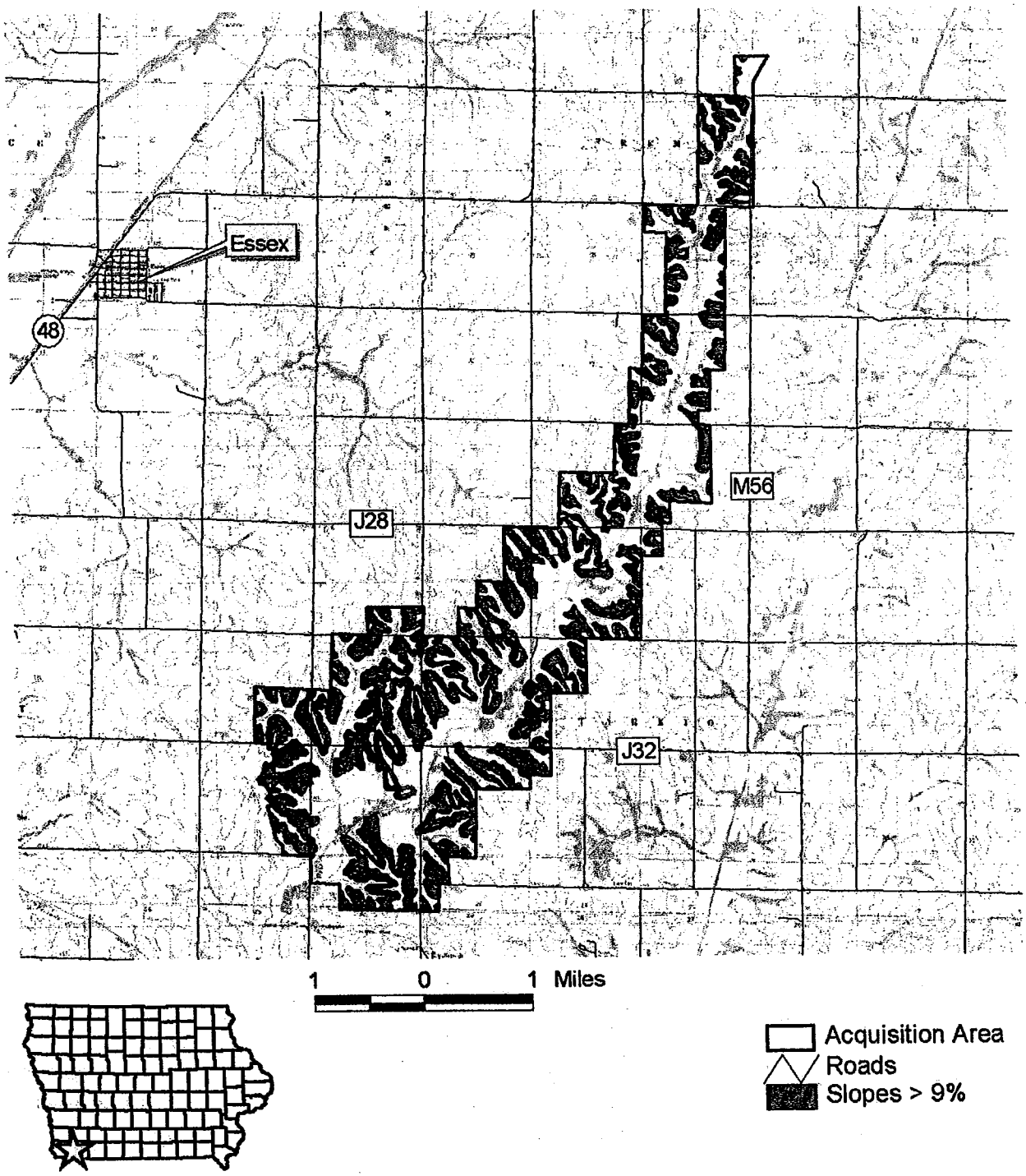
Hydric soils are excluded from archeological survey if the hydric deposits are deeper than ground disturbance. The same will apply to hydric inclusions as they are identified in the field.

Hydric Soils
- Hydric
- Hydric Inclusions
- Acquisition Area
- Roads

West Tarkio Creek Watershed
Site 3 Archeological Assessment

NRCS
1/24/06 JP

Figure 5. Slopes >9% Excluded From Archeological Survey



West Tarkio Creek Watershed
Site 3 Archeological Assessment

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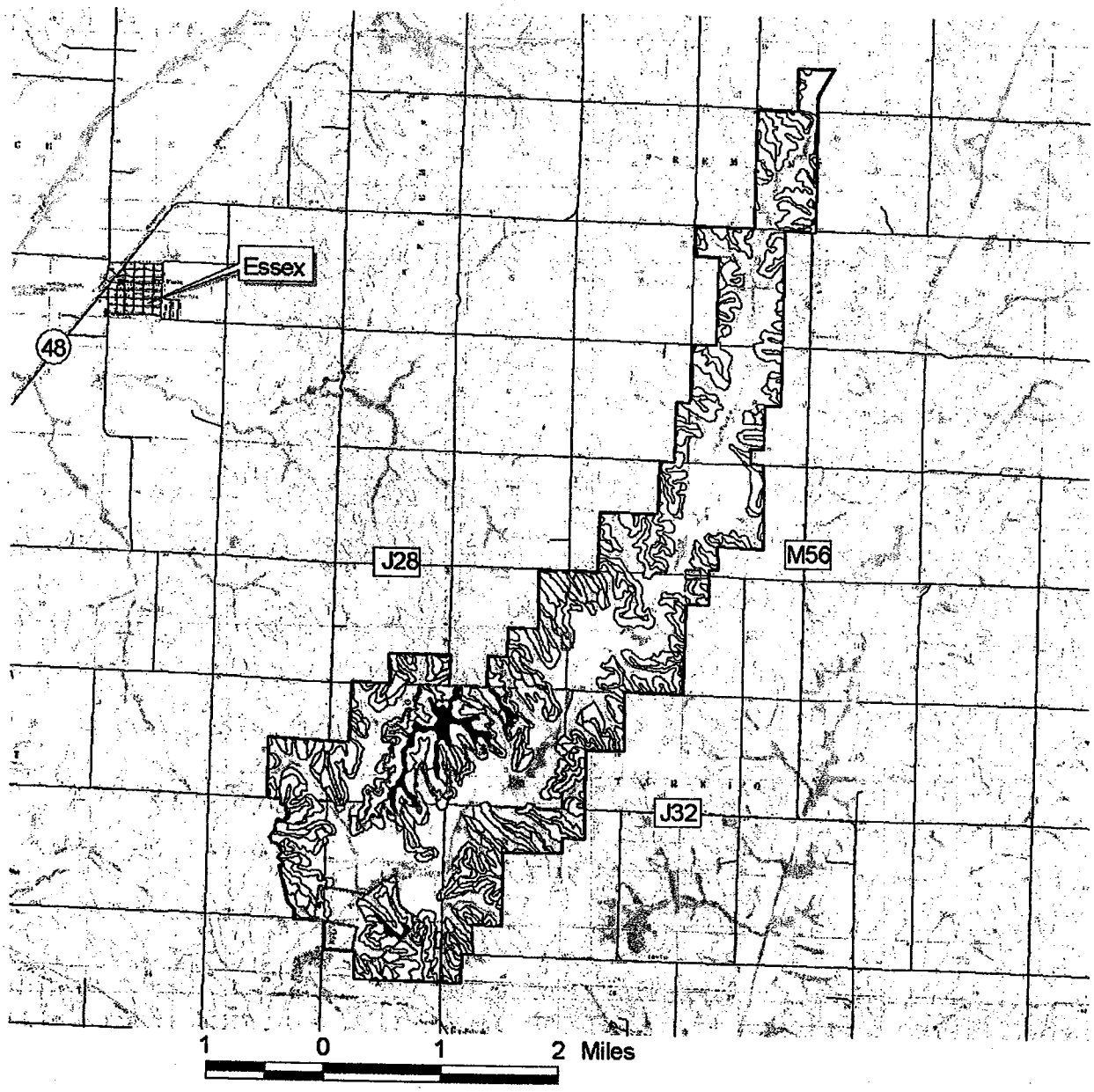
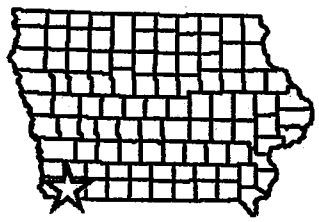
Figure 6. Disturbed Loess Soils to be Surveyed for Cultural Resources*





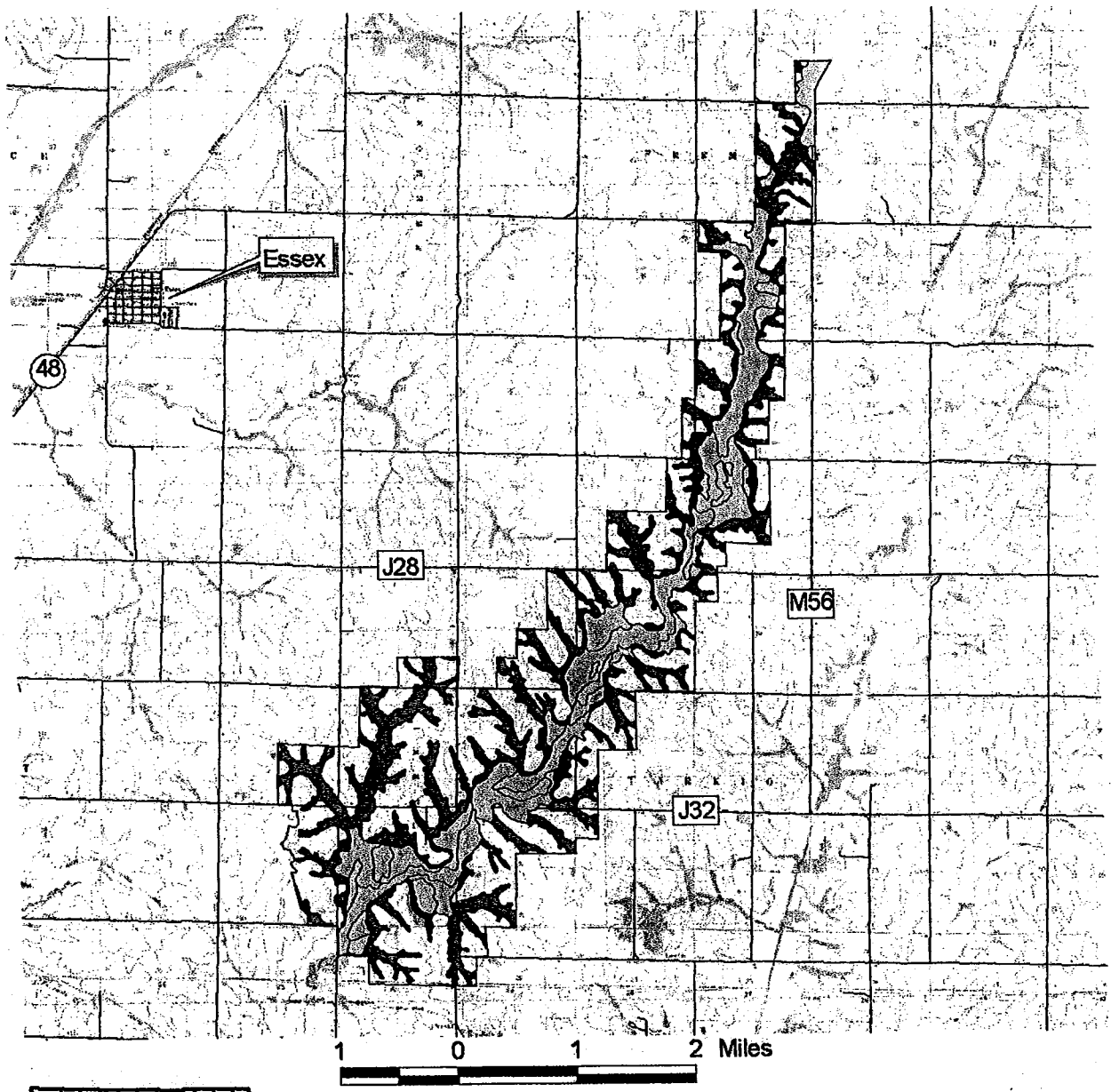
Loess that will be disturbed by construction activities and/or wave action will be surveyed for cultural resources unless on slopes >9%.

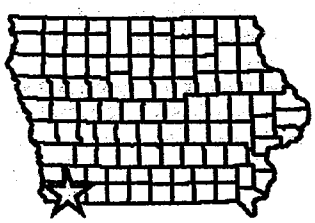
- Construction Work Limits
- Developed Recreation Area
- Slopes > 9%
- Disturbed Loess - Wave Action
- Disturbed Loess - Construction
- Acquisition Area
- Roads

West Tarkio Creek Watershed
Site 3 Archeological Assessment

NRCS
1/24/06 JP

Figure 7. Alluvium and Local Alluvium (Colluvium) With Potential to Bury Cultural Resources*





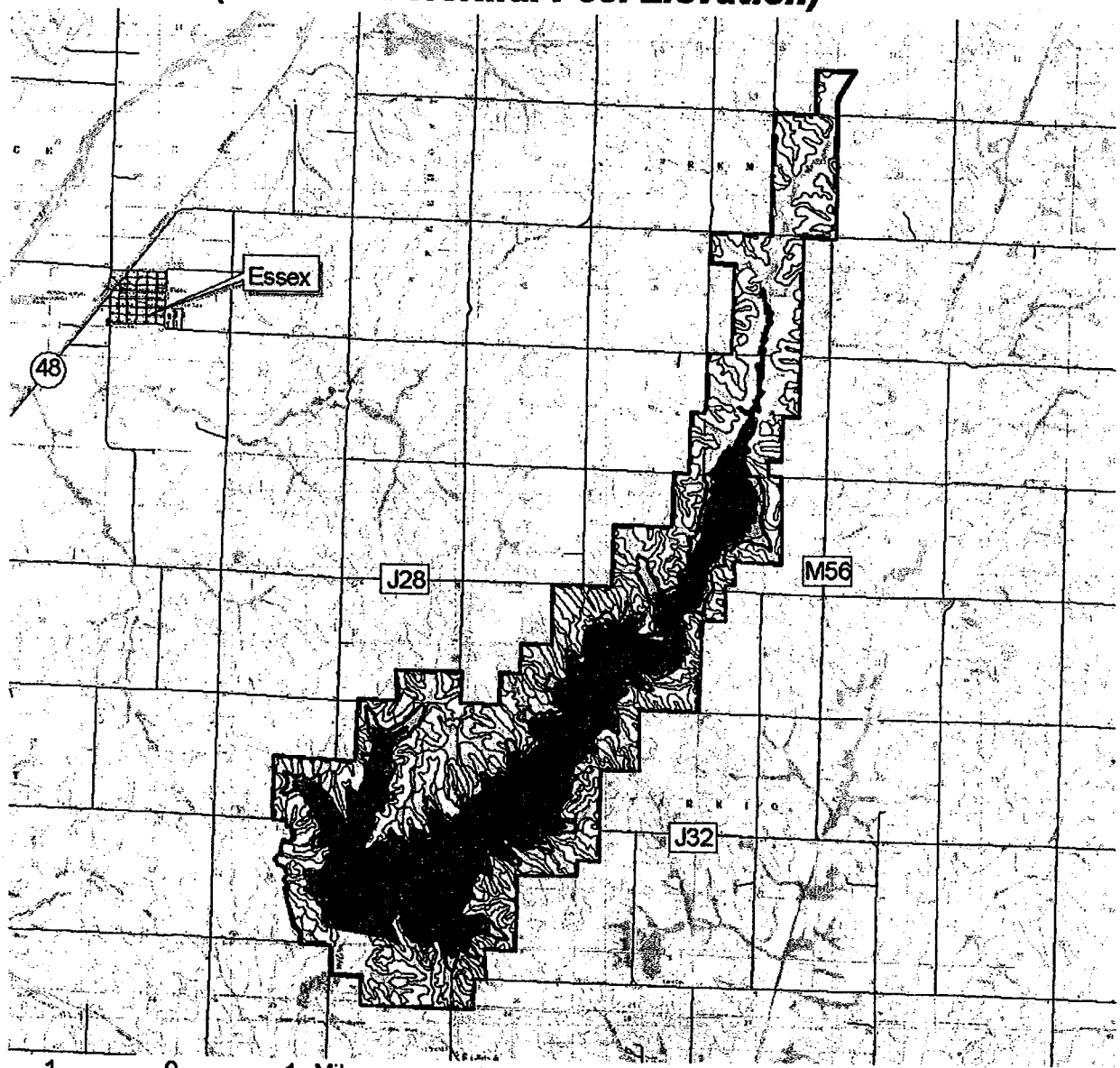
*These deposits have the potential to contain buried archeological sites and will be surveyed if disturbed, and disturbance is deeper than PSA or hydric deposits.

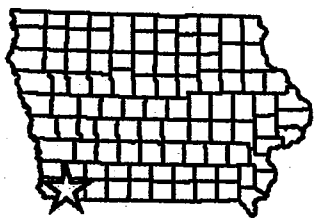
Alluvium
Colluvium (Local Alluvium)
Alluvium/Colluvium
Acquisition Area
Roads

West Tarkio Creek Watershed
Site 3 Archeological Assessment

NRCS
1/24/06 JP

Figure 8. Areas of Potential Wave Damage on Shorelines (10' Above Normal Pool Elevation)*





An area 10' in elevation above the normal pool elevation will be surveyed for cultural resources this is due to the potential for damage to the shoreline from wave action. Areas of cultivated glacial drift (diamicton) and areas with slopes greater than 9% will not be surveyed. Some areas of the pool have a short fetch where wave action will not be a problem and will be excluded from survey.

- In-Channel Sediment Basin
- Potential Wave Damage Zone
- Normal Pool
- Slopes > 9%
- Glacial Till
- PSA Disturbed by Wave Action
- Hydric Soils Disturbed by Wave Action
- Loess Disturbed by Wave Action
- Acquisition Area
- Roads

West Tarkio Creek Watershed
Site 3 Archeological Assessment

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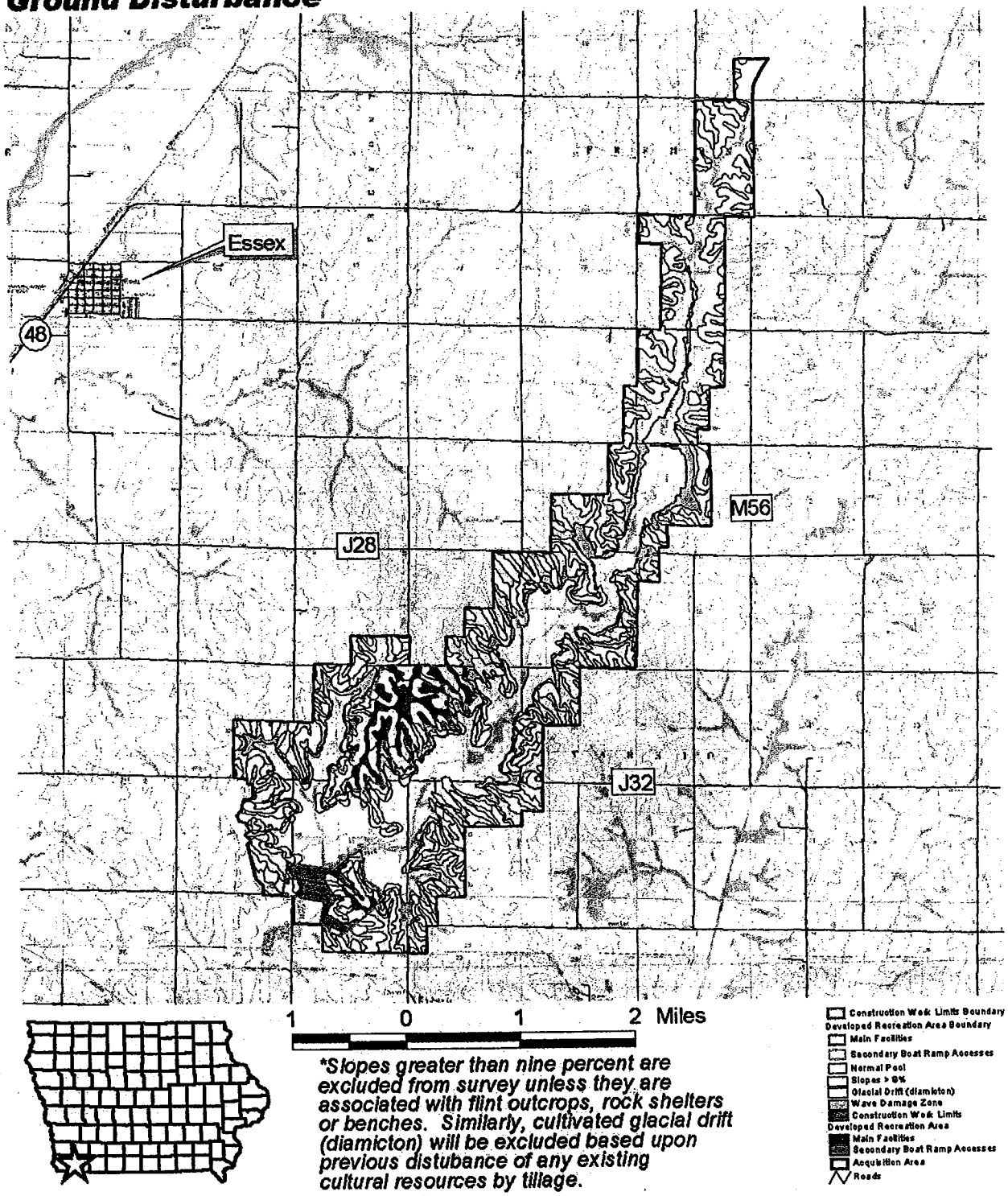
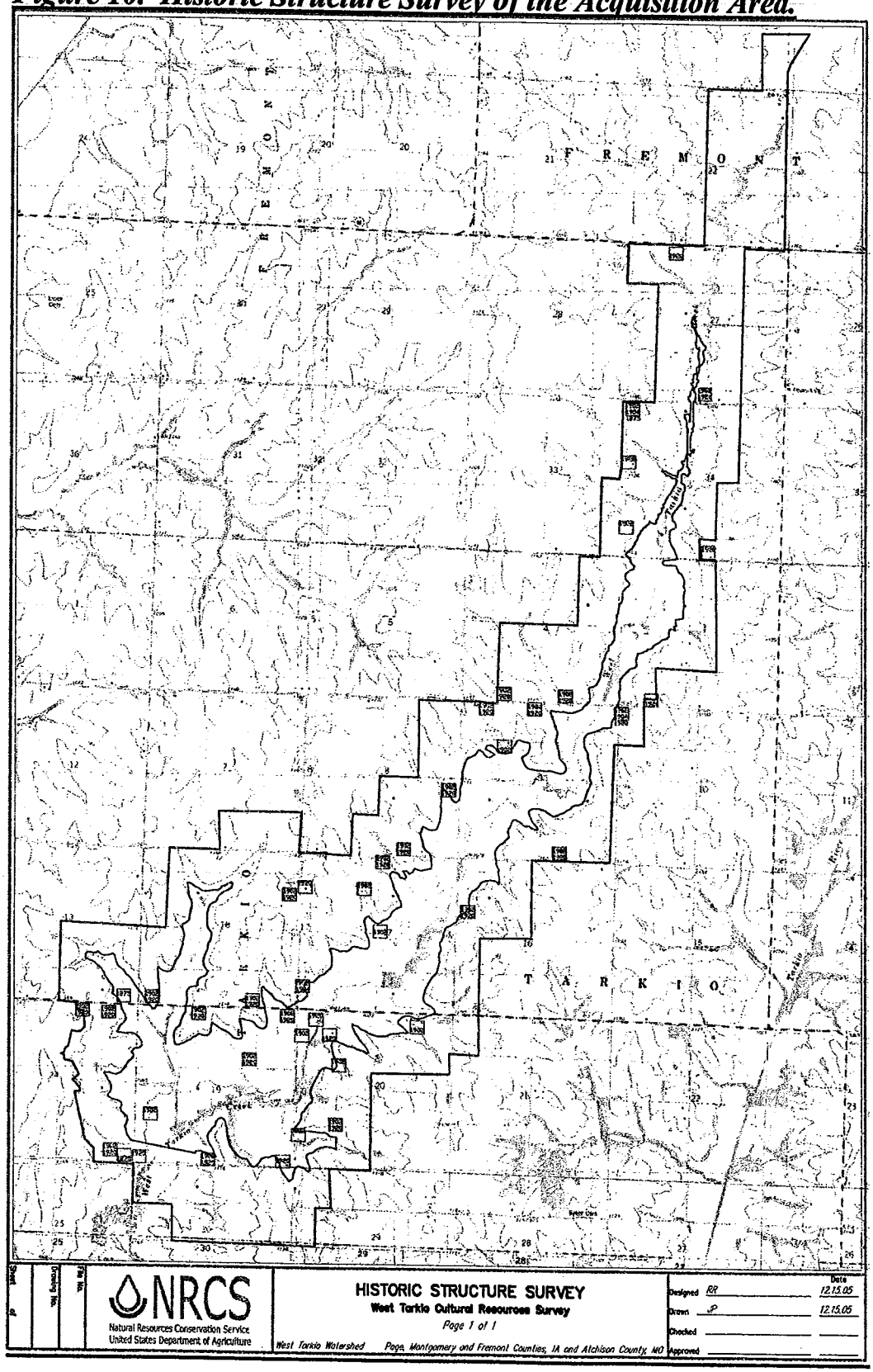
1/24/08 JP

Figure 9. Areas of Significant Construction Ground Disturbance



*Slopes greater than nine percent are excluded from survey unless they are associated with flint outcrops, rock shelters or benches. Similarly, cultivated glacial drift (diamicton) will be excluded based upon previous distubance of any existing cultural resources by tillage.

Figure 10. Historic Structure Survey of the Acquisition Area.



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Appendix E – Supporting Information

History of watershed activities:

Local sponsors requested planning assistance in 1963 from the Soil Conservation Service (SCS now NRCS) to stabilize the main stem by studying channel degradation and flood problems. The recommendation was to create a water impoundment on West Tarkio Creek about half a mile north of Hiway 2 and a smaller impoundment 2 miles southeast of the larger impoundment. Public meeting participants expressed concerns that too much cropland would be lost resulting in a loss of tax receipts. In addition, concerns were that there were no funds to purchase land lost in the watershed. Subsequently, the sponsors rejected the plan and planning activities were discontinued in 1966.

In 1975, the SCS was again asked to study West Tarkio Creek to locate a site for a water source for the Page County Water Association. A water supply study was completed, but no action was taken by local sponsors.

A reconnaissance report was prepared by the SCS in 1992 to locate potential multi-use reservoirs in Page and Montgomery Counties. Recommendations included development of a long range plan, retaining a consulting engineer, water conservation, determine sources of funding and land treatment above water supply pools. No action was taken by local sponsors.

Summary of West Tarkio Watershed Scoping Meeting; 2/17/04; Shenandoah, IA

Procedure:
Attendees were asked to sign in by NRCS staff as they entered the meeting. Individuals were asked on the sign-in sheet if they wished to speak for a maximum of two minutes and to indicate so on the sign-in sheet. Eighty-three individuals signed in. Handouts offered to each attendee included: meeting agenda, watershed map, and a response sheet. Steve Manternach served as the timer for members of the public who spoke.

Bo Harris, Steering Committee Chairman opened meeting with welcoming remarks, named the West Tarkio Watershed sponsors, and reviewed the sponsor's objectives that were printed in red on the meeting agenda.

Speakers:
Roger Link: NRCS Water Quality Specialist - Planning Staff
Link explained the scoping meeting structure and reviewed the agenda. The scoping process is started early and is a very open process. All real problems should be identified as early as possible. The scoping process gathers information from many sources such as individuals (local and all others) and agencies that include local, state, and private. The scoping process involves anyone who has input in these projects.

Public informational meetings were held the afternoon and evening of August 19, 2003, in Shenandoah. Agencies, environmental groups, and others interested in water resources planning were not specifically invited to these public meetings. Over 90 letters of invitation to this scoping meeting were sent to contacts at state and federal agencies, private conservation groups, and other individuals.
Dave Beck: NRCS Planning Leader - Watershed Overview
Beck explained that the PL-566 Small Watershed Program enables the NRCS to work with local groups on multiple resource issues. PL-566 constraints do not allow NRCS to cost-share for beneficial water storage greater than 25,000 acre feet in one structure. NRCS can work on plans including structures above that amount and share that plan with groups that can use this information. NRCS will be looking at the following:

Flooding	Water Supply	Stream bank & channel erosion
Recreation	Upland Soil Erosion	Fish & Wildlife
Wetlands	Mitigation	Threatened & Endangered Species

Beck said DNR wants cleanest lake possible. Ideal drainage area to surface area ratio is about 20:1. The NRCS needs to perform more extensive field work and technical studies. To date several cross section studies have been completed for running flood models.

Intent of meetings is to present information to lay ground work and present information to sponsors. Current goal of NRCS is to report to Steering Committee in March with more definite information on flood and gully studies.

Water Supply and Recreation:
As presented in November study site No. 4 has been dropped from studies. The reason is because the site location doesn't provide adequate water supply and infrastructure redesign is too expensive. NRCS will concentrate studies on site location No.'s 1, 2 & 3 for recreation and water supply. The proposed park areas for these three sites need more economic evaluation and a lot more refinement.

Ground Water:
NRCS is working with the Iowa Geological Survey Bureau for providing technical assistance to the cities of Clarinda and Shenandoah. Studies are now ongoing to provide goals for water output. NRCS will not provide TA or provide financial assistance to put down test wells. Sponsors need additional testing and find other means to do this study.

Tom Oswald: NRCS Soil Conservationist – Planning Staff
Oswald reported on the stream assessment on 65 sites throughout watershed. Areas studied were: amount of sediment in stream; bank heights; how many feet per year of bank recession; streambed degradation; gully erosion; and ephemeral gully erosion. The study covered not only the main stream but also tributaries. The study showed that south of Coin road the stream bed is stable. North of Coin road the stream is degrading. Streambed in tributaries below Coin road is degrading and north of the Coin road is also degrading. Amount of erosion in this watershed is typical for streams in Southwest Iowa. As a result of the 6 Hungry Canyons Structures, 25 to 30 feet of grade are removed in the West Tarkio main channel. While doing field studies, 2 landowners told our team that when the West Tarkio was originally straightened in the 1930's, the stream was 7 feet wide and banks were 7 feet high.

Steve Manternach: NRCS Resource Conservationist Planning Staff
Upland Soil erosion on sloping farmland was calculated using RUSLE 2. This soil loss equation and parts of others have been used and studied for over 50 years. The NRCS feels very comfortable using the RUSLE 2 soil erosion equation. Study uses infrared photos, field boundaries and terraces were identified. Rainfall, soil type, slope length and steepness, crops grown, and the amount of residue left after planting were all combined to determine the amount of soil loss occurring in this watershed. This study shows that 70 percent of this watershed has been treated to "T".

Mark Lindflott: NRCS State Biologist – Ecological Sciences Staff
The task is to work with other agencies and to identify any impacted resources. To find any mitigation that might need to be performed and to find best location. Identify threatened or endangered species and make sure that any work does not have a negative impact on these species. Also work with recreational development and work with local sponsors.

Richard Rogers: NRCS State Archeologist – Ecological Sciences Staff
Review and evaluate all legal requirements for Cultural Resources and assign value of these cultural resources against any land improvement. Locate cultural resources and determine if resource is significant. Most cultural resources that are found are not significant, but we have to decide on what to do with them after determination is made. The amount of and extent of land disturbance determines how detailed the Cultural Resources study will be. On structures, avoidance of cultural resources can not be the norm. Avoidance can be used on small area.

Dave Beck: NRCS Planning Leader – Planning Staff
The planning process takes long periods of time and all information collected has to be reviewed. NRCS plans to come to the sponsors hopefully in July with alternatives and recommendations for a plan. It will be the responsibility of the sponsors to choose what alternatives they want to use for their plan. The local decision has to be made before process can proceed. The timetable for an inter-agency review for a plan to be ready for this review is for early 2005. Private groups and individuals are also invited to review and comment on the plan during this 45 day review period. A public information session will be conducted at that time. Final plan will hopefully be ready by June 1, 2005. Work has been on going already for one year, and a lot of public input has been collected so far.

Link reviewed the response sheet that was available to each meeting attendee. The sheet listed resource planning studies and sponsor objectives and could be completed today or mailed to the planning staff within 30 days. Other comments can also be mailed to the staff in letter or other forms. Roger then called on the five individuals who had asked to speak.

Statements from those who asked to speak:

David Rydberg – President of Page Co Farm Bureau
Farm Bureau does not support the removal of so much farmland for recreational purposes. Farm Bureau sees too much economic loss, relocation of farms, and loss of income for future use is too much for this project. It is more than just the cost of the land. Farm Bureau believes that this farm ground should not be taken when a water source other than a reservoir is available. (Mr. Rydberg later forwarded additional Page County Farm Bureau questions and comments to the planning staff and a letter from Bob Johnson of the Iowa Cattlemen's Association and an economic analysis by Mark Salvador of the Iowa Farm Bureau Federation. These 3 items were forwarded in an email to Roger Link dated 2-24-04.)

Bob Bowman: Farmer
Mr. Bowman is in favor of soil conservation and structures. He is not in favor of a lake on this kind of land. Mr. Bowman feels that the flatness of watershed and evaporation will cause mud flats throughout the proposed mulitpurpose lake.

Linda Stoops: Representative of Page County Cattleman's Association.
Ms. Stoops believes that with other sources for water supplies this farmland should not be used for this lake. Ms. Stoops feels that this is a land rights issue, and people in Page County should decide on what to do with their own property and not outsiders. Ms. Stoops also feels that many lakes in Iowa have severe maintenance problems and these should be taken care of before they build more.

Ernie Aust: Citizen Page County
Mr. Aust wants Planning Staff to look closer at road structures and the benefits they might bring to area. Mr. Aust feels that if 70 percent of area is already treated it would be a good clean and easily maintained reservoir. He was also concerned about losing the Vision Iowa funding that was received earlier by local sponsors.

Brian Walker: Farmer - President of Citizens for Responsible Choices

Mr. Walker spoke in agreement to Mr. Bob Bowman's comments about this lake being a big mud flat. Mr. Walker also has concerns that if they dam up this stream that there will be a shortness of water downstream. Mr. Walker also feels that the NRCS has not been truthful with everyone. A list of questions and comments were also presented to the planning staff.

Marion Conover: Iowa DNR

Mr. Conover welcomes the studies that the NRCS is doing and appreciates the sponsors' interest in developing water resources. The DNR is interested in a high quality lake for recreation and water quality and they will be interested in being a part of the project as the plan is developed.

Southwest Iowa Water Improvement Project Chronology of Events[1/]

- ***August, 1992*** – "Reconnaissance Report-Potential Multi-Use Reservoir Sites Page/Montgomery County Iowa." Prepared by U.S. Department of Agriculture, Soil Conservation Service. (See booklet with same date).

- ***November 23, 1999*** – Shenandoah's City Council discussed City's low water situation and status of City well fields. (See Council minutes with same date and time "Finish Water Pumping Totals, 1/99 to Present").

- ***March 28, 2000*** – Shenandoah's City Council discussed water level of City wells passed resolution approving expenditures to rehabilitate well #17. (See copy of City Council minutes with same date).

- ***June 27, 2000*** – Shenandoah's City Council discussed City water levels and passed resolution enacting Stage II of Water Conservation Ordinance, Chapter 95 of City Code of Ordinances. (See copy of City Council minutes with same date).

- ***July 11, 2000*** – Shenandoah's City Council passed Ordinance 2000-3, adding new section to City Code making violations of Chapter 95, "Water Conservation" a Municipal Infraction. (See copy of City Council minutes with same date).

- ***November 2, 2000*** – Shenandoah's City Council approves resolution to expend $5,000 from City Emergency Fund to hire a Hydrologist to study the City's well field status and determine a future water supply source. (See copy of City Council minutes with same date).

- ***November 14, 2000*** – Based on Hydrologist's findings, Shenandoah's City Council adopts a resolution approving the concept of Water Impoundment Project and directs the Mayor and City Manager to initiate the study. (See copy of City council minutes with same date).

- ***December, 2000*** – Shenandoah's City Manager begins search for engineering firm familiar with Water Impoundment Projects. Visits with City officials in Maryville, Missouri regarding Mozingo Lake mulitpurpose reservoir built to serve the need of Maryville.

- ***December 12, 2000*** – Shenandoah's Mayor discusses Water Impoundment Project with City Council. City Council approves a resolution appropriated $7,500 to hire Howard R. Green Engineering to study City's water supply needs and present a series of public meetings on actions necessary to develop a water impoundment project. Representative of engineering firm requests a copy of the 1992 "Reconnaissance Report." (See copy of City Council minutes with same date).

- ***December 15, 2000*** – Shenandoah's City Manager mailed approximately 70 certified letters to organizations, agencies, and individuals to determine the amount of interest in a future Southwest Iowa Water Impoundment Project. (See copy of City Council minutes with same date).

- ***January, 2001*** – After receiving correspondence indicating interest in a Southwest Iowa Water Impoundment Project, Shenandoah's City Manager is directed to mail invitations to respondents to attend a special presentation of the engineering firm's concept report.

- ***January 16, 2001*** – At 7:00 P.M., Shenandoah City Officials host a public meeting in the Shenandoah High School Auditorium to present the engineer's report and discuss the need for developing a water impoundment reservoir along the West Tarkio Creek. Representatives of Iowa Emergency Management Division also attended to discuss the limited water resources available in southwest Iowa and the importance to develop a water reservoir project. (See copy of engineer's Concept Study and local newspaper article of meeting dated January 18, 2001).

- ***January 23, 2001*** – Clarinda City Councilman, Rod Nester, reports to Clarinda's Council on the possibility of a Southwest Iowa Reservoir Project and Clarinda's participation in the project. (See copy of Clarinda's Council minutes with same date).

- ***January 23, 2001*** – Shenandoah's City Council approves a resolution to pursue Phase II, "Preliminary Engineering Design Study of Water Impoundment Project" and authorize determination of sources of $99,000 to fund the study. (See copy of Council minutes, correspondence from Ernie Oust-January 25, 2001, Debra Reed-USDA-January 21, 2001 and copy of Phase II contract from Howard R. Green Engineering).

- ***February 6, 2001*** – After listening to Shenandoah City Officials explain the need for a Southwest Iowa Reservoir to solve Page County's water supply problem, the Page County Board of Supervisors voted unanimously to support the development of a 1,600 acre reservoir project. (See copy of Page County Board of Supervisors minutes with same date).

- ***February 13, 2001*** – Shenandoah's City Council approves a resolution to authorize signing a contract with Howard R. Green Company to proceed with Phase II of the Reservoir Project. (See copy of Council minutes with same date).

- ***February 15, 2001*** – Shenandoah sends letter of appreciation to U.S. Senator, Tom Harkin for resources provided to assist in rehabilitating City wells and announcing City's intentions to pursue a long-term solution to Southwest Iowa's water supply needs. (See copy of letter from same date).

- ***March 4, 2001*** – Shenandoah's City Council approves a resolution enacting Phase IV of City's Water Conservation Ordinance. (See copy Council minutes with same date).

- ***March 27, 2001*** – Shenandoah's City Council approved a resolution announcing City's Emergency Proclamation and request for State of Iowa assistance to mitigate a drought situation. (See copy of Council minutes from same date and copy of Proclamation dated March 1, 2001).

- ***April 9, 2001*** – Shenandoah's City Manager and Clerk attend the Iowa Watershed meeting in Afton, Iowa. City receives a copy of Emergency Community Water Assistance Grant application from USDA. (See copy of meeting agenda and completed grant application).

- ***April 10, 2001*** – Shenandoah's City Council discussed the City's water well levels and Phase 4 of the Water Conservation Ordinance. Council directed employees of the Water Department to enclose a copy of the Water Conservation Ordinance and a copy of Water Conservation Tips in each City's water utility customer's next billing statement.

- ***May 1, 2001*** – Shenandoah's City Council reviews the City Water Conservations Program and mandatory water conservation requirements. Council also reviewed an engineering study to rehabilitate the City's wells from Snyder and Associated Engineering. Council approved a motion to accept an offer from Page I Rural Water Association to provide water to fill the Community Swimming Pool and for Fire protection. (See copy of City Council minutes with same date).

- ***June 8, 2001*** – Shenandoah's City Council approved a motion to return to Phase 2 of the Water Conservation Ordinance from Phase 4, based on current water well levels and continue to monitor well levels. (See copy of City Council minutes with same date).

- ***July 26, 2001*** – Page County Board of Supervisors will hold public meeting in the Page Room at the County Courthouse to discuss petitioner's request for establishment of an Agricultural Land Use Area within the proposed Southwest Iowa Water Impoundment Project site.

- ***August 23, 2001*** – Page County Board of Supervisors met in regular session to announce the Board's decision regarding the petitioners' request for 3 Agricultural Land Use Areas within the proposed Southwest Iowa Impoundment site. The Board voted 2-1 to approve the petitioner's request. (See copy of minutes from Page County Board of Supervisors' 8/23/01 meeting).

- ***August 24, 2001*** – Mayor Connell issues press release responding to County Board of Supervisor's decision on designating Agricultural Land Use Areas.

- ***August 29, 2001*** – Meeting with Mark Duben, Howard R. Green, Engineering, to discuss progress of Phase II of Reservoir Project.

- ***September 4, 2001*** – Phone conference with Mark Duben to discuss Preliminary Draft Report for Page County Reservoir Project.

- ***September 12, 2001*** – Received Preliminary Draft Report from Howard R. Green Engineering.

- ***November 4, 2002*** – A public forum to discuss the Lake project at the Clarinda High School Gymnasium drew close to 1,000 people, the majority in overwhelming support. Further evidence of support was provided by the Page County Supervisors in acknowledging the receipt of letters favoring the project 10 to 1.

- ***November 22, 2002*** – Bo Harris delivered 20 copies of the Vision Iowa Grant application entitled "West Tarkio Reservoir/Lake Project" to Nichole Warren at the Iowa Department of Economic Development for review by the Vision Iowa Board.

- ***December 11, 2002*** – Representatives from the City of Clarinda and Shenandoah made a presentation to the Vision Iowa Board of the West Tarkio Reservoir/Lake Project Vision Iowa Grant Application.

- ***January 8, 2003*** – The Vision Iowa Board voted unanimously with two abstentions to award a grant of twelve million dollars ($US 12,000,000) to the City of Shenandoah and City of Clarinda for construction of the lake and recreational facilities associated with West Tarkio Reservoir/Lake Project subject to the terms and conditions listed in the "Vision Iowa Grant Award Agreement."

- ***February 12, 2003*** – The Vision Iowa Board approved the Vision Iowa Award Agreement to be entered into by the Board, City of Shenandoah and City of Clarinda.

- ***March 11, 12, and 13, 2003*** – Delegation from the City of Shenandoah and City of Clarinda met in Washington D.C. with Congressmen King and Graves and Senators Harkin and Grassley to discuss the West Tarkio Reservoir/Lake Project.

- ***March 26, 2003*** – Delegation from City of Shenandoah and the City of Clarinda met with representatives of the Army Corps of Engineers to discuss the Corps' involvement in the West Tarkio Reservoir/Lake Project.

- ***April 17, 2003*** – The first West Tarkio Watershed Planning Committee meeting was held at the Shenandoah Safety Center. Since then the Committee has met an average of once a month, usually the third Tuesday of the month at 7:00 P.M.

- ***July 1, 2003*** – Representatives of Shenandoah and Clarinda successfully deliver to the Vision Iowa Board by todays deadline over 500 signatures of support in addition to pledges totaling $29,000 more in private funds than the Board requested (challenge=$50,000. Amount raised=more than $79,000).

[1/] Any references to council minutes, booklets, grant applications, etc. are not included in this plan.

Livestock Operations in Drainage Area of Site 3

There are 56 livestock operations in the watershed of Alternative 6. There are 28 cow/calf herds, typically on pasture near streams. There are approximately 1,600 cow/calf head in the watershed area. These tend to be smaller operations that sell the calves in the fall. The pastures are typically overgrazed and near a natural water source with access to it. This causes accelerated streambank and streambed erosion. In addition, there are 16 feeder cattle operations in the watershed with a total of approximately 1,400 head in small lots. Also, there are two small sheep herds totaling 75 head. There are 10 hog operations in the watershed, mostly confinement, with approximately 12,000 head, mostly in finishing units. There is one large state permitted hog finishing operation in the watershed, and trends indicate that additional facilities may locate in the watershed in the future. State law requires that permitted operations apply livestock nutrients according to an IDNR approved nutrient management plan. Livestock manure is applied on cropland in agreement with other landowners. The amount of manure applied in the watershed may be more, or less, than the manure produced in the watershed.

Help Us Plan the West Tarkio Watershed Project

The West Tarkio Watershed sponsors have identified objectives for solving natural resource problems and for meeting community needs. These objectives are listed in red print below.

The NRCS is conducting studies to develop a watershed plan to meet these objectives. An Environmental Evaluation will be incorporated with the studies to identify the major positive and negative effects of each alternative plan developed.

If you have information to provide for consideration in planning studies or determining effects, please share it with us. List your information under each planning study area shown below. You can return the form today or mail to our office at the address printed on the back within 30 days.

Planning Studies and Sponsor Objectives

Flooding – Flood prevention

Water – Water supply for Clarinda, Shenandoah and surrounding rural areas

Recreation – Water-based recreation development

Streambank, channel erosion/Upland soil erosion – Land treatment

Fish and wildlife habitat/Wetlands/Threatened species – Fish and wildlife development

Cultural resources

Economic analysis

Other environmental and social issues

Want more information? Please send us your Name:
Mailing Address:
City, State, Zip:
Email:

Biology

State and Federally listed species for Page and Montgomery Counties, Iowa. Lists acquired from the Iowa DNR Species-at-Risk Mapper (http://igsims.igsb.uiowa.edu/website/species_risk/viewer.htm).

Montgomery County	Scientific Name	Common Name	State Status	Federal Status
Mammals	Synaptomys Cooperi	southern bog lemming	Threatened	
Birds	Tyto Alba	barn owl	Endangered	

Page County	Scientific Name	Common Name	State Status	Federal Status
Mammals	Synaptomys Cooperi	southern bog lemming	Threatened	
Birds	Asio Otus	long eared owl	Threatened	
Butterflies	Satyrium EdwardsII	Edward's hairstreak	Special Concern	
Plants	Veratrum WoodII	false hellebore	Threatened	

A listing of breeding birds, exotic plant species and noxious plants, Iowa DNR fish surveys, migratory birds, and butterfly species found in the watershed can be found on the web address below.

www. Address will be added later

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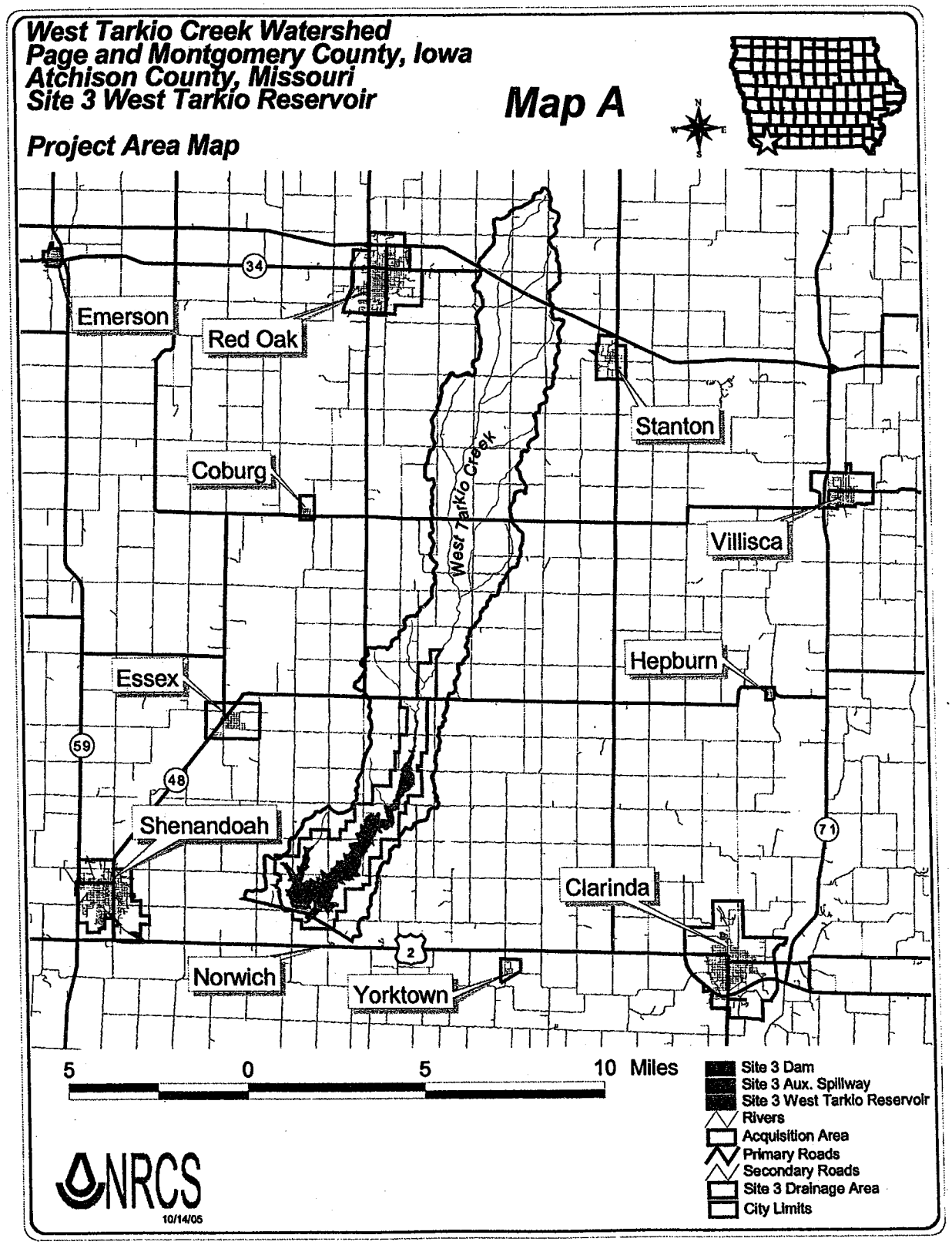
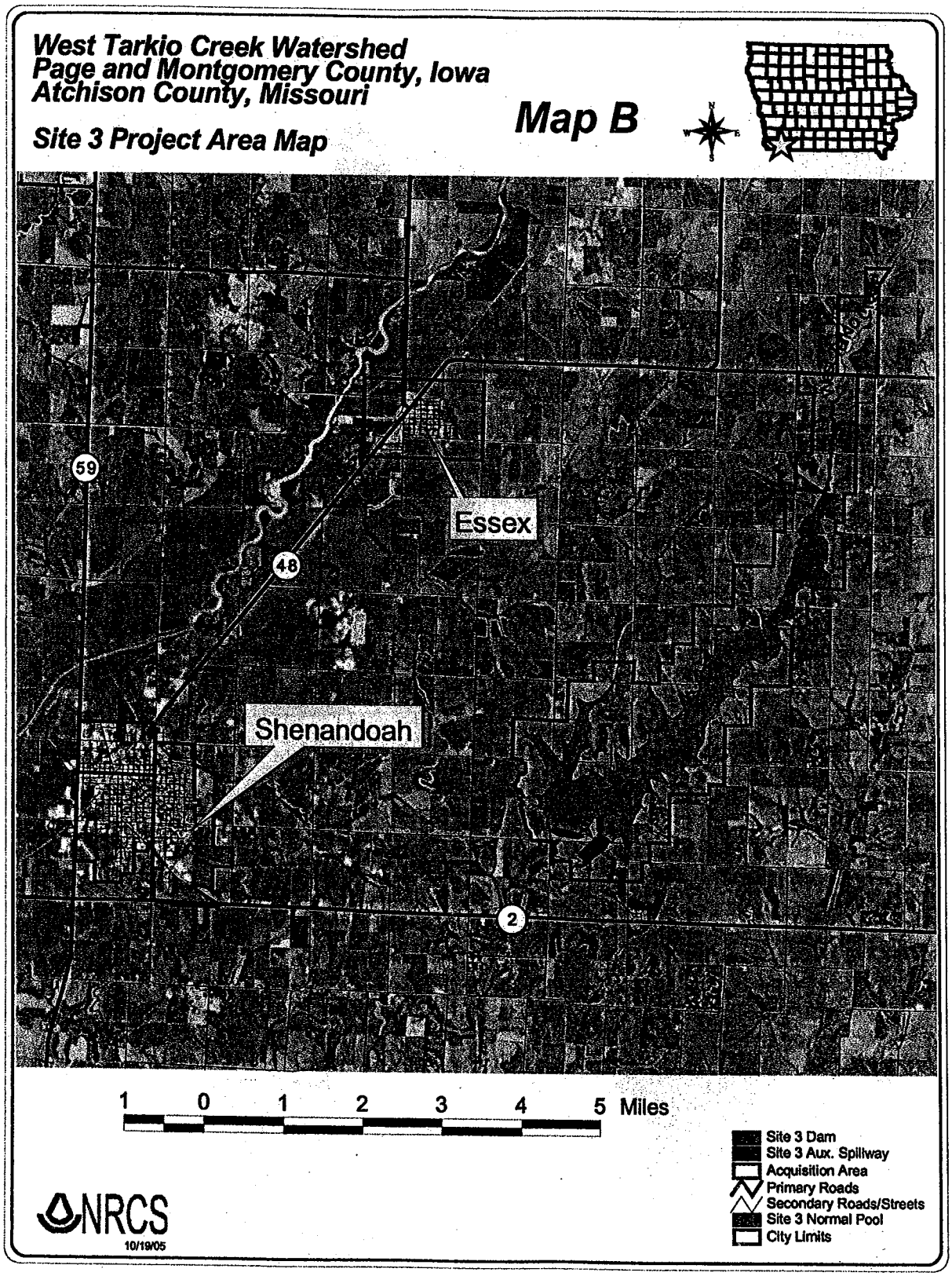
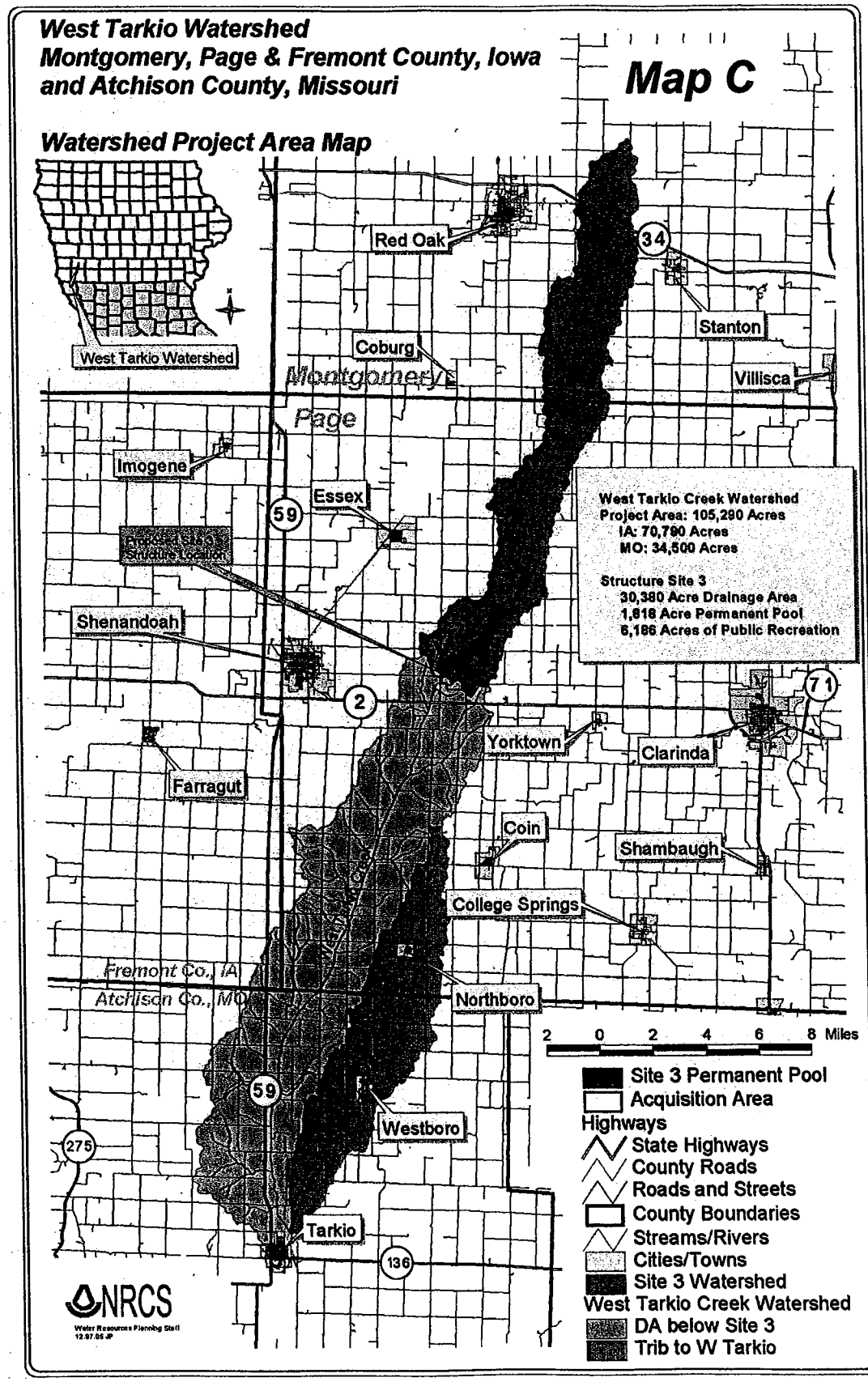
Appendix F – Project Map




West Tarkio Creek Watershed
Page and Montgomery County, Iowa
Atchison County, Missouri
Site 3 Project Area Map
Map B
59
48
2
Essex
Shenandoah
1 0 1 2 3 4 5 Miles
NRCS
10/19/05
Site 3 Dam
Site 3 Aux. Spillway
Acquisition Area
Primary Roads
Secondary Roads/Streets
Site 3 Normal Pool
City Limits


West Tarkio Watershed
Montgomery, Page & Fremont County, Iowa
and Atchison County, Missouri
Watershed Project Area Map
Map C
West Tarkio Watershed
Red Oak
Coburg
Montgomery
Page
Imogene
Essex
Shenandoah
Stanton
Villisca
Yorktown
Clarinda
Farragut
Coin
Shambaugh
College Springs
Fremont Co., IA
Atchison Co., MO
Northboro
Westboro
Tarkio
34
59
2
71
275
136
West Tarkio Creek Watershed
Project Area: 105,290 Acres
IA: 70,790 Acres
MO: 34,500 Acres
Structure Site 3
30,380 Acre Drainage Area
1,818 Acre Permanent Pool
6,186 Acres of Public Recreation
2 0 2 4 6 8 Miles
Site 3 Permanent Pool
Acquisition Area
Highways
State Highways
County Roads
Roads and Streets
County Boundaries
Streams/Rivers
Cities/Towns
Site 3 Watershed
West Tarkio Creek Watershed
DA below Site 3
Trib to W Tarkio
NRCS
Water Resources Planning Staff
12.97.05 JP