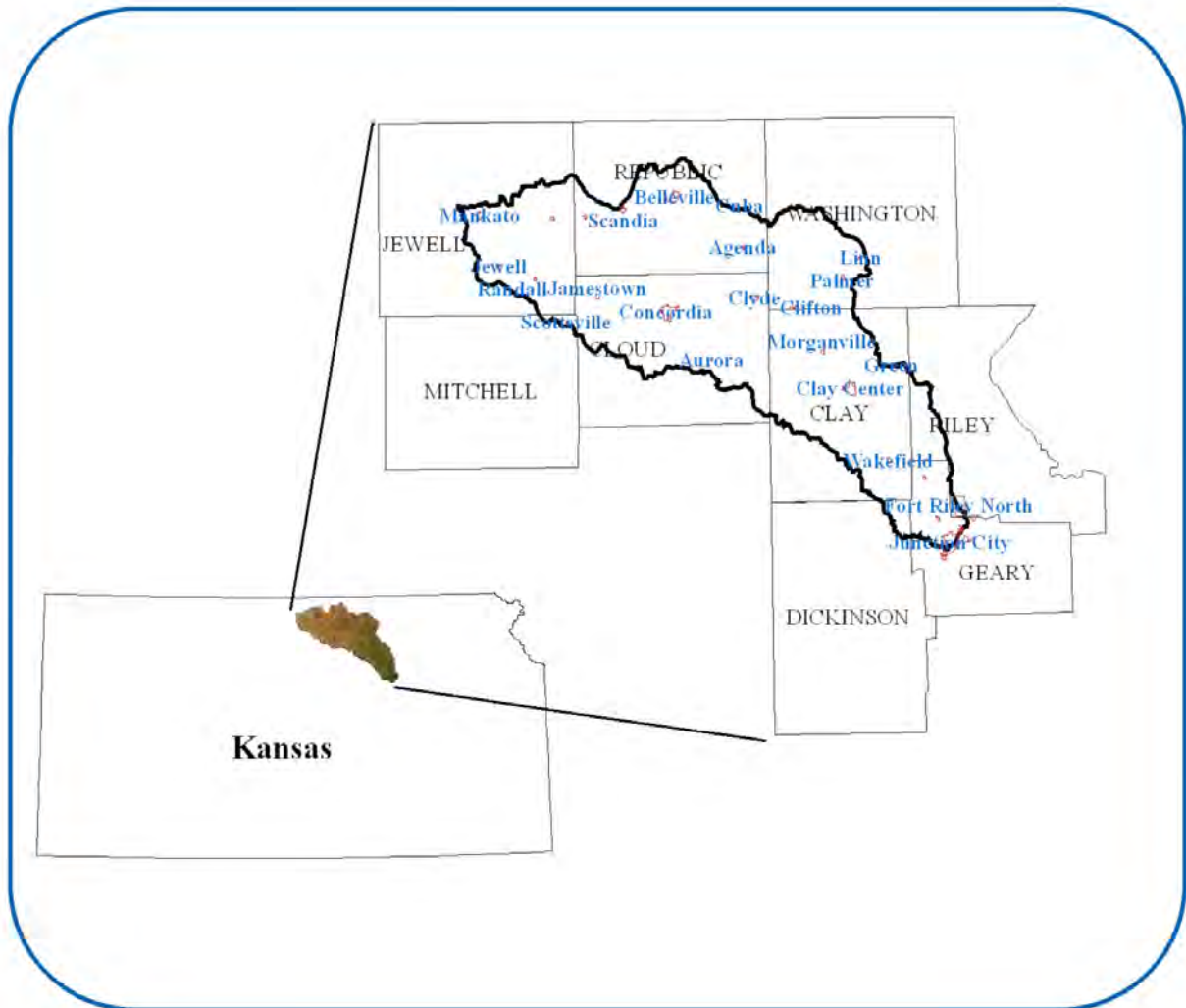


Milford Lake Watershed

Assessment: Preliminary Report



2009

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1.0 Milford (Lower Republican) Watershed Assessment

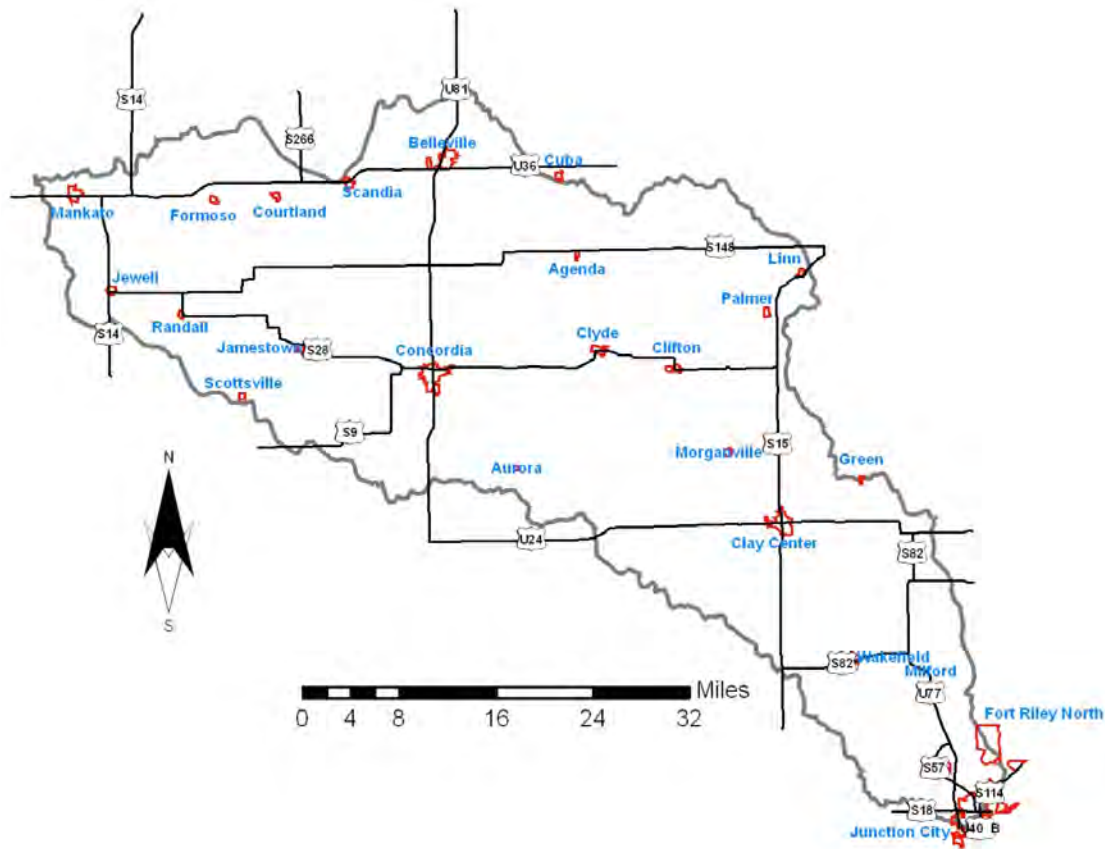


Figure 1. Major roads and cities – Milford Lake Watershed

1.1 Watershed Summary

Milford Reservoir is located in north central Kansas. It impounds 16,000 acres and has 163 miles of shoreline. Drainage originates from the upper reaches of the Republican River and its tributaries from Kansas, as well as the southern part of the state of Nebraska. The Lower Republican watershed has been issued a Category I designation by the Kansas Department of Health and Environment (KDHE) indicating that the watershed is in need of restoration and protection to sustain water quality.

Cropland in the Lower Republican Watershed is the predominant land usage covering 51 percent of land area. Grassland covers 36 percent of the land area. The grazing density is estimated at 30 to 34 animal units/sq. mile. Woodland, water and urban areas constitute the remaining 13 percent of land cover¹.

1.2 Overview of Water Quality Issues and Potential Pollution Sources

When river segments or lakes that are monitored by Kansas Department of Health and Environment (KDHE) have experienced poor quality, a Total Maximum Daily Load (commonly referred to as a TMDL) is established. A TMDL is the maximum amount of pollution that a surface water body can receive and still meet water quality standards.

Fecal Coliform Bacteria (FCB) is present in the digestive tract of all warm blooded animals including humans and animals (domestic and wild). FCB detection in water is a sign that the water has become contaminated with waste. While FCB is not itself harmful to humans, its presence indicates that disease causing organisms, or pathogens, may also be present. A few of these are Giardia, Hepatitis, and cryptosporidium. FCB is listed as a TMDL in the Republican River, Buffalo Creek, Salt Creek and Jamestown Wildlife Area. Potential sources of fecal coliform bacteria include failing septic systems, runoff from livestock production areas, close proximity of animals in riparian areas, and manure application to land if it is applied before a rainfall event or on frozen ground. TMDLs for fecal coliform bacteria have an upper limit of 200 cfu (colony forming units)/100ml of water for primary contact recreation, such as swimming, and an upper limit of 2,000 cfu/100ml of water for secondary, non-contact recreation, such as boating and fishing.

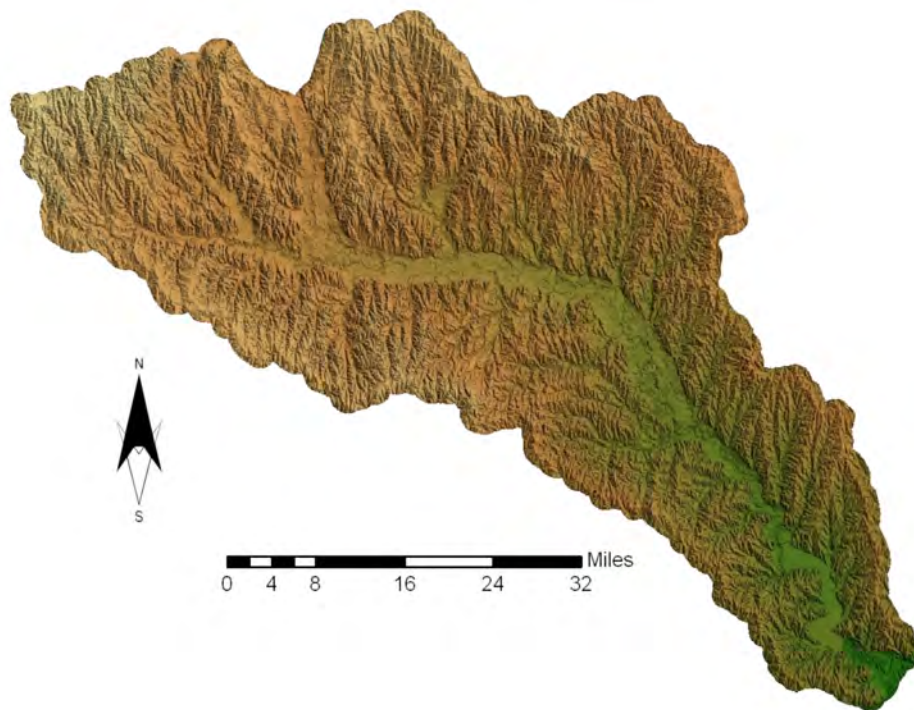


Figure 2. Relief Maps – Milford Lake Watershed ³

Low dissolved oxygen is an impairment in Salt Creek and Milford Reservoir. This has resulted in a TMDL aimed at increasing dissolved oxygen concentrations to provide full support of aquatic life. Riparian vegetation restoration, grass buffer strips along streams, proper manure storage and distribution, adequately functioning septic systems, and proper chemical fertilizer rates should help improve water quality and raise dissolved oxygen rates.

Chloride is a naturally occurring mineral found in Kansas lakes, streams, and groundwater. Due to elevated concentrations, it is listed as a TMDL in Buffalo Creek. Excess chloride in water can result from intrusion of leaching parent bedrock material. Concentrations of these minerals in the surface water may increase with low water flow and excessive irrigation.

Eutrophication is a primary pollutant for Milford Reservoir, Lake Jewell, Belleville City Lake and Jewell Wildlife Area. Excess nutrient loading from the watershed creates conditions favorable for algae blooms and aquatic plant growth resulting in low dissolved oxygen rates and an unfavorable habitat for aquatic life. Surplus nutrients originate from manure and fertilizer runoff in rural and urban areas. Many agricultural producers in the watershed implement best management practices (known as BMPs) to prevent nutrient runoff. Some common BMPs include: the use of conservation tillage and cover crops, maintaining buffer strips along field edges, and proper timing of fertilizer application. Jewell Wildlife Area also has TMDLs for pH and siltation².

2.0 Climate Mapping System

2.1 Precipitation Map⁴

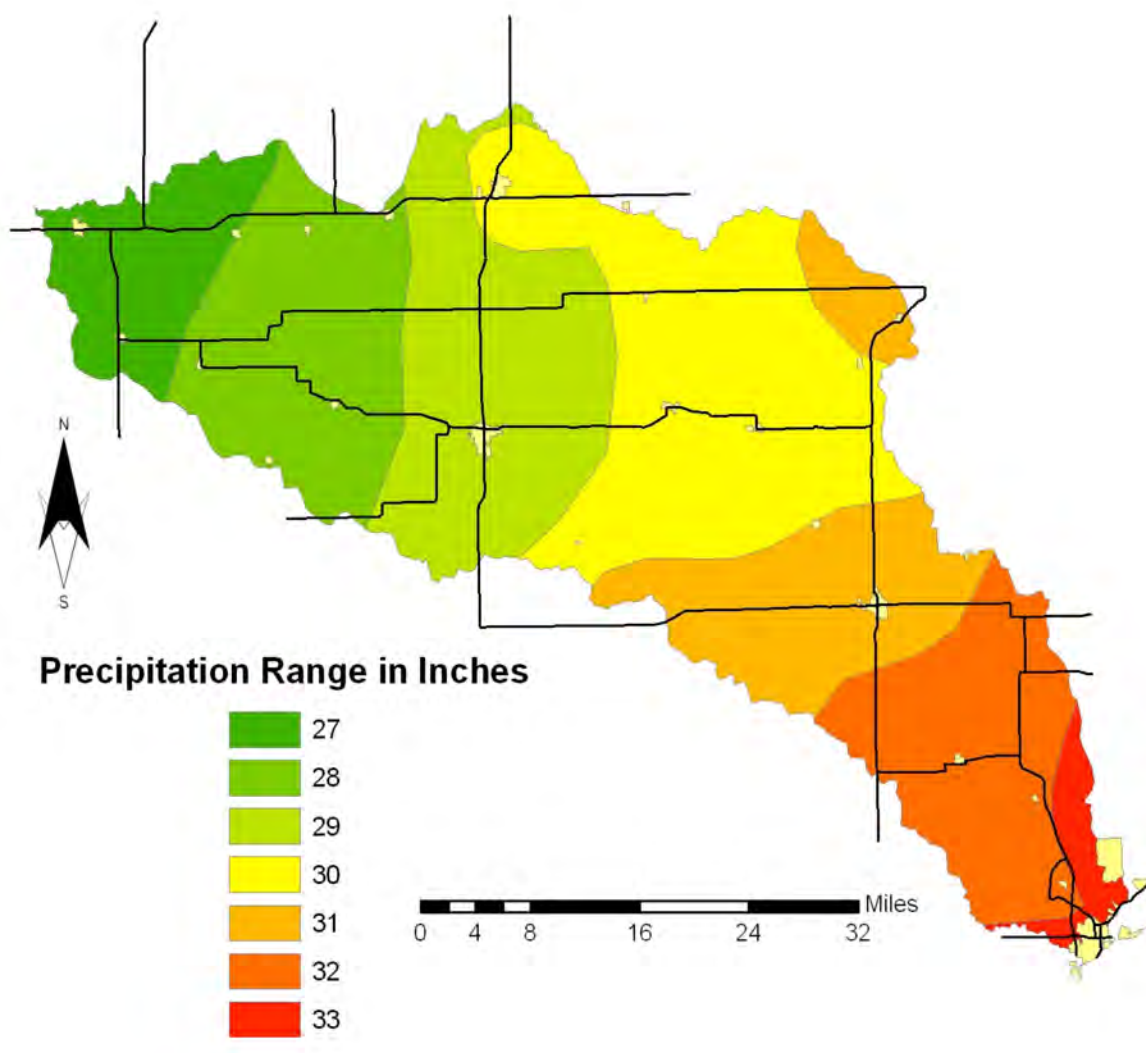


Figure3. 30-year average annual precipitation in inches, 1971 – 2000.

2.2 30-Year Average Daily Maximum Temperature Map⁵

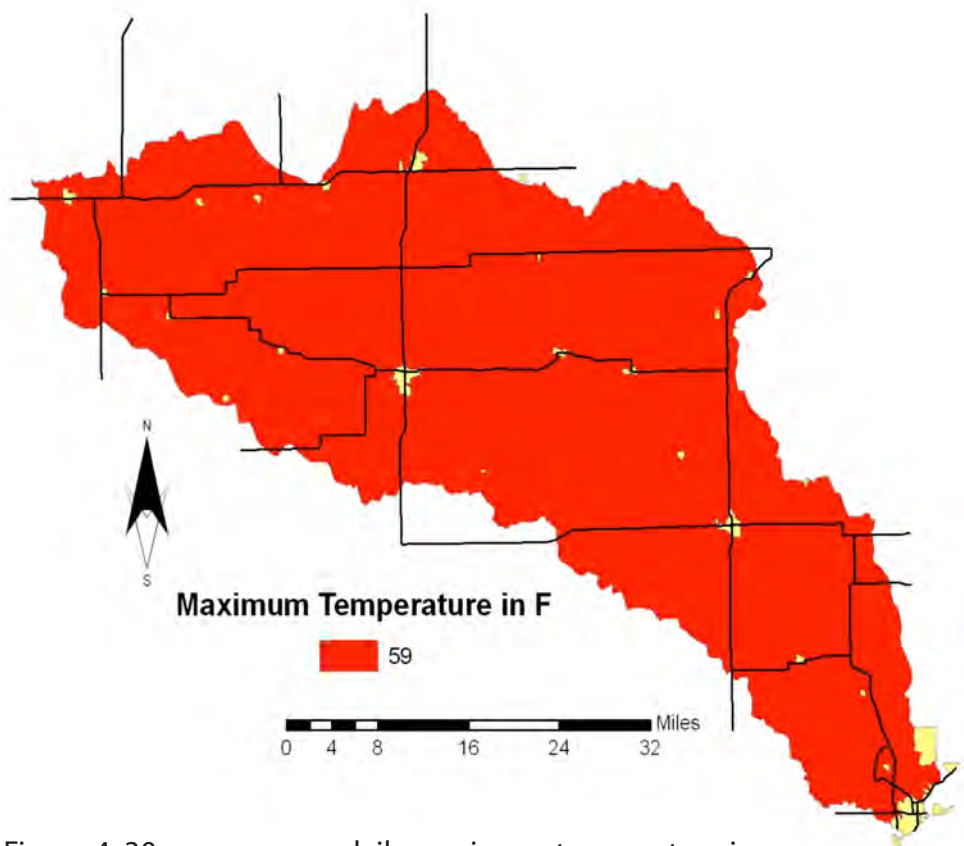


Figure 4. 30-year average daily maximum temperature in degrees Fahrenheit, 1971 – 2000

2.3 30-Year Average Daily Minimum Temperature Map⁶

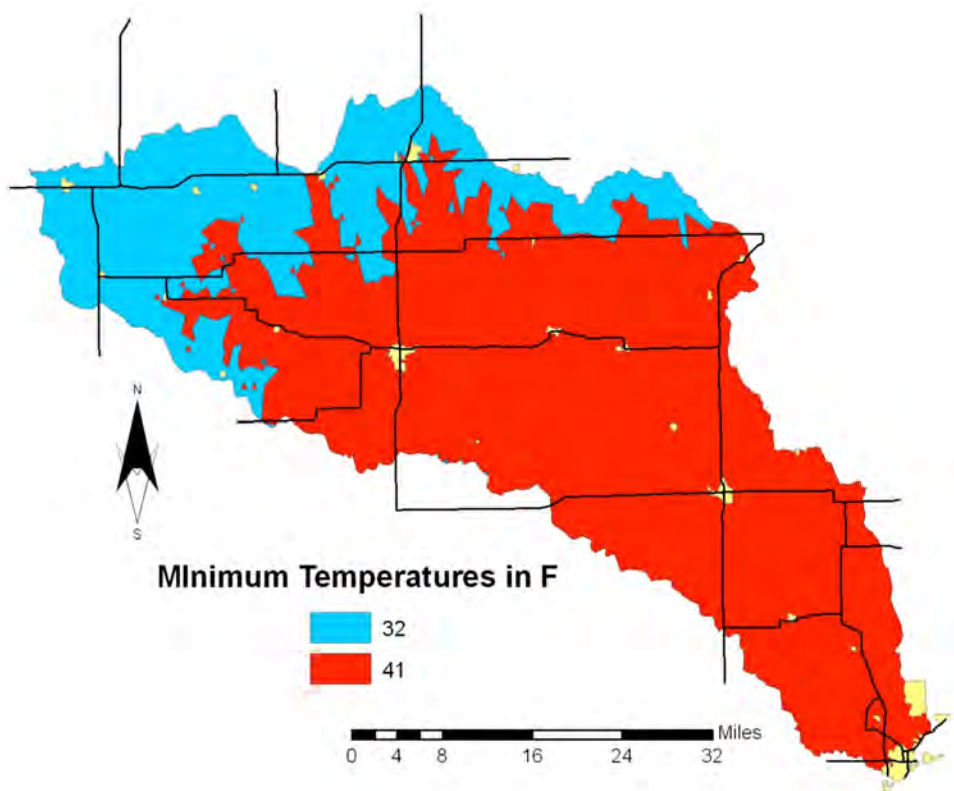


Figure 5. 30-year average daily minimum temperature in degrees Fahrenheit, 1971 – 2000

3.0 Land Use/ Land Cover

3.1 Land Use (GIRAS 1980s)⁷

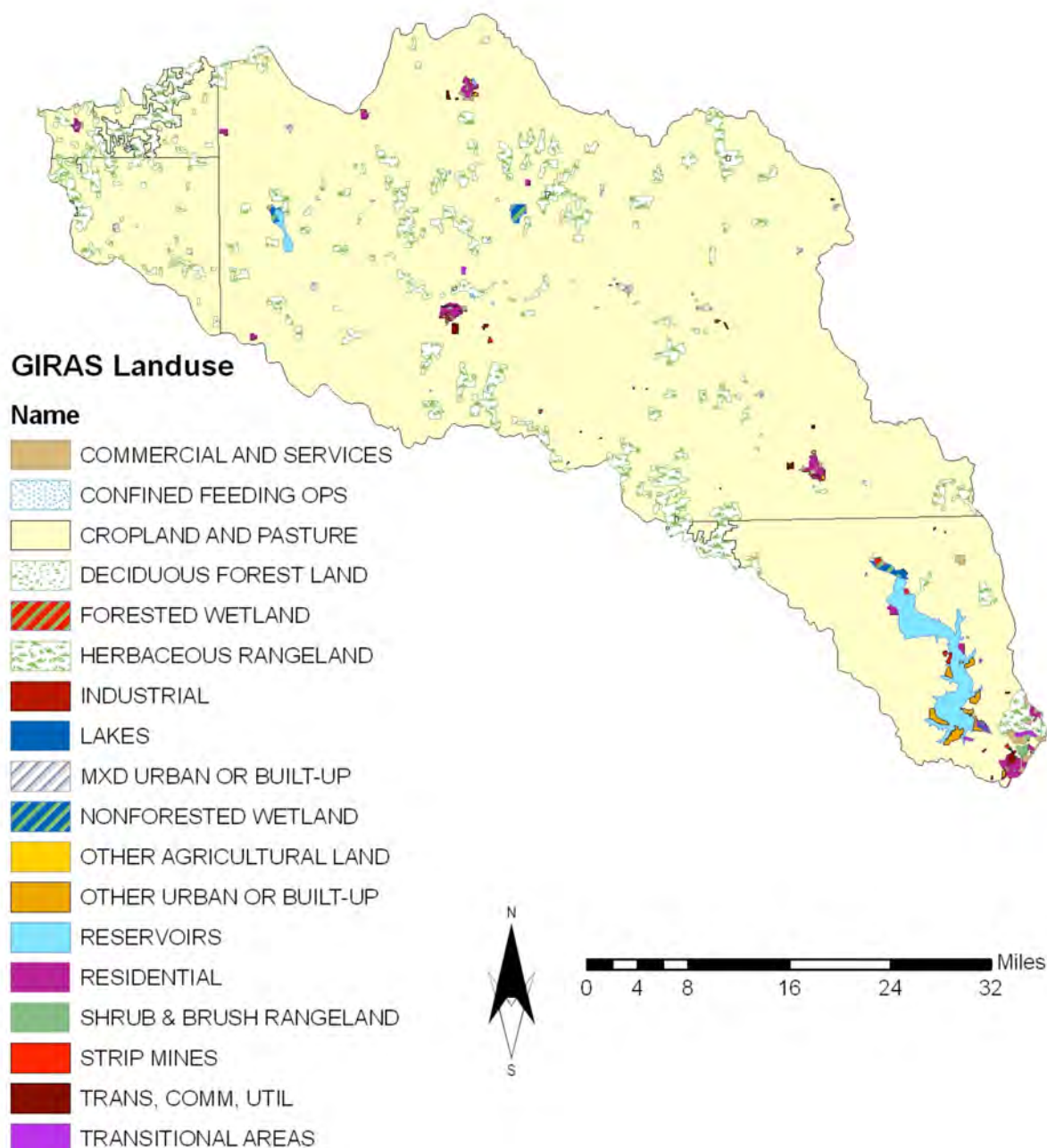


Figure 6. GIRAS 1980s land use classification.

3.2 Land Use (NLCD 1992)⁸

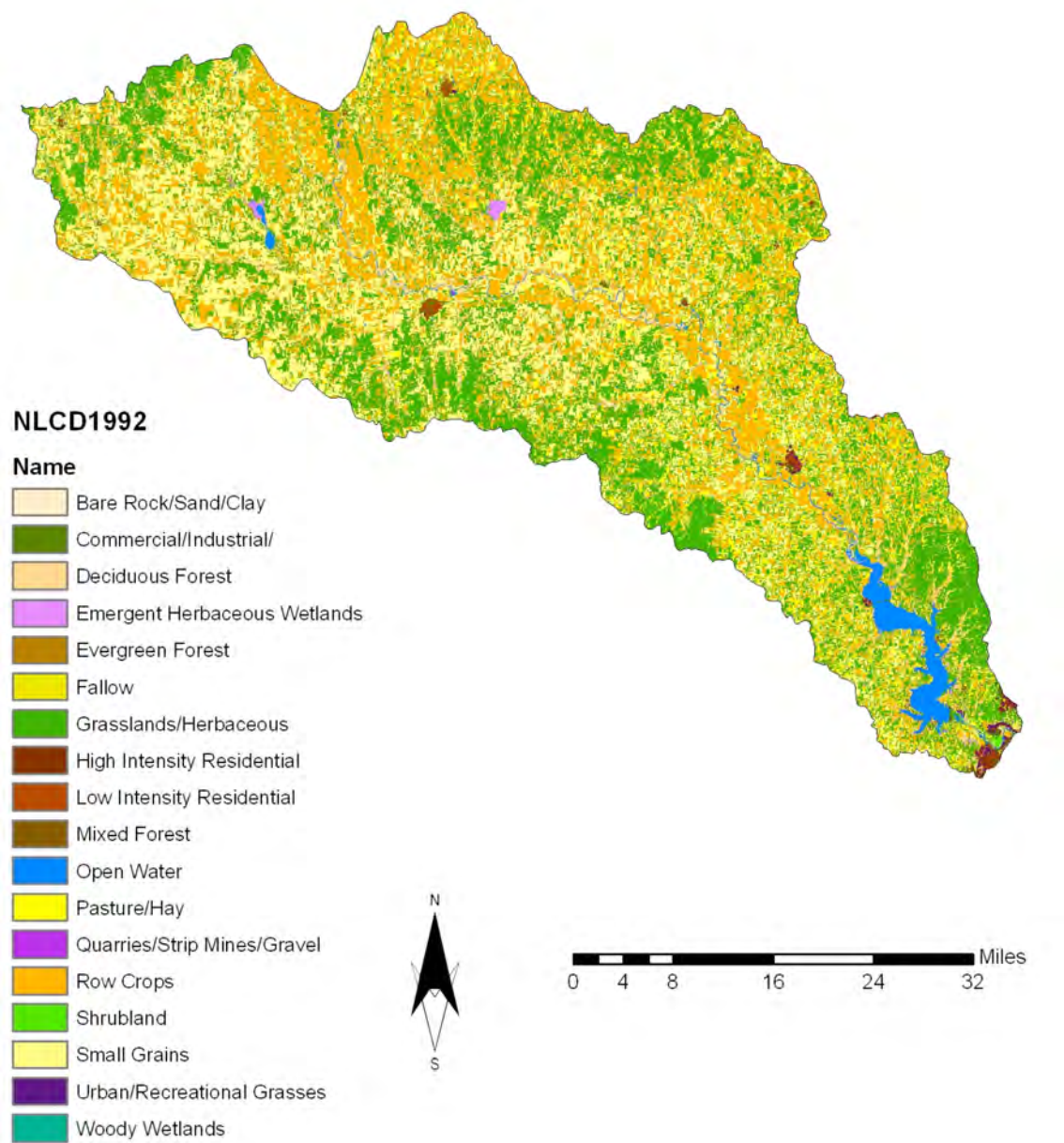


Figure 7. NLCD 1992 land use classification.

3.2.1 NLCD 1992 Land Cover Class Definitions³⁶

The following definitions are from the EPA's National Land Cover Database, found at: <http://www.epa.gov/mrlc/definitions.html#1992>

- 11. Open Water** – all areas of open water, generally with less than 25 percent cover of vegetation/land cover.
- 21. Low Intensity Residential** – Includes areas with a mixture of constructed materials and vegetation. Constructed materials account for 30-80 percent of the cover. Vegetation may account for 20 to 70 percent of the cover. These areas most commonly include single-family housing units. Population densities will be lower than in high intensity residential areas.
- 22. High Intensity Residential** – Includes highly developed areas where people reside in high numbers. Examples include apartment complexes and row houses. Vegetation accounts for less than 20 percent of the cover. Constructed materials account for 80 to 100 percent of the cover.
- 23. Commercial/Industrial/Transportation** – Includes infrastructure (e.g. roads, railroads, etc.) and all highly developed areas not classified as High Intensity Residential.
- 31. Bare Rock/Sand/Clay** – Perennially barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, beaches, and other accumulations of earthen material.
- 32. Quarries/Strip Mines/Gravel Pits** – Areas of extractive mining activities with significant surface expression.
- 41. Deciduous Forest** – Areas dominated by trees where 75 percent or more of the tree species shed foliage simultaneously in response to seasonal change.
- 42. Evergreen Forest** – Areas dominated by trees where 75 percent or more of the tree species maintain their leaves all year. Canopy is never without green foliage.
- 43. Mixed Forest** – Areas dominated by trees where neither deciduous nor evergreen species represent more than 75 percent of the cover present.
- 51. Shrubland** – Areas dominated by shrubs; shrub canopy accounts for 25-100 percent of the cover. Shrub cover is generally greater than 25 percent when tree cover is less than 25 percent. Shrub cover may be less than 25 percent in cases when the cover of other life forms (e.g. herbaceous or tree) is less than 25 percent and shrubs cover exceeds the cover of the other life forms.
- 71. Grasslands/Herbaceous** – Areas dominated by upland grasses and forbs. In rare cases, herbaceous cover is less than 25 percent, but exceeds the combined cover of the woody species present. These areas are not subject to intensive management, but they are often utilized for grazing.
- 81. Pasture/Hay** – Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops.
- 82. Row Crops** – Areas used for the production of crops, such as corn, soybeans, vegetables, tobacco, and cotton.
- 83. Small Grains** – Areas used for the production of graminoid crops such as wheat, barley, oats, and rice.
- 84. Fallow** – Areas used for the production of crops that do not exhibit visible vegetation as a result of being tilled in a management practice that incorporates prescribed alternation between cropping and tillage.
- 85. Urban/Recreational Grasses** – Vegetation (primarily grasses) planted in developed settings for recreation, erosion control, or aesthetic purposes. Examples include parks, lawns, golf courses, airport grasses, and industrial site grasses.
- 91. Woody Wetlands** – Areas where forest or shrubland vegetation accounts for 25-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.
- 92. Emergent Herbaceous Wetlands** – Areas where perennial herbaceous vegetation accounts for 75-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.

3.3 Land Use (NLCD 2001)¹

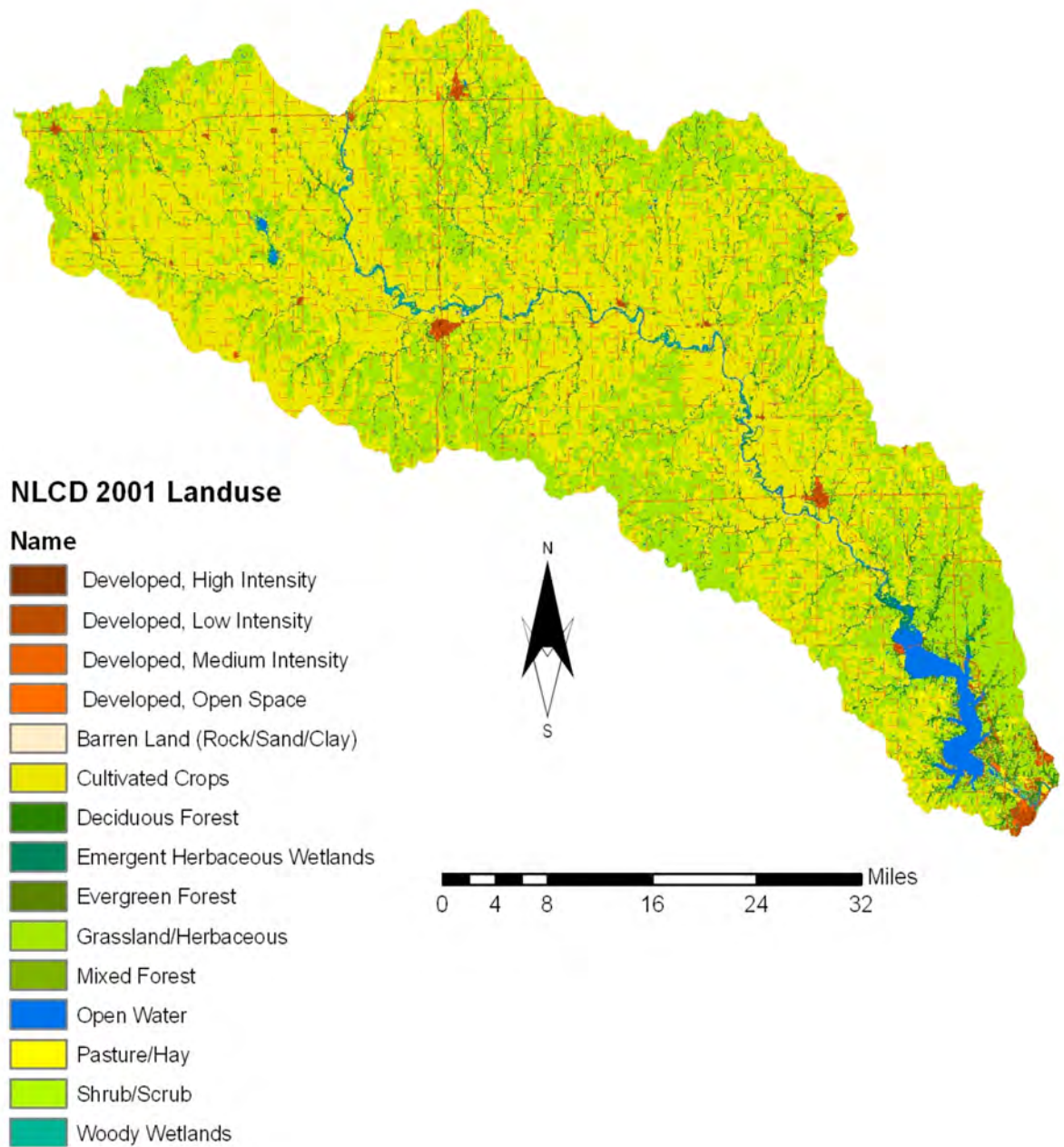


Figure 8. NLCD 2001 land use classification.

3.3.1 NLCD 2001 Land Cover Class Definitions³⁷

The following definitions are from the EPA's National Land Cover Database, found at: <http://www.epa.gov/mrlc/definitions.html#2001>

- 11. Open Water** – All areas of open water, generally with less than 25% cover of vegetation or soil.
- 21. Developed, Open Space** – Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
- 22. Developed, Low Intensity** – Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20–49 percent of total cover. These areas most commonly include single-family housing units.

- 23. Developed, Medium Intensity** – Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units.
- 24. Developed, High Intensity** – Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to 100 percent of the total cover.
- 31. Barren Land (Rock/Sand/Clay)** – Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.
- 41. Deciduous Forest** – Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species shed foliage simultaneously in response to seasonal change.
- 42. Evergreen Forest** – Areas dominated by trees generally greater than 5 meters tall, and greater than 20 percent of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.
- 43. Mixed Forest** – Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent of total tree cover.
- 52. Shrub/Scrub** – Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20 percent of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
- 71. Grassland/Herbaceous** – Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.
- 81. Pasture/Hay** – Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.
- 82. Cultivated Crops** – Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.
- 90. Woody Wetlands** – Areas where forest or shrubland vegetation accounts for greater than 20 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
- 92. Emergent Herbaceous Wetlands** – Areas where perennial herbaceous vegetation accounts for 75-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.

Table 1. Summary of land use covers

Land Use Type	Agriculture			Barren Land	Forest Land	Grass-land	Urban	Wet-lands/ Water	Shrub	Total
	Cropland	Pasture	Total							
GIRAS 1980s	1134592		1134592	1290	4877	96129	14153	20060	0	1271101
NLCD 1992	622089	131125	750548	381	58895	414937	9983	31336	5372	1271118
NLCD 2001	632139	10182	642321	141	62084	462316	67821	36273	74	1271030

4.0 River Network⁹

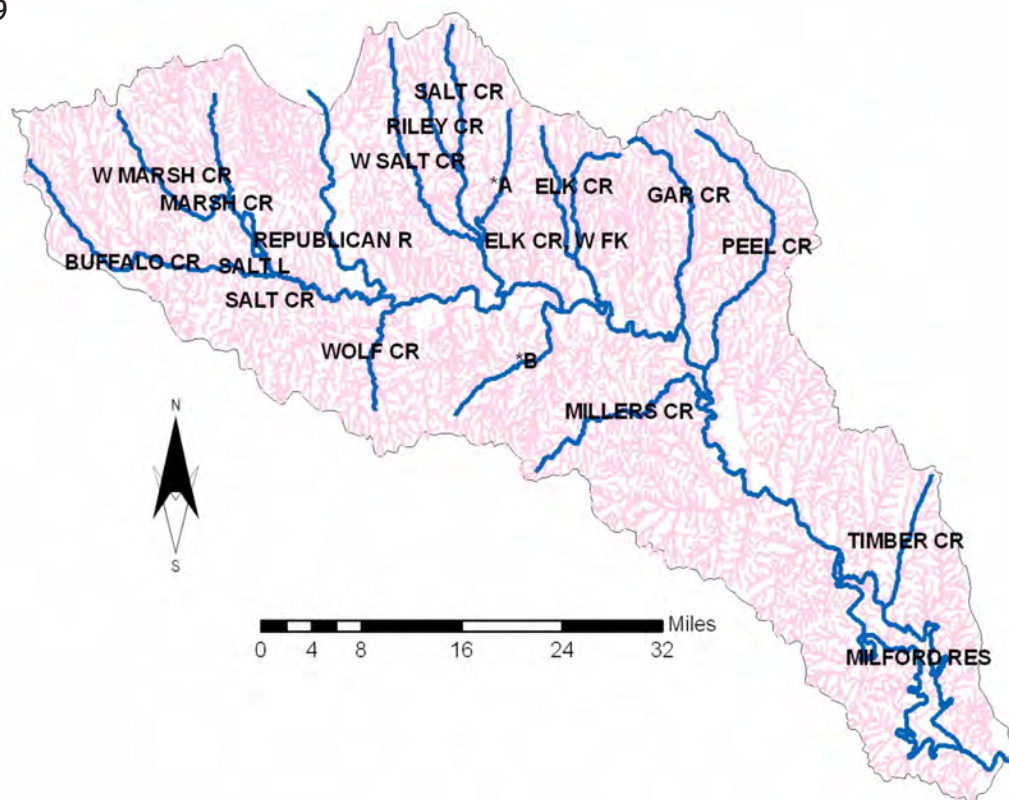


Figure 9. River network – Milford Lake Watershed

5.0 Hydrologic Soil Groups¹⁰

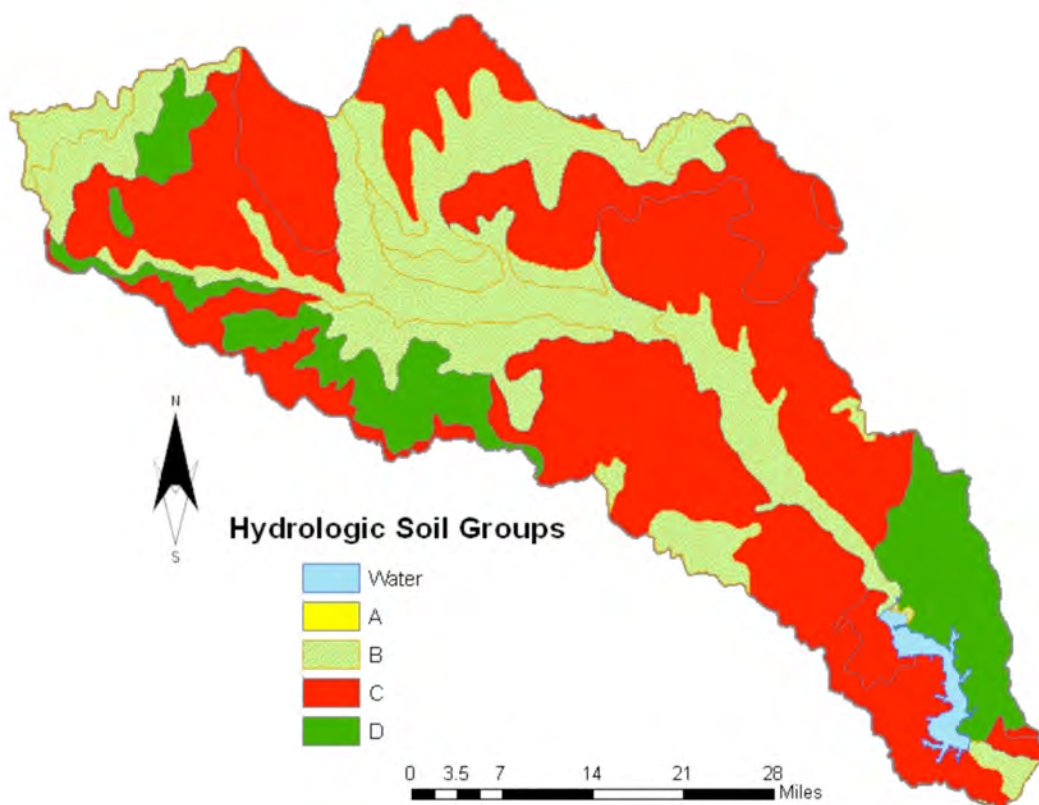


Figure 10. Hydrologic Soil Groups – SSURGO Database – Milford Lake Watershed

6.0 Water Quality Conditions

6.1 The 303d List of Impaired Waterbodies²

This map shows all impaired streams that are not meeting their designated uses (impaired waters) because of excess pollutants as defined in Section 303(d) of the Clean Water Act. The list of impaired waterways is updated by the states every two years. This can be used to identify specific stream segments and lakes for which, in accordance with their priority ranking, TMDLs may need to be developed.

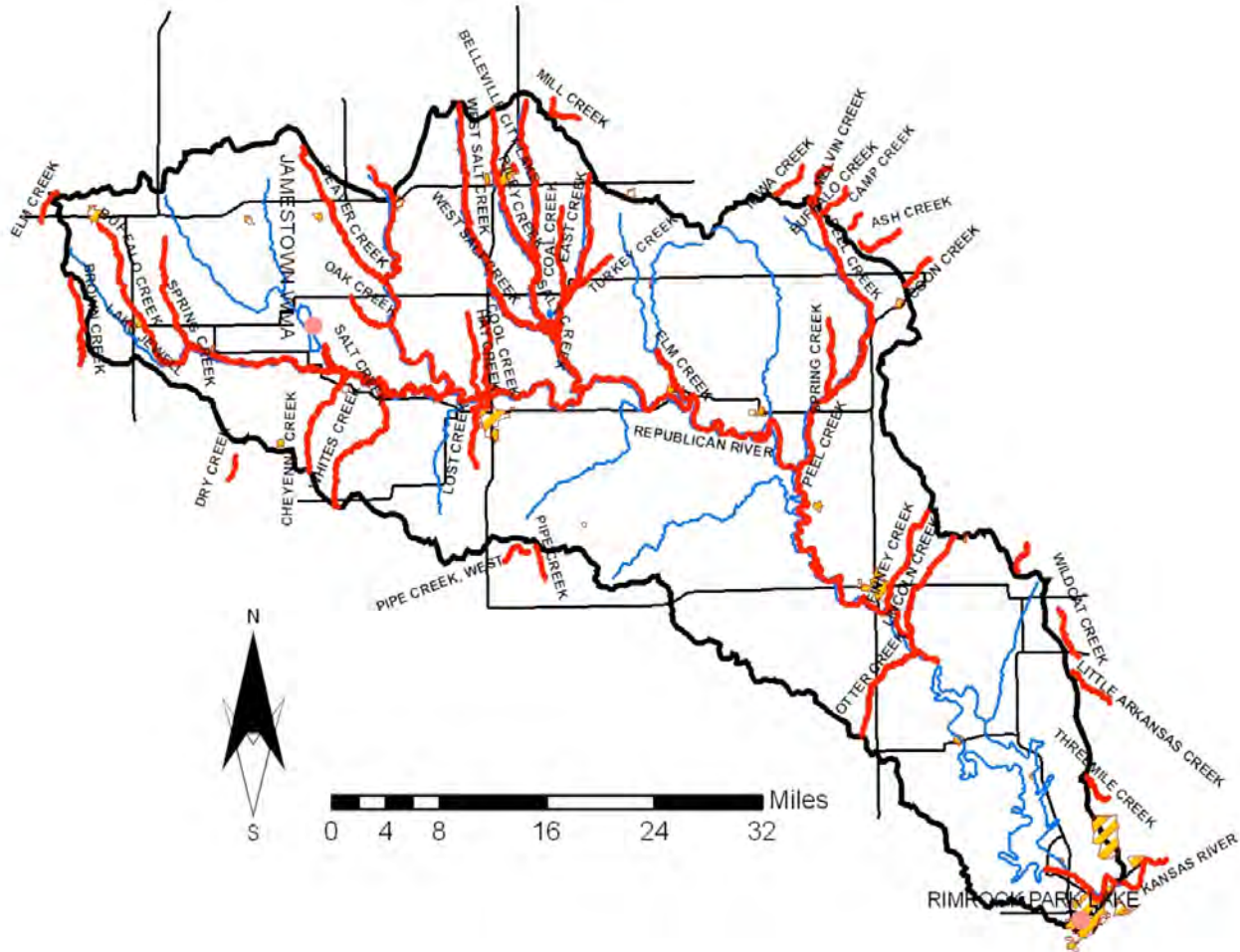


Figure 11. Impaired Waterbodies based on the 303d list – Milford Lake Watershed.

Table 2. The 303d List of Impaired Waterbodies

State	Waterbody Name	Impairment
KS	Republican River	Pathogens
KS	Buffalo Creek	Chlorine, Pathogens, Unionized Ammonia
KS	Spring Creek	Chlorine, Pathogens
KS	Peel Creek	Pathogens
KS	Salt Creek	Pathogens, Organic Enrichment/Low DO, Unionized Ammonia
KS	Riley Creek	Pathogens, Organic Enrichment/Low DO
KS	Salt Creek	Chlorine, Pathogens
KS	Beaver Creek	Pathogens
KS	Coal Creek	Pathogens, Organic Enrichment/Low DO
KS	Oak Creek	Pathogens
KS	Cool Creek	Pathogens
KS	Otter Creek	Pathogens
KS	Republican River	Pathogens, Unionized Ammonia
KS	West Salt Creek	Pathogens, Organic Enrichment/Low DO
KS	Whites Creek	Chlorine, Pathogens
KS	Cheyenne Creek	Chlorine, Pathogens
KS	Lincoln Creek	Pathogens
KS	East Creek	Pathogens, Organic Enrichment/Low DO
KS	Turkey Creek	Pathogens, Organic Enrichment/Low DO
KS	Lost Creek	Pathogens
KS	Hay Creek	Pathogens
KS	Belleville City Lake	Organic Enrichment/Low DO
KS	Finney Creek	Pathogens
KS	Lake Jewell	Organic Enrichment/Low Do, Nutrients
KS	Dry Creek	Pathogens
KS	Pipe Creek, West	Pathogens, Organic Enrichment/Low DO
KS	Pipe Creek	Pathogens, Organic Enrichment/Low DO
KS	Brown Creek	Pathogens, Organic Enrichment/Low DO
KS	Elm Creek	Metals, Pathogens, Organic Enrichment/Low DO
KS	Threemile Creek	Pathogens
KS	Little Arkansas Creek	Pathogens, Organic Enrichment/Low DO
KS	Wildcat Creek	Pathogens, Organic Enrichment/Low DO
KS	Kansas River	Chlorine, Sulfates, Pathogens
KS	Coon Creek	Pathogens
KS	Mill Creek	Pathogens
KS	Iowa Creek	Pathogens
KS	Ash Creek	Pathogens
KS	Melvin Creek	Pathogens
KS	Camp Creek	Pathogens
KS	Jamestown WMA	Ph, Sediment/Siltation, Organic Enrichment/Low DO, Pathogens
KS	Rimrock Park Lake	Organic Enrichment/Low DO, Other Cause

6.2 Water Quality Observation Stations¹¹

USEPA Observation-level water quality monitoring data is useful for identifying the location of water quality data in a given watershed.

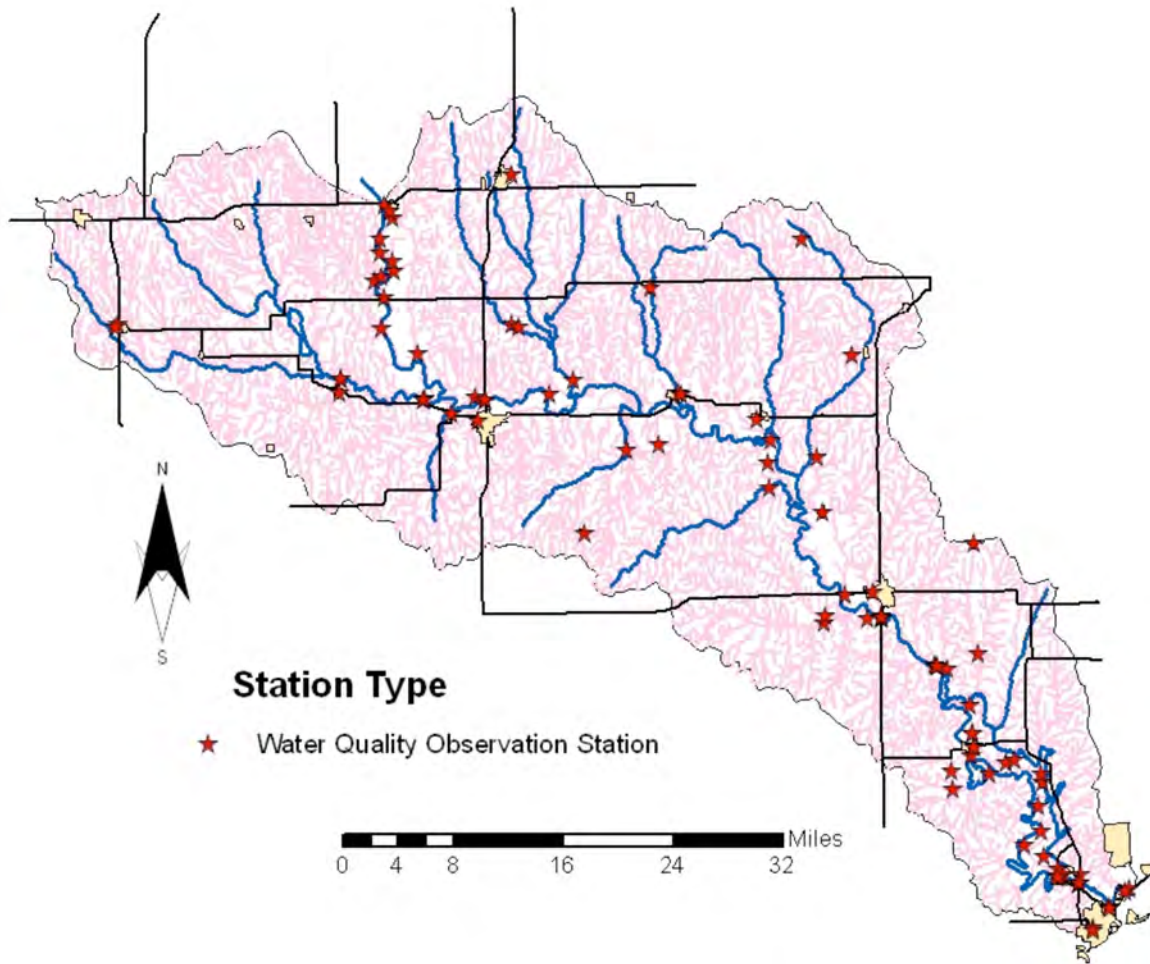


Figure 12. Lakes and Streams Water Quality Observation Stations – Milford Lake Watershed.

Table 3. Water Quality Observation Station

State	Agency	Station ID	Station Name
KS	US EPA	2009A1	Republican River
KS	US EPA	2009A2	Republican River
KS	US EPA	2009B1	Five Creeks
KS	US EPA	2009C1	Unnamed Stream
KS	US EPA	2009D1	Mall Creek
KS	US EPA	2009F1	Unnamed Creek
KS	US EPA	2009G1	Unnamed Creek
KS	US EPA	200901	Milford Reservoir
KS	US EPA	200902	Milford Reservoir
KS	US EPA	200903	Milford Reservoir
KS	US EPA	200904	Milford Reservoir
KS	STATE OF MICHIGAN National Sanitation Data	000025	Repub R At K18 In Junction City
KS	US EPA REGION 7	009487	Republican River
KS	US EPA REGION 7	009488	Republican River

State	Agency	Station ID	Station Name
KS	US EPA REGION 7	009489	Four Mile Creek
KS	US EPA REGION 7	009790	Buffalo Creek
KS	USGS	06854500	Republican R At Scandia, Ks
KS	USGS	06855800	Buffalo C Nr Jamestown, Ks
KS	USGS	06856000	Republican R At Concordia, Ks
KS	USGS	06856100	West C Nr Talmo, Ks
KS	USGS	06856320	Elk C At Clyde, Ks
KS	USGS	06856600	Republican R At Clay Center, Ks
KS	USGS	06857050	Milford Lk Nr Junction City, Ks
KS	USGS	06857100	Republican R Bl Milford Dam, Ks
KS	USGS	390238096494403	12S 05E 01Bba 03
KS	USGS	391036096544801	10S 05E 18Dcc 01
KS	USGS	391226097003201	10S 04E 05Cdb 01
KS	USGS	392549096595701	07S 04E 20Adc 01
KS	USGS	392656097314101	07S 02W 15Bad 01
KS	USGS	392802097121301	07S 02E 03Ccc 01
KS	USGS	393111097163601	06S 01E 24Bcb 01
KS	USGS	393229097252701	06S 01W 10Ccb 01
KS	USGS	393354097172401	06S 01E 02Bac 01
KS	USGS	393406097401401	05S 03W 32Ddd 01
KS	USGS	393538097233201	05S 01W 26Abd 01
KS	USGS	393538097402200	Hay C Nr Mile 99.3, Ks
KS	USGS	393603097512901	05S 05W 22Dad 01
KS	USGS	393754097093201	05S 02E 12Cba 01
KS	USGS	393827097450000	Grave C At Mile 106.2, Ks
KS	USGS	394005097475800	Oak C At Mile 111.0, Ks
KS	USGS	394030098093302	04S 08W 25Dab 02
KS	USGS	394202097474100	Republican R Nr Norway At Mile 113.4, Ks
KS	USGS	394222097255901	04S 01W 16Acc 01
KS	USGS	394307097483200	Beaver C At Mile 114.5, Ks
KS	USGS	394321097475800	Republican R Trib At Mile 115.2, Ks
KS	USGS	394340097465000	Republican R Trib At Mile 116.6, Ks
KS	USGS	394419097465900	Republican R At Mile 117.0, Ks
KS	USGS	394452097475800	Republican R Tr At Mile 118.2, Ks
KS	USGS	394518097133001	03S 02E 32Abb 01
KS	USGS	394544097475800	Republican R Trib At Mile 118.4, Ks
KS	USGS	394702097465900	School C At Mile 120.4, Ks
KS	USGS	394728097470701	03S 04W 17Dab 01
KS	ARMY CORPS OF ENG	190199	Republican R@Milford Res Outflow
KS	ARMY CORPS OF ENG	190414	Milford L 2.5Mi Uplake From Dam
KS	ARMY CORPS OF ENG	190415	Milford L Above Mouth/Farnum Cr.
KS	ARMY CORPS OF ENG	190416	Milford L 11 Mi Uplake From Dam
KS	ARMY CORPS OF ENG	190417	Milford L 12 Mi Uplake From Dam
KS	ARMY CORPS OF ENG	190418	Milford L 16 Mi Uplake From Dam
KS	ARMY CORPS OF ENG	190419	Republican R 1.2Mi S/Broughton,K
KS	ARMY CORPS OF ENG	190420	Republican R 2Mi Ne/Jct. City, K
KS	ARMY CORPS OF ENG	190421	Republican R 2.5Mi Nw/Jct City,K

State	Agency	Station ID	Station Name
KS	ARMY CORPS OF ENG	190422	Republucan R .7Mi S/Clay Center
KS	ARMY CORPS OF ENG	190811	Milford L Outlet Beach
KS	KDHE	000003	Republican River At Concordia
KS	KDHE	000142	Republican River At Junction City
KS	KDHE	000241	Republican River At Clay Center
KS	KDHE	000263	Republican R. Bl Milford Res.,Ks
KS	KDHE	000503	Republican River Below Clay Center
KS	KDHE	000504	Republican River Above Clay Center
KS	KDHE	000509	Buffalo Creek Near Concordia
KS	KDHE	000510	Republican River Near Rice
KS	KDHE	000649	Peats Creek Near Clifton
KS	KDHE	000650	Salt Creek Near Hollis
KS	KDHE	000707	Wolf Creek Near Concordia
KS	KDHE	000709	Elm Creek Near Ames
KS	KDHE	000710	Mulberry Creek Near Clifton
KS	KDHE	000711	Five Creek Near Clay Center
KS	KDHE	001400	Republican River Nr Clay Center
KS	KDHE	001401	Republican River Near Clifton
KS	KDHE	001402	Republican River At Concordia
KS	KDHE	001403	Buffalo Creek At Jamestown
KS	KDHE	001406	Republican R At Junction City
KS	KDHE	019001	Milford Reservoir Sta 1
KS	KDHE	019002	Milford Reservoir Sta 2
KS	KDHE	019003	Milford Reservoir Sta 3
KS	KDHE	019004	Milford Reservoir Sta 4
KS	KDHE	019005	Milford Reservoir Sta 5
KS	KDHE	019006	Milford Reservoir Sta 6
KS	KDHE	019011	Milford Lake/ Republican R. Inflow Station
KS	KDHE	019021	Milford Lake/ Republican R. Outflow Station
KS	KDHE	019022	Milford Lake/ Republican R. Outlet Channel
KS	KDHE	060701	Belleville City Lake Sta. 1
KS	KDHE	062901	Lake Jewell Sta. 1
KS	KDHE	070501	Rimrock Park Lake Sta. No. 1
KS	KDHE	070511	Rimrock Park Lake Inflow Sta. No. 11

6.3. USGS Gage Stations¹²

USGS inventory of surface water gaging station data including 7Q10 low and monthly mean stream flow.

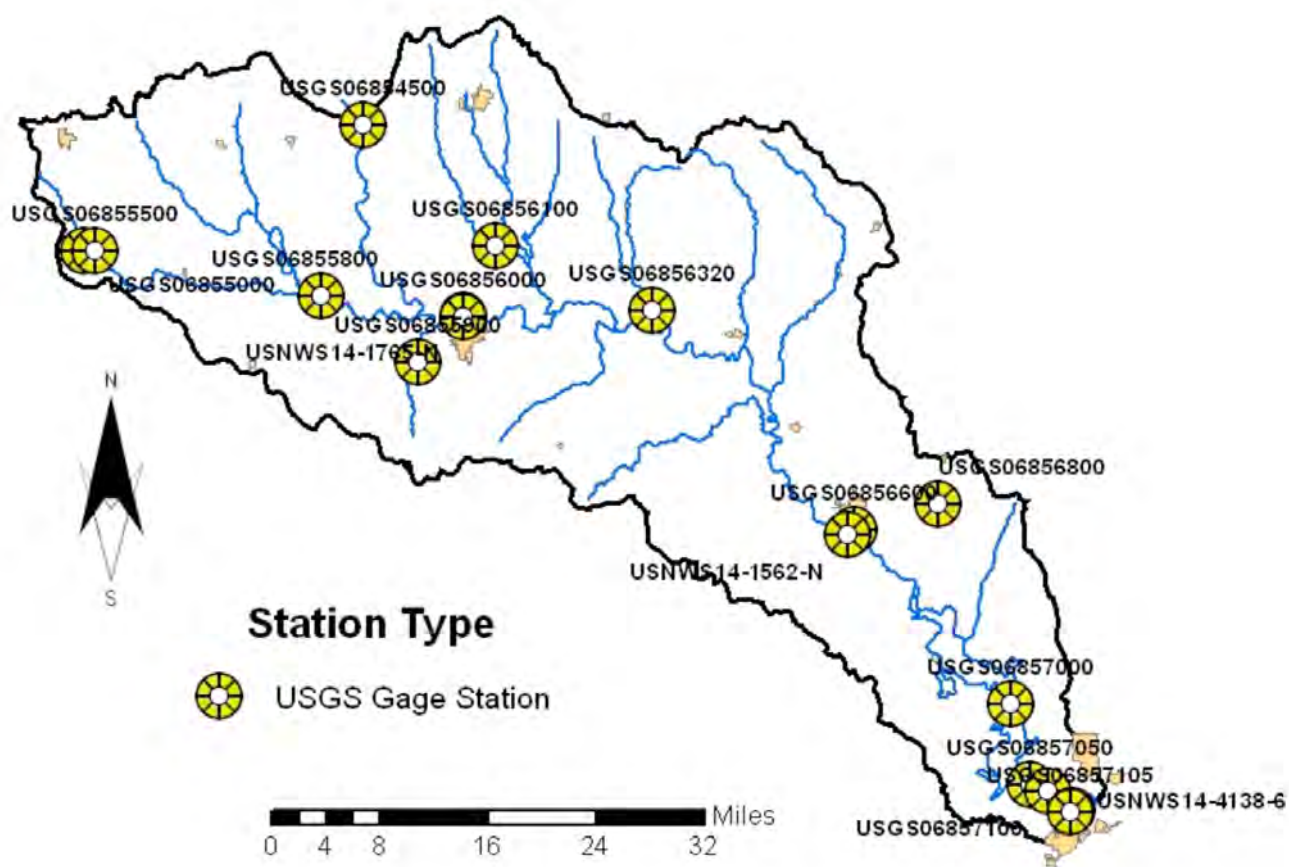


Figure 13. USGS Gage Stations – Milford Lake Watershed.

Table 4. USGS Gage Station¹²

Gage ID	Stream Flow (cfs)												
	Mean	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
USGS06854500	694.84	301.77	549.18	610.03	716.01	977.10	1867.92	1008.56	613.29	678.03	337.48	311.66	299.15
USGS06855000	2.52	0.00	0.14	0.02	0.00	11.07	11.05	0.09	0.57	7.33	0.00	0.00	0.00
USGS06855500	3.76	0.00	0.18	0.02	0.00	15.94	17.16	0.08	0.49	11.34	0.00	0.00	0.00
USGS06856100	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS06855800	69.39	33.55	44.21	99.72	57.09	76.31	119.84	76.78	65.51	120.84	95.40	24.32	13.22
USNWS14-1765-N	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS06856320	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS06856000	726.40	289.79	525.31	769.60	710.51	862.46	1535.18	1261.84	656.08	786.15	616.71	374.63	285.02
USGS06855900	11.16	5.42	9.93	19.17	10.91	12.63	21.28	12.11	8.97	13.31	10.42	5.11	4.02
USGS06856800	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS06856600	1009.76	400.09	684.04	972.04	1019.18	1408.57	2490.50	1560.23	934.89	1065.96	698.99	459.42	387.50
USNWS14-1562-N	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS06857000	1280.77	397.52	616.82	1104.82	1031.71	2413.54	3126.24	2772.60	1084.84	1400.51	607.18	430.97	352.88
USGS06857050	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS06857100	863.50	407.16	623.60	1292.52	912.40	934.67	1054.72	1313.13	688.00	749.51	824.70	1007.84	509.64
USNWS14-4138-6	-	-	-	-	-	-	-	-	-	-	-	-	-
USGS06857105	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5. Estimated peak-streamflow frequencies for selected gaging stations with at least 10 years of annual peak-discharge data for unregulated, rural streams in Kansas¹³

USGS ID	Station Name	Drainage Area (mi ²)	2-year ft ³ /s	5-year ft ³ /s	10-year ft ³ /s	25-year ft ³ /s	50-year ft ³ /s	100-year ft ³ /s	200-year ft ³ /s
6855800	Buffalo Creek near Jamestown	330	1670	3890	6140	10100	14000	18900	25000
6856320	Elk Creek at Clyde	73	546	1350	2170	3640	5100	6910	9150
6855900	Wolf Creek near Concordia	56	910	1770	2490	3570	4490	5520	6640
6856800	Moll Creek near Green	3.6	371	809	1190	1750	2230	2750	3320

Table 6. USGS gaging stations period of record for Milford Lake¹²

USGS ID	Drainage Area (mi ²)	Period of record	
		Begin	End
USGS06854500	16060	08/27/1919	09/30/1972
USGS06855000	15.2	03/31/1934	06/30/1938
USGS06855500	16.8	09/30/1934	06/30/1938
USGS06855800	330	06/30/1959	06/30/1990
USGS06856000	16060	03/31/1946	Present
USGS06855900	56	03/31/1962	11/06/1981
USGS06856600	17042	05/31/1917	Present
USGS06857000	24900	04/01/1895	03/31/1964
USGS06857100	24890	10/01/1963	Present
USGS06857105	24906	10/01/1994	09/30/1995

6.4 Permitted Point Source Facilities¹⁴

NPDES permit-holding facility information; contains parameter-specific loadings to surface waters computed using the EPA Effluent Decision Support System (EDSS) for 1990–1999. The summary of discharge concentrations and loads allows the user to perform a planning-level assessment of the magnitude and severity of point source contributions. Analyzing the data for different years can provide information to evaluate changes in contributions from various point sources over time and support trend analysis.

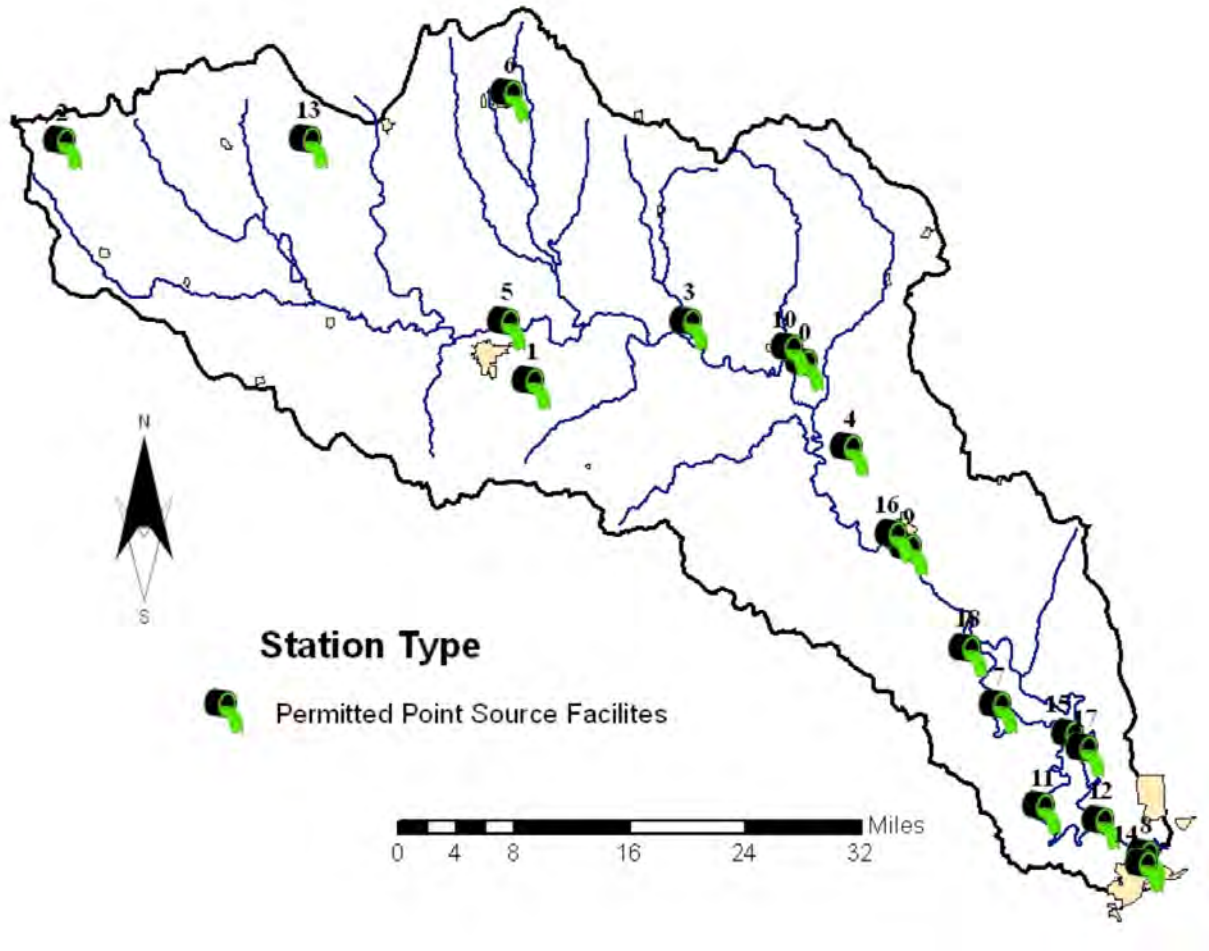


Figure 14. NPDES permit-holding facilities – Milford Lake Watershed.

Table 7. Permitted Point Source Facilities¹⁴

ID	NPDES	Facility Name	Ownership	Description	Industrial Classification	City	County	Flow Rate (million gallons/day)
0	KS0001988	Northern Natural Gas Clifton	Private	Natural Gas Transmission	Not ON Elg	Clifton	Washington	0.00000
1	KS0002682	General Finance Inc Clay Pits	Private	Clay, Ceramic & Refrac Mat Nec	ON Elg	Concordia	Cloud	0.00000
2	KS0021385	Mankato City Of Stp	Public	Sewerage Systems	Municipal	Mankato	Jewell	0.20000
3	KS0022403	Clyde City Of Stp	Public	Sewerage Systems	Municipal	Clyde	Cloud	0.00000
4	KS0024678	Morganville City Of Stp	Public	Sewerage Systems	Municipal	Morganville	Clay	0.00000
5	KS0025577	Concordia City Of Stp	Public	Sewerage Systems	Municipal	Concordia	Cloud	1.35000
6	KS0027529	Belleville City Of Stp	Public	Sewerage Systems	Municipal	Belleville	Republic	0.00000
7	KS0027545	Wakefield City Of Stp	Public	Sewerage Systems	Municipal	Wakefield	Clay	0.08000
8	KS0034011	Junction City-City Of Stp	Public	Sewerage Systems	Municipal	Junction City	Geary	7.00000
9	KS0048399	Clay Center City Of Stp	Public	Sewerage Systems	Municipal	Clay Center	Clay	0.71000
10	KS0048437	Clifton City Of Stp	Public	Sewerage Systems	Municipal	Clifton	Washington	0.01000
11	KS0079197	Geary Cnty Sewer Dist #4	Public	Sewerage Systems	Municipal	Geary County	Geary	0.01000
12	KS0083275	Milford Fish Hatchery	Private	Fish Hatcheries And Preserves	Not On El	Milford	Geary	0.00000
13	KS0083399	Courtland Wwt Facility	Private	Sewerage Systems	Not On El	Courtland	Republic	0.00000
14	KS0085898	Fina Oil \7	Private	Petroleum Refining	Primary O			0.00000
15	KS0086231	Milford Wwtf	Public	Sewerage Systems	Municipal	Milford	Geary	5.80000
16	KS0090018	Valley Fertilizer	Pub /Pri			Clay Center	Clay	0.00000
17	KS0090891	Ps Quarry	Private			Chapman	Geary	0.00000
18	KS0117340	Hamm N R Quarry Wakefield #80	Private	Crushed & Broken Limestone	On Elg	Clay Center	Clay	0.00000

6.5 Confined Animal Feeding Operations (CAFOs)¹⁵

Animal feeding operations classified as large or presenting a high risk to discharge can be classified as CAFOs and are likely required to have an NPDES permit. This map shows the locations and permit numbers for these sites in the Milford Lake Watershed.

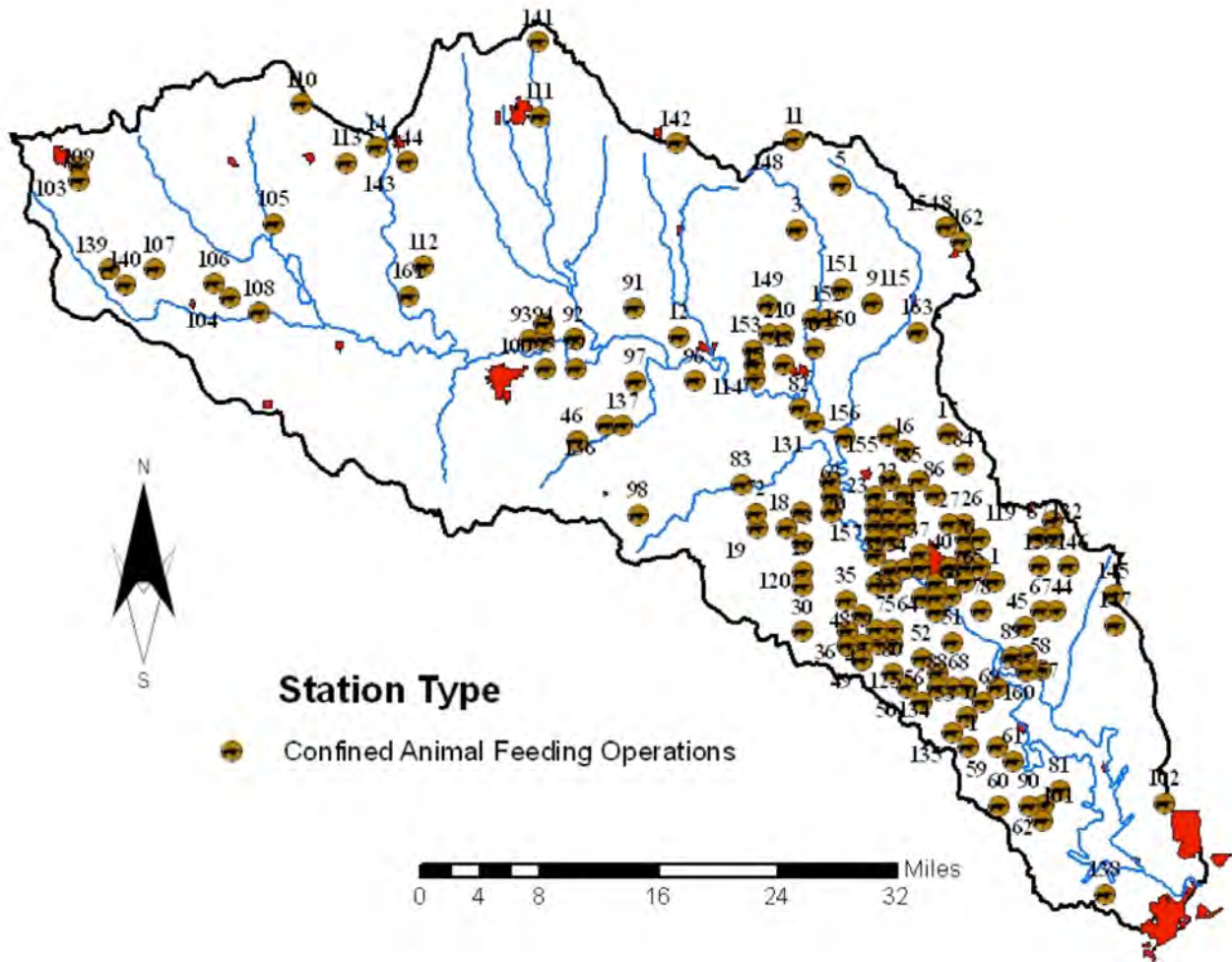


Figure 15. Confined Animal Feeding Operations facilities – Milford Lake Watershed.

Table 8. Confined Animal Feeding Operations¹⁵

ID	Permit No.	Total Head	Animal Unit System Kansas	Animal Unit System Federal	Animal Type
0	A-LRWS-H005	3940	1576	1576	Swine
1	A-LRCY-P001	79000	2607	0	Chickens
2	A-LRWS-H002	14030	3158	2340	Swine
3	A-LRWS-H006	4800	1920	1920	Swine
4	A-LRCD-H002	3600	1440	1440	Swine
5	A-BBWS-H005	3600	1440	1440	Swine
6	A-LRCD-H003	3600	1440	1440	Swine
7	A-LRCY-H004	3900	1200	1080	Swine
8	A-LRWS-D001	1500	2100	2100	Dairy
9	A-LRWS-H007	8000	3200	3200	Swine
10	A-LRWS-H008	8000	3200	3200	Swine
11	A-LRWS-H009	5940	2520	2580	Swine, Beef
12	A-LRCD-C001	1700	1275	1700	Beef
13	A-LRWS-H001	5675	1640	1430	Swine
14	A-LRRP-C001	25000	25000	25000	Beef
15	A-LRCY-BA09	150	150	150	Beef
16	A-LRCY-BA61	120	90	120	Beef
17	A-LRCY-BA35	400	400	400	Beef
18	A-LRCY-BA44	200	200	200	Beef
19	A-LRCY-BA56	225	225	225	Beef
20	A-LRCY-BA57	50	50	50	Beef
21	A-LRCY-EA03	300	0	0	Exotic
22	A-LRCY-BA42	175	175	175	Beef
23	A-LRCY-BA50	80	80	80	Beef
24	A-LRCY-BA66	448	338	448	Beef
25	A-LRCY-BA15	100	100	100	Beef
26	A-LRCY-SA05	250	100	100	Swine
27	A-LRCY-BA28	150	150	150	Beef
28	A-LRCY-SA04	500	200	200	Swine
29	A-LRCY-BA18	130	130	130	Beef
30	A-LRCY-BA64	60	45	60	Beef
31	A-LRCY-BA48	60	60	60	Beef
32	A-LRCY-BA32	550	550	550	Beef
33	A-LRCY-BA54	500	500	500	Beef
34	A-LRCY-SA06	50	20	20	Swine
35	A-LRCY-MA02	50	70	70	Dairy
36	A-LRCY-BA45	500	500	500	Beef
37	A-LRCY-SA03	357	143	143	Swine
38	A-LRCY-BA26	200	200	200	Beef
39	A-LRCY-BA38	10	10	10	Beef
40	A-LRCY-BA47	130	130	130	Beef
41	A-LRCY-BA25	200	200	200	Beef
42	A-LRCY-BA40	70	70	70	Beef
43	A-LRCY-BA37	150	150	150	Beef
44	A-LRCY-BA65	120	90	120	Beef

ID	Permit No.	Total Head	Animal Unit System Kansas	Animal Unit System Federal	Animal Type
45	A-LRCY-BA52	600	600	600	Beef
46	A-LRCY-BA24	200	200	200	Beef
47	A-LRCY-BA19	50	50	50	Beef
48	A-LRCY-BA12	250	250	250	Beef
49	A-LRCY-BA11	250	250	250	Beef
50	A-LRCY-BA68	100	100	100	Beef
51	A-LRCY-BA14	250	250	250	Beef
52	A-LRCY-BA08	450	250	290	Beef, Swine
53	A-LRCY-BA71	250	163	250	Beef
54	A-LRCY-BA20	100	100	100	Beef
55	A-LRCY-BA16	150	150	150	Beef
56	A-LRCY-BA69	50	25	50	Beef
57	A-LRCY-BA41	80	80	80	Beef
58	A-LRCY-BA62	200	100	200	Beef
59	A-LRCY-BA02	250	250	250	Beef
60	A-LRCY-BA05	250	250	250	Beef
61	A-LRCY-BA03	250	250	250	Beef
62	A-LRCY-BA63	100	100	100	Beef
63	A-LRCY-BA17	150	150	150	Beef
64	A-LRCY-MA03	30	42	42	Dairy
65	A-LRCY-BA58	250	250	250	Beef
66	A-LRCY-BA59	250	250	250	Beef
67	A-LRCY-BA70	200	200	200	Beef
68	A-LRCY-BA27	350	350	350	Beef
69	A-LRCY-BA13	100	100	100	Beef
70	A-LRCY-BA39	150	150	150	Beef
71	A-LRCY-BA72	100	75	100	Beef
72	A-LRCY-BA22	250	250	250	Beef
73	A-LRCY-BA43	325	325	325	Beef
74	A-LRCY-BA10	400	400	400	Beef
75	A-LRCY-BA67	765	443	765	Beef
76	A-LRCY-BA29	200	200	200	Beef
77	A-LRCY-BA60	700	650	700	Beef
78	A-LRCY-BA53	600	600	600	Beef
79	A-LRCY-BA30	275	275	275	Beef
80	A-LRCY-BA31	150	150	150	Beef
81	A-LRCY-BA33	250	250	250	Beef
82	A-LRCY-BA04	500	500	500	Beef
83	A-LRCY-BA21	200	200	200	Beef
84	A-LRCY-BA46	125	125	125	Beef
85	A-LRCY-BA49	50	50	50	Beef
86	A-LRCY-BA51	80	80	80	Beef
87	A-LRCY-SA07	950	380	380	Swine
88	A-LRCY-BA36	125	125	125	Beef
89	A-LRCY-BA55	300	300	300	Beef
90	A-LRCY-BA34	100	100	100	Beef
91	A-LRCD-BA02	750	750	750	Beef

ID	Permit No.	Total Head	Animal Unit System Kansas	Animal Unit System Federal	Animal Type
92	A-LRCD-BA07	290	290	290	Beef
93	A-LRCD-BA01	600	600	600	Beef
94	A-LRCD-BA08	290	290	290	Beef
95	A-LRCD-BA04	300	300	300	Beef
96	A-LRCD-BA03	400	400	400	Beef
97	A-LRCD-MA04	50	70	70	Dairy
98	A-LRCD-MA02	60	84	84	Dairy
99	A-LRCD-BA09	800	545	800	Beef
100	A-LRCD-BA06	575	575	575	Beef
101	A-LRDK-BA01	200	200	200	Beef
102	A-LRGE-BA01	400	400	400	Beef
103	A-LRJW-BA11	205	148	205	Beef
104	A-LRJW-BA07	600	300	600	Beef
105	A-LRJW-MA01	40	56	56	Dairy
106	A-LRJW-BA08	600	300	600	Beef
107	A-LRJW-BA01	250	250	250	Beef
108	A-LRJW-BA02	200	200	200	Beef
109	A-LRJW-BA06	200	200	200	Beef
110	A-LRRP-LA01	1600	355	430	Sheep, Beef
111	A-LRRP-MA02	25	35	35	Dairy
112	A-LRRP-BA07	240	240	240	Beef
113	A-LRRP-BA03	300	300	300	Beef
114	A-LRWS-BA04	150	150	150	Beef
115	A-LRWS-MA01	50	70	70	Dairy
116	A-LRCY-S052	425	170	0	Swine
117	A-LRCY-S050	3645	999	846	Swine
118	A-LRCY-S051	1540	391	316	Swine
119	A-LRCY-S012	1404	331	254	Swine
120	A-LRCY-B004	180	120	180	Beef
121	A-LRCY-BD02	300	300	300	Beef
122	A-LRCY-M003	220	227	264	Dairy
123	A-LRCY-B003	639	641	641	Beef, Horses
124	A-LRCY-S049	386	58	26	Swine
125	A-LRCY-S047	536	76	30	Swine
126	A-LRCY-S053	1915	556	486	Swine
127	A-LRCY-S013	1574	408	334	Swine
128	A-LRCY-BD01	280	280	280	Beef
129	A-LRCY-S054	1788	553	102	Swine, Beef
130	A-LRCY-S056	2800	940	880	Swine
131	A-LRCY-B001	450	400	450	Beef, Kennel
132	A-LRCY-S031	2218	788	725	Swine, Beef
133	A-LRCY-S023	2390	875	870	Swine, Beef
134	A-LRCY-B002	300	150	300	Beef
135	A-LRCY-S005	360	99	84	Swine
136	A-LRCD-S006	1000	280	240	Swine
137	A-LRCD-S007	696	218	198	Swine
138	A-LRGE-M001	200	280	280	Dairy

ID	Permit No.	Total Head	Animal Unit System Kansas	Animal Unit System Federal	Animal Type
139	A-LR JW-B005	400	400	400	Beef
140	A-LR JW-B006	999	999	999	Beef
141	A-LRRP-B002	999	999	999	Beef
142	A-LRRP-B004	999	999	999	Beef
143	A-LRRP-B001	999	500	999	Beef
144	A-LRRP-B003	999	999	999	Beef
145	A-KSRL-S001	1379	462	412	Swine, Beef
146	A-LRRL-S001	1728	391	291	Swine
147	A-KSRL-S003	860	297	290	Swine, Beef
148	A-LRWS-S028	2770	688	548	Swine
149	A-LRWS-S021	859	110	32	Swine
150	A-LRWS-S029	4450	820	500	Swine
151	A-LRWS-S005	740	308	368	Swine, Beef
152	A-LRWS-S018	240	96	96	Swine
153	A-LRWS-S023	1270	331	272	Swine
154	A-LRWS-S013	535	223	265	Swine, Beef
155	A-LRCY-S037	1625	372	290	Swine, Beef
156	A-LRCY-S043	750	75	0	Swine
157	A-LRCY-S041	914	174	110	Swine
158	A-LRCY-M004	126	143	158	Dairy
159	A-LRCY-M005	180	180	220	Dairy
160	A-LRCY-S022	3100	940	840	Swine
161	A-LRCD-B001	999	999	999	Beef
162	A-BBWS-S049	500	200	200	Swine
163	A-LRWS-S024	2400	720	640	Swine

6.6 1990 Population and Sewerage by Census Tract¹⁶

The 1990 Population and Sewerage by Census Tract can be used to examine specific areas for population density and the prevalence of septic systems, which can be significant sources of pathogens, household chemicals, and nutrients (especially nitrate) escaping into groundwater and nearby receiving water bodies.

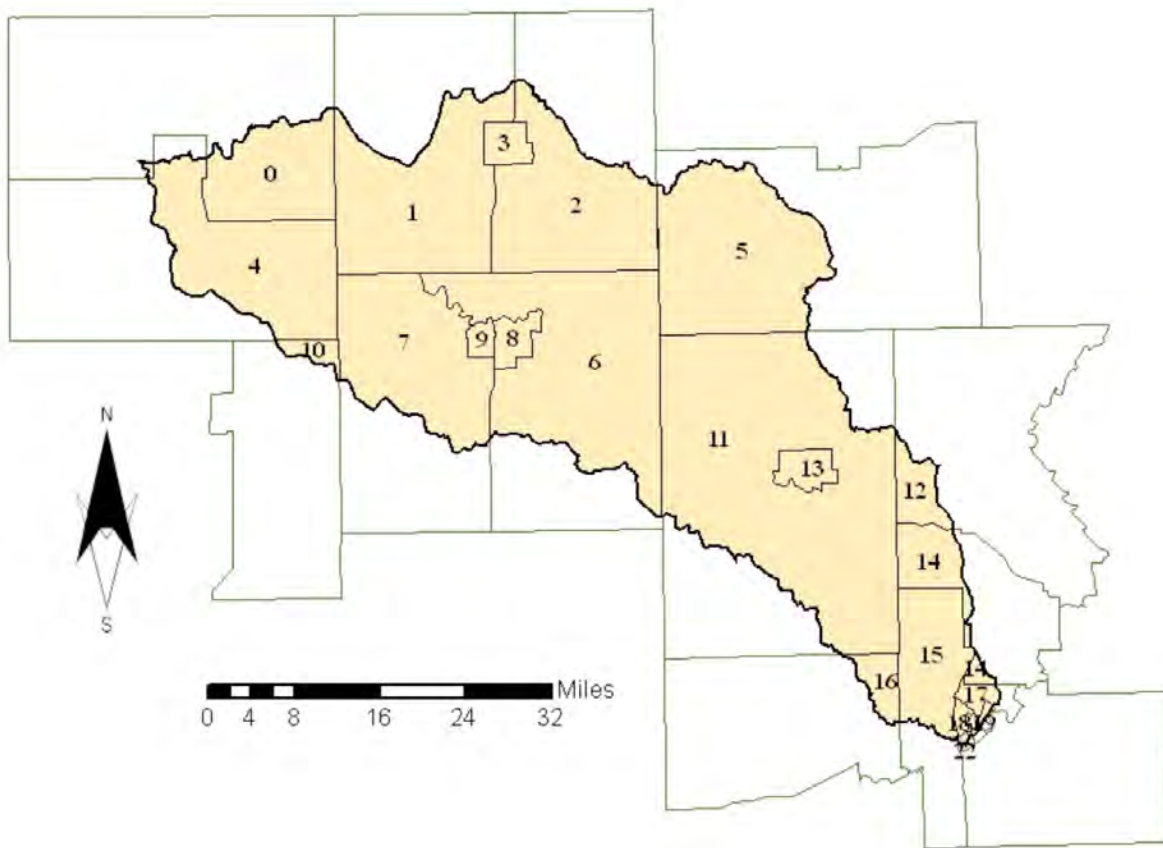


Figure 16. Population and Sewerage by Census – Milford Lake Watershed.

Table 9. 1990 Population and Sewerage by Census Tract¹⁶

ID	Tract	Population	House Units	Sewerage Public	Sewerage Septic	Sewerage Other
0	9761	1658	1038	369	541	128
1	9782	2147	1130	535	548	47
2	9781	1652	812	352	405	55
3	9783	2683	1341	1248	93	0
4	9762	2593	1371	883	447	41
5	9787	3129	1479	813	634	32
6	9771	2774	1362	695	651	16
7	9774	1719	845	508	322	15
8	9772	2830	1255	1170	78	7
9	9773	3700	1736	1658	73	5
10	9766	4858	2183	1805	366	12
11	9581	4271	1831	711	1099	21
12	0001	6191	2758	1437	1257	64
13	9582	4887	2307	2120	187	0
14	0010	13408	2114	2068	35	11
15	0008	2970	1143	539	597	7
16	9841	3455	1403	610	782	11
17	0006	4804	1003	978	19	6
18	0003	3962	1664	1613	51	0
19	0001	3741	1660	1650	10	0
20	0002	3435	1559	1514	6	39
21	0005	3724	1748	1694	54	0
22	0004	5493	2162	2142	20	0

7.0. Agricultural Economy

7.1 Corn Cost-Return Budget¹⁷

Table 10. Cost-return projections for corn crops in the Milford Lake Watershed, 2006.

Corn	Yield Level (bu)		
	88	110	133
Income Per Acre			
A. Yield per acre	88	110	133
B. Price per bushel	\$2.73	\$2.73	\$2.73
C. Net government payment	\$12.51	\$13.60	\$14.69
D. Indemnity payments			
E. Miscellaneous income			
F. Returns/acre ((AxB)+C+D+E)	\$252.75	\$313.90	\$377.78
Costs Per Acre			
1. Seed	\$51.57	\$51.57	\$51.57
2. Herbicide	30.80	30.80	30.80
3. Insecticide/Fungicide			
4. Fertilizer and Lime	35.36	44.82	54.80
5. Crop Consulting			
6. Crop Insurance			
7. Drying	11.44	14.30	17.29
8. Miscellaneous	8.25	8.25	8.25
9. Custom Hire / Machinery Expense	65.27	71.63	78.28
10. Non-machinery Labor	7.38	8.09	8.85
11. Irrigation			
12. Land Charge/Rent	48.80	61.00	73.20
G. Sub Total	\$258.86	\$290.46	\$323.04
13. Interest on ½ Nonland Costs	8.94	9.68	10.46
H. Total Costs	\$267.80	\$300.15	\$333.50
I. Returns Over Costs (F-H)	-\$15.05	\$13.75	\$44.28
J. Total Costs/bushel (H/A)	\$3.04	\$2.73	\$2.51
K. Return To Annual Cost (I+13)/G	-2.36%	8.07%	16.95%

Table 11. Northeast Kansas Farm Management Association profit Center Analysis: 5-year Average and 2006 Nonirrigated Corn.²⁶

	2001-2005 Average			2006		
Number of Farms	76			55		
Crop Acres	325			282		
Acres Owned	100			103		
Acres Rented	225			179		
Yield / Acre	115			107		
Bushels	29,310			24,840		
Operator Percentage	78.20%			82.46%		
Gross Income / Acre	\$238.49			\$310.34		
Variable Costs / Acre	\$189.87			\$225.16		
Total Expense / Acre	\$270.55			\$325.62		
Gross Income / Bushel	\$2.64			\$3.52		
Total Expense / Bushel	\$3.00			\$3.70		

	Total Dollars	\$/Bushel	\$/Acre	Total Dollars	\$/Bushel	\$/Acre
INCOME:						
Corn (Operator's Share)	\$57,958.11	\$1.98	\$178.55	\$75,684.78	\$3.05	\$268.39
Patronage Refunds	\$182.56	0.01	0.56	\$500.34	0.02	1.77
Government Payments	\$11,978.69	0.41	36.90	\$7,094.41	0.29	25.16
Miscellaneous Income	\$2,666.98	0.09	8.22	\$1,915.97	0.08	6.79
Crop Insurance Proceeds	\$4,626.09	0.16	14.25	\$2,320.02	0.09	8.23
OTHER INCOME	\$19,454.31	\$0.66	\$59.93	\$11,830.74	\$0.48	\$41.95
GROSS INCOME	\$77,412.42	\$2.64	\$238.49	\$87,515.52	\$3.52	\$310.34
EXPENSES:						
Labor Hired	\$2,040.47	0.07	6.29	\$1,214.60	\$0.05	\$4.31
General Machinery Repairs	\$5,704.74	0.19	17.57	\$5,649.40	0.23	20.03
Interest Paid	\$4,053.27	0.14	12.49	\$4,121.71	0.17	14.62
Seed / Other Crop Expense	\$10,437.43	0.36	32.15	\$9,612.67	0.39	34.09
Crop Insurance	\$2,284.00	0.08	7.04	\$2,636.77	0.11	9.35
Fertilizer / Lime	\$13,417.53	0.46	41.34	\$15,593.94	0.63	55.30
Machine Hire - Lease	\$2,522.94	0.09	7.77	\$2,873.54	0.12	10.19
Farm Org Fees / Travel / Publ	\$1,003.30	0.03	3.09	\$1,096.69	0.04	3.89
Gas / Fuel / Oil	\$3,657.68	0.12	11.27	\$4,994.82	0.20	17.71
Crop Storage & Marketing	\$138.03	0.00	0.43	\$346.77	0.01	1.23
Personal Property Tax	\$431.96	0.01	1.33	\$370.77	0.01	1.31
General Farm Insurance	\$1,427.45	0.05	4.40	\$1,495.90	0.06	5.30
Utilities	\$707.29	0.02	2.18	\$625.83	0.03	2.22
Cash Farm Rent	\$5,327.54	0.18	16.41	\$5,156.58	0.21	18.29
Herbicide / Insecticide	\$8,072.50	0.28	24.87	\$7,181.71	0.29	25.47
Conservation	\$361.91	0.01	1.11	\$507.25	0.02	1.80
Auto Expense	\$42.31	0.00	0.13	\$15.46	0.00	0.05
TOTAL VARIABLE COSTS	\$61,630.37	\$2.10	\$189.87	\$63,494.41	\$2.56	\$225.16
RETURN ABOVE VARIABLE COSTS	\$15,782.05	\$0.54	\$48.62	\$24,021.11	\$0.97	\$85.18
Depreciation	\$7,597.00	0.26	23.40	\$6,780.92	0.27	24.05
Real Estate Tax	\$1,175.84	0.04	3.62	\$1,017.85	0.04	3.61
Unpaid Operator Labor	\$7,934.47	0.27	24.44	\$7,053.30	0.28	25.01
Interest Charge *	\$2,010.51	0.07	6.19	\$1,619.81	0.07	5.74
TOTAL FIXED COSTS	\$18,717.82	\$0.64	\$57.66	\$16,471.88	\$0.66	\$58.41
Land Charge **	\$7,472.81	\$0.25	\$23.02	\$11,857.61	\$0.48	\$42.05
TOTAL EXPENSE	\$87,821.00	\$3.00	\$270.55	\$91,823.90	\$3.70	\$325.62
NET RETURN TO MANAGEMENT	(\$10,408.58)	(\$0.36)	(\$32.07)	(\$4,308.38)	(\$0.17)	(\$15.28)
NET RETURN TO LABOR-MGT	(\$433.64)	(\$0.01)	(\$1.34)	\$3,959.52	\$0.16	\$14.04

*Interest charge equals: ((8.0% times three-fourths the variable costs) plus (4.0% times depreciation times 8)) minus cash interest paid.

**Land charge represents a charge (equal to landlord's share) on owned land and equals (production from owned acres X price / unit X 33.33%). Crop production paid to the landlord on rented land (already removed above), or cash rent is the charge on rented land.

This crop enterprise is based on the operator's share of production, and thus includes only production expenses paid by the operator. A charge for management is not included in the expenses.

7.2 Soybean Cost-Return Budget¹⁷

Table 11. Cost-return projections for soybean crops in the Milford Lake Watershed, 2006.

Soybeans	Yield Level (bu)		
	26	33	40
Income Per Acre			
A. Yield per acre	26	33	40
B. Price per bushel	\$5.92	\$5.92	\$5.92
C. Net government payment	\$12.51	\$13.60	\$14.69
D. Indemnity payments			
E. Miscellaneous income			
F. Returns/acre ((AxB)+C+D+E)	\$166.43	\$208.96	\$251.49
Costs Per Acre			
1. Seed	\$36.30	\$36.30	\$36.30
2. Herbicide	10.34	10.34	10.34
3. Insecticide/Fungicide			
4. Fertilizer and Lime	10.96	12.51	14.07
5. Crop Consulting			
6. Crop Insurance			
7. Drying			
8. Miscellaneous	8.25	8.25	8.25
9. Custom Hire / Machinery Expense	47.98	50.06	52.13
10. Non-machinery Labor	5.42	5.66	5.89
11. Irrigation			
12. Land Charge/Rent	48.80	61.00	73.20
G. Sub Total	\$168.04	\$184.11	\$200.18
13. Interest on ½ Nonland Costs	5.37	5.54	5.71
H. Total Costs	\$173.41	\$189.65	\$205.89
I. Returns Over Costs (F-H)	-\$6.98	\$19.31	\$45.59
J. Total Costs/bushel (H/A)	\$6.67	\$5.75	\$5.15
K. Return To Annual Cost (I+13)/G	-0.96%	13.50%	25.63%

Table 13. Northeast Kansas Farm Management Association profit Center Analysis: 5-year Average and 2006 Nonirrigated Soybeans.²⁶

	2001-2005 Average			2006		
Number of Farms	80			58		
Crop Acres	368			355		
Acres Owned	105			123		
Acres Rented	263			232		
Yield / Acre	38			38		
Bushels	11,169			11,298		
Operator Percentage	79.24%			84.26%		
Gross Income / Acre	\$211.48			\$221.09		
Variable Costs / Acre	\$131.35			\$154.52		
Total Expense / Acre	\$198.98			\$230.13		
Gross Income / Bushel	\$6.97			\$6.95		
Total Expense / Bushel	\$6.56			\$7.23		

	Total Dollars	\$/Bushel	\$/Acre	Total Dollars	\$/Bushel	\$/Acre
INCOME:						
Soybeans (Operator's Share)	\$59,699.69	\$5.35	\$162.14	\$66,490.12	\$5.89	\$187.30
Patronage Refunds	\$163.70	0.01	0.44	\$522.45	0.05	1.47
Government Payments	\$12,770.80	1.14	34.68	\$8,437.88	0.75	23.77
Miscellaneous Income	\$2,431.40	0.22	6.60	\$2,165.24	0.19	6.10
Crop Insurance Proceeds	\$2,801.37	0.25	7.61	\$872.13	0.08	2.46
OTHER INCOME	\$18,167.27	\$1.63	\$49.34	\$11,997.70	\$1.06	\$33.80
GROSS INCOME	\$77,866.96	\$6.97	\$211.48	\$78,487.82	\$6.95	\$221.09
EXPENSES:						
Labor Hired	\$1,824.25	\$0.16	\$4.95	\$1,362.36	\$0.12	\$3.84
General Machinery Repairs	\$5,569.17	0.50	15.13	\$5,928.72	0.52	16.70
Interest Paid	\$4,306.40	0.39	11.70	\$4,272.50	0.38	12.04
Seed / Other Crop Expense	\$10,576.51	0.95	28.72	\$12,253.77	1.08	34.52
Crop Insurance	\$2,069.06	0.19	5.62	\$2,969.31	0.26	8.36
Fertilizer / Lime	\$1,575.53	0.14	4.28	\$2,723.99	0.24	7.67
Machine Hire - Lease	\$2,333.34	0.21	6.34	\$2,578.87	0.23	7.26
Farm Org Fees / Travel / Publ	\$1,043.56	0.09	2.83	\$1,109.94	0.10	3.13
Gas / Fuel / Oil	\$3,594.91	0.32	9.76	\$5,598.35	0.50	15.77
Crop Storage & Marketing	\$144.43	0.01	0.39	\$294.96	0.03	0.83
Personal Property Tax	\$433.92	0.04	1.18	\$404.42	0.04	1.14
General Farm Insurance	\$1,497.57	0.13	4.07	\$1,700.46	0.15	4.79
Utilities	\$699.65	0.06	1.90	\$695.95	0.06	1.96
Cash Farm Rent	\$5,801.57	0.52	15.76	\$6,316.15	0.56	17.79
Herbicide / Insecticide	\$6,502.40	0.58	17.66	\$5,998.78	0.53	16.90
Conservation	\$349.09	0.03	0.95	\$630.54	0.06	1.78
Auto Expense	\$41.70	0.00	0.11	\$16.50	0.00	0.05
TOTAL VARIABLE COSTS	\$48,363.03	\$4.33	\$131.35	\$54,855.57	\$4.86	\$154.52
RETURN ABOVE VARIABLE COSTS	\$29,503.93	\$2.64	\$80.13	\$23,632.25	\$2.09	\$66.57
Depreciation	\$7,383.46	0.66	20.05	\$6,911.44	0.61	19.47
Real Estate Tax	\$1,188.42	0.11	3.23	\$1,299.74	0.12	3.66
Unpaid Operator Labor	\$8,153.96	0.73	22.15	\$8,044.49	0.71	22.66
Interest Charge *	\$903.34	0.08	2.45	\$981.83	0.09	2.77
TOTAL FIXED COSTS	\$17,629.19	\$1.58	\$47.88	\$17,237.50	\$1.53	\$48.56
Land Charge **	\$7,272.18	\$0.65	\$19.75	\$9,602.29	\$0.85	\$27.05
TOTAL EXPENSE	\$73,264.40	\$6.56	\$198.98	\$81,695.36	\$7.23	\$230.13
NET RETURN TO MANAGEMENT	\$4,602.56	\$0.41	\$12.50	(\$3,207.54)	(\$0.28)	(\$9.04)
NET RETURN TO LABOR-MGT	\$14,580.77	\$1.31	\$39.60	\$6,199.31	\$0.55	\$17.46

*Interest charge equals: ((8.0% times three-fourths the variable costs) plus (4.0% times depreciation times 8)) minus cash interest paid.

**Land charge represents a charge (equal to landlord's share) on owned land and equals (production from owned acres X price / unit X 33.33%). Crop production paid to the landlord on rented land (already removed above), or cash rent is the charge on rented land.

This crop enterprise is based on the operator's share of production, and thus includes only production expenses paid by the operator. A charge for management is not included in the expenses.

7.3 Wheat Cost-Return Budget¹⁷

Table 12. Cost-return projections for wheat crops in the Milford Lake Watershed, 2006.

Wheat	Yield Level (bu)		
	40	50	60
Income Per Acre			
A. Yield per acre	40	50	60
B. Price per bushel	\$4.65	\$4.65	\$4.65
C. Net government payment	\$12.51	\$13.60	\$14.69
D. Indemnity payments			
E. Miscellaneous income			
F. Returns/acre ((AxB)+C+D+E)	\$198.51	\$246.10	\$293.69
Costs Per Acre			
1. Seed	\$9.90	\$13.20	\$13.20
2. Herbicide	1.68	5.09	5.09
3. Insecticide/Fungicide			
4. Fertilizer and Lime	35.41	43.32	50.61
5. Crop Consulting			
6. Crop Insurance			
7. Drying			
8. Miscellaneous	8.25	8.25	8.25
9. Custom Hire / Machinery Expense	45.83	48.84	56.43
10. Non-machinery Labor	5.18	5.52	6.38
11. Irrigation			
12. Land Charge/Rent	48.80	61.00	73.20
G. Sub Total	\$155.04	\$185.21	\$219.45
13. Interest on ½ Nonland Costs	4.78	5.59	6.30
H. Total Costs	\$159.83	\$190.80	\$219.45
I. Returns Over Costs (F-H)	\$38.69	\$55.30	\$74.24
J. Total Costs/bushel (H/A)	\$4.00	\$3.82	\$3.66
K. Return To Annual Cost (I+13)/G	28.04%	32.88%	37.78%

Table 15. Northeast Kansas Farm Management Association profit Center Analysis: 5-year Average and 2006 Nonirrigated Wheat.²⁶

	2001-2005 Average			2006		
Number of Farms		43			33	
Crop Acres		122			106	
Acres Owned		36			38	
Acres Rented		86			68	
Yield / Acre		49			52	
Bushels		5,208			4,936	
Operator Percentage		86.31%			89.41%	
Gross Income / Acre		\$174.72			\$254.36	
Variable Costs / Acre		\$112.33			\$167.82	
Total Expense / Acre		\$174.36			\$249.83	
Gross Income / Bushel		\$4.10			\$5.46	
Total Expense / Bushel		\$4.09			\$5.37	

	Total Dollars	\$/Bushel	\$/Acre	Total Dollars	\$/Bushel	\$/Acre
INCOME:						
Wheat (Operator's Share)	\$17,134.54	\$3.29	\$140.22	\$23,166.70	\$4.69	\$218.55
Patronage Refunds	\$38.28	0.01	0.31	\$211.47	0.04	2.00
Government Payments	\$3,480.80	0.67	28.48	\$2,636.15	0.53	24.87
Miscellaneous Income	\$475.09	0.09	3.89	\$886.53	0.18	8.36
Crop Insurance Proceeds	\$221.53	0.04	1.81	\$80.88	0.01	0.57
OTHER INCOME	\$4,215.69	\$0.81	\$34.50	3,795.03	\$0.77	\$35.80
GROSS INCOME	\$21,350.23	\$4.10	\$174.72	\$26,961.73	\$5.46	\$254.36
EXPENSES:						
Labor Hired	\$328.69	\$0.06	\$2.69	\$413.32	\$0.08	\$3.90
General Machinery Repairs	\$1,911.30	0.37	15.64	\$2,090.72	0.42	19.72
Interest Paid	\$1,093.26	0.21	8.95	\$1,361.57	0.28	12.85
Seed / Other Crop Expense	\$1,146.46	0.22	9.38	\$1,343.15	0.27	12.67
Crop Insurance	\$447.98	0.09	3.67	\$508.75	0.10	4.80
Fertilizer / Lime	\$3,296.53	0.63	26.98	\$4,418.63	0.90	41.69
Machine Hire - Lease	\$752.83	0.14	6.16	\$1,238.54	0.25	11.68
Farm Org Fees / Travel / Publ	\$257.85	0.05	2.11	\$244.72	0.05	2.31
Gas / Fuel / Oil	\$1,144.10	0.22	9.36	\$1,931.57	0.39	18.22
Crop Storage & Marketing	\$44.16	0.01	0.36	\$73.42	0.01	0.69
Personal Property Tax	\$107.82	0.02	0.88	\$98.16	0.02	0.93
General Farm Insurance	\$423.48	0.08	3.47	\$477.26	0.10	4.50
Utilities	\$184.02	0.04	1.51	\$256.50	0.05	2.42
Cash Farm Rent	\$2,167.64	0.42	17.74	\$3,027.31	0.61	28.56
Herbicide / Insecticide	\$308.68	0.06	2.53	\$100.58	0.02	0.95
Conservation	\$98.01	0.02	0.80	\$197.26	0.04	1.86
Auto Expense	\$14.31	0.00	0.12	\$7.73	0.00	0.07
TOTAL VARIABLE COSTS	\$13,727.13	\$2.64	\$112.33	\$17,789.19	\$3.60	\$167.82
RETURN ABOVE VARIABLE COSTS	\$7,623.10	\$1.46	\$62.38	\$9,172.54	\$1.86	\$86.53
Depreciation	\$2,103.82	0.40	17.22	\$2,422.73	0.49	22.86
Real Estate Tax	\$356.16	0.07	2.91	\$361.84	0.07	3.41
Unpaid Operator Labor	\$2,674.97	0.51	21.89	\$2,255.93	0.46	21.28
Interest Charge *	\$395.07	0.08	3.23	\$402.38	0.08	3.80
TOTAL FIXED COSTS	\$5,530.01	\$1.06	\$45.25	\$5,442.88	\$1.10	\$51.35
Land Charge **	\$2,049.79	\$0.39	\$16.77	\$3,250.07	\$0.66	\$30.66
TOTAL EXPENSE	\$21,306.93	\$4.09	\$174.36	\$26,482.14	\$5.37	\$249.83
NET RETURN TO MANAGEMENT	\$43.30	\$0.01	\$0.35	\$479.59	\$0.10	\$4.52
NET RETURN TO LABOR-MGT	\$3,046.97	\$0.59	\$24.93	\$3,148.84	\$0.64	\$29.71

*Interest charge equals: ((8.0% times three-fourths the variable costs) plus (4.0% times depreciation times 8)) minus cash interest paid.

**Land charge represents a charge (equal to landlord's share) on owned land and equals (production from owned acres X price / unit X 33.33%). Crop production paid to the landlord on rented land (already removed above), or cash rent is the charge on rented land.

This crop enterprise is based on the operator's share of production, and thus includes only production expenses paid by the operator. A charge for management is not included in the expenses.

7.4 Grain Sorghum Cost-Return Budget¹⁷

Table 13. Cost-return projections for grain sorghum crops in the Milford Lake Watershed, 2006.

Grain Sorghum	Yield Level (bu)		
	61	76	90
Income Per Acre			
A. Yield per acre	61	76	90
B. Price per bushel	\$2.79	\$2.79	\$2.79
C. Net government payment	\$12.51	\$13.60	\$14.69
D. Indemnity payments			
E. Miscellaneous income			
F. Returns/acre ((AxB)+C+D+E)	\$182.70	\$225.64	\$265.79
Costs Per Acre			
1. Seed	\$12.74	\$12.74	\$12.74
2. Herbicide	27.41	27.41	27.41
3. Insecticide/Fungicide			
4. Fertilizer and Lime	23.27	30.01	35.96
5. Crop Consulting			
6. Crop Insurance			
7. Drying	7.93	9.88	11.70
8. Miscellaneous	8.25	8.25	8.25
9. Custom Hire / Machinery Expense	58.31	62.84	67.07
10. Non-machinery Labor	6.59	7.10	7.58
11. Irrigation			
12. Land Charge/Rent	48.80	61.00	73.20
G. Sub Total	\$193.30	\$219.24	\$243.91
13. Interest on ½ Nonland Costs	6.15	6.68	7.16
H. Total Costs	\$199.45	\$225.91	\$251.07
I. Returns Over Costs (F-H)	-\$16.74	-\$0.27	\$14.72
J. Total Costs/bushel (H/A)	\$3.27	\$2.97	\$2.79
K. Return To Annual Cost (I+13)/G	-5.48%	2.92%	8.97%

Table 17. Northeast Kansas Farm Management Association profit Center Analysis: 5-year Average and 2006 Nonirrigated Sorghum.²⁶

	2001-2005 Average			2006		
Number of Farms	22			7		
Crop Acres	134			165		
Acres Owned	41			70		
Acres Rented	93			95		
Yield / Acre	80			88		
Bushels	8,568			13,917		
Operator Percentage	80.27%			95.45%		
Gross Income / Acre	\$167.19			\$333.59		
Variable Costs / Acre	\$128.28			\$197.97		
Total Expense / Acre	\$198.37			\$286.61		
Gross Income / Bushel	\$2.62			\$3.96		
Total Expense / Bushel	\$3.11			\$3.40		

	Total Dollars	\$/Bushel	\$/Acre	Total Dollars	\$/Bushel	\$/Acre
INCOME:						
Grain Sorghum (Operator's Share)	\$16,697.47	\$1.95	\$124.42	\$47,862.55	\$3.44	\$290.08
Patronage Refunds	\$37.89	0.00	0.28	\$397.29	0.03	2.41
Government Payments	\$4,011.35	0.47	29.89	\$4,037.11	0.29	24.47
Miscellaneous Income	\$737.36	0.09	5.49	\$2,623.95	0.19	15.90
Crop Insurance Proceeds	\$952.60	0.11	7.10	\$121.63	0.01	0.74
OTHER INCOME	\$5,739.20	\$0.67	\$42.77	\$7,179.98	\$0.52	\$43.52
GROSS INCOME	\$22,436.67	\$2.62	\$167.19	\$55,042.53	\$3.96	\$333.59
EXPENSES:						
Labor hired	\$446.93	\$0.05	\$3.33	\$434.80	\$0.03	\$2.64
General Machinery Repairs	\$1,948.30	0.23	14.52	\$2,525.52	0.18	15.31
Interest Paid	\$992.21	0.12	7.39	\$2,029.96	0.15	12.30
Seed / Other Crop Expense	\$1,466.33	0.17	10.93	\$1,989.43	0.14	12.06
Crop Insurance	\$548.12	0.06	4.08	\$1,042.32	0.07	6.32
Fertilizer / Lime	\$3,840.26	0.45	28.62	\$5,242.48	0.38	31.77
Machine hire - Lease	\$824.24	0.10	6.14	\$2,896.03	0.21	17.55
Farm Org Fees / Travel / Publications	\$256.82	0.03	1.91	\$319.19	0.02	1.93
Gas / Fuel / Oil	\$1,308.67	0.15	9.75	\$2,507.74	0.18	15.20
Crop Storage & Marketing	\$56.47	0.01	0.42	\$66.04	0.00	0.40
Personal Property Tax	\$98.10	0.01	0.73	\$136.49	0.01	0.83
General Farm Insurance	\$463.81	0.05	3.46	\$678.81	0.05	4.11
Utilities	\$182.08	0.02	1.36	\$382.84	0.03	2.32
Cash Farm Rent	\$1,928.11	0.23	14.37	\$6,113.20	0.58	49.17
Herbicide / Insecticide	\$2,763.38	0.32	20.59	\$3,847.82	0.28	23.32
Conservation	\$71.26	0.01	0.53	\$451.94	0.03	2.74
Auto Expense	\$20.39	0.00	0.15	\$0.00	-	-
TOTAL VARIABLE COSTS	\$17,215.48	\$2.01	\$128.28	\$32,664.61	\$2.35	\$197.97
RETURN ABOVE VARIABLE COSTS	\$5,221.18	\$0.61	\$38.91	\$22,377.92	\$1.61	\$135.62
Depreciation	\$2,487.52	0.29	18.54	\$3,191.04	0.23	19.34
Real Estate Tax	\$504.21	0.06	3.76	\$919.35	0.07	5.57
Unpaid Operator Labor	\$3,641.05	0.42	27.13	\$3,182.14	0.23	19.29
Interest Charge *	\$890.08	0.10	6.63	\$829.25	0.06	5.03
TOTAL FIXED COSTS	\$7,522.86	\$0.88	\$56.06	\$8,121.78	\$0.58	\$49.22
Land Charge **	\$1,882.24	\$0.22	\$14.03	\$6,504.65	\$0.47	\$39.42
TOTAL EXPENSE	\$26,620.59	\$3.11	\$198.37	\$47,291.04	\$3.40	\$286.61
NET RETURN TO MANAGEMENT	(\$4,183.92)	(\$0.49)	(\$31.18)	\$7,751.49	\$0.56	\$46.98
NET RETURN TO LABOR-MGT	(\$95.94)	(\$0.01)	(\$0.71)	\$11,368.43	\$0.82	\$68.90

*Interest charge equals: ((8.0% times three-fourths the variable costs) plus (4.0% times depreciation times 8)) minus cash interest paid.

**Land charge represents a charge (equal to landlord's share) on owned land and equals (production from owned acres X price / unit X 33.33%). Crop production paid to the landlord on rented land (already removed above), or cash rent is the charge on rented land.

This crop enterprise is based on the operator's share of production, and thus includes only production expenses paid by the operator. A charge for management is not included in the expenses.

7.5 Alfalfa Cost-Return Budget¹⁷

Table 14. Cost-return projections for alfalfa crops in the Milford Lake Watershed, 2006.

Alfalfa	Yield Level (ton)		
	3.0	3.5	4.0
Income Per Acre			
A. Yield per acre	3.0	3.5	4.0
B. Price per bushel	\$101.00	\$101.00	\$101.00
C. Net government payment	\$12.30	\$13.37	\$14.44
D. Indemnity payments			
E. Miscellaneous income			
F. Returns/acre ((AxB)+C+D+E)	\$315.30	\$366.87	\$418.44
Costs Per Acre			
1. Seed	\$10.17	\$10.17	\$10.17
2. Herbicide	2.51	2.51	2.51
3. Insecticide/Fungicide	7.08	7.08	7.08
4. Fertilizer and Lime	19.90	26.89	33.88
5. Crop Consulting			
6. Crop Insurance			
7. Drying			
8. Miscellaneous	6.38	6.38	6.38
9. Custom Hire / Machinery Expense	109.42	118.08	126.61
10. Non-machinery Labor	12.36	13.34	14.31
11. Irrigation			
12. Land Charge/Rent	31.60	39.50	47.40
G. Sub Total	\$199.43	\$223.96	\$248.34
13. Interest on ½ Nonland Costs	7.55	8.30	9.04
H. Total Costs	\$206.98	\$232.26	\$257.38
I. Returns Over Costs (F-H)	\$108.32	\$134.61	\$161.06
J. Total Costs/bushel (H/A)	\$68.99	\$66.36	\$64.35
K. Return To Annual Cost (I+13)/G	58.10%	63.81%	68.50%

Table 19. Northeast Kansas Farm Management Association profit Center Analysis: 5-year Average and 2006 Nonirrigated Alfalfa.²⁶

	2001-2005 Average			2006		
Number of Farms	59			48		
Crop Acres	110			89		
Acres Owned	33			29		
Acres Rented	77			60		
Yield / Acre	3.1			2.4		
Tons (Operator's Share)	312			199		
Operator Percentage	91.63%			92.78%		
Gross Income / Acre	\$219.03			\$231.36		
Variable Costs / Acre	\$113.98			\$122.37		
Total Expense / Acre	\$184.78			\$196.58		
Gross Income / Ton	\$77.46			\$103.47		
Total Expense / Ton	\$65.35			\$87.92		

	Total Dollars	\$/Ton	\$/Acre	Total Dollars	\$/Ton	\$/Acre
INCOME:						
Alfalfa (Operator's Share)	\$22,493.06	\$72.19	\$204.11	\$19,160.69	\$96.28	\$215.29
Patronage Refunds	\$14.95	0.05	0.14	\$0.73	0.00	0.01
Government Payments	\$1,422.71	4.57	12.91	\$1,422.10	7.15	15.98
Miscellaneous Income	\$206.86	0.66	1.88	\$7.29	0.04	0.08
OTHER INCOME	\$1,644.52	\$5.28	\$14.92	\$1,430.12	\$7.19	\$16.07
GROSS INCOME	\$24,137.58	\$77.46	\$219.03	\$20,590.81	\$103.47	\$231.36
EXPENSES:						
Labor Hired	\$1,148.14	\$3.68	\$10.42	\$630.58	\$3.17	\$7.09
General Machinery Repairs	\$1,925.66	6.18	17.47	\$1,606.54	8.07	18.05
Interest Paid	\$1,304.65	4.19	11.84	\$1,287.64	6.47	14.47
Seed / Other Crop Expense	\$712.54	2.29	6.47	\$689.06	3.46	7.74
Fertilizer / Lime	\$1,022.89	3.28	9.28	\$1,177.41	5.92	13.23
Machine Hire - Lease	\$1,399.64	4.49	12.70	\$1,331.95	6.69	14.97
Farm Org Fees / Travel / Publ	\$279.49	0.90	2.54	\$139.96	0.70	1.57
Gas / Fuel / Oil	\$1,295.52	4.16	11.76	\$1,268.50	6.37	14.25
Crop Storage & Marketing	\$95.27	0.31	0.86	\$5.06	0.03	0.06
Personal Property Tax	\$80.00	0.26	0.73	\$48.07	0.24	0.54
General Farm Insurance	\$357.45	1.15	3.24	\$251.11	1.26	2.82
Utilities	\$356.96	1.15	3.24	\$275.09	1.38	3.09
Cash Farm Rent	\$1,325.31	4.25	12.03	\$1,057.05	5.31	11.88
Herbicide / Insecticide	\$1,112.14	3.57	10.09	\$1,029.63	5.17	11.57
Conservation	\$2.42	0.01	0.02	\$4.35	0.02	0.05
Auto Expense	\$142.67	0.46	1.29	\$88.66	0.45	1.00
TOTAL VARIABLE COSTS	\$12,560.75	\$40.31	\$113.98	\$10,890.66	\$54.73	\$122.37
RETURN ABOVE VARIABLE COSTS	\$11,576.83	\$37.15	\$105.05	\$9,700.15	\$48.74	\$108.99
Depreciation	\$2,232.90	7.17	20.26	\$1,842.74	9.26	20.70
Real Estate Tax	\$309.45	0.99	2.81	\$334.85	1.68	3.76
Unpaid Operator Labor	\$2,586.30	8.30	23.47	\$2,031.56	10.21	22.83
Interest Charge *	\$178.84	0.57	1.62	\$0.00	-	-
TOTAL FIXED COSTS	\$5,307.50	\$17.03	\$48.16	\$4,209.15	\$21.15	\$47.29
Land Charge **	\$2,494.30	\$8.00	\$22.63	\$2,395.39	\$12.04	\$26.91
TOTAL EXPENSE	\$20,362.55	\$65.35	\$184.78	\$17,495.20	\$87.92	\$196.58
NET RETURN TO MANAGEMENT	\$3,775.03	\$12.11	\$34.26	\$3,095.61	\$15.56	\$34.78
NET RETURN TO LABOR-MGT	\$7,509.47	\$24.10	\$68.14	\$5,757.75	\$28.93	\$64.69

*Interest charge equals: ((8.0% times three-fourths the variable costs) plus (4.0% times depreciation times 5)) minus cash interest paid.

**Land charge represents a charge (equal to landlord's share) on owned land and equals (production from owned acres X price / unit X 33.33%). Crop production paid to the landlord on rented land (already removed above), or cash rent is the charge on rented land.

This crop enterprise is based on the operator's share of production, and thus includes only production expenses paid by the operator. A charge for management is not included in the expenses.

7.6 Common Cropland BMPs in Milford Lake Watershed

BMPs help reduce the amount of soil and nutrients that run off of cropland fields. Keeping these valuable inputs (soil and nutrients) in the field can be of benefit to both the landowner/producer and to society as a whole. Here are just a couple of the benefits:

1. Top soil savings can result in higher yields and lower fertilizer costs.
2. Certain BMPs can offer both water quality protection and wildlife habitat.

Below are some of the more popular BMPs in use throughout the state of Kansas and in the Milford Lake Watershed.

Contour farming²⁴ is farming the land, tillage and planting of the crop, on the level around the hill. By doing this, each furrow or ridge left by the different implements acts as a miniature dam, trapping water, allowing more to soak into the ground. Each row of crop also slows the water. Combined, less water runs off. Soil erosion is reduced. Crop yields are increased in arid areas.

Grassed waterways²⁵ are used as outlets to prevent silt and gully formation. The vegetation cover slows the water flow and minimizes channel surface erosion. They can also be used as outlets for water from terraces.

Vegetative buffers²⁵ are areas of land that are maintained in permanent vegetation to help reduce nutrient and sediment loss from agricultural fields, improve runoff water quality, and provide habitat for wildlife. Because of these societal benefits, there are several federal and state programs that encourage the installation and maintenance of vegetative buffers.

No-till²⁵ is a form of conservation tillage in which chemicals are used in place of tillage for weed control and seedbed preparation. In other words, the soil surface is never disturbed except for planting or drilling operations in a 100 percent no-till system. Two other forms of tillage, **reduced tillage** and **rotational no-till**, involve a light to moderate use of tillage equipment. These forms of tillage also control erosion and nutrient runoff, but are not as effective as 100 percent no-till.

Terraces²⁵ are embankments constructed perpendicular to the slope of the field and are designed to reduce the length of a field slope and catch water flowing off the slope. Terraces reduce the rate of runoff and allow soil particles to settle out.

Streambank stabilization²⁵ projects can reduce the amount of streambank erosion and help prevent the loss of valuable cropland. Stabilization techniques reduce streambank erosion through diverting and/or slowing the movement of water in a stream channel. Some methods that can be employed include bendway-weirs, stone toes, pools and riffles, stream barbs, and willow post plantings.

The following pages contain typical BMP budgets and economic analyses for vegetative buffers and streambank stabilization projects in the Milford Watershed. These reports were generated using the KSU-Vegetative Buffer and KSU-Streambank Stabilization Decision-Making Tools²⁷.

7.6.1 Vegetative Buffer: Economic Analysis

Your project area is located in Clay County, Kansas. Your project area (buffer size) is 1.0 acres.

The results are based upon the following assumptions:

One time Costs: \$187.28	One time Cost-Share Payments: \$268.55	Time Period Selected: 10 years
Annual Costs: \$6.67	Annual Incentive Payments: \$90.35	Opportunity Cost of Your Money: 5.00%

The first year out-of-pocket costs of the vegetative buffer would be **\$0.00** this accounts for any cost-share payments you may receive.

Based on the information you have provided, a vegetative buffer on the project area would **return \$92.99** per acre annually.

Based on the information you have provided, a vegetative buffer on the project area would **return \$92.99** annually.

Based on the information you have provided, cropland on the project area would return **\$63.03** per acre annually.

Based on the information you have provided, cropland on the project area would return **\$63.03** annually.

Take Home Message:

You would be **\$29.96** per year **better off** installing this area to a vegetative buffer versus using it for crop production.

Discussion

In order to effectively compare scenarios which occur over multiple years (10 to 15 years), we must convert all costs and returns to today's dollars (e.g., 2008 dollars).

Net Present Value calculations convert future values into today's dollars. The net present value analysis uses a discount factor to equate a series of future cash flows into an equivalent amount of cash today. For example, if you are considering enrolling land into a 15 year Continuous Conservation Reserve Program (CRP) program, the projected net income in years 2 through 15 is discounted back to its equivalent value in today's dollars. Because a dollar today can earn interest until next year, it will be valued more highly than a dollar received in the future

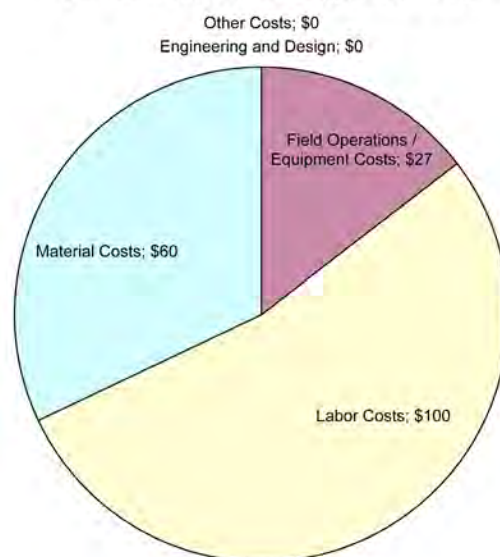
For more information regarding the economics of vegetative buffers, check out K-State Research and Extension publication MF-2536 "Using Conservation Buffers to Protect Water Quality and Enhance Agricultural Profitability." <http://www.oznet.ksu.edu/library/h20ql2/mf2536.pdf>

For vegetative buffer assistance, be sure to contact your local county conservation district. A Kansas Conservation District Directory can be found at: http://scc.ks.gov/index.php?option=com_content&task=view&id=779&Itemid=178

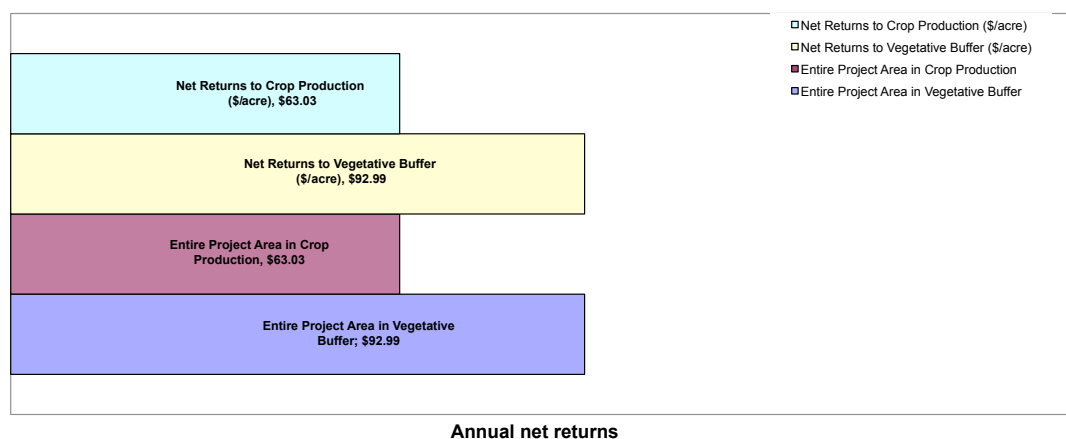
If you have any questions regarding this decision-making tool, please contact:

Craig Smith
Ph.D. Graduate Student
Kansas State University
craigsmith@agecon.ksu.edu

One Time Costs of the Vegetative Buffer



Annual Net Returns to the Project Area



Budget information for the vegetative buffer project

General Data For Vegetative Buffer				
Discount Rate			5.00%	
Cropland Rental Rate - not CCRP rental rate			\$55.47 per acre/year	
Annual Cropland Rental Growth Rate			3.07%	
Total Annual Costs			\$6.67 per acre/year	
Inflation Rate of Annual Costs			4.00%	
Project Length (feet)			660	
Project Width (feet)			66	
Acres (length x width/43,560)			1.00	
Length of analysis (years)			10	
Cropland Property Tax (\$/acre)			\$5.00	
Tame Grass Property Tax (\$/acre)			\$5.00	
Costs			Payments Received	
Total one-time	\$187.28		Total one-time	\$268.55
Total annual	\$6.67		Total annual	\$96.53

Net Present Value Table: Vegetative Buffer (per acre)					
Year	One Time Costs	Annual Costs	One Time Payments	Annual Payments	Net Property Tax Impact
0	\$187.28	\$0.00	\$268.55	\$0.00	\$0.00
1	\$0.00	\$6.67	\$0.00	\$90.35	\$0.00
2	\$0.00	\$6.94	\$0.00	\$90.35	\$0.00
3	\$0.00	\$7.21	\$0.00	\$90.35	\$0.00
4	\$0.00	\$7.50	\$0.00	\$90.35	\$0.00
5	\$0.00	\$7.80	\$0.00	\$90.35	\$0.00
6	\$0.00	\$8.12	\$0.00	\$90.35	\$0.00
7	\$0.00	\$8.44	\$0.00	\$90.35	\$0.00
8	\$0.00	\$8.78	\$0.00	\$90.35	\$0.00
9	\$0.00	\$9.13	\$0.00	\$90.35	\$0.00
10	\$0.00	\$9.49	\$0.00	\$90.35	\$0.00
11	\$0.00	-	\$0.00	-	\$0.00
12	\$0.00	-	\$0.00	-	\$0.00
13	\$0.00	-	\$0.00	-	\$0.00
14	\$0.00	-	\$0.00	-	\$0.00
15	\$0.00	-	\$0.00	-	\$0.00
Sum totals	\$187.28	\$80.08	\$268.55	\$903.46	\$0.00
Present Value	\$187.28	\$60.87	\$268.55	\$697.63	\$0.00
Net Present Value	\$718.03				
Annualized Value	\$92.99				

NPV Table: Cropland Rent (per acre)	
Year	Rent
0	\$0.00
1	\$55.47
2	\$57.17
3	\$58.93
4	\$60.74
5	\$62.60
6	\$64.52
7	\$66.50
8	\$68.55
9	\$70.65
10	\$72.82
11	-
12	-
13	-
14	-
15	-
Sum totals	\$637.96
Present Value	\$486.66
Net Present Value	\$486.66
Annualized Value	\$63.03

Net Present Value Table: Vegetative Buffer (total project area)					
Year	One Time Costs	Annual Costs	One Time Payments	Annual Payments	Net Property Tax Impact
0	\$187.28	\$0.00	\$268.55	\$0.00	\$0.00
1	\$0.00	\$6.67	\$0.00	\$90.35	\$0.00
2	\$0.00	\$6.94	\$0.00	\$90.35	\$0.00
3	\$0.00	\$7.21	\$0.00	\$90.35	\$0.00
4	\$0.00	\$7.50	\$0.00	\$90.35	\$0.00
5	\$0.00	\$7.80	\$0.00	\$90.35	\$0.00
6	\$0.00	\$8.12	\$0.00	\$90.35	\$0.00
7	\$0.00	\$8.44	\$0.00	\$90.35	\$0.00
8	\$0.00	\$8.78	\$0.00	\$90.35	\$0.00
9	\$0.00	\$9.13	\$0.00	\$90.35	\$0.00
10	\$0.00	\$9.49	\$0.00	\$90.35	\$0.00
11	\$0.00	-	\$0.00	-	\$0.00
12	\$0.00	-	\$0.00	-	\$0.00
13	\$0.00	-	\$0.00	-	\$0.00
14	\$0.00	-	\$0.00	-	\$0.00
15	\$0.00	-	\$0.00	-	\$0.00
Sum totals	\$187.28	\$80.08	\$268.55	\$903.46	\$0.00
Present Value	\$187.28	\$60.87	\$268.55	\$697.63	\$0.00
Net Present Value	\$718.03				
Annualized Value	\$92.99				

NPV Table: Cropland Rental Rate (total project area)	
Year	Rent
0	\$0.00
1	\$55.47
2	\$57.17
3	\$58.93
4	\$60.74
5	\$62.60
6	\$64.52
7	\$66.50
8	\$68.55
9	\$70.65
10	\$72.82
11	-
12	-
13	-
14	-
15	-
Sum totals	\$637.96
Present Value	\$486.66
Net Present Value	\$486.66
Annualized Value	\$63.03

7.6.2 Streambank Stabilization: Economic Analysis

Your project area is located in Clay County, Kansas on a 80 acre field. Your project area is: 4.55 acres in size.

The results are based upon the following assumptions:

One time Costs: \$18,495.60 One time Cost-Share Payments: \$9,702.30 Time Period Selected: 10 years
Annual Costs: \$30.32 Annual Incentive Payments: \$410.66 Opportunity Cost of Your Money: 5.00%

The first year out-of-pocket costs of the streambank project would be \$8,793.30. This accounts for any cost-share payments you may receive.
Based on the information you have provided, a streambank stabilization project could potentially save 2.00 acres annually.

Take Home Message:

If you consider the asset value of the land that is preserved by the streambank stabilization project, then the take-home message is:

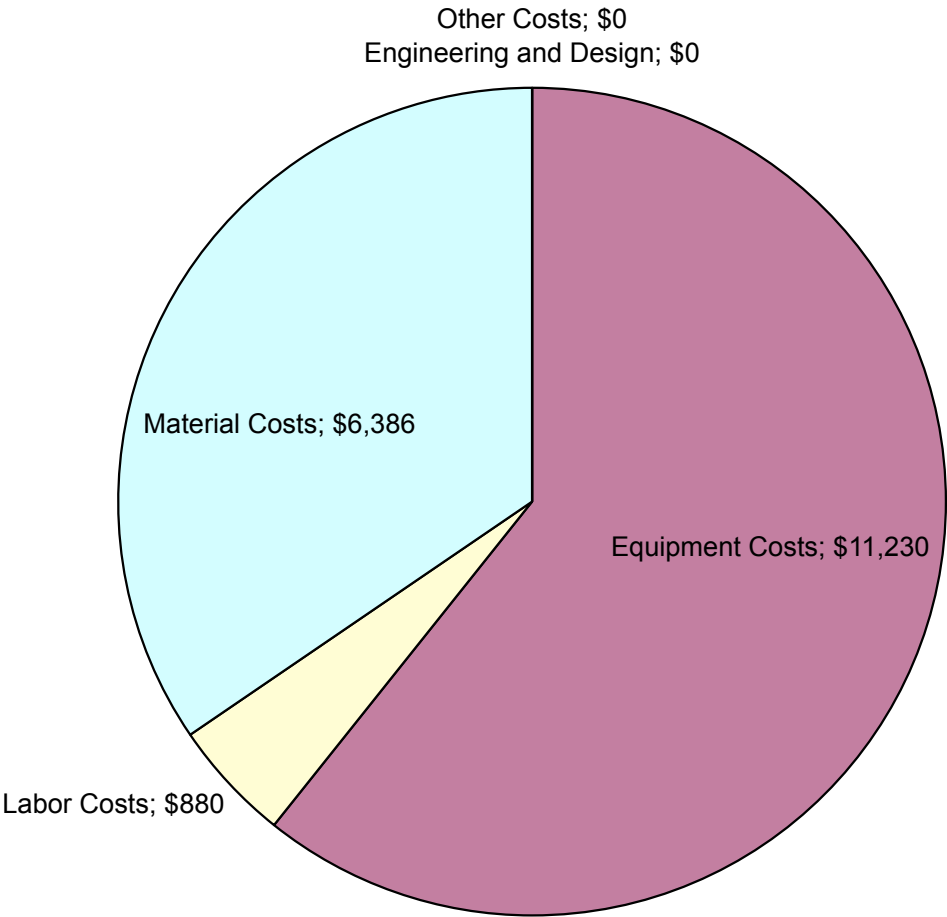
You would be \$2,899.47 per year better off by stabilizing this streambank versus doing nothing.
A streambank project would return \$22,388.96 in total over the 10 year time period you have selected.

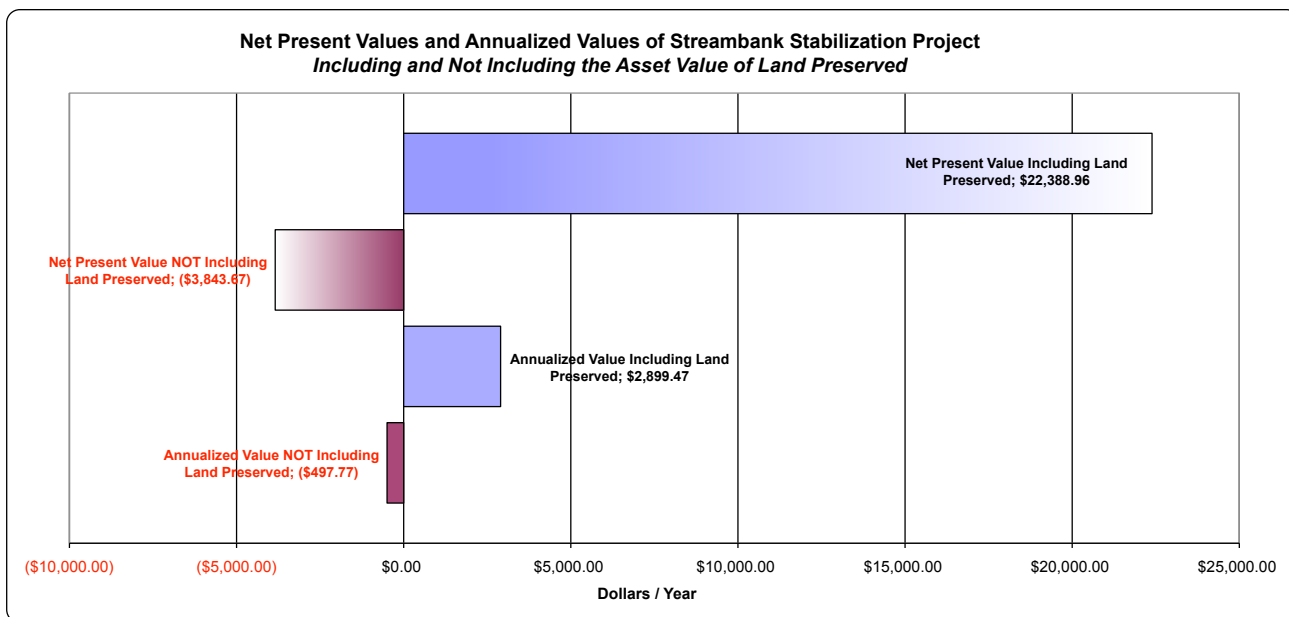
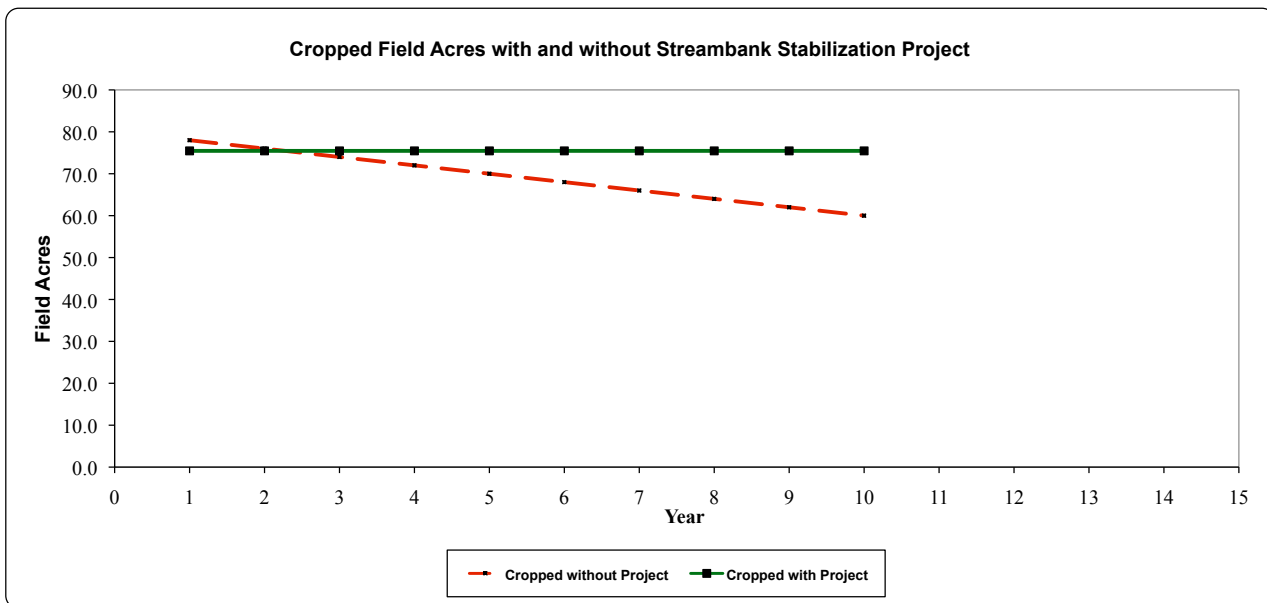
If you DO NOT consider the asset value of the land that is preserved by the streambank stabilization project, then the take-home message is:

You would be (\$497.77) per year worse off by stabilizing this streambank versus doing nothing.
A streambank project would lose (\$3,843.67) in total over the 10 year time period you have selected.

The asset value of the land that is preserved by the project is a real value that should probably be considered in your decision-making. It is, however, a value that would not be realized as cash until the property is sold.

One Time Costs of the Streambank Stabilization Project





Discussion

In general, the **benefits** of a streambank stabilization project come in the form of: value of acres not lost to erosion, income from being able to crop the preserved acres not in CCRP acres, cost-share and incentive payments, and tax breaks from the reclassification of ag land.

The **costs** of a streambank stabilization project come in the form of: one time installation costs, annual maintenance costs, and the initial loss of cropping income from cropland being taken out of production and enrolled into CCRP.

In order to effectively compare scenarios which occur over multiple years (10 to 15 years), we must convert all costs and returns to today's dollars (e.g., 2008 dollars).

Net Present Value calculations convert future values into today's dollars. The net present value analysis uses a discount factor to equate a series of future cash flows into an equivalent amount of cash today. For example, if you are considering enrolling land into a 15 year Continuous Conservation Reserve Program (CRP) program, the projected net income in years 2 through 15 is discounted back to its equivalent value in today's dollars. Because a dollar today can earn interest until next year, it will be valued more highly than a dollar received in the future

For streambank stabilization assistance, be sure to contact your local county conservation district. A Kansas Conservation District Directory can be found at: http://scc.ks.gov/index.php?option=com_content&task=view&id=779&Itemid=178

If you have any questions regarding this Decision-Making Tool, please contact:

Craig Smith
Ph.D. Graduate Student Kansas State University
craigsmith@agecon.ksu.edu

Budget information for the streambank stabilization project

General Data For Streambank Stabilization						
Discount Rate	5.00%	per acre				
Cropland Value	\$1,397.00					
Annual Cropland Value Growth Rate	4.34%					
Cropland Rental Rate - not CCRP rental rate	\$55.47	per acre / year				
Annual Cropland Rental Growth Rate	3.07%					
Total Annual Costs	\$6.67	per acre / year				
Inflation Rate of Annual Costs	4.00%					
Project Length (feet)						1,980
Project Width (feet)						100
Acres (length x width/43,560)						4.55
Estimated acreage lost over time period						20.00
Value of estimated acreage lost				20	acres	@ \$1,397.00 per acre \$27,940.00
Estimated average annual acreage lost over period of				10	yr.	2.00
Estimated acreage preserved over				10	yr.	20.00
Value of estimated acres preserved				20.00	acres	@ \$2,136.51 per acre \$42,730.18
Cropland Property Tax (\$/acre)						\$9.88
Tame Grass Property Tax (\$/acre)						\$9.88
Costs		Payments				
Total one-time	\$18,495.60	Total one-time	\$9,702.30			
Total annual	\$30.32	Total annual	\$410.66			

Land Effects

								With Project			Without Project						
Year	Net Acres for Income	Rental Rate \$/ Ac	Rental Rate Effect	Total Acres Preserved	Land Value \$/Ac	Total Additional Value	Property Tax Cropland \$/Ac	Property Tax Tame Grass \$/Ac	CCRP Acres	Crop Acres	Property Tax	Crop Acres	Property Tax	Net Property Tax Impact	CCRP Acres	Net Cropland Preserved	Total Saved
0	(4.55)	\$55.47	(\$252.14)	-	\$1,397.00		\$9.88	\$9.88	4.55	15.45	\$197.60	20.00	\$197.60	\$0.00	4.55	-	4.55
1	(2.55)	\$57.17	(\$145.53)	2.00	\$1,457.63	\$0.00	\$10.18	\$10.18	4.55	15.45	\$203.67	20.00	\$203.67	\$0.00	4.55	-	4.55
2	(0.55)	\$58.93	(\$32.14)	4.00	\$1,520.89	\$0.00	\$10.50	\$10.50	4.55	15.45	\$209.92	18.00	\$188.93	\$20.99	4.55	-	4.55
3	1.45	\$60.74	\$88.35	6.00	\$1,586.90	\$0.00	\$10.82	\$10.82	4.55	15.45	\$216.36	16.00	\$173.09	\$43.27	4.55	1.45	6.00
4	3.45	\$62.60	\$216.26	8.00	\$1,655.77	\$0.00	\$11.15	\$11.15	4.55	15.45	\$223.01	14.00	\$156.10	\$66.90	4.55	3.45	8.00
5	5.45	\$64.52	\$351.95	10.00	\$1,727.63	\$0.00	\$11.49	\$11.49	4.55	15.45	\$229.85	12.00	\$137.91	\$91.94	4.55	5.45	10.00
6	7.45	\$66.50	\$495.76	12.00	\$1,802.61	\$0.00	\$11.85	\$11.85	4.55	15.45	\$236.91	10.00	\$118.45	\$118.45	4.55	7.45	12.00
7	9.45	\$68.55	\$648.07	14.00	\$1,880.84	\$0.00	\$12.21	\$12.21	4.55	15.45	\$244.18	8.00	\$97.67	\$146.51	4.55	9.45	14.00
8	11.45	\$70.65	\$809.27	16.00	\$1,962.47	\$0.00	\$12.58	\$12.58	4.55	15.45	\$251.68	6.00	\$75.50	\$176.17	4.55	11.45	16.00
9	13.45	\$72.82	\$979.76	18.00	\$2,047.64	\$0.00	\$12.97	\$12.97	4.55	15.45	\$259.40	4.00	\$51.88	\$207.52	4.55	13.45	18.00
10	15.45	\$75.06	\$1,159.94	20.00	\$2,136.51	\$42,730.18	\$13.37	\$13.37	4.55	15.45	\$267.37	2.00	\$26.74	\$240.63	4.55	15.45	20.00
11	-	-	-	-	-	\$0.00	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	\$0.00	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	\$0.00	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	\$0.00	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	\$0.00	-	-	-	-	-	-	-	-	-	-	-

7.7 Economic Contributions of Recreation at Milford Lake^{28, 29, 30, 31, 32, 33, 34, 35}

This study estimated the regional economic effects arising from recreation at Milford Lake (Figure 17). This analysis can help local Watershed Restoration & Protection Strategies leaders and others appreciate the value of preserving recreational amenities at Milford Lake.

Milford Lake is a 15,314 acre impoundment located in northeastern Kansas in the Kansas-Lower Republican River Basin. The watershed consists of 3,796 square miles in Clay, Cloud, Dickinson, Geary, Jewell, Mitchell, Phillips, Republic, Riley, Smith, and Washington counties. Milford Lake was built in 1964 by the U.S. Army Corps of Engineers (COE) for flood control, water supply, water quality, navigation, recreation, and fish and wildlife.

This analysis estimated two types of regional recreation effects associated with Milford Lake. The first type includes the economic impact to the region arising from direct recreation expenditures in the area and the associated indirect effects which occur as the money “ripples” throughout the region. This impact is modeled using an economic accounting system that charts the financial connections between businesses, governments and households in the region.

In 2007, the Army COE reported 746,666 visits to Milford Lake for a total of 7,024,587 visitor-hours from 10/2006 to 9/2007. Using this data (together with visitor-type and expenditure profiles shown in Tables 20 and 21 and Figure 18) and accounting for imported purchases, it was estimated that visitor expenditures generated \$7.57 million (2007\$) in direct economic activity (sales) within the regional economy, \$3.65 million in all types of income associated with the production of economic activities, and 159 area full- and part-time jobs. After calculating the indirect economic impacts, it was estimated that visitor expenditures were closely associated with \$10.7 million (2007\$) in overall economic activity, \$5.31 million in total income, and 193 jobs in the region. The total economic contributions to the local region are displayed in Table 22.

Not all of the economic effects of recreation are captured by observable market transactions. A second type of economic effect considered here includes certain non-market benefits derived through the self-reported value of participation in recreation activities. This notion acknowledges the value of benefit an individual experiences through participation in an activity exceeds what it actually costs, thereby motivating participation. These benefits are estimated through a process known as non-market valuation. Through surveys, economists have developed general estimates of what people report being willing to pay over and above what they actually are required to spend. This net willingness-to-pay value represents the additional incremental value of benefits afforded to the recreation participant. Net willingness-to-pay has been acknowledged by a U.S. governmental interagency committee as an appropriate measure of the economic benefits associated with outdoor recreation programs. Accepting the legitimacy of purported and generalized willingness-to-pay values and applying them to Milford Lake recreation, it was estimated that Milford Lake visitors receive up to \$17.6 million (2007\$) in additional non-market recreation benefits annually. The values by recreation activity are reported in Table 23.

On average, the annual visitation rates for Milford Lake has increased steadily from 1996-2007 (Figure 19). Among the 17 Army COE Lakes in Kansas, Milford Lake ranked 2nd in number of visits and 3rd in terms of visitor-hours in 2007. A graphical comparison of visits and visitor-hours for all 17 Army COE reservoirs in Kansas can be found in Figures 20 and 21

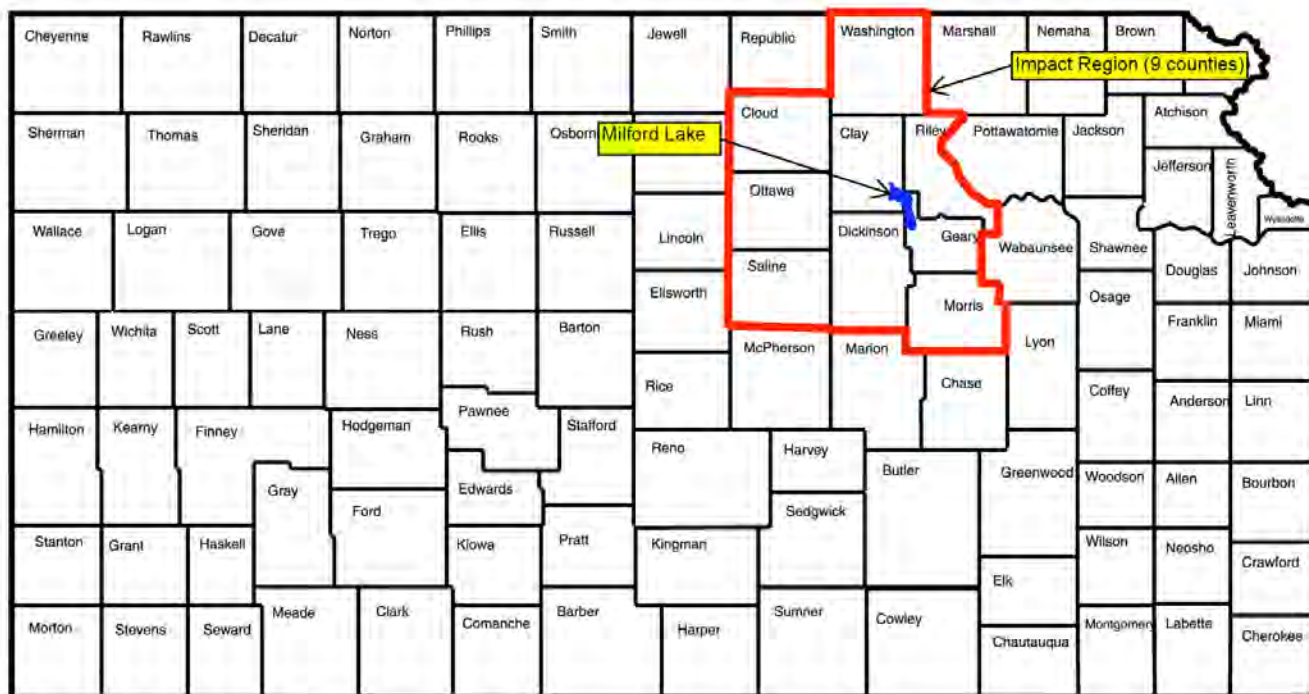


Figure 17. Milford Lake economic impact region

Table 20. Visitation and spending for visits made to Milford Lake, 2007

Visitation	Camper		Day User		Other Overnight		Total
	Boater	Nonboater	Boater	Nonboater	Boater	Nonboater	
Percent of Total	0.8%	2.9%	20.6%	73.0%	0.6%	2.2%	100.0%
2007 Milford visits	6,041	21,419	153,665	544,717	4,564	16,260	746,666
Spending	\$445,256	\$1,338,845	\$3,443,864	\$7,342,071	\$432,404	\$901,734	\$13,904,174

Table 21. Spending categories by visitor type (dollars per visit, 2007\$)

Spending Category	Campers		Day Users		Other Overnight		Weighted Average
	Boater	Nonboater	Boater	Nonboater	Boater	Nonboater	
Hotels, motels, cabins, B&B, and rental homes	0.83	0.12	0.00	0.00	19.46	20.17	0.57
Camping fee	15.47	16.01	0.00	0.00	0.11	0.03	0.59
Restaurants, bars, etc.	8.00	9.18	2.66	3.32	14.14	15.84	3.73
Groceries and take-out food	20.41	16.62	4.39	4.39	14.71	6.31	4.97
Gas & oil	12.62	8.71	6.96	2.75	15.36	7.39	4.05
Other auto expenses	0.97	1.51	1.70	0.31	6.09	0.00	0.66
Other boat expenses	4.97	0.00	2.13	0.00	12.19	0.00	0.55
Entertainment and recreation fees	2.34	2.91	0.97	0.52	4.35	1.66	0.75
Sporting goods and boat equipment	4.76	1.51	3.09	0.86	4.95	2.37	1.43
Other expenses	3.34	5.94	0.50	1.33	3.37	1.69	1.33
Total (within 30 miles)	\$73.71	\$62.51	\$22.41	\$13.48	\$94.74	\$55.46	\$18.62

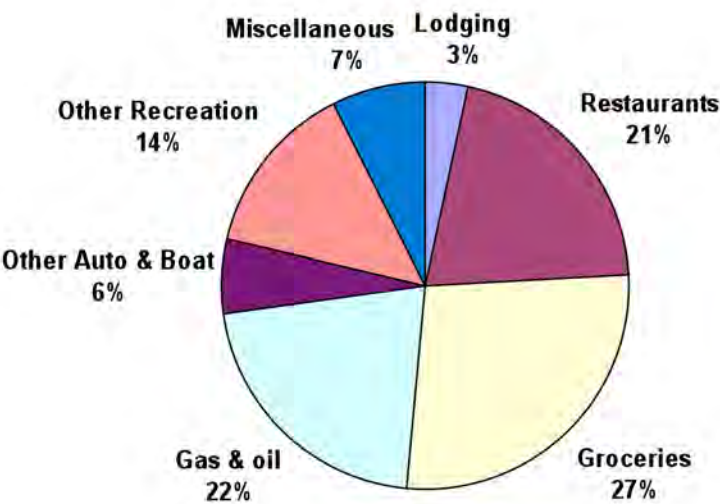


Table 22. Milford Lake total economic contributions

Impact Measure	Direct	Indirect	Total
Output	\$7,574,919	\$3,087,958	\$10,662,877
Total Value Added	\$3,653,684	\$1,659,095	\$5,312,779
Employment	159	34	193

Figure 18. Trip spending by category

Table 23. Non-market benefits of Milford Lake recreation, 2007\$

Activity	Days Spent in Activity	Activity Value per Day (2007\$)	Total Value per Year
Fish	247,031	\$38.58	\$9,530,695
Swim	133,467	\$19.75	\$2,635,698
Camp	71,417	\$29.54	\$2,109,555
Boat	48,001	\$27.45	\$1,317,515
Picnic	27,513	\$30.42	\$836,889
Other	57,953	\$19.94	\$1,155,466
Total	585,382	-----	\$17,585,818

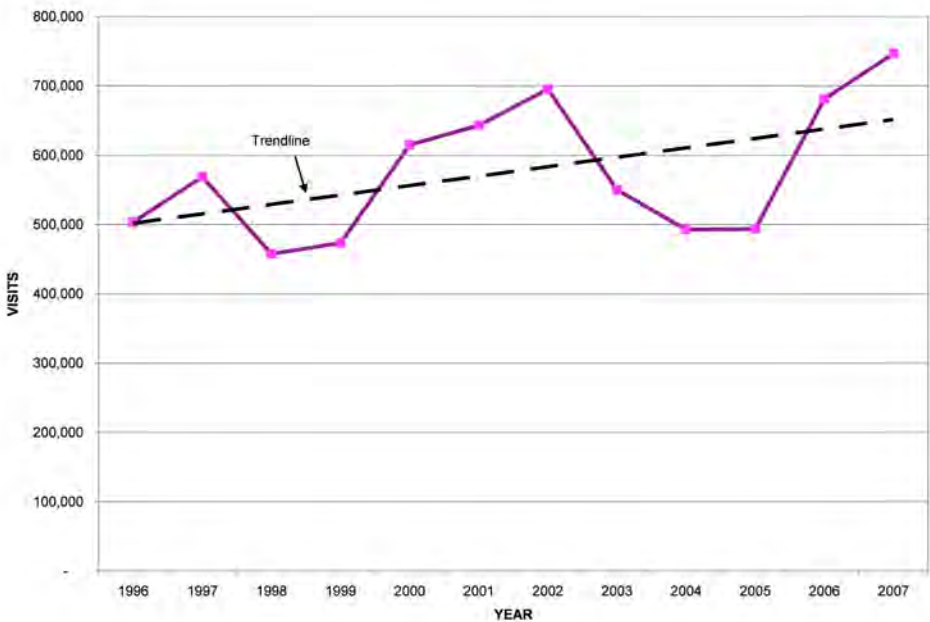


Figure 19. Trends in Milford Lake visitation

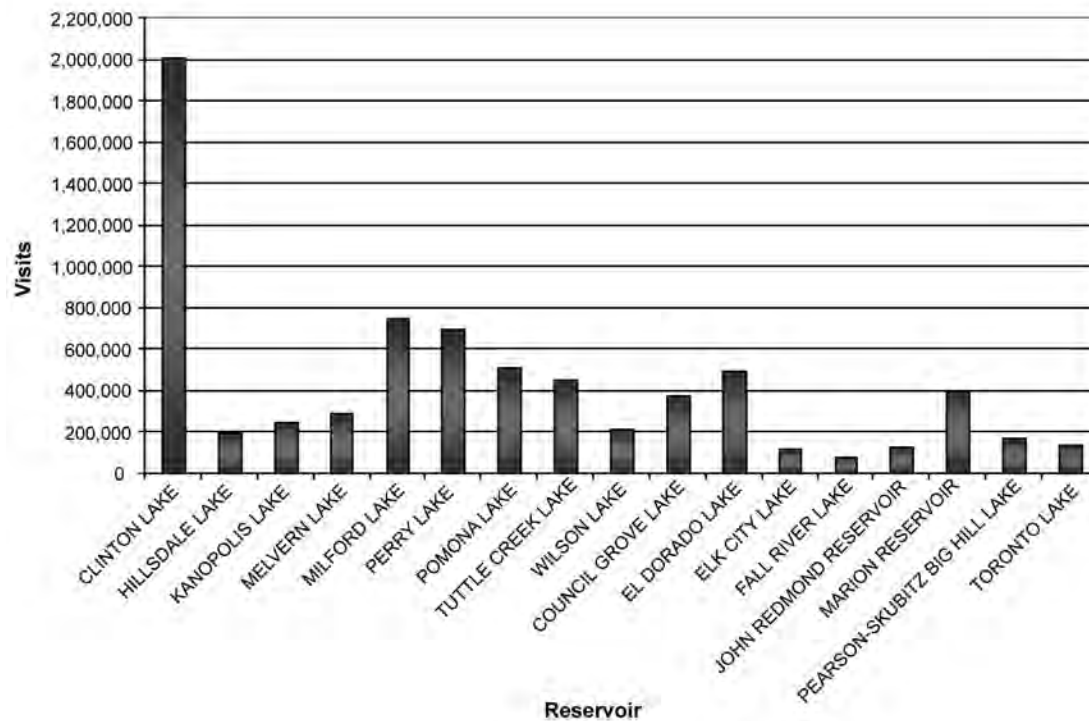


Figure 20. Visits to Kansas Reservoirs in 2007

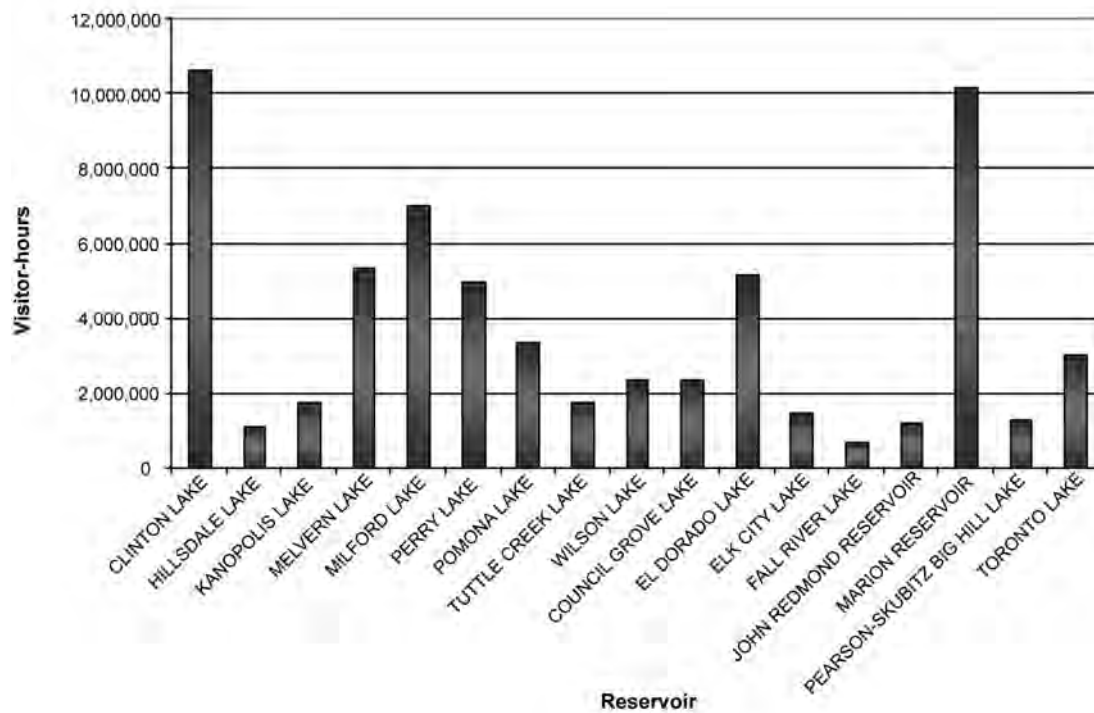


Figure 21: Visitor-hours at Kansas Reservoirs in 2007

7.8 Census Data¹⁸

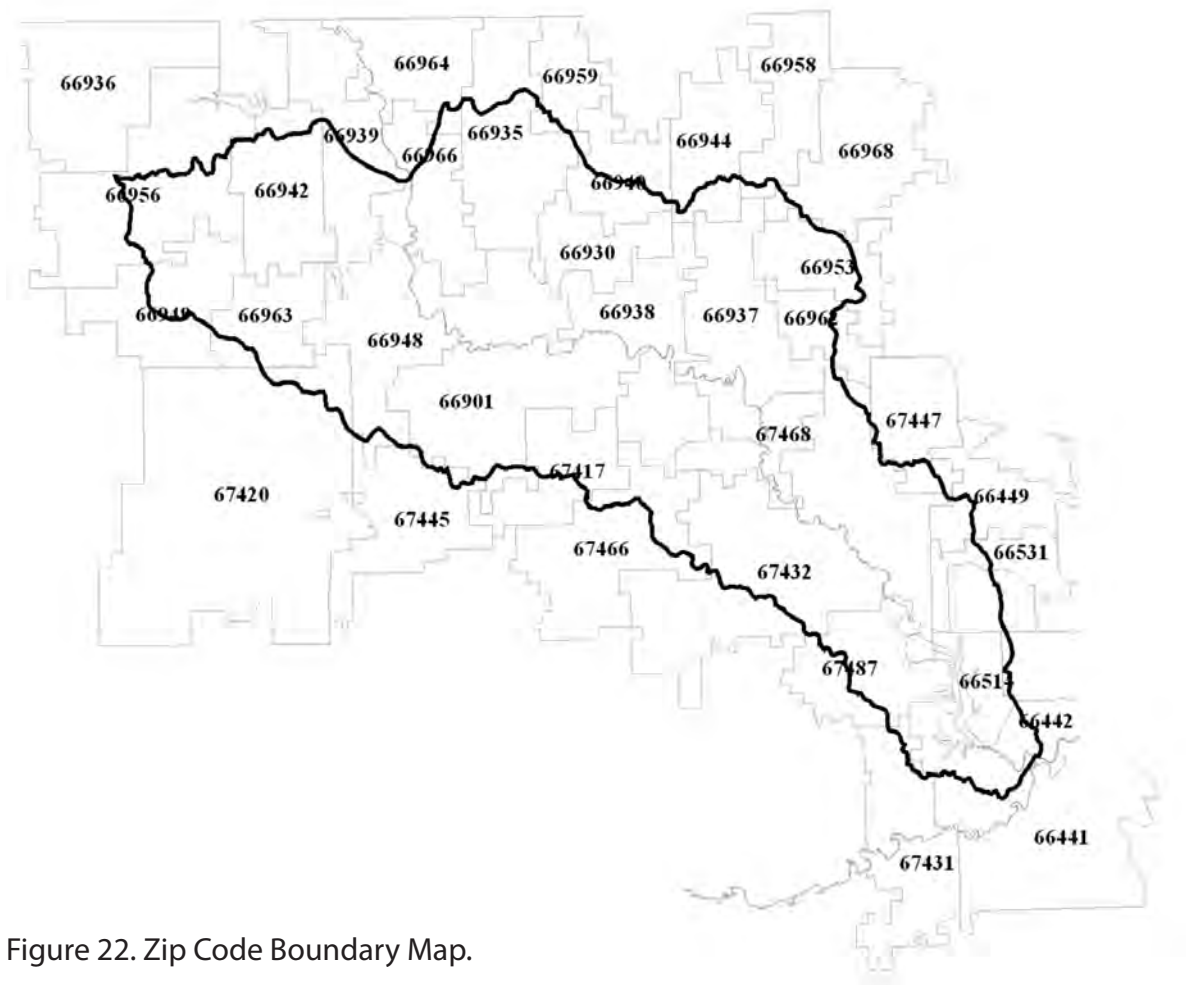


Figure 22. Zip Code Boundary Map.

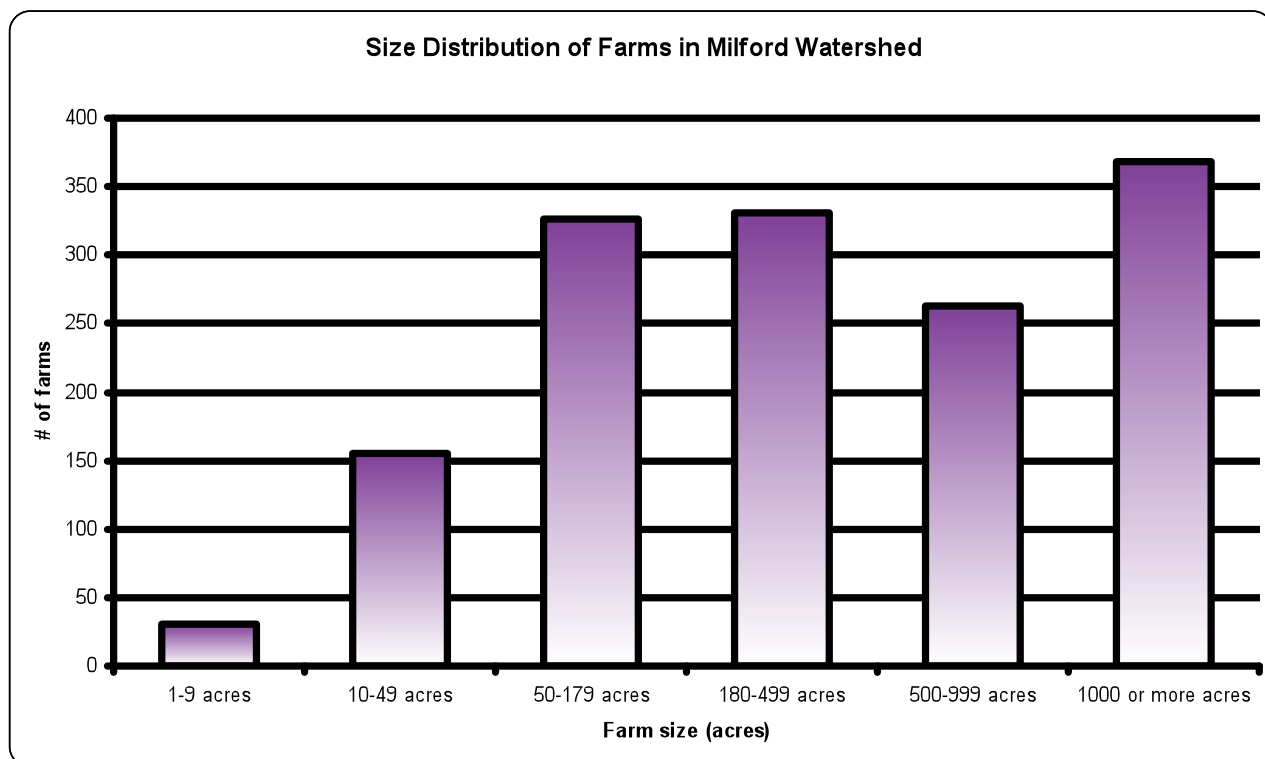


Figure 23. Size Distribution of Farms in Milford Lake Watershed, 2002¹⁸

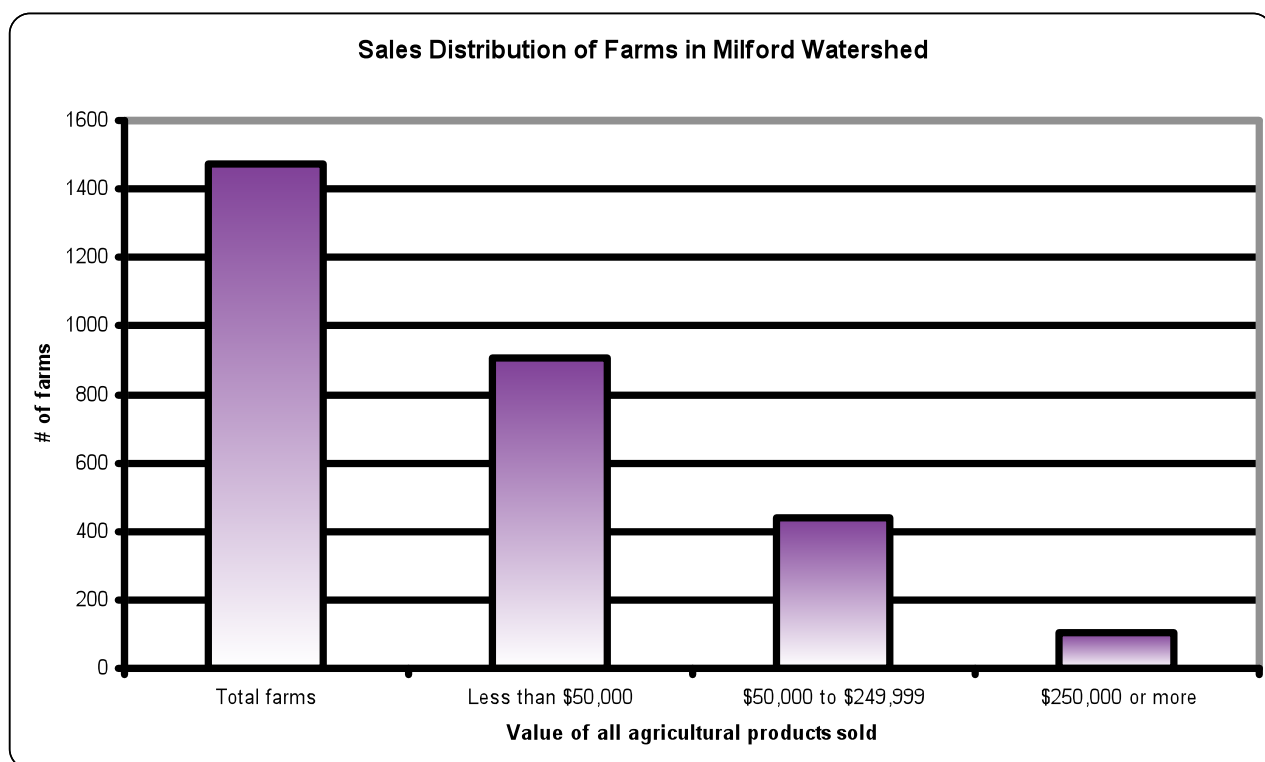


Figure 24. Sales Distribution of Farms in Milford Lake Watershed, 2002¹⁸

Harvested Crop Acreage in Milford Watershed

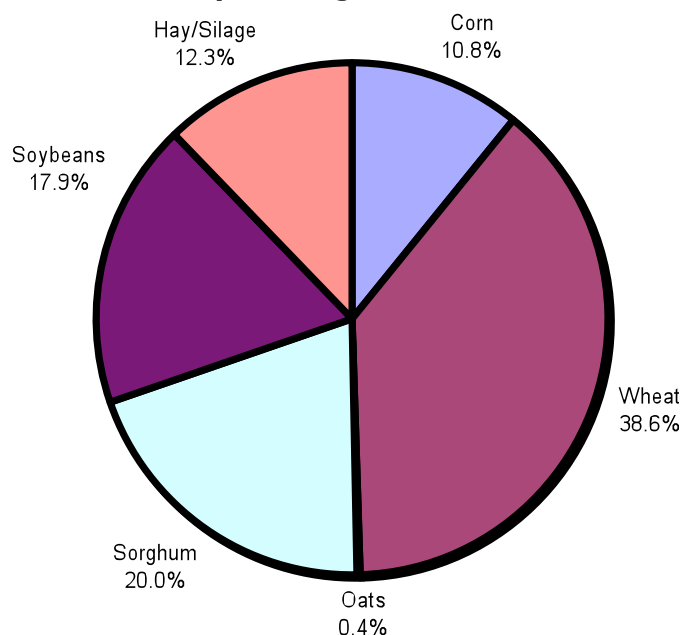


Figure 25. Harvested Crop Acreage in Milford Lake Watershed, 2002¹⁸

Livestock Number Distribution in Milford Watershed

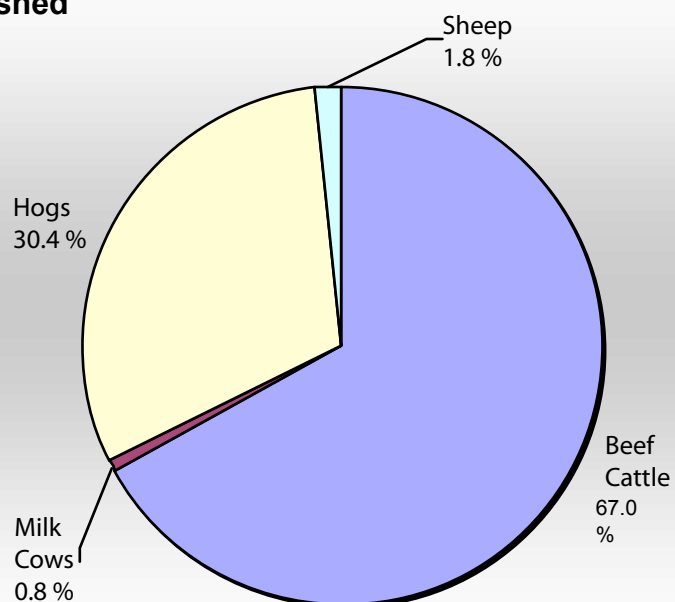


Figure 26. Livestock Number Distribution in Milford Lake Watershed, 2002¹⁸

8.0 Modeling

8.1 Subbasin Map¹⁹

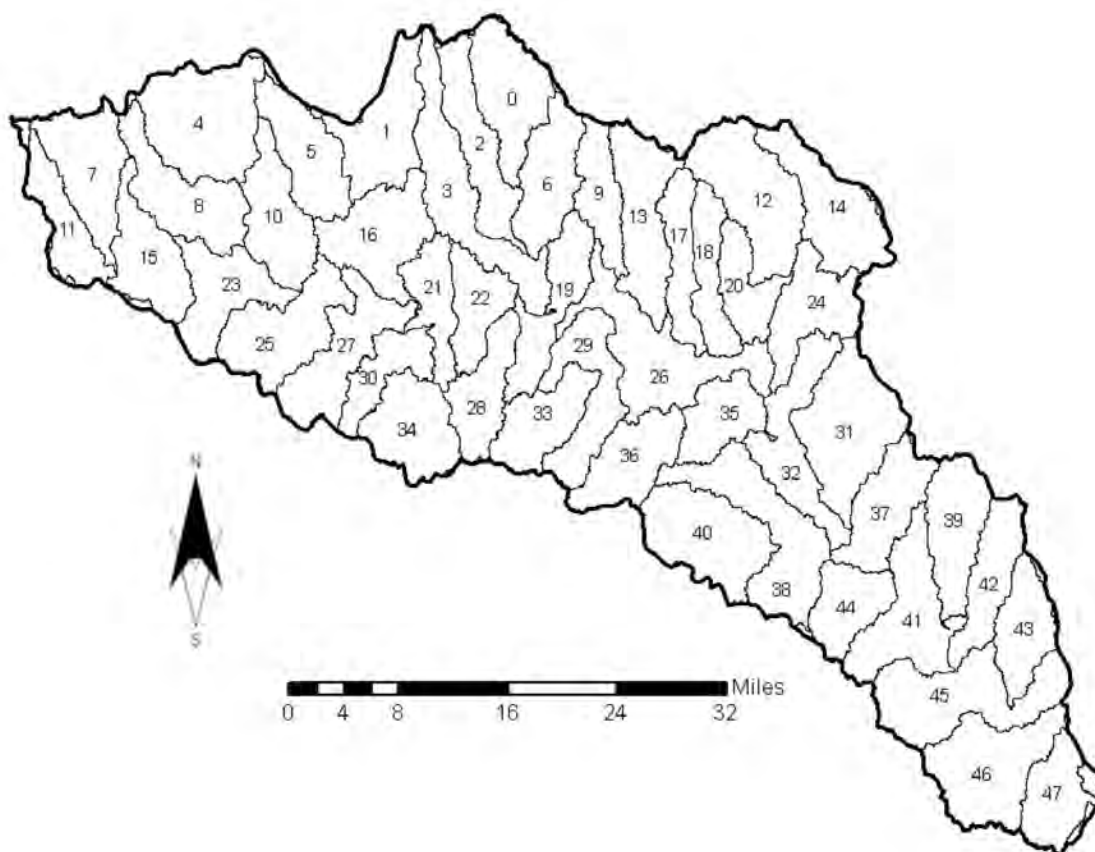


Figure 27. Subbasin Map – Lower Milford Lake Watershed.

Table 24. Milford Lake Watershed Subbasin Area

Subbasin	State	HUC ID	Area (acres)
0	KS	10250017030060	28120
1	KS	10250017020010	29872
2	KS	10250017030070	24546
3	KS	10250017030090	35990
4	KS	10250017010050	40940
5	KS	10250017020020	25020
6	KS	10250017030080	24569
7	KS	10250017010010	28088
8	KS	10250017010060	28818
9	KS	10250017040030	17234
10	KS	10250017010070	25652
11	KS	10250017010020	18217
12	KS	10250017040070	36594

Subbasin	State	HUC ID	Area (acres)
13	KS	10250017040040	29520
14	KS	10250017050010	30503
15	KS	10250017010030	23891
16	KS	10250017020030	30105
17	KS	10250017040050	16712
18	KS	10250017040060	16992
19	KS	10250017030100	22990
20	KS	10250017040080	16171
21	KS	10250017030030	17068
22	KS	10250017030040	17641
23	KS	10250017010040	24591
24	KS	10250017050020	24995
25	KS	10250017020040	30970
26	KS	10250017040090	39860
27	KS	10250017020050	29071
28	KS	10250017030050	20204
29	KS	10250017040020	26370
30	KS	10250017030020	16205
31	KS	10250017050080	39894
32	KS	10250017050030	27923
33	KS	10250017040010	21809
34	KS	10250017030010	26545
35	KS	10250017050050	18482
36	KS	10250017050040	24101
37	KS	10250017060010	24378
38	KS	10250017050070	37697
39	KS	10250017060040	25239
40	KS	10250017050060	35163
41	KS	10250017060030	32411
42	KS	10250017060050	20918
43	KS	10250017060060	19976
44	KS	10250017060020	18888
45	KS	10250017060070	39865
46	KS	10250017060080	36061
47	KS	10250017060090	19346
Total			1266216

8.2 Input Data

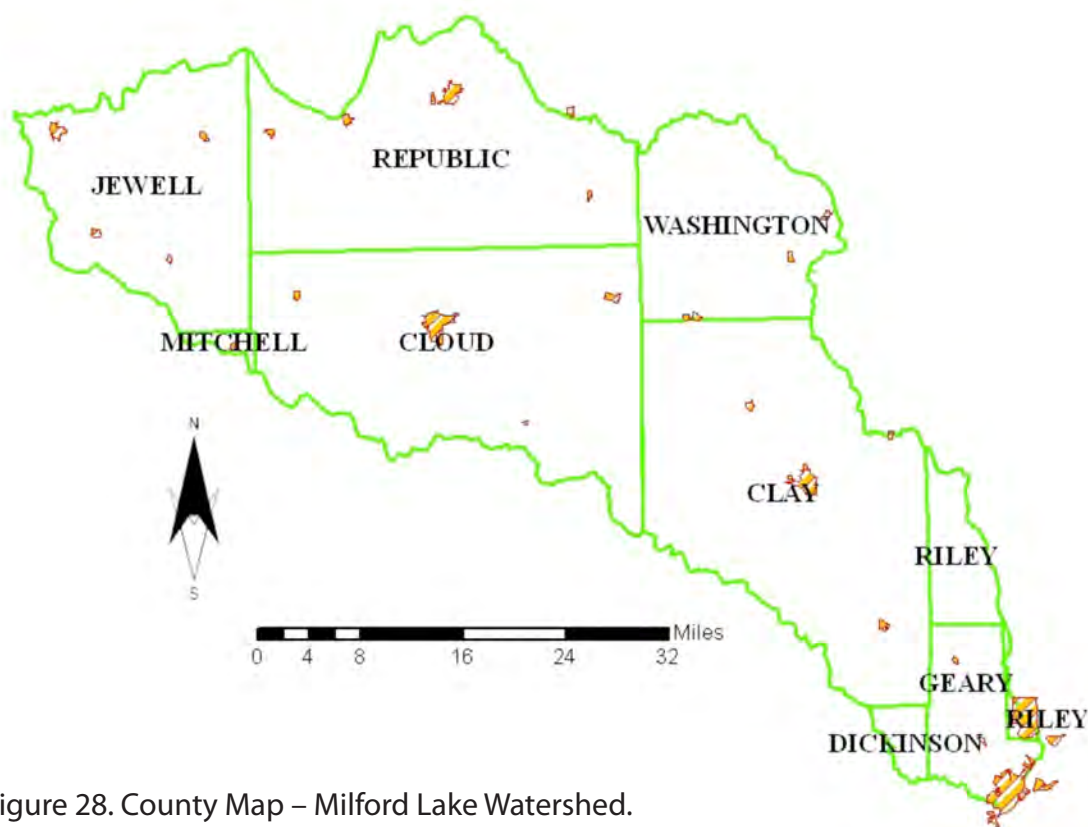


Figure 28. County Map – Milford Lake Watershed.

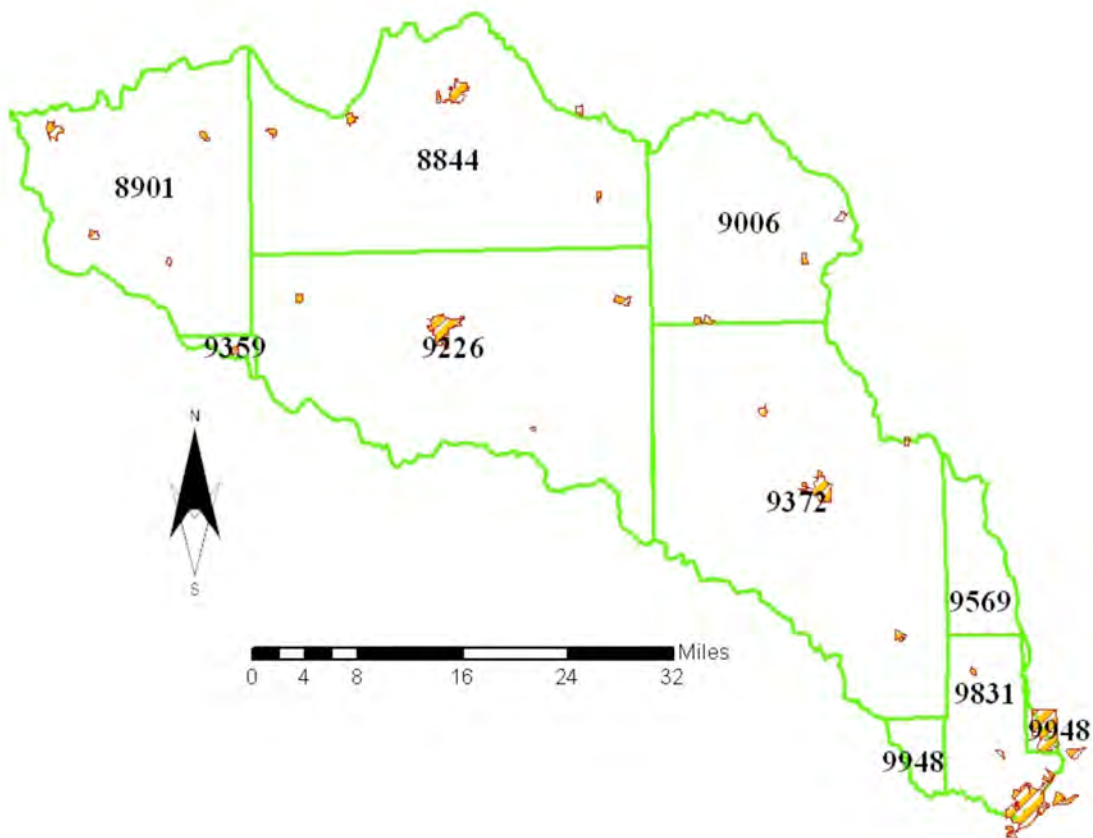


Figure 29. HUCO Map (overlay of county and 8-digit hydrologic unit boundary) – Milford Lake Watershed²³

Table 25. Milford Lake Watershed Summary²³

Polygon ID	County Name	State	HUC	Area (acre)	% in County	% in HUC
8844	Republic	KS	10250017	265832.6	57.07%	20.82%
8901	Jewell	KS	10250017	176723.4	29.75%	13.84%
9006	Washington	KS	10250017	132889.9	23.30%	10.41%
9226	Cloud	KS	10250017	291025.6	63.76%	22.79%
9359	Mitchell	KS	10250017	5648.53	1.22%	0.44%
9372	Clay	KS	10250017	300925.8	70.83%	23.56%
9569	Riley	KS	10250017	37214.68	9.43%	2.91%
9831	Geary	KS	10250017	53995.29	20.54%	4.23%
9924	Riley	KS	10250017	1781.94	0.45%	0.14%
9948	Dickinson	KS	10250017	11029.86	2.02%	0.86%

Table 26. Landuse Area (acre)²⁰

Polygon ID	Urban/Transportation	Cropland	Pasture/Rangeland	Forest	Feedlots	Water	Others
8844	10900	134400	73300	14100	0.28	2700	9700
8901	3000	118500	44600	6300	4.48	700	2400
9006	2900	82200	34500	1900	11.11	400	10900
9226	10500	185500	84400	5600	1.7	2200	10600
9359	500	7000	0	0	0.13	0	0
9372	9500	179600	72300	5800	12.75	8700	24000
9569	381.72	7157.29	8397.89	0	1.31	190.86	24811.94
9831	2700	11800	12600	2400	1.04	11000	17800
9924	18.28	342.71	402.11	0	0.06	9.14	1188.06
9948	100	2000	3700	0	0.32	0	1500
Total	40500	728500	334200	36100	33.18	25900	102900

Table 27. Agricultural Animals¹⁸

Polygon ID	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck
8844	D	D	D	552	169	203	D	5
8901	5120	106	3230	1250	98	119	0	1
9006	4991	672	21994	307	0	68	D	1
9226	D	D	4079	292	233	127	D	0
9359	D	D	370	11	2	2	0	0
9372	10145	415	18118	388	199	1020	18	5
9569	1078	41	1726	31	50	67	D	0
9831	1565	63	D	35	72	24	0	1
9924	51	1	82	1	2	3	D	0
9948	341	14	243	50	20	10	0	0
Total	23291	1312	49842	2917	845	1643	18	13

D = data withheld to avoid disclosing information for individual farms

Table 28. Septic System²¹

Polygon ID	No. of Septic Systems	Population per Septic System	Septic Failure Rate,%
8844	596	1.97	0.93
8901	293	1.76	0.93
9006	261	2.11	0.93
9226	716	2.12	0.93
9359	8	2.14	0.93
9372	910	2.21	0.93
9569	258	2.94	0.93
9831	246	2.55	0.93
9924	12	2.94	0.93
9948	49	2.25	0.93
Total	596	1.97	0.93

Table 29. Hydrological Soil Group²²

Polygon ID	Hydrological Group
8844	B
8901	B
9006	C
9226	B
9359	B
9372	C
9569	B
9831	B
9924	B
9948	C

A = well to excessively drained soil

B = moderately-well to well drained soil

C = poorly drained soil

D = very poorly drained soil

Table 30. Modify the Universal Soil Loss Equation (USLE) parameters²³

Polygon ID	Land Cover	R	K	LS	C	P
8844	Crop land	175.000	0.344	0.345	0.235	0.870
8901	Crop land	150.000	0.321	0.320	0.217	0.761
9006	Crop land	175.000	0.357	0.377	0.236	0.653
9226	Crop land	175.000	0.335	0.397	0.243	0.805
9359	Crop land	150.000	0.323	0.302	0.234	0.885
9372	Crop land	175.000	0.353	0.301	0.244	0.604
9569	Crop land	200.000	0.360	0.271	0.226	0.685
9831	Crop land	200.000	0.346	0.236	0.226	0.697
9924	Crop land	200.000	0.360	0.271	0.226	0.685
9948	Crop land	150.000	0.257	0.266	0.227	1.000
8844	Pasture Land	175.000	0.348	0.680	0.020	1.000
8901	Pasture Land	150.000	0.320	2.006	0.010	1.000
9006	Pasture Land	175.000	0.322	0.749	0.019	1.000
9226	Pasture Land	175.000	0.370	0.378	0.013	1.000
9359	Pasture Land	150.000	0.320	1.334	0.020	1.000
9372	Pasture Land	175.000	0.339	0.466	0.003	1.000
9569	Pasture Land	200.000	0.363	0.434	0.013	1.000
9831	Pasture Land	200.000	0.328	1.747	0.016	1.000
9924	Pasture Land	200.000	0.363	0.434	0.013	1.000
9948	Pasture Land	150.000	0.254	0.464	0.019	1.000
8844	Forest	175.000	0.320	0.565	0.003	1.000
8901	Forest	150.000	0.331	0.564	0.003	1.000
9006	Forest	175.000	0.311	0.566	0.003	1.000
9226	Forest	175.000	0.283	0.523	0.003	1.000
9359	Forest	150.000	0.320	0.458	0.003	1.000
9372	Forest	175.000	0.323	0.428	0.003	1.000
9569	Forest	200.000	0.305	1.002	0.003	1.000
9831	Forest	200.000	0.306	1.116	0.003	1.000
9924	Forest	200.000	0.305	1.002	0.003	1.000
9948	Forest	150.000	0.280	0.339	0.003	1.000

8.3 Model Outputs

Table 31. Total Pollution Load²³

Polygon ID	N Load (lb/year)	P Load (lb/year)	BOD Load (lb/year)	Sediment Load (t/year)
8844	740105.0	105441.6	1965189.2	16969.5
8901	536765.6	77493.8	1340918.1	9009.1
9006	566061.8	79902.5	1426936.7	8482.9
9226	936906.5	137077.9	2420394.0	22928.4
9359	22722.2	3976.6	51476.1	582.6
9372	1193685.4	164403.8	3060194.1	13656.5
9569	58084.8	7083.0	160121.4	669.9
9831	99158.5	12781.3	284230.8	1623.3
9924	2774.9	337.9	7658.3	32.1
9948	30442.6	3170.8	89002.4	159.9
Total	4186707.2	591669.0	10806121.0	74114.2

Table 32. Total Load by Land Uses²³

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	197536.81	30458.83	765722.69	4532.99
Cropland	2388930.26	424211.70	5007536.75	64689.41
Pastureland	1517871.74	118608.91	4913855.21	4806.99
Forest	5934.16	2935.87	14699.69	84.82
Feedlots	75563.50	15112.70	100751.34	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	870.69	341.02	3555.33	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00	0.00
Total	4186707.17	591669.03	10806121.00	74114.21

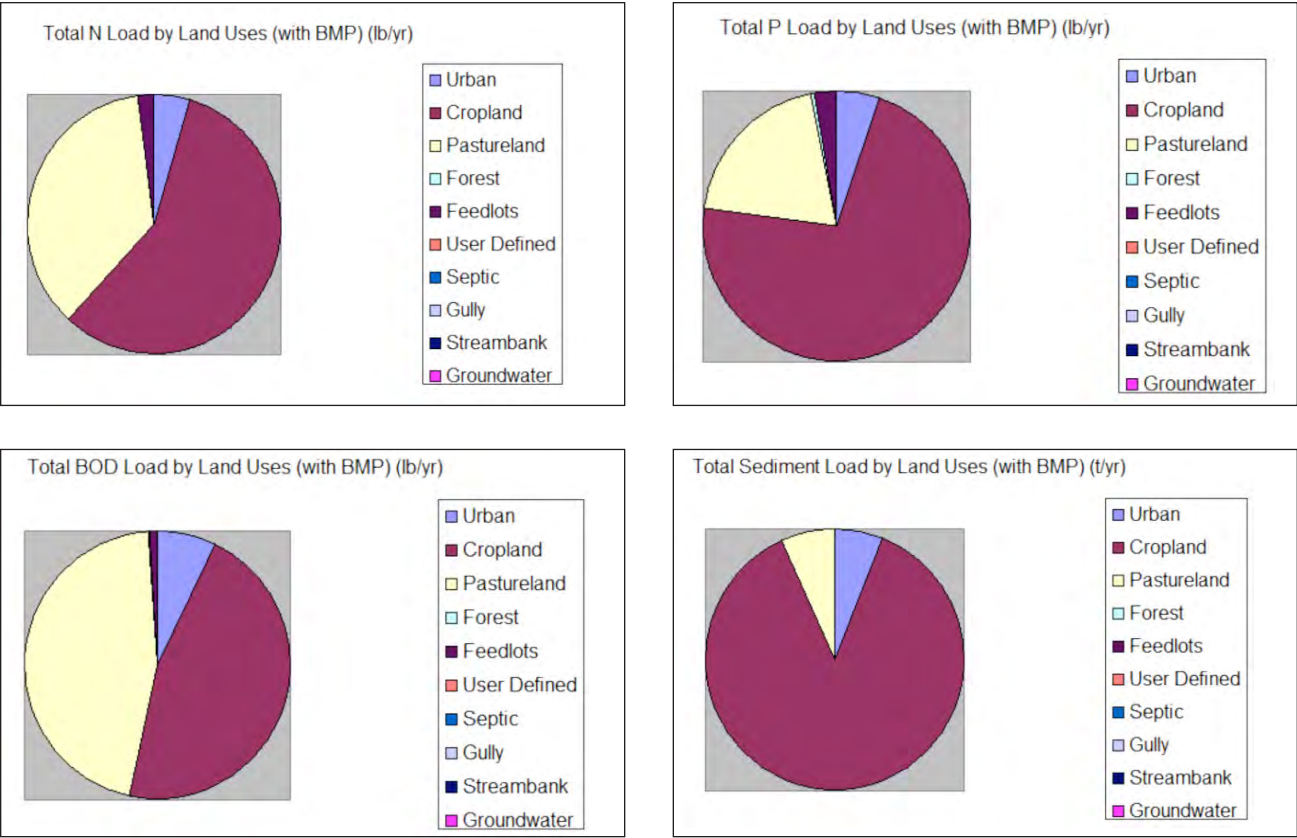


Figure 30. Total Load by Land Uses – Milford Lake Watershed.

9.0 Acknowledgment

The authors would like to acknowledge Dr. William Hargrove, Dr. Danny Rogers, Ms. Judy Willingham, and Mr. Don Snethen for their help and comments.

Funding for this project was provided in part by Kansas Water Plan Funds, and EPA 319 funds through Kansas Department of Health and Environment, Watershed Management Section.

10.0 Footnotes/Bibliography

1. *National Land Cover Database 2001 (NLCD 2001)*: “NLCD 2001 products include 21 classes of Land Cover, Percent Tree Canopy and Percent Urban Imperviousness at 30 m cell resolution.”

Online reference information available at: http://www.mrlc.gov/mrlc2k_nlcd.asp

2. *TMDLs for the Kansas Lower Republican River Basin*: “In 1999, 55 watershed and 38 lake TMDLs were developed. The TMDLs were submitted to EPA on June 30, 1999. The high priority TMDLs were approved on August 9 and the remainder were approved on September 23, 1999.”

Online reference information available at: <http://www.kdheks.gov/tmdl/klr.htm>

3. *National Elevation Dataset*: “The USGS National Elevation Dataset (NED) has been developed by merging the highest-resolution, best quality elevation data available across the United States into a seamless raster format. NED is the result of the maturation of the USGS effort to provide 1:24,000-scale Digital Elevation Model (DEM) data for the conterminous US.”

Online reference information available at: <http://ned.usgs.gov/>

4. *Precipitation Map*: “Point estimates of precipitation originated from some or all of the following sources: 1) National Weather Service (NWS) Cooperative (COOP) stations, 2) Natural Resources Conservation Service (NRCS) SNOTEL, 3) United States Forest Service (USFS) and Bureau of Land Management (BLM) RAWS Stations, 4) Bureau of Reclamation (AGRIMET) stations, 5) California Data Exchange Center (CDEC) stations, 6) Storage gauges, 7) NRCS Snowcourse stations, 8) Other State and local station networks, 9) Estimated station data, 0) Canadian stations, 10) Upper air stations, and 11) NWS/Federal Aviation Administration (FAA) Automated surface observation stations (ASOS). All COOP station data were subjected to quality control checks by the National Climatic Data Center (NCDC). All COOP, SNOTEL and other data were subjected to further quality control checks by the PRISM Group.”

Online reference information available at: http://prism.oregonstate.edu/docs/meta/ppt_30s_meta.htm#7

5. *Maximum Temperature Map*: “Point estimates of temperature originated from some or all of the following sources: 1) National Weather Service (NWS) Cooperative (COOP) stations, 2) Natural Resources Conservation Service (NRCS) SNOTEL, 3) United States Forest Service (USFS) and Bureau of Land Management (BLM) RAWS Stations, 4) Bureau of Reclamation (AGRIMET) stations, 5) California Data Exchange Center (CDEC) stations, 6) Storage gauges, 7) NRCS Snowcourse stations, 8) Other State and local station networks, 9) Estimated station data, 0) Canadian stations, 10) Upper air stations, and 11) NWS/Federal Aviation Administration (FAA) Automated surface observation stations (ASOS). All COOP station data were subjected to quality control checks by the National Climatic Data Center (NCDC). All COOP, SNOTEL and other data were subjected to further quality control checks by the PRISM Group.”

Online reference information available at: http://prism.oregonstate.edu/docs/meta/tmax_30s_meta.htm

6. *Minimum Temperature Map*: “Point estimates of temperature originated from some or all of the following sources: 1) National Weather Service (NWS) Cooperative (COOP) stations, 2) Natural Resources Conservation Service (NRCS) SNOTEL, 3) United States Forest Service (USFS) and Bureau of Land Management (BLM) RAWS Stations, 4) Bureau of Reclamation (AGRIMET) stations, 5) California Data Exchange Center (CDEC) stations, 6) Storage gauges, 7) NRCS Snowcourse stations, 8) Other State and local station networks, 9) Estimated station data, 0) Canadian stations, 10) Upper air stations, and 11) NWS/Federal Aviation Administration (FAA) Automated surface observation stations (ASOS). All COOP station data were subjected to quality control checks by the National Climatic Data Center (NCDC). All COOP, SNOTEL and other data were subjected to further quality control checks by the PRISM Group.”

Online reference information available at: http://prism.oregonstate.edu/docs/meta/tmin_30s_meta.htm

7. *Land Use (GIRAS 1980s)*: “This is land use/land cover digital data collected by USGS and converted to ARC/INFO by the EPA. This data which resides in EPA’s Spatial Data Library (ESDLS), is useful for environmental assessment of land use patterns with respect to water quality analysis, growth management, and other types of environmental impact assessment. GIRAS LU/LC is being used in EPA’s, Office of Water/OST BASINS water quality assessment model.”

Online reference information available at: <http://www.epa.gov/waterscience/basins/metadata/giras.htm>

8. *National Land Cover Database 1992 (NLCD 1992)*: “Derived from the early to mid-1990s Landsat Thematic Mapper satellite data, the National Land Cover Data (NLCD) is a 21-class land cover classification scheme applied consistently over the United States. The spatial resolution of the data is 30 meters and mapped in the Albers Conic Equal Area projection, NAD 83. The NLCD are provided on a state-by-state basis. The state data sets were cut out from larger “regional” data sets that are mosaics of Landsat TM scenes. At this time, all of the NLCD state files are available for free download as 8-bit binary files and some states are also available on CD-ROM as a Geo-TIFF.”

Online reference information available at: http://landcover.usgs.gov/us_map.php

9. *River Network*: “The National Hydrography Dataset (NHD) is a comprehensive set of digital spatial data that contains information about surface water features such as lakes, ponds, streams, rivers, springs and wells. The NHD is based upon the content of USGS Digital Line Graph (DLG) hydrography data integrated with reach-related information from the EPA Reach File Version 3 (RF3). The stream network was generated based on the USEPA Reach File, Version 1 and National Hydrography Dataset (NHD).”

Online reference information available at: <http://nhd.usgs.gov/>

USEPA Reach File, Version 1.0.

Online reference information available at: <http://www.epa.gov/>

10. *Hydrologic Soil Groups*: “Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. Mapping scales generally range from 1:12,000 to 1:63,360; SSURGO is the most detailed level of soil mapping done by the Natural Resources Conservation Service (NRCS). SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships, and county natural resource planning and management. The user should be knowledgeable of soils data and their characteristics.”

Online reference information available at: <http://www.ncgc.nrcs.usda.gov/products/datasets/ssurgo/>

11. *Water Quality Observations Stations*: “Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. Mapping scales generally range from 1:12,000 to 1:63,360; SSURGO is the most detailed level of soil mapping done by the Natural Resources Conservation Service (NRCS). SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships, and county natural resource planning and management. The user should be knowledgeable of soils data and their characteristics.”

Online reference information available at: <http://www.ncgc.nrcs.usda.gov/products/datasets/ssurgo/>

12. *USGS Gage Stations*: “Inventory of surface water gaging station data including 7Q10 low and monthly mean stream flow. Better Assessment Science Integrating Point & Nonpoint Sources (BASIN v. 4.0).”

Online reference information available at: <http://www.epa.gov/waterscience/basins/index.html>

13. *Estimated Peak-Streamflow Frequencies*: “Estimated peak-streamflow frequencies for selected gaging stations with at least 10 years of annual peak-discharge data for unregulated, rural streams in Kansas.”

Online reference information available at: <http://ks.water.usgs.gov/Kansas/waterwatch/flood/flood-freq.html>

14. *Permitted Point Source Facilities*: “BASINS also includes information on pollutant loading from point source discharges. The location, type of facility, and estimated loading are provided. These loadings are also used to support evaluation of watershed-based loading summaries combining point and nonpoint sources.”

Online reference information available at: <http://www.epa.gov/waterscience/basins/index.html>

15. *Confined Animal Feeding Operations*: Obtained from Watershed Planning Section -Kansas Department of Health and Environment.

16. *The 1990 Population and Sewerage by Census Tract*: “Summarizes the selected area by census tract ID. For each census tract, the report lists the population, number of housing units, type of residential sewer system, and spatial percentage of that tract located within the subject watershed area.”

Online reference information available at: <http://www.epa.gov/waterscience/basins/index.html>

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