LOWER ARKANSAS BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody / Assessment Unit: Turkey Creek
Water Quality Impairment: Total Phosphorus

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Little Arkansas

Counties: McPherson and Harvey

HUC8: 11030012 **HUC10** (12): **02** (04, 05, 06, 07, 08)

Ecoregion: Central Great Plains, Wellington-McPherson Lowland (27d)

Drainage Area: Approximately 194 square miles

Main Stem Water Quality Limited Segments: Turkey Creek Segments 11 & 12

Water Quality Limited Segments Covered Under this TMDL:

Station	***Main Stem Segment***	***Trib 1***	***Trib2***
Station 533	Turkey Cr (11)	Dry Turkey Cr (13)	Bull Cr (24)
	Turkey Cr (12)	Running Turkey Cr (25)	

2010 & 2012 303(d) Listing: Kansas Stream segments monitored by station SC533 are cited as impaired by Total Phosphorus (TP) for the Lower Arkansas Basin.

Impaired Use: Expected Aquatic Life, Contact Recreation and Domestic Water Supply

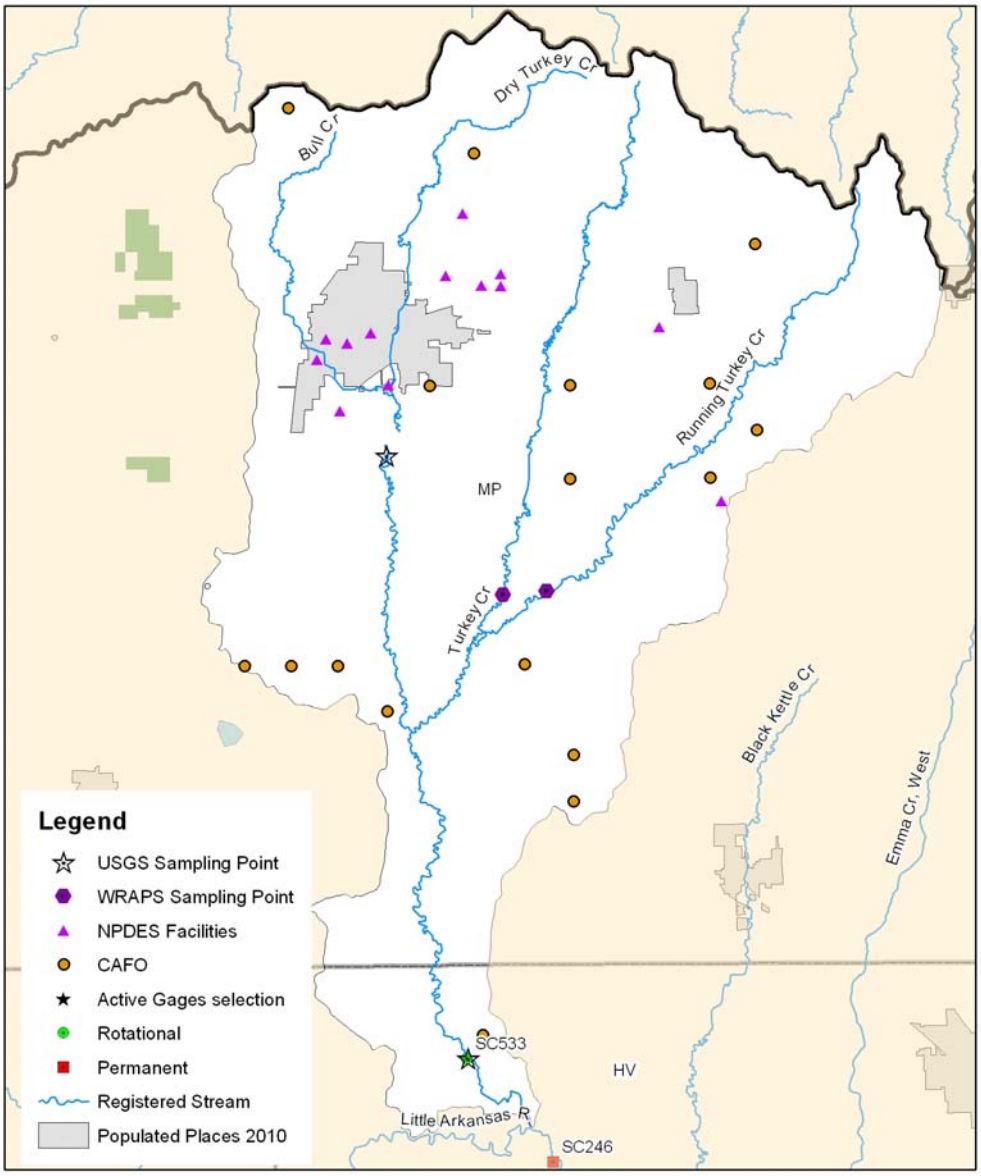
Water Quality Criteria:
Nutrients – Narratives: The introduction of plant nutrient into surface waters designated for domestic water supply use shall be controlled to prevent interference with the production of drinking water (K.A.R. 28-16-28e(c)(3)(D)).

The introduction of plant nutrients into streams, lakes, or wetlands from artificial sources shall be controlled to prevent the accelerated succession or replacement of aquatic biota or the production of undesirable quantities or kinds of aquatic life (K.A.R. 28-16-28e(c)(2)(A)).

The introduction of plant nutrients into surface waters designated for primary or secondary contact recreational use shall be controlled to prevent the development of objectionable concentrations of algae or algal by-products or nuisance growths of submersed, floating, or emergent aquatic vegetation (K.A.R. 28-26-28e(c)(7)(A)).

Designated Uses: Expected Aquatic Life Support; Primary Contact Recreation B (segment 13); Primary Contact Recreation C (segments 11 & 24); Secondary Contact Recreation b (segments 12 & 25); Drinking Water Supply (13, 25, & 24); Food Procurement (segment 11, 12, & 13); Groundwater Recharge (segment 11, 13, 24, & 25); Industrial Use (segments 13, 24, & 25); Irrigation Use; and Livestock Use.

Figure 1. Turkey Creek Watershed Base Map



2. CURRENT WATER QUALITY CONDITIONS AND DESIRED ENDPOINT

Level of Support for Designated Uses under 2012-303(d): Phosphorus levels on Turkey Creek are consistently high. Excessive nutrients are not being controlled and are thus impairing aquatic life, domestic water supply, and contact recreation.

Stream Monitoring Sites and Period of Record: KDHE Rotational Station SC533 on Turkey Creek is sampled bimonthly or quarterly during the sampling years of: 1990, 1994, 1998, 2002, 2006, and 2010.

Supplementing the routine KDHE sampling, the Little Arkansas Watershed Restoration and Protection Strategy (WRAPS) group sampled two locations within the Turkey Creek watershed from 2008-2010. This sampling was conducted by Kansas State University.

USGS sampled Turkey Creek near Buhler and Dry Turkey Creek in 2007 and 2008.

Hydrology: Long term flow conditions for Turkey Creek at SC533 were estimated based on the drainage area ratios between SC533 and USGS gage 07143665 (1990-2011) on the Little Arkansas River at Alta Mills. As displayed in Table 1, Long term flow estimates for the Dry Turkey Creek, Turkey Creek, and Running Turkey Creek tributaries within the watershed are derived from the USGS Scientific Investigations Report 2004-5033 (Perry, 2004).

Table 1. Long Term Flow Conditions in the Little Arkansas Watershed as calculated from USGS gage 07143665 for Turkey Creek and estimated tributary flow values as estimated from USGS (Perry, 2004).

Stream	Drainage Area	Mean Flow (cfs)	Percent of Flow Exceedance				
			90% (cfs)	75% (cfs)	50% (cfs)	25% (cfs)	10% (cfs)
Turkey Cr at SC533 (area ratio from USGS Gage 07143665, Little Arkansas R at Alta Mills)	194	53.7	0.98	2.27	4.74	14.23	71.0
USGS Estimated Flows (Perry, 2004)							
Dry Turkey Cr (13) (above confluence with Turkey Cr)	124	24.44	0	0.06	1.47	5.93	24.42
Turkey Cr (12) (above confluence with Running Turkey Cr)	38	8.23	0	0	0.39	1.7	6.92
Running Turkey Cr (25)	55	12.06	0	0	0.74	2.87	10.94
Bull Cr (24)	48	8.96	0	0	0.26	1.51	7.08

Flow durations curves over the period of record from 1990-2011 are illustrated for the USGS Gage 07143665 and estimated for Turkey Creek at KDHE sampling station SC533 in Figure 2. Annual flow averages for Turkey Creek are detailed in Figure 3. Extremely dry years were observed in 1990, 1991, 1994, 2006, and 2011. Based on annual flow averages, the wetter years include 1993, 1995, 1998, 1999 and 2007. As seen in Figure 4, monthly flow averages indicate the months with the highest flows are May, June, and July and the highest monthly median flows are seen in June, May and April.

Figure 2. Flow duration curve for USGS gage 07143665 on the Little Arkansas River and estimated for Turkey Creek at SC533.

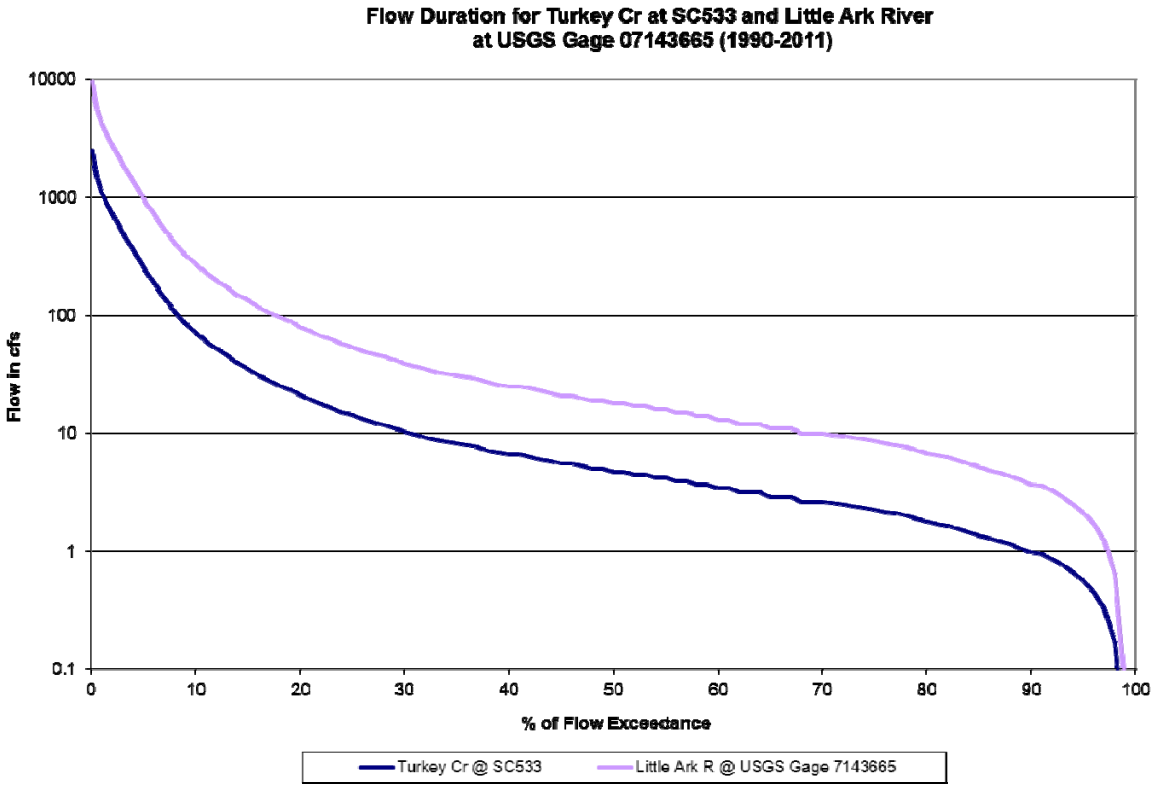


Figure 3. Estimated Annual Flow Averages at SC533 on Turkey Creek.

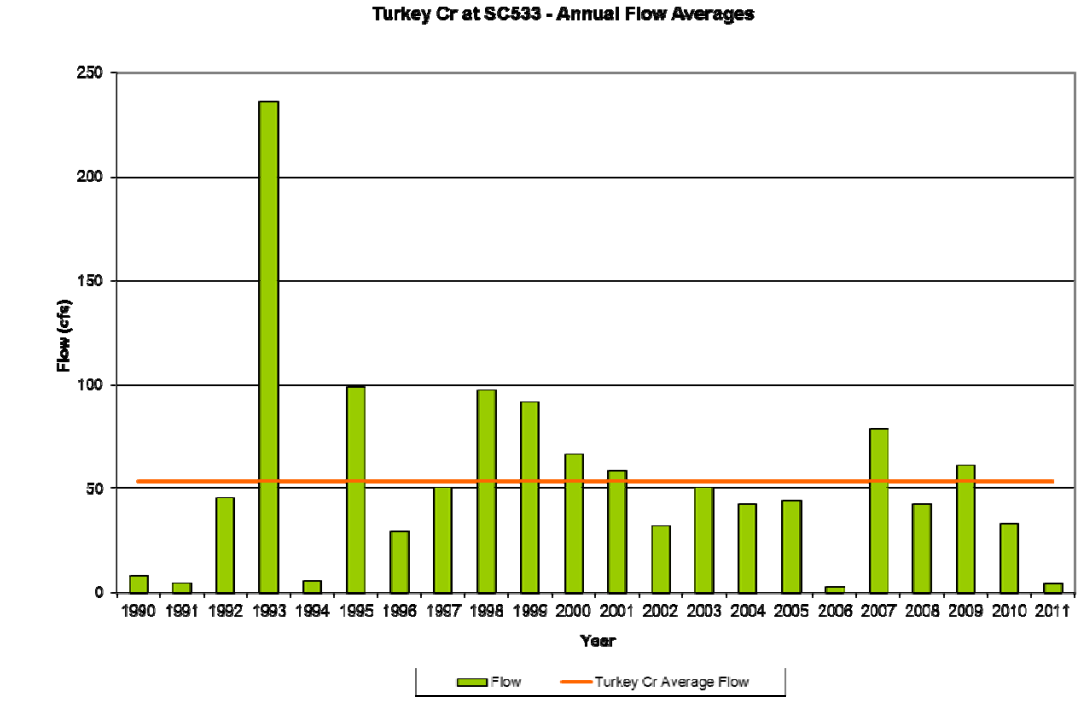
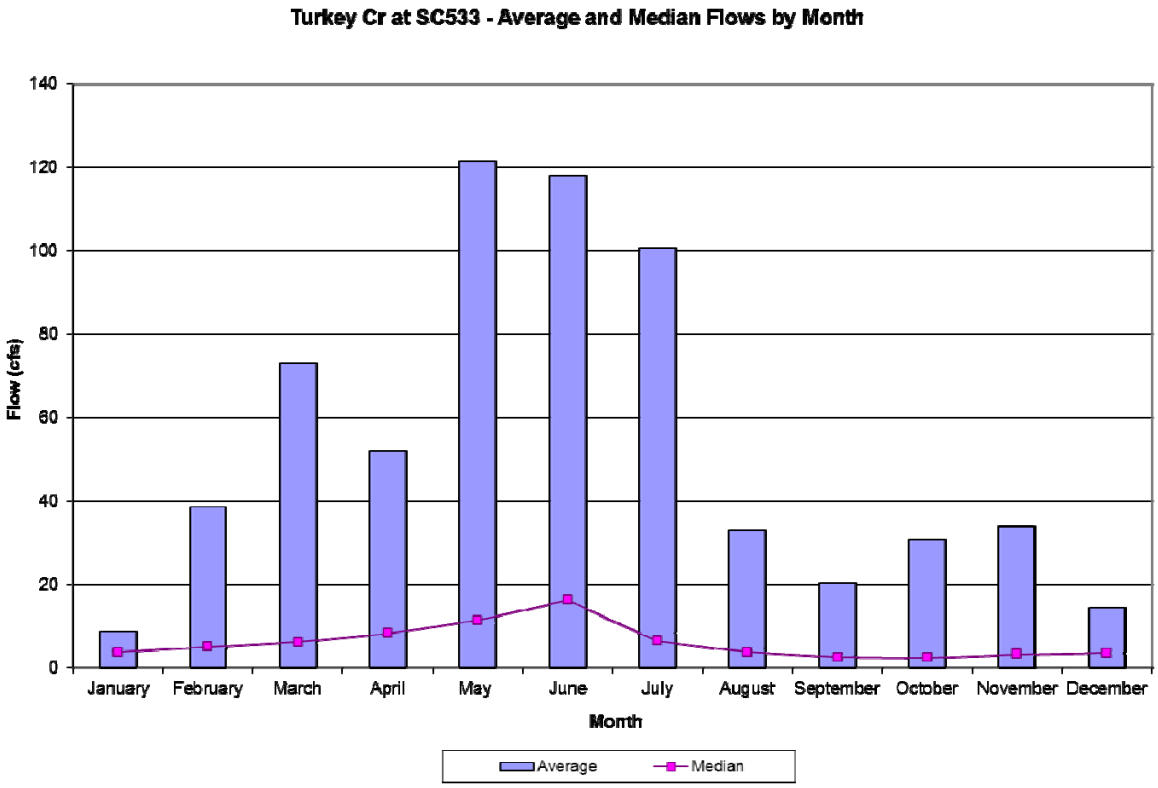


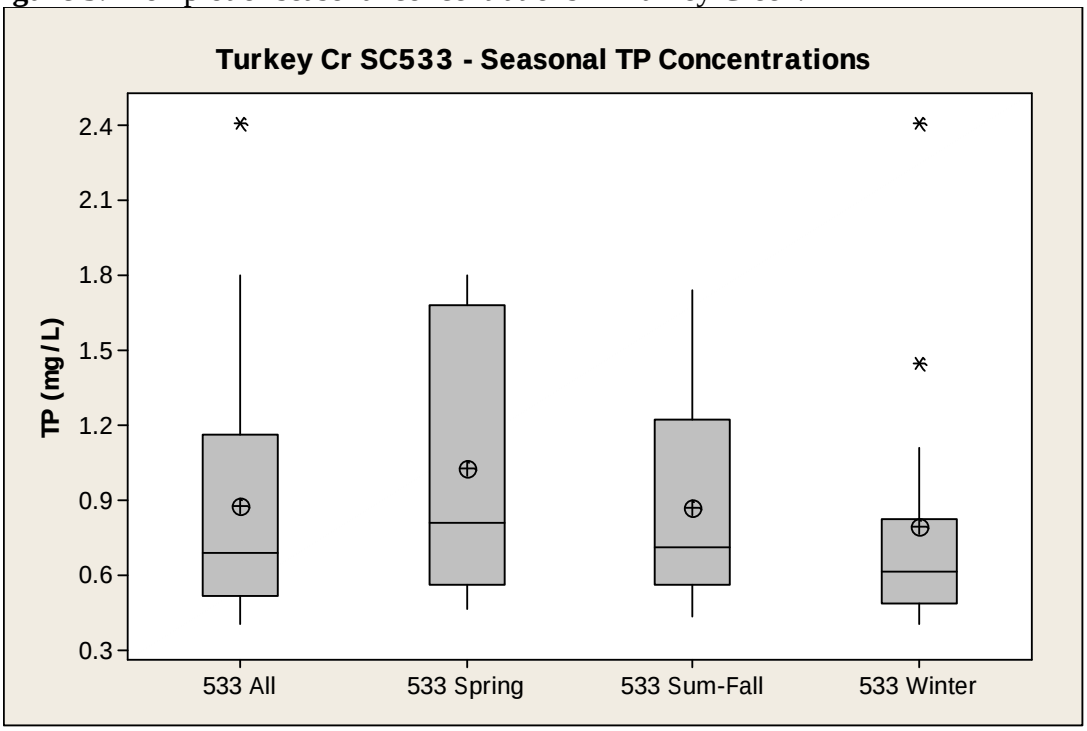
Figure 4. Estimated Monthly flow averages at SC533 on Turkey Creek.



Assessment Season: Seasonal variability has been accounted for in this TMDL. A three season approach was utilized to include: the Spring season consisting of the months of April, May, and June; the Summer-Fall season consisting of the months of July, August, September, and October, and the Winter season that includes January, February, March, November, and December.

Phosphorus Concentrations: The overall Total Phosphorus (TP) concentration average is 0.88 mg/L at SC533, with a median concentration of 0.69 mg/L. Seasonal TP averages range from a low of 0.79 mg/L in the Winter season to a high of 1.02 mg/L in the Spring season. Seasonal median concentrations are similar between the three seasons with median concentrations ranging from a low of 0.71 mg/L in the Summer-Fall, to 0.79 mg/L in the Winter, to a high of 0.81 mg/L in the Spring. Seasonal Total Phosphorus (TP) concentrations are further detailed in Figure 5.

Figure 5. Box plot of seasonal concentrations in Turkey Creek.



Phosphorus concentration averages based on the flow conditions are the highest during the low flow condition (75-99% flow exceedance) with an average of 1.22 mg/L at SC533. During normal flows (25-74% flow exceedance) TP averages 0.73 mg/L and during the high flow condition (0-24% flow exceedance) TP has the lowest average at 0.62 mg/L at SC533. Median concentrations during the low flow condition are 1.22 mg/L, matching the average concentration for this flow condition. Median TP concentrations for the normal and high flow conditions are 0.62 mg/L and 0.49 mg/L respectively. TP concentrations based on the flow condition are detailed in Figure 6a.

Figure 6a. Boxplot of TP concentrations relative to percent of flow exceedance ranges.

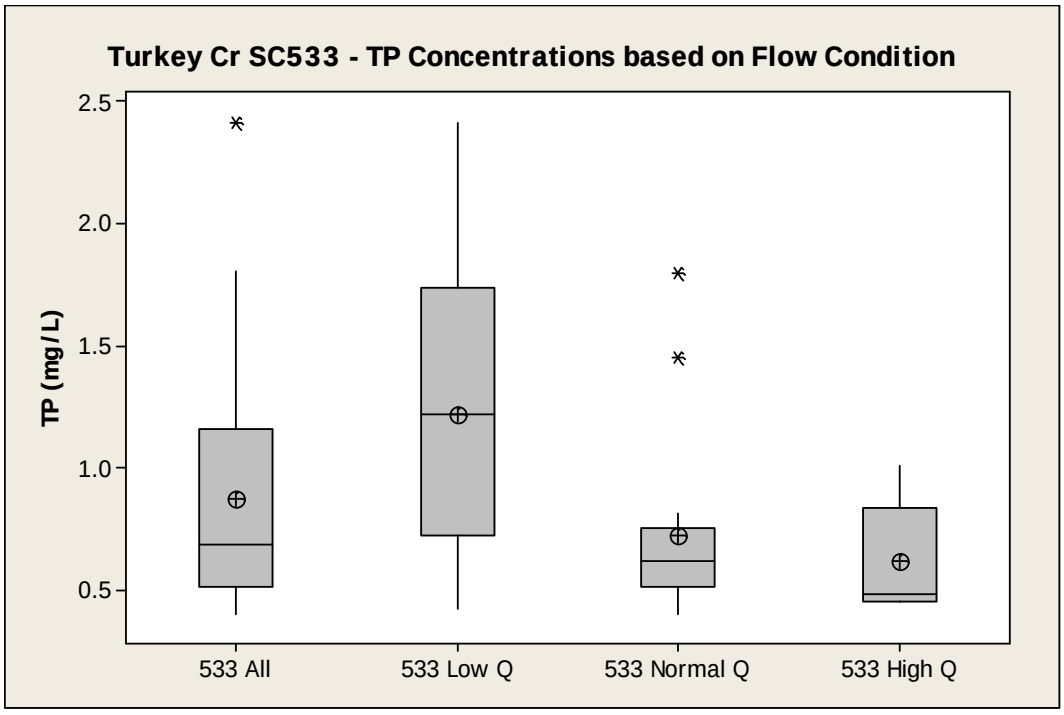
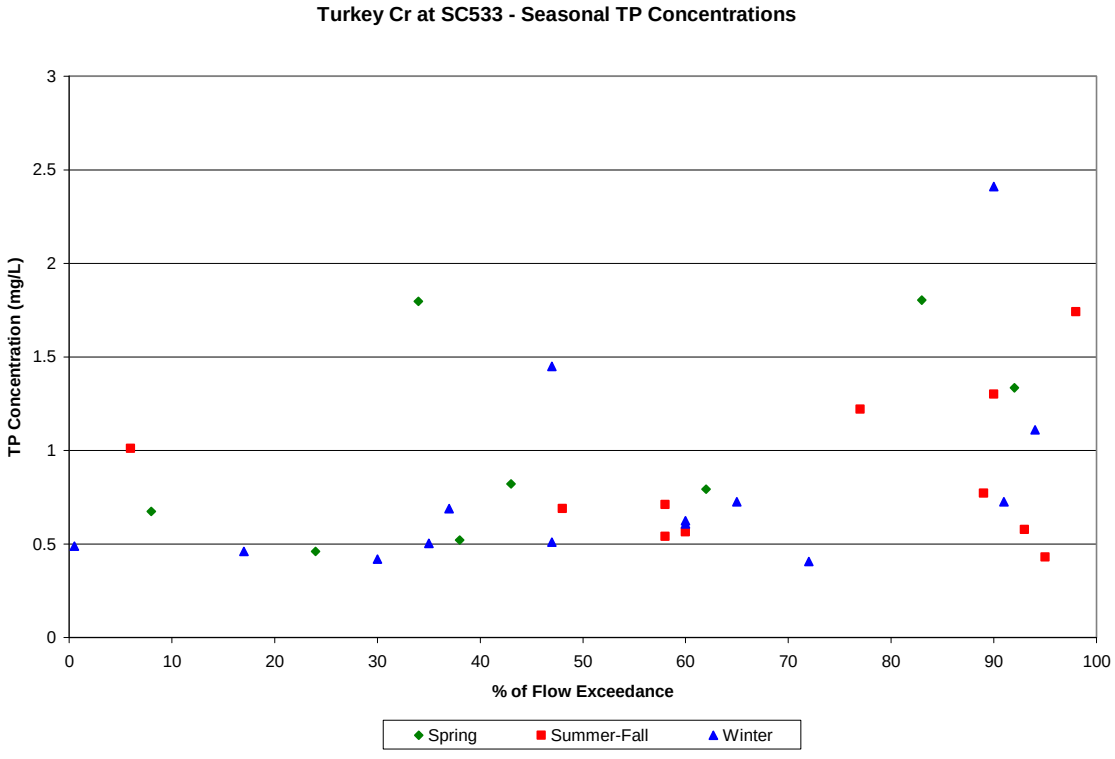


Figure 6b. Seasonal TP Concentrations relative to flow at SC533.



Seasonal TP concentrations based on the flow conditions are further detailed in Table 2 and Figure 6b. The highest average TP concentrations are observed during the low flow condition during the spring season and the lowest average TP concentrations are observed during the high flow condition in the winter. The higher TP concentrations during the low flow condition are indicative of wastewater loading, which in this case is a result of TP loading from the City of McPherson's wastewater treatment plant.

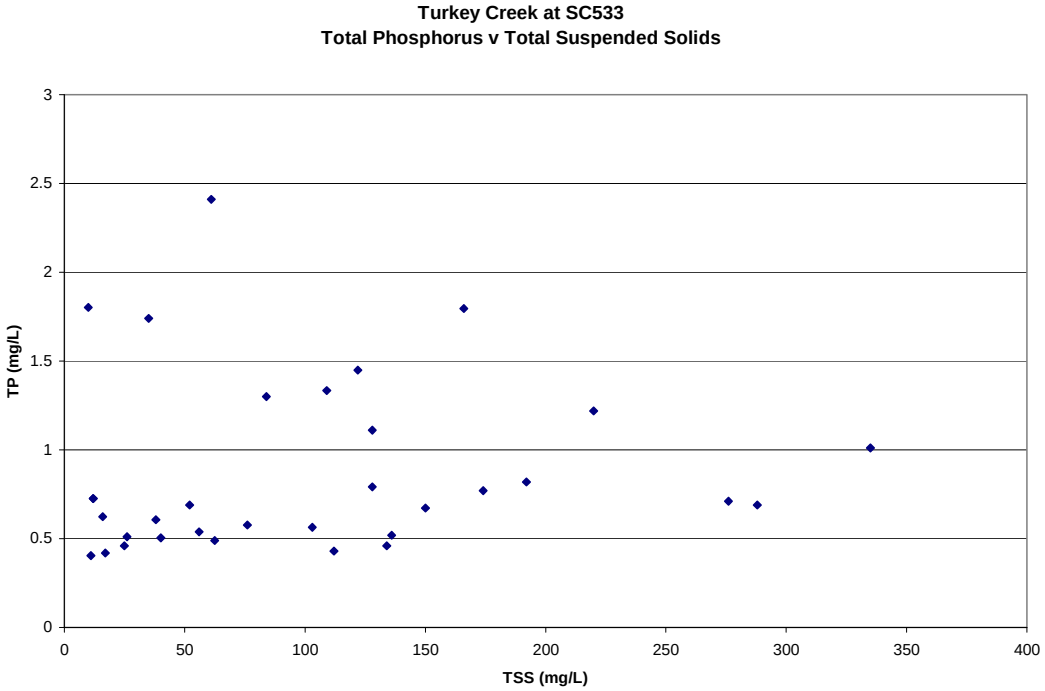
Table 2. Seasonal average and median TP concentrations based on flow conditions.

Season / Flow Condition	TP (mg/L) Low Q (75-99%) cfs	TP (mg/L) Normal Q (25-74%) cfs	TP (mg/L) High Q (0-24%) cfs	TP (mg/L) Average (mg/L)	TP Season Median (mg/L)
Spring	1.57	0.98	0.57	1.02	0.81
Summer-Fall	1.01	0.63	1.01	0.87	0.71
Winter	1.42	0.69	0.48	0.79	0.79
Flow Condition Average (mg/L)	1.22	0.73	0.62	0.88	
Flow Condition Median (mg/L)	1.22	0.62	0.49	0.69	

Because of the large variability in ambient phosphorus concentrations, median values are appropriate for determining long-term conditions. Listing on the 2010 and 2012 Section 303(d) lists for phosphorus was determined by median concentrations exceeding 0.201 mg/L for any station.

Phosphorus is typically linked to sediment or total suspended solids because of the propensity of those solids to adsorb phosphorus. As seen in Figure 7, TSS levels on Turkey Creek are poorly correlated with phosphorus concentrations. This notable lack of relation between the two is indicative of the dominant influence of the McPherson wastewater with the elevated phosphorus and low TSS content within Turkey Creek.

Figure 7. Relationship between TP and TSS at SC533.



Data collected by USGS in the watershed are detailed in Tables 3 and 4. The USGS Turkey Creek near Buhler sampling location is the same sampling location as the KDHE SC533 site. Comparing the data between the two USGS sampling sites, we can conclude that during low flow conditions any McPherson wastewater TP loads decrease as they move downstream, such as on December 3, 2007. Conversely, we see that during higher flow conditions TP concentrations and loads increase at the downstream sampling site from nonpoint source TP contributions entering the watershed such as in April of 2008. In addition, the higher ortho-phosphorus concentrations also indicate the significant contributions associated with wastewater discharge.

Table 3. USGS sampling data from Dry Turkey Cr 2 miles south of McPherson.

Sample Date	TP (mg/L)	Ortho P (mg/L)	Recorded Flow (cfs)
12/3/2007	1.24	1.14	2
2/19/2008	0.83	0.437	48
4/10/2008	0.98	0.452	68
5/27/2008	0.7	0.349	177
Average	0.938	0.595	

Table 4. USGS sampling data from Turkey Cr near Buhler, KS

Sample Date	TP (mg/L)	Ortho P (mg/L)	Recorded Flow (cfs)
12/3/2007	0.65	0.506	2.5
2/19/2008	0.93	0.372	792
4/11/2008	1.47	0.288	572
5/31/2008	0.8	0.383	40
Average	0.963	0.387	

There are three mechanisms in place dictating phosphorus concentrations in the lower reaches of Turkey Creek. The first factor is the effect of McPherson's wastewater on the downstream hydrology and nutrient content. The second influence is nonpoint sources in proximity to Turkey Creek that contribute direct loadings. The final influence is wet weather sources that dominate loading during runoff events, which includes the wet weather impacts of urban stormwater from McPherson and runoff from nonpoint sources in the aftermath of rainfall. Stormwater runoff from McPherson is viewed as a point source and would have to be distinguished from the rural nonpoint sources in the watershed.

The Little Arkansas Watershed Restoration and Protection Strategy Group (WRAPS) have collected water quality data since 2008 along Running Turkey Creek, including total phosphorus (Barnes, 2011). A TP profile along Running Turkey Creek for the sampling years of 2008, 2009, and 2010 is illustrated in Figure 8. Along with the monthly TP averages in Running Turkey Creek as seen in Figure 9, the figures detail that the higher TP concentrations within the Running Turkey Creek subwatershed occur during the months of April, May, June and July. Figure 10 illustrates the seasonal concentration along Running Turkey Creek in relation to the flow condition within the stream. The seasonal flow profile indicates that nonpoint source pollution resulting from runoff events is the driving factor for elevated TP concentrations. Furthermore, Figure 11 details a strong relationship between TP and TSS concentrations within Running Turkey Creek, reflective of nonpoint source loading within this subwatershed.

Figure 8. Little Arkansas WRAPS TP concentrations from 2008-2010 on Running Turkey Creek.

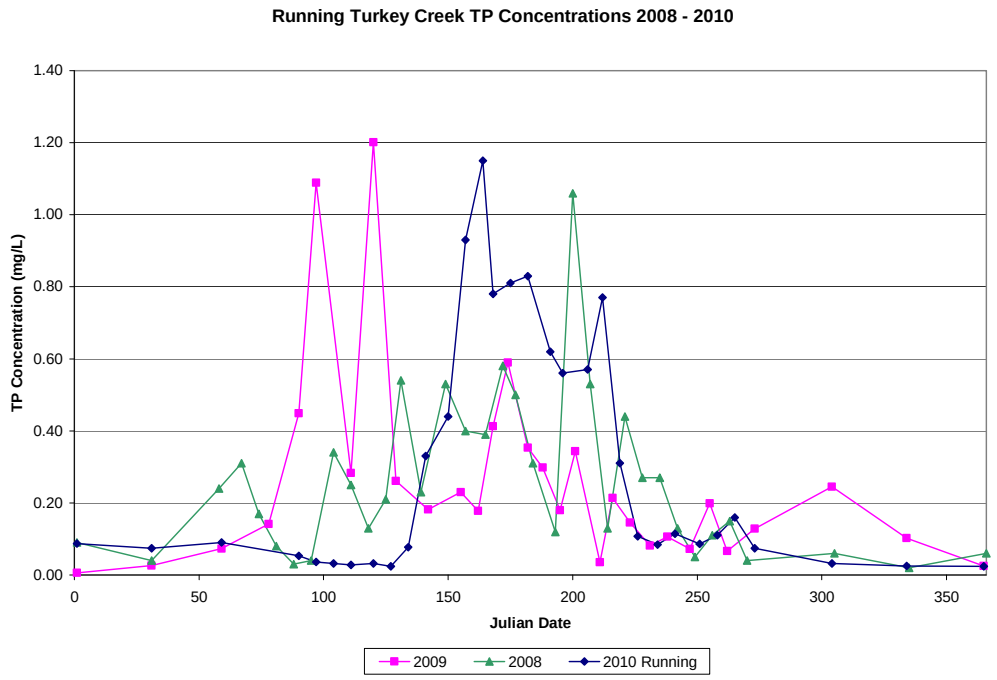


Figure 9. Monthly Average TP concentrations on Running Turkey Creek (2008-2010).

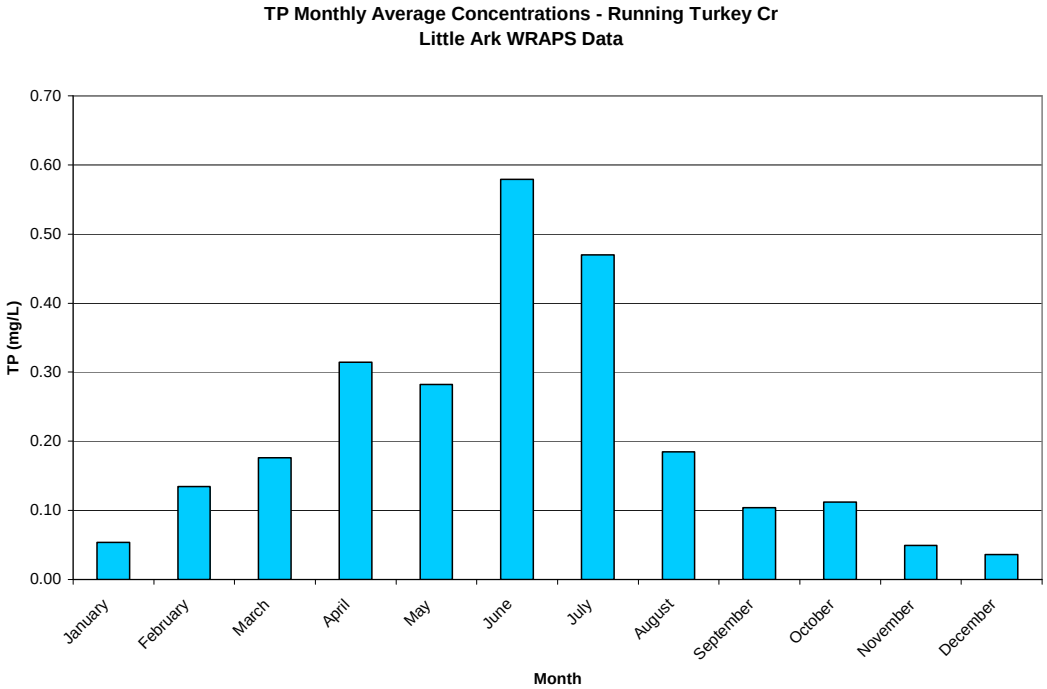


Figure 10. Seasonal TP concentrations on Running Turkey Creek relative to flow.

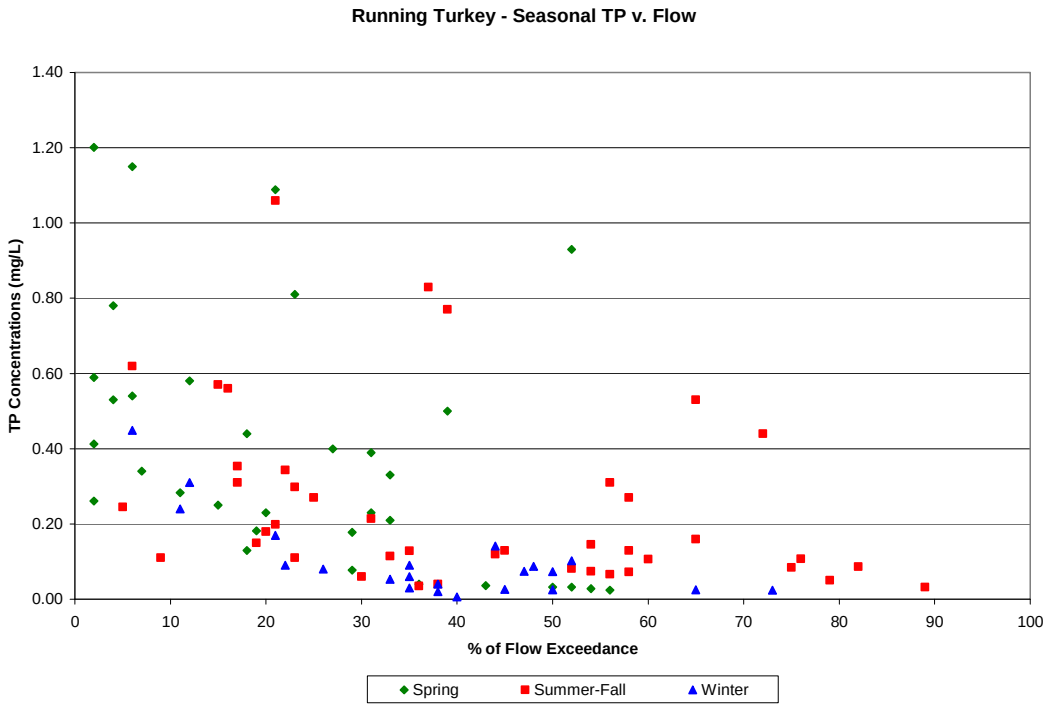
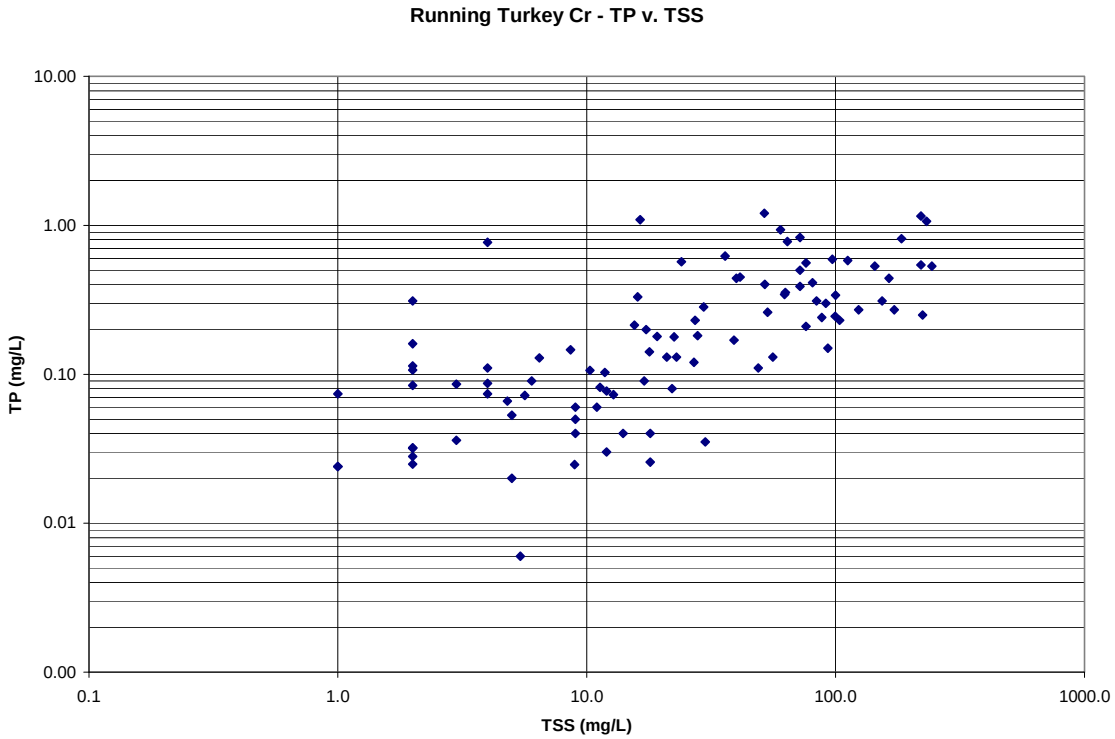


Figure 11. Relationship between TP and TSS on Running Turkey Creek.



Relationship between Phosphorus and Biological Indicators: The narrative criteria of the Kansas Water Quality Standards are based on indications of the prevailing biological community. Excessive primary productivity may be indicated by extreme swings in dissolved oxygen or pH as the chemical reactions of photosynthesis and respiration alter the ambient levels of oxygen or acid-base balance of a stream. The relationship between pH and stream temperature is illustrated in Figure 12. Higher pH values tend to occur during higher photosynthesis periods. Levels of pH at SC533 have exceeded the pH criterion of 8.5 on only one sample. The average pH at SC533 is 7.6, well within the range of criteria for Kansas waters. Figure 13 illustrates the relationship between stream pH and the TP concentration. Generally, the TP concentrations were less than the average concentration when pH values were elevated. On Turkey Creek, dissolved oxygen tends to swing inversely to the ambient temperature of the stream as seen in Figure 14, which also details the monthly average DO concentrations and temperature at SC533. Monthly averages for DO are below the 5 mg/L during the months of July and September. A Dissolved Oxygen TMDL was approved in 2000 for Turkey Creek. Sestonic chlorophyll samples have not been collected by KDHE at SC533.

Figure 12. Relationship between pH and temperature in Turkey Creek.

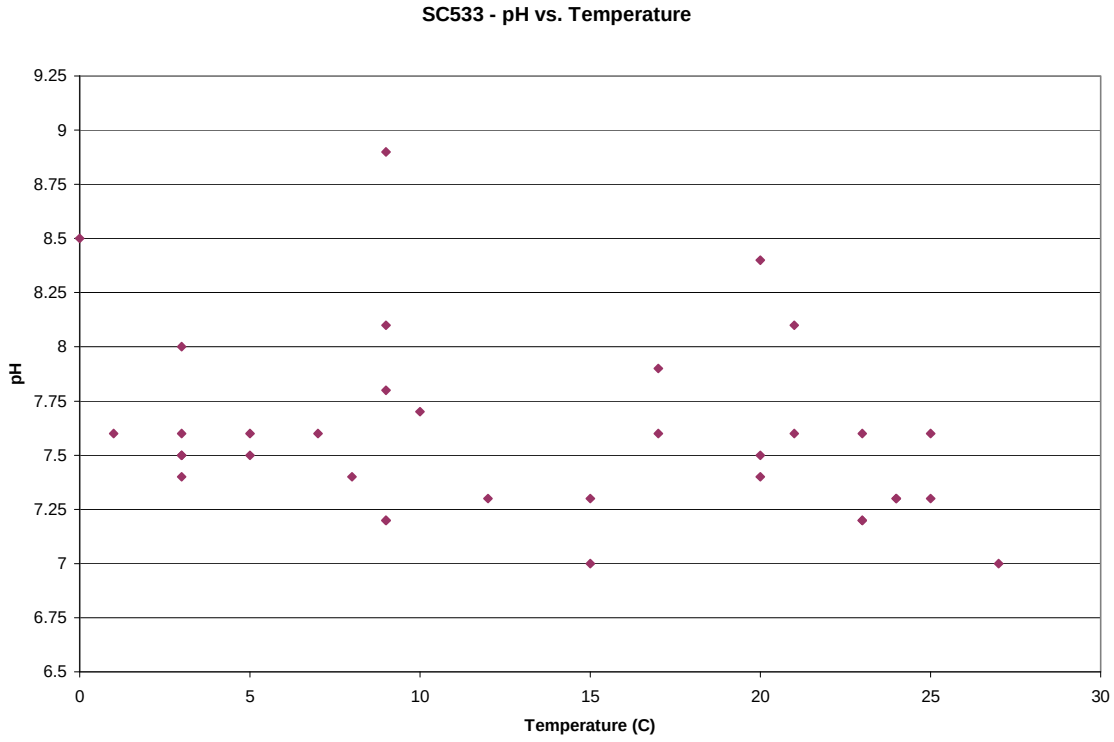


Figure 13. Relationship between pH values and TP concentrations at SC533.

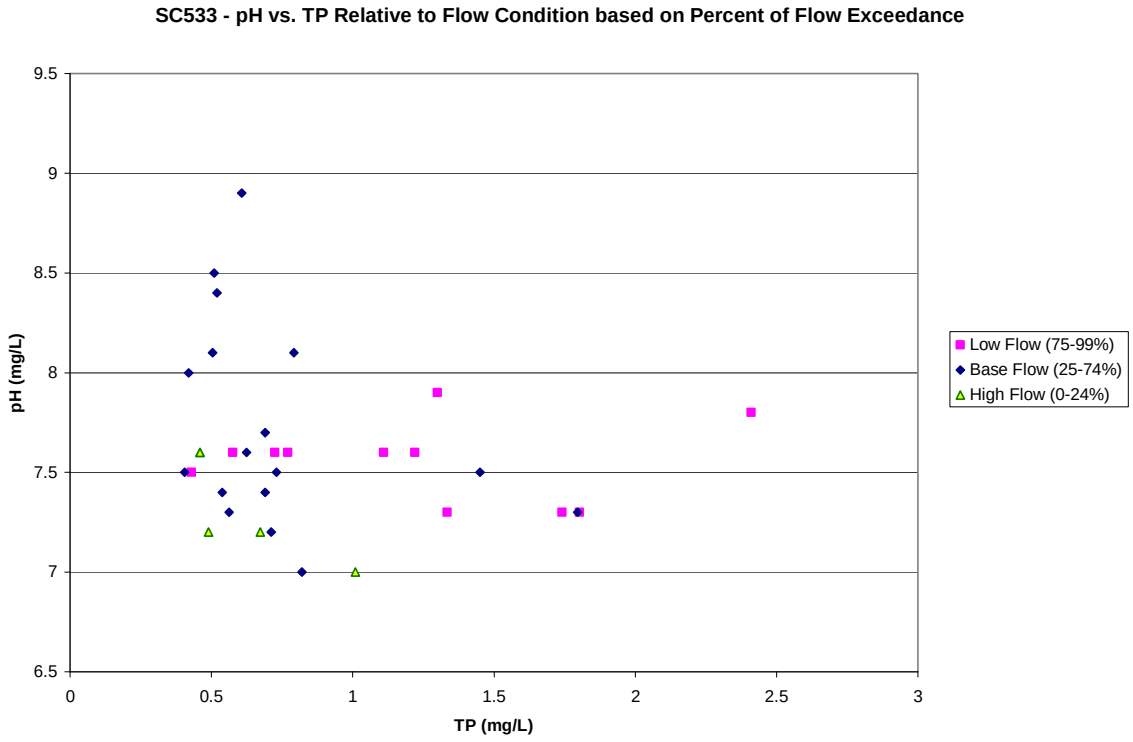
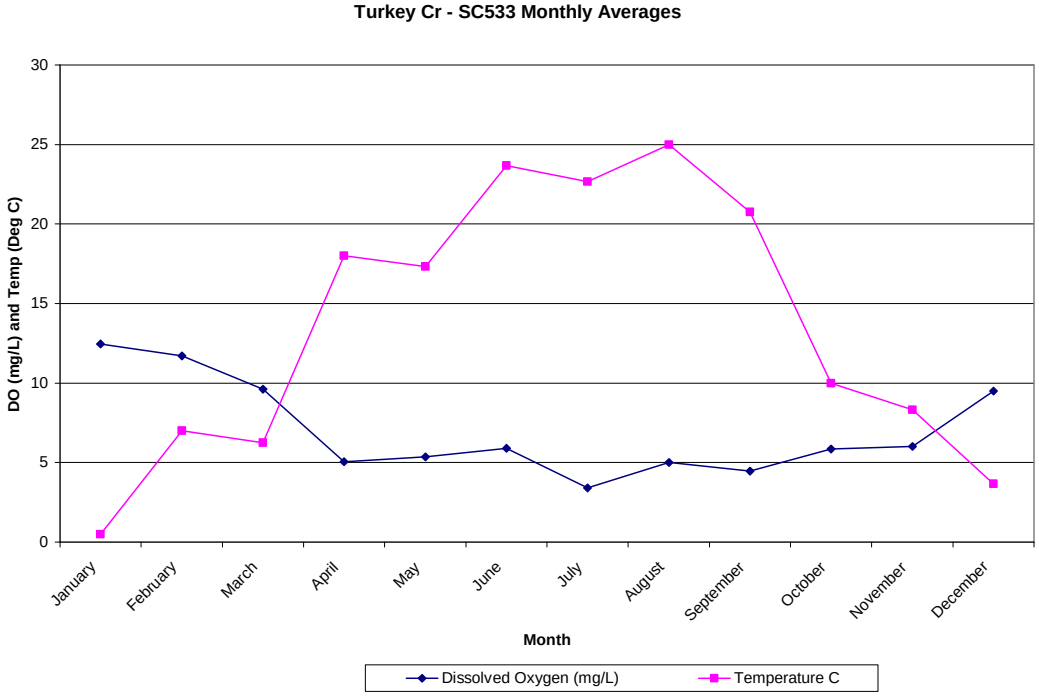


Figure 14. Monthly average Dissolved Oxygen concentrations and Temperatures at SC533.



Current EPA philosophy is predicated on the lowest quartile of stream total phosphorus within an ecoregion as indicative of minimum impact conditions (in absence of reference streams). This generalization is not tied to specific biological conditions, but represents water quality protection policy guiding EPA's administration of clean water programs. Figure 15 displays the relationship between lower quartile phosphorus values and Macroinvertebrate Biotic Index (MBI) scores for streams within the four Level IV ecoregions within the Central Great Plains ecoregion of Kansas. Turkey Creek resides largely within ecoregion 27d, the Wellington-McPherson Lowland area. Low MBI scores are indicative of high quality biological communities. Kansas protocol has been to delineate the boundaries between full and partial aquatic life support and between partial support and nonsupport for aquatic life as MBI scores of 4.5 and 5.4, respectively. The data of Figure 15, compiled by Region VII of EPA, does not show a definite relationship between the suggested EPA criteria and associated biological use. Conditions of full support span phosphorus levels of 0.070 to 0.160 mg/L. Partial support is indicative on streams with phosphorus levels of 0.020 – 0.430 mg/L. Apparently, other factors influence the biological community of macroinvertebrates beyond the ambient nutrient levels present in those Central Kansas streams.

A similar pattern emerges if an index of the selected families of water quality sensitive macroinvertebrates is used as the indicator of biological health. Figure 16 shows the lower quartile phosphorus levels versus the percent of individuals comprising Ephemeroptera [mayflies], Plecoptera [stoneflies], and Trichoptera [caddisflies] (EPT). EPT percentages over 48% are viewed as signs of fully supporting environment of aquatic life, while percentages below 30% are deemed non-supportive. Once again, streams in the Central Great Plains show some resilience to higher phosphorus levels impacting clean water species. Identification of a specific threshold of phosphorus concentration is difficult to tie to desired biological conditions.

There are no current measurements from Turkey Creek of benthic or attached periphyton which may predominate in fast flowing, shallow streams (EPA, 2000). Studies on streams in area such as Montana suggest periphyton levels should remain below 150 mg/m^2 (Suplee, et al. 2009).

Figure 15. Lower quartile phosphorus levels and MBI scores for the Central Great Plains.

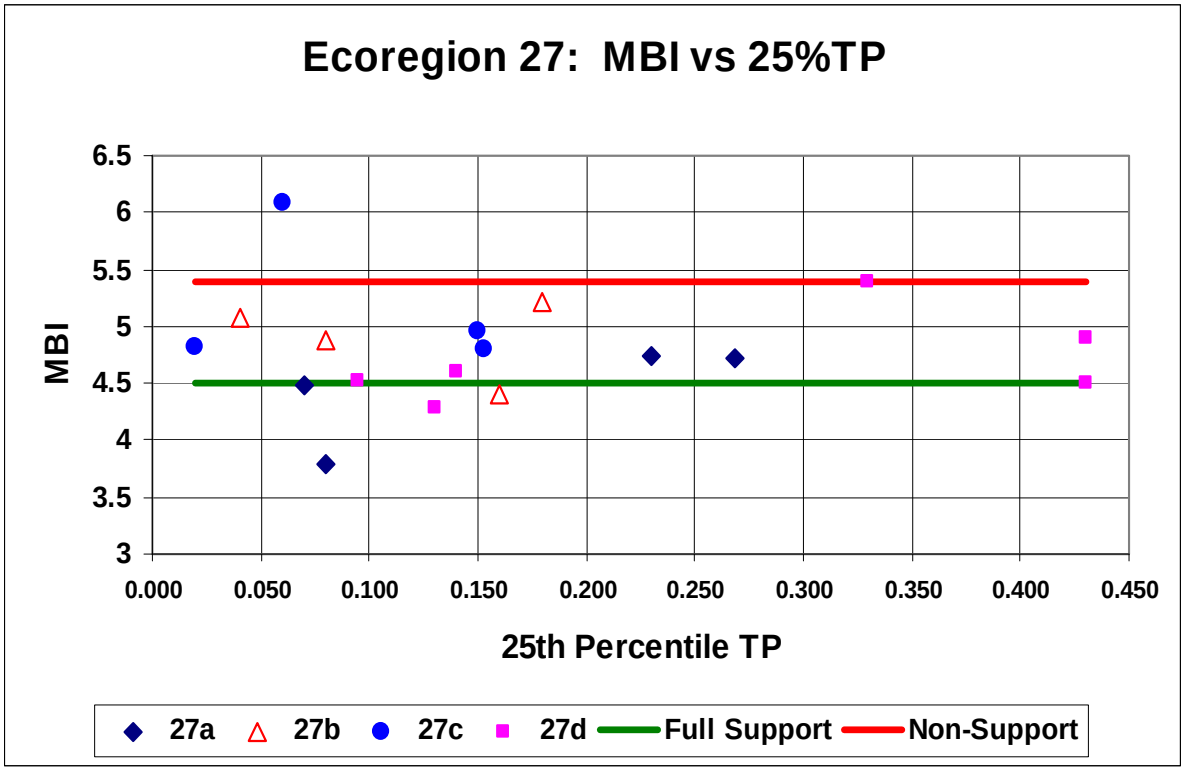
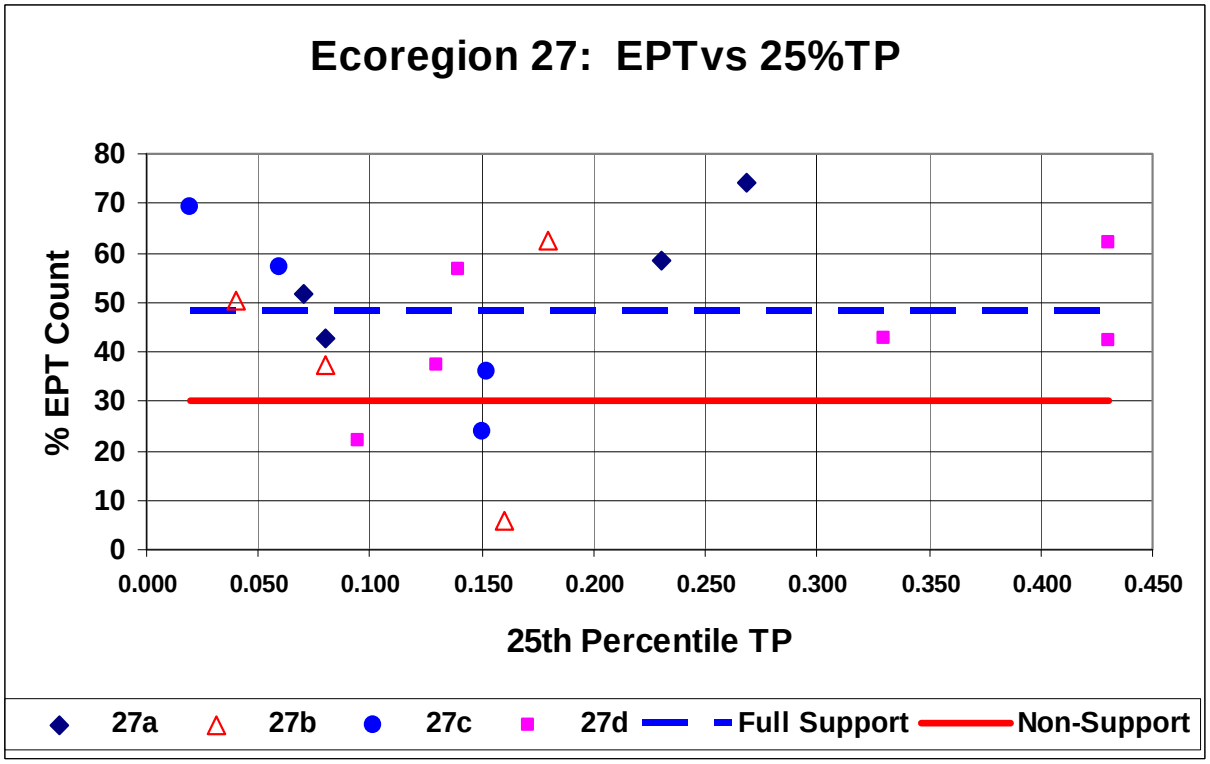


Figure 16. Phosphorus Levels and EPT Scores for Streams in the Central Great Plains.



Desired Endpoint: The ultimate endpoint of this TMDL will be to achieve the Kansas Water Quality Standards by eliminating any of the impacts to aquatic life, domestic water supply or recreation associated with excessive phosphorus and objectionable amounts of algae as described in the narrative criteria pertaining to nutrients. There are no existing numeric phosphorus criteria currently in Kansas. The current EPA suggested benchmarks for stream TP in the South-Central Cultivated Great Plains ecoregion is 0.067 mg/L TP over the 10-state aggregate of Level III ecoregions. A similar TP benchmark for the Central Great Plains was 0.090 mg/L, spanning from Nebraska to Texas.

Turkey Creek resides in the 27d ecoregion, the Wellington-McPherson Lowlands. Comparable analysis of data from 2000-2010 and restricted to the Kansas stations in the Central Great Plains indicates the lower quartile value of median TP from 113 stations is 0.132 mg/L TP. Further analysis for the stations within the 27d ecoregion from 1990-2011 for rotational sampling stations and from 2000-2011 for permanent fixed sampling stations indicates the value for the best 25% of medians from the 32 stations in the 27d ecoregion is 0.154 mg/L. The median concentration mean for the 32 stations in ecoregion 27d is 0.348 mg/L.

Four metrics will serve to establish if the biological community of Turkey Creek reflects recovery, renewed diversity and minimal disruption by the impacts described in the narrative criteria for nutrient on aquatic life, recreation and domestic water supply.

1. Macroinvertebrate Biotic Index (MBI): A statistical measure that evaluates the effects of nutrients and oxygen demanding substances on macroinvertebrates based on the relative abundance of certain indicator taxa (orders and families): for Kansas, MBI values below 4.5 are indicative of fully supported aquatic life communities.
2. Ephemeroptera, Plecoptera and Trichoptera (EPT) abundance as a percentage of the total abundance of macroinvertebrates; for Kansas, EPT percentages over 48% are indicative of fully supported aquatic life communities.
3. Periphyton density on substrate: The concentration of attached algae (measured by chlorophyll a) over a unit surface area. Supplee (2009) and others have suggested the range of acceptable conditions lies below a value of 150 mg/ sq. meter.
4. Sestonic chlorophyll: The concentration of planktonic algae floating in the water column of the stream. Heiskary (2008) found that total chlorophyll values over 25 µg/l exceeded the threshold of biological disruption to aquatic communities in Minnesota streams. EPA (2000) notes a value in its Table 2 demarcating the boundary between stream mesotrophy and eutrophy at 30 µg/l. That same document also cites studies indicating sestonic chlorophyll levels over 8 – 15 µg/l are problematic. For Turkey Creek, a target value of 5 µg/l will be sought.

Therefore, the numeric endpoints for this TMDL indicating attainment of water quality standards on Turkey Creek will be:

1. MBI values below 4.5

2. Percentage of Individuals comprising the EPT families exceeds 50%
3. Periphyton chlorophyll concentrations below 150 mg/square meter.
4. Sestonic chlorophyll concentrations below 5 µg/l.

The endpoints have to initially be maintained over three consecutive years to constitute full support of the designated uses of Turkey Creek. After standards are attained, simultaneous digression of these endpoints more than once every three years, on average, constitutes a resumption of impaired conditions.

The endpoints will be evaluated periodically as phosphorus levels decline in Turkey Creek over time. This TMDL looks to establish management milestones for phosphorus concentrations in Turkey Creek that would be the cue to examine the biological conditions of the creek. This TMDL establishes two milestones to achieve the ultimate endpoint of this TMDL. The first milestone will be a reduction of the median TP concentration at SC533 to **0.348 mg/L**, based on the average of the median values of sampling stations with the 27d ecoregion. The second milestone will be targeted once the first milestone is reached. The second milestone will be a reduction of the TP median at SC533 to **0.154 mg/L**, reaching a median equal to that of the best 25% of the stations within the 27d ecoregion. These milestones represent a reduction of the current TP median concentration by 50% and 78% for each milestone respectively.

Presuming the first Phase of reducing phosphorus levels on Turkey Creek improves water quality but does not attain the biological indicators, a second phase of implementation will commence. Stage One will direct further reductions in wastewater phosphorus by McPherson, while Stage Two installs treatment and practices on the tributaries to Turkey Creek . In time, median phosphorus concentrations on Turkey Creek should approach the lower quartile value of the stations within ecoregion 27d (0.154 mg/L), encompassing all flow conditions.

Achievement of the biological endpoints indicates any loads of phosphorus are within the loading capacity of the stream, water quality standards are attained and full support of the designated uses of the stream has been restored.

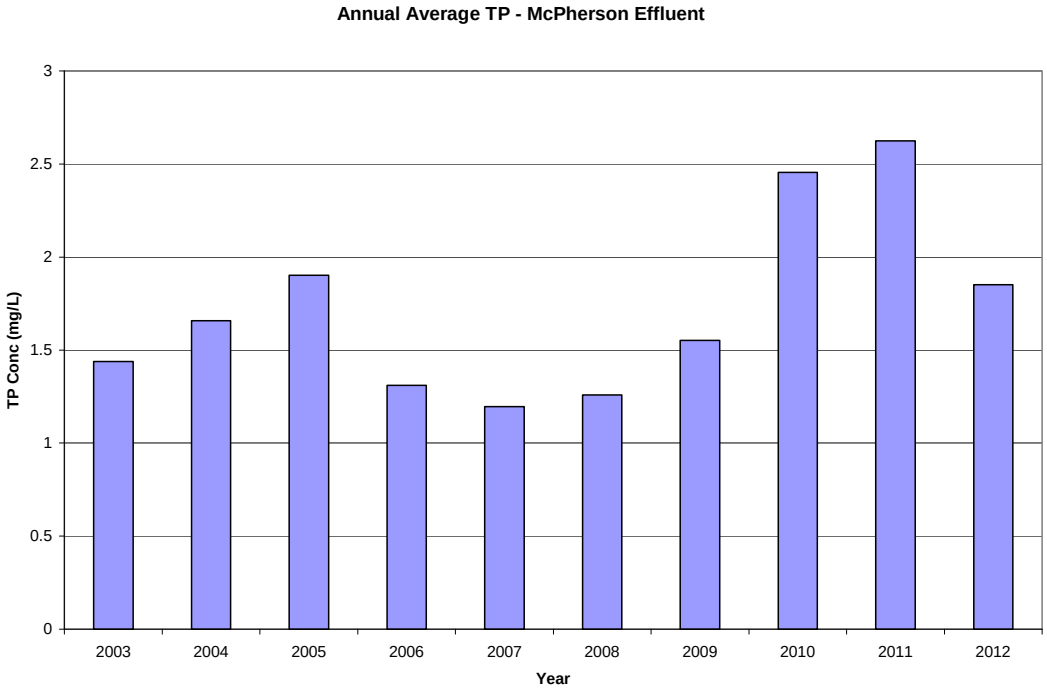
3. SOURCE INVENTORY AND ASSESSMENT

Point Sources: There are 13 permitted NPDES facilities located upstream of station SC533, all of which are in McPherson County. The permitted facilities are categorized as follows: three “non-overflowing” ponds or lagoons that are prohibited from discharging, six industrial facilities, one commercial facility, two municipal facilities, and one MS4 stormwater permit. The permitted facilities are detailed in Table 5. The City of McPherson and the City of Galva are the only two municipal treatment plants in the Turkey Creek watershed.

The municipal NPDES permit for the City of McPherson requires daily effluent flow measurements and monthly total phosphorus measurements from the effluent composite

sampler. The permit states that the facility is designed and built to provide for nutrient removal and Total Phosphorus should be $\leq$ 1.5 mg/L as an annual average. The TP concentration average for the City of McPherson from 2003-2012 has been 1.69 mg/L. Annual averages are detailed in Figure 17. The City of McPherson utilizes the treated wastewater for irrigation purposes at the City Park and a golf course. During drier conditions when irrigation is in use the transport of the TP load to Dry Turkey Creek may be delayed and significantly reduced. A wastewater holding cell and a retention pond on the golf course adjacent to the treatment facility are used to delay the transport of water to Dry Turkey Creek. When irrigation is not in use and conditions are dry, the discharge from McPherson will account for the majority of the water seen in Dry Turkey Creek below the outfall and retention pond of the plant.

Figure 17. Annual average TP concentration for McPherson Effluent.



The NCRA facility discharges only when their disposal wells are down for maintenance. Typically this facility has discharged a few times per year and monitors total phosphorus concentrations on a monthly basis when discharging. This facility has sampled for total phosphorus 13 times from 2007 through 2010, with an average TP concentration of 0.55 mg/L.

The City of Galva is a five-cell lagoon system that monitors Biological Oxygen Demand (BOD), Total Suspended Solids (TSS), pH, Ammonia, Fecal Coliform Bacteria, E. Coli Bacteria, Chlorides, Selenium and Zinc on a quarterly basis. This facility does not monitor flow or total phosphorus. The discharge from Galva must travel some distance prior to reaching the upper portions of Turkey Creek. During low flow conditions the discharge originating from Galva reaching the main stem segment leading to station 533

is likely minimal, as Turkey Creek in this area lacks sustainable flow during these conditions.

The City of McPherson's MS4 permit expired in 2009, but is still in effect until the new permit is issued. The MS4 permit follows a general permit format, requiring six minimum controls to be implemented throughout the permitted areas. The new permits will require the implementation of BMPs to address total phosphorus during the new permit cycle, along with subsequent monitoring to evaluate performance.

The two concrete batch plants do not have any discharges on record. The BPU Water Treatment Air Stripping Unit has a design flow of 4.03 MGD but typically does not discharge. This facility is a public water supply treatment facility designed to remove volatile organic chemicals from groundwater prior to placement in the City of McPherson's potable water system. This facility does not monitor total phosphorus. The following industrial facilities have minimal or no potential to contribute to the TP impairment in the watershed: the BPU Power plant #3 facility has a wastewater detention pond with no reported discharge; the BPU McPherson #2 facility is used for emergency use during peak operations and there is no reported discharge; the Hospira, Inc. facility typically discharges to the sanitary sewer and has not reported any discharge and the permit has not been renewed.

The non-discharging facilities, which include Sunflower School, Krehbiel Specialty Meats, and the Johns Manville Corporation, are not contributing to the total phosphorus impairment in the watershed since they do not discharge.

Table 5. NPDES permitted facilities in the Turkey Creek watershed.

KS Permit #	Facility	NPDES #	Design Flow (MGD)	Type / Comment	Receiving Stream	Permit Expiration Date
C-LA03-NO03	SUNFLOWER SCHOOL	KSJ000211		Non-overflowing		8/31/2016
I-LA11-CO03	BPU-(MCPHERSON) POWER PLANT #3	KS0093602	0.0	Wastewater detention pond	DRY TURKEY CREEK	12/31/2012
I-LA11-NO06	KREHBIEL SPECIALTY MEATS, INC.	KSJ000103		Non-overflowing		1/31/2016
I-LA11-NP01	JOHNS MANVILLE CORP.-MCPHERSON	KSJ000503		Non-overflowing		12/31/2012
I-LA11-PO02	NCRA REFINERY – MCPHERSON	KS0000337	0.0	Only discharges during well maintenance	BULL CREEK	3/31/2012
I-LA11-PO04	BPU-MCPHERSON #2	KS0079758	0.0	Emergency/peak use	BULL CREEK	12/31/2012
I-LA11-PO09	BPU-(MCPHERSON) WT AIR STRIPPER	KS0088625	4.03	Emergency discharge	BULL CREEK	12/31/2012
I-LA11-PO11	HOSPIRA, INC.	KS0092517	0.027	Normally goes to Sanitary sewer, lake, no discharge data	DRY TURKEY CR/LAKE/PIPELIN	12/31/2012
I-LA11-PR01	MCPHERSON CONCRETE PRODUCTS-WEST PLANT	KSG110090	0.0	Concrete Basin, No flow data	BULL CREEK	9/30/2017
I-LA11-PR02	MID AMERICA READY MIX - MCPHERSON EAST	KSG110092	0.0	Wash water earth basin, no discharges on file	TURKEY CREEK	9/30/2017
M-LA03-OO01	GALVA, CITY OF	KS0022560	0.058	Lagoon discharge	TURKEY CREEK VIA UNNAMED TRIBUTARY	12/31/2017
M-LA11-OO01	MCPHERSON, CITY OF	KS0036196	2.0	Mechanical plant	DRY TURKEY CR	6/30/2017
M-LA11-SN01	MCPHERSON, CITY OF	KSR044013	0.0	MS4		9/30/2009

Livestock and Waste Management Systems: There are 17 certified or permitted confined animal feeding operations (CAFOs) within the Turkey Creek watershed (see Appendix A). All of these livestock facilities have waste management systems designed to minimize runoff entering their operation and detain runoff emanating from their facilities. These facilities are designed to retain a 25-year, 24-hour rainfall/runoff event as well as an anticipated two weeks of normal wastewater from their operations. Typically, this rainfall event coincides with streamflow that occurs less than 1-5% of the time. It is unlikely TP loading would be attributable to properly operating permitted facilities, though extensive loading may occur if any of these facilities were in violation and discharged.

Though the total potential number of animals is approximately 20,200 head in the watershed, the actual number of animals at the feedlot operations is typically less than the allowable permitted number.

According to the 2007 Agriculture Census, there are 1,142 farms with 566,309 acres of farmland in McPherson County and 829 farms with 338,598 acres of farmland in Harvey County. According to the 2010 Kansas Farm Facts, there are 55,000 head of cattle in McPherson County and 24,000 head of cattle in Harvey County.

Population Density: According to the 2010 Census Block information, the watershed has 15,927 people, with a population density of 57.1 people/square mile. There are approximately 14,025 people residing within the cities of McPherson and Galva within the watershed. Population changes from the 2000 to the 2010 census show that the population of Galva has increased 24%, going from 701 to 870 people over this period. Contrary, the population for McPherson has declined by 4.5%, going from 13,770 in 2000 to 13,155 people in 2010.

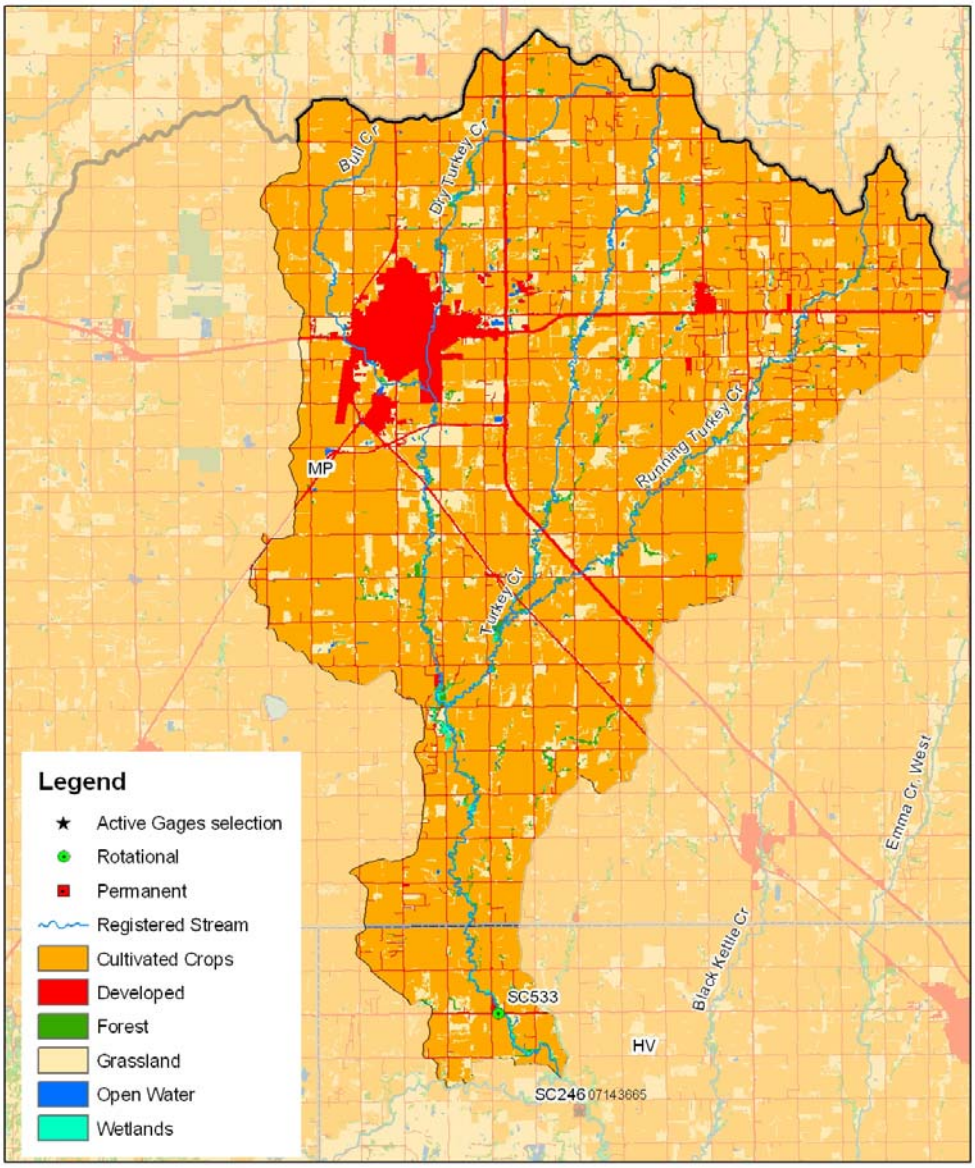
On-Site Waste Systems: Households outside of the municipalities that operate wastewater treatment facilities are presumably utilizing on-site septic systems. Based on the populations of McPherson and Galva relative to the watershed population, there are an estimated 1,902 people being served by on-site waste systems in the watershed. The Spreadsheet Tool for Estimating Pollutant Load (STEPL) was utilized to identify the number of septic systems within the HUC12s within the watershed. According to STEPL, there are approximately 976 septic systems within the Turkey Creek watershed with an anticipated failure rate of 0.93%. Since 88% of the population within the watershed reside within McPherson and Galva and are served by wastewater treatment facilities, failing on-site septic systems do not likely contribute to the total phosphorus impairment within the Turkey Creek watershed.

Land Use: Land use within the Turkey Creek watershed is dominated by cropland (76.3%) according to the 2001 National Land Cover Data (NLCD). Grassland and developed areas comprise about 11.2% and 9.8% of the watershed respectively. The land use percentages and acres within the watershed are in Table 6 and are further illustrated in the land use map (Figure 18). Runoff from the cropland and developed areas could contribute significant sources of total phosphorus loading.

Table 6. Landuse acres and percentages in the Turkey Creek watershed.

Land Use	Acres	Percent
Cropland	95,681	76.3%
Grassland	14,087	11.2%
Developed	12,263	9.8%
Forest	2,264	1.8%
Wetlands	768	0.6%
Open Water	352	0.3%

Figure 18. Turkey Creek Watershed Landuse map.



Contributing Runoff: The Turkey Creek watershed has a mean soil permeability value of 0.54 inches/hour, ranging from 0.02 to 1.30 inches/hour according to the NRCS STATSGO database. About 84% of the watershed has a permeability value less than 1.14 inches/hour, which contributes to runoff during very low rainfall intensity events. According to an USGS open-file report (Juracek, 2000), the threshold soil permeability values are set at 3.43 inches/hour for very high, 2.86 inches/hour for high, 2.29 inches/hour for moderate, 1.71 inches/hour for low, 1.14 inches/hour for very low, and 0.57 inches/hour for extremely low soil-permeability. As the watersheds' soil profiles become saturated, excess overland flow is produced. The majority of the nonpoint source

nutrient runoff will be associated with cropland areas throughout the watershed that are in close proximity to the stream corridors.

Background Levels: Phosphorus is present over the landscape, in the soil profile as well as terrestrial and aquatic biota. Wildlife can contribute phosphorus loadings, particularly if they congregate to a density that exceeds the assimilative capacity of the land or water.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

This TMDL will be established in Phases and Stages to progressively reduce phosphorus loadings and ambient concentrations with periodic assessment of the biological endpoints on the lower reaches of Turkey Creek and is detailed in Table 7. The initial phase will entail reductions in phosphorus levels of the McPherson wastewater that should translate to median concentrations approaching the median TP concentration for ecoregion 27d. TP load reductions will occur throughout the stream and be monitored at SC533. Reduced upstream TP loading will be indicative as the TP concentrations approach the TP target concentrations, which will result in favorable biological support throughout the stream. Additionally, riparian management in areas adjacent to cropland and livestock management in the vicinity of streams within the watershed should reduce nonpoint source loads under conditions of moderate flows as part of Stage Two.

Once the concentrations at Station SC533 approach the Phase One target of a median TP concentration of 0.348 mg/L, periphyton < 150 mg/m^2 , and sestonic chlorophyll <5 µg/L, an intensive assessment of macroinvertebrate diversity will be made to determine compliance with the narrative nutrient criteria.

Presuming one or more of the biologic endpoints are not met at the end of Phase One, Phase Two will commence. Additional reductions in loads and phosphorus concentrations will be accomplished through enhanced implementation of controls on point and non-point sources. The desired target levels are comparable to the median concentrations seen on the best streams in ecoregion 27d. McPherson wastewater will undergo enhanced nutrient removal and the management of riparian activities will be extended to urban stormwater contributing areas and along tributaries adjacent to cropland throughout the watershed. A second intensive biological assessment will be made once phosphorus levels approach that seen at the regional benchmark of 0.154 mg/L of TP.

The established TMDL is detailed in Figure 19 relative to the current seasonal observed loads.

Table 7. Turkey Creek TP TMDL Phases, Milestones and Actions.

TMDL Phase / Stage	TP Milestone at SC533	Anticipated Action	Biological Endpoints
I – 1 (NPDES)	0.348 mg/L	McPherson WW BNR and Enhance Disposal by Irrigation; McPherson MS4	MBI < 4.5 EPT > 50% Periphyton < 150 mg/m^2 Sestonic chlorophyll < 5 µg/L
I – 2 (Nonpoint Source)	0.348 mg/L	Riparian and Livestock Management	
II – 1 (NPDES)	0.154 mg/L	McPherson WW ENR; McPherson MS4	
II – 2 (Nonpoint Source)	0.154 mg/L	Targeted Tributary Riparian Management adjacent to cropland	

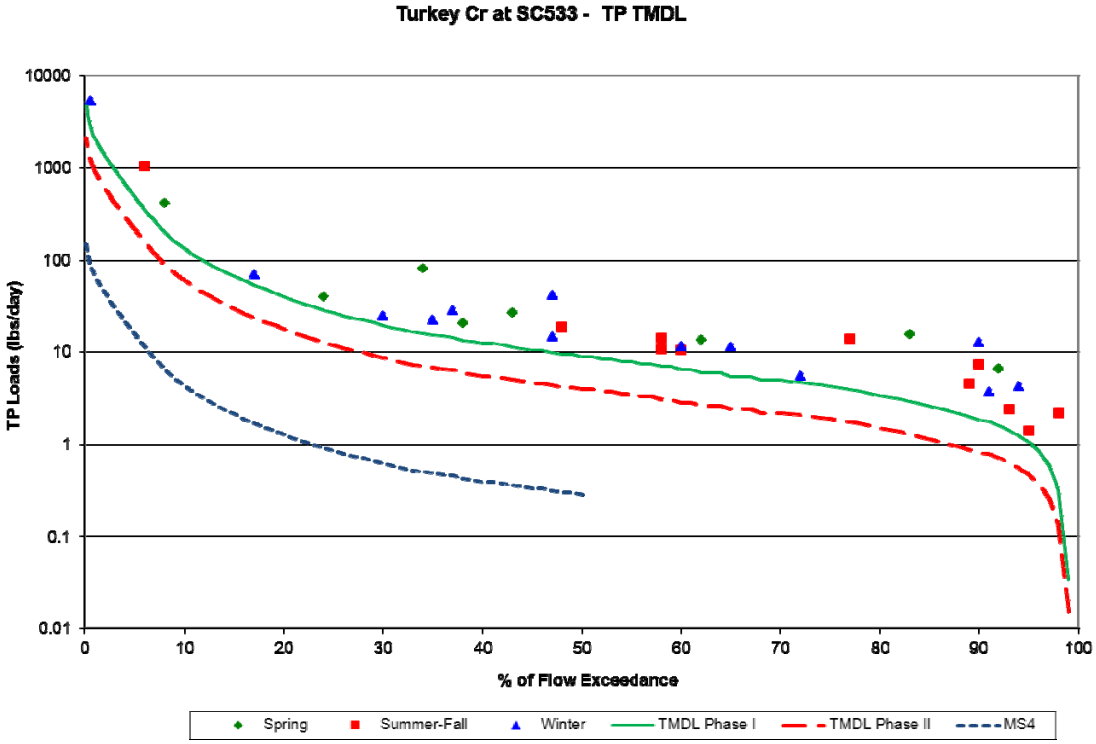
Point Sources: The Wasteload Allocation (WLA) is associated with the wastewater treatment facilities for the City of McPherson, City of Galva and the NCRA Refinery facility to manage any local effects below their respective outfalls. The phosphorus loads from Galva typically do not reach station SC533 downstream under dry conditions.

The phosphorus loads from NCRA are for short durations since this facility only discharges from a retention pond when the facility's disposal wells are down for maintenance. From 2006 through 2010, this facility has averaged a discharge of only 12 days per year with an average flow of 1.44 MGD. To be conservative, a WLA will be assigned to this facility based on 30 days of discharge at the average discharge flow of 1.44 MGD at the current TP concentration average of 0.55 mg/L during this period. The initial Phase I WLA for the City of McPherson is based on the design flow of 2.0 MGD with a TP concentration of 1.5 mg/L, which reflects the refinement of their Biological Nutrient Removal processes. No modifications or treatment or removal processes are anticipated for the lagoon system associated with the City of Galva. Therefore, the WLA for the City of Galva is based on the design flow of 0.058 MGD with a discharge concentration of 2.0 mg/L, an effluent TP concentration commonly seen from Kansas lagoon systems. Table 8 details the wasteload allocations within the Turkey Creek watershed.

Table 8. Wasteload Allocations for the Turkey Creek watershed.

Facility	Total Phosphorus WLA– Daily Load (lbs/day)	WLA – Annual Load (lbs/year)
City of McPherson	25.06	9147.4
City of Galva	0.97	353.7
NCRA Refinery	0.54	198.5

Figure 19. Turkey Creek TP TMDL at SC533.



Use of wastewater for irrigation and efficient operation of the treatment processes at McPherson will assist lowering phosphorus loading and concentrations seen at SC533. Prior to initiating Phase Two and Enhanced Nutrient Removal at the City of McPherson, an evaluation should be initiated to consider the growth in current wasteloads among the three facilities and the probability of discharge and transport of wastewater from the City of Galva and the NCRA facility to the lower reaches of Turkey Creek. In addition, consideration of assimilation rates of wastewater phosphorus, wasteload trading opportunities among cities, opportunities to further irrigate with wastewater and actual efficiency in phosphorus removal by the mechanical and lagoon systems should be evaluated, along with resulting downstream total phosphorus concentrations at SC533.

Phase Two would commence if biological information indicated the impacts identified in the narrative criterion for nutrients were still occurring after Phase One was complete. Should the Stage II-1 milestone become the new goal, the wasteload allocation for McPherson will be reduced to reflect a typical annual average effluent concentration of 0.5 mg/L from Enhanced Nutrient Removal. In addition, urban best management practices would be installed to reduce loads delivered to Dry Turkey Creek by stormwater generated within the jurisdictional limits of McPherson under the purview of their MS4 permit. Under Phase II, WLAs associated with the City of Galva and the NCRA Refinery will be the same as Phase I.

Actual wasteload allocations attributed to ambient concentrations seen downstream under normal conditions are anticipated to be much less than the allocations of Table 8 because

of adsorption to sediments and absorption by biota. Table 9 outlines the expected impact of these Wasteload Allocations at SC533 on Turkey Creek based on a mass balance analysis of the current loads. Under the low flow conditions (75%), wasteloads will be largely reduced through efficient treatment, transit losses along the channel and alternative disposal such as irrigation, so that they match up with the overall Load Capacity. In-stream wasteloads at the low flow condition assimilate, but still account for 99.3% of the load capacity at SC533. Under this low flow condition, the wasteloads from the City of Galva and the NCRA facility do not reach SC533. During the median flow condition, wasteloads assimilate and account for approximately 87% of the load capacity with the wasteloads from the City of Galva and the NCRA facility again not reaching SC533. The mass balance scenarios that detail the percent of load associated with the City of McPherson for these conditions are detailed in Appendix B. During the high flow condition, it is conservatively assumed that the entire wasteload from all three facilities reach SC533 and do not assimilate. Table 9 details the load capacity and allocations at SC533 under these three flow conditions.

Table 9. Load Capacities and Allocations (lbs/day) at SC533 on Turkey Creek under the two TMDL phases.

Phase I					
Percent Flow	Flow (cfs)	Load Capacity (lbs/day)	WLA (lbs/day)	LA (lbs/day)	MS4 Allocation (lbs/day)
75%	2.27	4.26	4.23	0.03	0
50%	4.74	8.92	7.76	0.87	0.29
10%	71.0	133.4	26.57	102.56	4.27

Phase II					
Percent Flow	Flow (cfs)	Load Capacity (lbs/day)	WLA (lbs/day)	LA (lbs/day)	MS4 Allocation (lbs/day)
75%	2.27	1.89	1.88	0.01	0
50%	4.74	3.95	3.44	0.38	0.13
10%	71.0	59.1	9.86	47.35	1.89

MS4 Stormwater: The Wasteload Allocation for the MS4 stormwater is provided by proportioning the remaining load capacity, after accounting for the NPDES WLA, between MS4 and nonpoint source loads. This was done by assuming load contributions would arise from the developed areas within the HUC12 of the MS4 permitted area for the City of McPherson. Thus, the MS4 WLA is based on the proportion of developed land in the McPherson HUC12, which accounts for 3.2% of the area. The MS4 allocation is therefore 3.2% of the TMDL and only applies to flows at or above median flow conditions at SC533. The MS4 allocations are observed in Table 9 for the median and high flow condition as well as detailed in the Figure 19.

Nonpoint Source Load Allocation: The load allocation for nonpoint sources is the remaining load capacity after assimilated wasteloads for NPDES wastewater and MS4 stormwater have been accounted (Table 9). Nonpoint sources are assumed to be very minimal at times during low flow conditions when Turkey Creek flow is composed strictly of McPherson wastewater. The load allocation grows proportionately as normal conditions occur. The allocation and contributing areas increase as wet weather ensues.

Defined Margin of Safety: The Margin of Safety provides some hedge against the uncertainty in phosphorus loading into Turkey Creek, predominantly from the point source dischargers in the watershed. This TMDL uses an implicit margin of safety, relying on conservative assumptions to be assured that future wasteload allocations will not cause further excursion from the nutrient criteria. First, design flows are used for the two municipal wastewater discharge facilities to set wasteload allocations, although demographic trends indicate McPherson and Galva are likely to decline in population. Additionally, biological endpoints are used to assess the narrative criteria and have to be maintained for three consecutive years before attainment of water quality standards can be claimed. Finally, because there is often a synergistic effect of phosphorus and nitrogen on in-stream biological activity, concurrent efforts by McPherson to reduce nitrogen content of its wastewater should complement the effect of phosphorus load reduction in improving the biological condition of Turkey Creek.

State Water Plan Implementation Priority: Phase One priority is focused on wastewater treatment at McPherson and riparian management along the lower reaches to effectively reduce the phosphorus loading to the creek. Phase Two priorities will expand nonpoint source abatement along Dry Turkey Creek, Running Turkey Creek and Turkey Creek. Additionally further reduction in wastewater phosphorus loads at McPherson will occur. Due to the need to reduce the high nutrient loads in the Turkey Creek watershed, which contributes to further impairments on the Little Arkansas River, this TMDL will be High Priority for implementation.

Nutrient Reduction Framework Priority Ranking: This watershed lies within the Little Arkansas Subbasin (HUC8: 11030012), which is among the top sixteen HUC8s targeted for state action to reduce nutrients.

Priority HUC12s: Although this TMDL is initially driven by implementation of point source treatment improvements, priority HUC12s within the watershed can be identified based on the cropland areas adjacent to the streams within the watershed. There are four priority HUC12s with the majority of the landuse as cropland that also are adjacent to Running Turkey Creek, Turkey Creek, and Dry Turkey Creek within the watershed. The four priority HUC12s are: 110300120205, 110300120206, 110300120207, and 110300120208. Nonpoint source reduction efforts within these priority areas should be further prioritize based on the riparian corridors adjacent to the cropland or any livestock facilities. These priority HUC12s are additionally identified in the approved 9-element WRAPS plan within the Little Arkansas WRAPS critical targeted areas for nutrients. In addition to the aforementioned HUC12s, the WRAPS also is targeting 110300120204.

5. IMPLEMENTATION

Desired Implementation Activities

1. Implement and maintain conservation farming, including conservation tilling, contour farming, and no-till farming to reduce runoff and cropland erosion.
2. Improve riparian conditions along stream systems by installing grass and/or forest buffer strips along the stream and drainage channels in the watershed.
3. Perform extensive soil testing to ensure excess phosphorus is not applied.
4. Ensure land applied manure is being properly managed and is not susceptible to runoff by implementing nutrient management plans.
5. Install pasture management practices, including proper stock density to reduce soil erosion and storm runoff.
6. Ensure proper on-site waste system operations in proximity to the main stream segments.
7. Ensure that labeled application rates of chemical fertilizers are being followed and implement runoff control measures.
8. Make operational changes in wastewater treatment at McPherson and alternative disposal such as irrigation and, if necessary, install enhanced nutrient reduction technology to reduce wasteloads.
9. Renew state and federal permits and inspect permitted facilities for permit compliance.
10. Facilitate urban stormwater management in McPherson to abate pollutant loads.
11. The stakeholder leadership team for the Little Arkansas WRAPS and KDHE have identified the following water quality protection/ restoration measures over the next 22-40 years in the Turkey Creek watershed for:
    a. Livestock: vegetative filter strips, relocate feeding sites, relocate pasture feeding sites off- stream and alternate watering system.
    b. Cropland: waterways, terraces, conservation crop rotations and water retention structures.

NPDES and State Permits – KDHE

a. Monitor influent into and effluent from the discharging permitted wastewater treatment facilities, continue to encourage wastewater reuse and irrigation disposal and ensure compliance and proper operation to control phosphorus levels in wastewater discharges.
b. Establish applicable permit limits and conditions after 2014 and implement the recommended nutrient reduction option from the 2011 study.
c. Inspect permitted livestock facilities to ensure compliance.
d. New Livestock permitted facilities will be inspected for integrity of applied pollution prevention technologies.
e. New Registered livestock facilities with less than 300 animal units will apply pollution prevention technologies.

f. Manure management plans will be implemented, to include proper land application rates and practices that will prevent runoff of applied manure.
g. Reduce runoff in McPherson through stormwater management program and MS4 permit.
h. Establish TP concentration effluent goal of 1.5 mg/L for the City of McPherson and TP permit limits for the City of McPherson in accordance with the WLA.
i. Establish nutrient reduction practices among urban homeowners to manage application on lawns and gardens, through the McPherson stormwater management program.
j. Interact with Little Arkansas WRAPS on opportunities for trading and offsets of loads between McPherson and agricultural producers within the watershed.

Nonpoint Source Pollution Technical Assistance – KDHE

a. Support Section 319 implementation projects for reduction of phosphorus runoff from agricultural activities as well as nutrient management.
b. Provide technical assistance on practices geared to the establishment of vegetative buffer strips.
c. Provide technical assistance on nutrient management for livestock facilities in the watershed and practices geared towards small livestock operations, which minimize impacts to stream resources.
d. Support the implementation efforts of the Little Arkansas WRAPS and incorporate long-term objectives of this TMDL into their 9-element watershed plan.
e. Engage the City of McPherson to discuss stormwater load trading opportunities.

Water Resource Cost Share and Nonpoint Source Pollution Control Program – KDA-DOC

a. Apply conservation farming practices and/or erosion control structures, including no-till, terraces, and contours, sediment control basins, and constructed wetlands.
b. Provide sediment control practices to minimize erosion and sediment transport from cropland and grassland in the watershed.
c. Install livestock waste management systems for manure storage.
d. Implement manure management plans.

Riparian Protection Program – KDA-DOC

a. Establish or reestablish natural riparian systems, including vegetative filter strips and streambank vegetation.
b. Develop riparian restoration projects along targeted stream segments, especially those areas with baseflow.
c. Promote wetland construction to reduce runoff and assimilate sediment loadings.
d. Coordinate riparian management within the watershed and develop riparian restoration projects.

Buffer Initiative Program – KDA-DOC

a. Install grass buffer strips near streams.
b. Leverage Conservation Reserve Enhancement Program to hold riparian land out of production.

Extension Outreach and Technical Assistance – Kansas State University

a. Educate agricultural producers on sediment, nutrient, and pasture management.
b. Educate livestock producers on livestock waste management, land applied manure applications, and nutrient management planning.
c. Provide technical assistance on livestock waste management systems and nutrient management planning.
d. Provide technical assistance on buffer strip design and minimizing cropland runoff.
e. Encourage annual soil testing to determine capacity of field to hold phosphorus.
f. Educate residents, landowners, and watershed stakeholders about nonpoint source pollution.
g. Promote and utilize the Little Arkansas WRAPS efforts for pollution prevention, runoff control and resource management. The WRAPS coordinator is also an extension watershed specialist that will provide technical assistance and outreach to producers for BMP implementation. According to the WRAPS 9 Element Plan, other entities for this task include NRCS and local conservation districts.

Timeframe for Implementation: Reduction strategies for McPherson wastewater should be evaluated by mid-2014 with subsequent planning, design, and construction of any necessary enhance treatment completed within the next permit cycle after 2017. Urban stormwater and rural runoff management should commence 2013 in McPherson. Pollutant reduction practices should be installed within the priority subwatersheds before 2015, with follow-up implementation, including other subwatersheds over 2016-2020. If biological conditions warrant, Phase Two will begin in 2022 and continue through 2032. The Little Arkansas WRAPS 9-element Plan Implementation Schedule is based on a 40 year plan, however if practices are implemented as documented, it will only take 22 years to meet the endpoint.

Targeted Participants: The primary participants for implementation will be the City of McPherson wastewater and stormwater programs, and agricultural and livestock producers operating immediately adjacent to the Turkey Creek and tributaries within the priority sub watersheds. Watershed coordinators and technical staff of the WRAPS, along with Conservation District personnel and county extension agents should assess possible sources adjacent to Turkey Creek, Running Turkey Creek, and Dry Turkey Creek below McPherson over 2013. Implementation activities to address nonpoint sources should focus on those areas with the greatest potential to impact nutrient concentrations adjacent to these creeks.

Targeted Activities to focus attention toward include:

1. Overused grazing land adjacent to the streams.
2. Sites where drainage runs through or adjacent to livestock areas.
3. Sites where livestock have full access to the stream as a primary water supply.
4. Poor riparian area and denuded riparian vegetation along the stream.
5. Unbufferred cropland adjacent to the stream.
6. Conservation compliance on highly erodible areas.
7. Total row crop acreage and gully locations.
8. High-density urban and residential development in proximity to streams and tributary areas.
9. Residents of McPherson should be informed on fertilizer and waste management through the McPherson Stormwater Management Program to reduce urban runoff loads.

Milestone for 2016: In accordance with the TMDL development, schedule for the State of Kansas, the year 2016 marks the next cycle of 303(d) activities in the Lower Arkansas Basin. At that point in time, phosphorus data from SC533 should show indications of declining concentrations relative to the pre-2011 data, particularly at baseflow conditions. By this date, the City of McPherson should be implementing the appropriate measures to decrease the phosphorus content of its wastewaters.

WRAPS 9 Element Plan: The Little Arkansas WRAPS 9-Element plan will be reviewed every five years starting in 2016. The timeframe of this document for BMP implementation of the sediment and phosphorus TMDLs is forty years. The WRAPS will examine BMP placement and implementation in 2016 and every subsequent five years after through 2051. Sub-watershed total reduction milestones for nutrient BMP implementation in the 9-element plan calls for 52,703 lbs of TP reductions through cropland BMPs and 38,199 lbs of TP reductions through Livestock BMPs, totaling 90,902 lbs in phosphorus reduction in the Turkey Creek watershed. The Turkey Creek watershed is considered a critical area for TP in the 9-Element Plan.

Delivery Agents: The primary delivery agents for program participation will be the City of McPherson, KDHE, the Little Arkansas WRAPS and Kansas State Extension.

Reasonable Assurances:

Authorities: The following authorities may be used to direct activities in the watershed to reduce pollution:

1. K.S.A. 65-164 and 165 empowers the Secretary of KDHE to regulate the discharge of sewage into the waters of the state.

2. K.S.A. 65-171d empowers the Secretary of KDHE to prevent water pollution and to protect the beneficial uses of the waters of the state through required treatment of sewage and established water quality standards and to require

permits by persons having a potential to discharge pollutants into the waters of the state.

3. K.S.A. 2002 Supp. 82a-2001 identifies the classes of recreation use and defines impairment for streams.

4. K.A.R. 28-16-69 through 71 implements water quality protection by KDHE through the establishment and administration of critical water quality management areas on a watershed basis.

5. K.S.A. 2-1915 empowers the Kansas Department of Agriculture, Division of Conservation to develop programs to assist the protection, conservation and management of soil and water resources in the state, including riparian areas.

6. K.S.A. 75-5657 empowers the Kansas Department of Agriculture, Division of Conservation to provide financial assistance for local project work plans developed to control nonpoint source pollution.

7. K.S.A. 82a-901, et. seq. empowers the Kansas Water Office to develop a state water plan directing the protection and maintenance of surface water quality for the waters of the state.

8. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the Kansas Water Plan, including selected Watershed Restoration and Protection Strategies.

9. The Kansas Water Plan and the Lower Arkansas Basin Plan provide the guidance to state agencies to coordinate programs intent on protecting water quality and to target those programs to geographic areas of the state for high priority implementation.

Funding: The State Water Plan annually generates $16-18 million and is the primary funding mechanism for implementing water quality protection and pollution reduction activities in the state through the Kansas Water Plan. The state water planning process, overseen by the Kansas Water Office, coordinates and directs programs and funding toward watershed and water resources of highest priority. Typically, the state allocates at least 50% of the fund to programs supporting water quality protection. This watershed and its TMDL are located within a High Priority WRAPS area and should receive support for pollution abatement practices that lower the loading of sediment and nutrients.

Effectiveness: Use of Biological Nutrient Removal technology has been well established to reduce nutrient levels in wastewater, including phosphorus. Additionally, nutrient control has been proven effective through conservation tillage, contour farming and use of grass waterways and buffer strips. In addition, the proper implementation of comprehensive livestock waste management plans has proven effective at reducing nutrient runoff associated with livestock facilities.

6. MONITORING

Future stream sampling will occur bimonthly at rotational station SC533 every fourth year, with 2014 being the next scheduled sampling year. The monitoring will include the initiation of sestonic chlorophyll sampling. Monitoring of tributary levels of TP during runoff events will help direct abatement efforts toward major nonpoint sources. Monitoring of TP below the McPherson outfall in Dry Turkey Creek will help assess improvements in their nutrient removal processes. Monitoring of TP should be a condition of the MS4 permits within the watershed.

Commencing in 2015, macroinvertebrate and periphyton sampling will occur at accessible locations on Dry Turkey Creek and Turkey Creek. The stream will be evaluated for possible delisting, after Phase One implementation in 2022. If the biological endpoints are achieved over 2018-2021, the conditions descried by the narrative nutrient criteria will be viewed as attained and Turkey Creek will be moved to Category 2 on the 2022 303(d) list. If they are not, Phase Two of this TMDL begins in 2022.

Once the water quality standards are attained, the adjusted ambient phosphorus concentrations on Turkey Creek will be the basis for establishing numeric phosphorus criteria through the triennial water quality standards process to protect the restored biological and chemical integrity of Turkey Creek.

7. FEEDBACK

Public Notice: An active Internet Web site is established at http://www.kdheks.gov/tmdl/index.htm to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Lower Arkansas Basin. Public Hearing: A Public Hearing on this TMDL was held on September 4, 2013 in Newton to receive public comments. No comments were received regarding this TMDL.

Basin Advisory Committee: The Lower Arkansas River Basin Advisory Committee met to discuss the TMDLs in the basin on May 31, 2012 in Hutchinson, September 12, 2012 in Halstead, KS and on April 3, 2013 in Hutchinson.

Milestone Evaluation: In 2016, evaluation will be made as to the degree of implementation that occurred within the watershed. Subsequent decisions will be made through the Little Arkansas River WRAPS, regarding the implementation approach and follow up of additional implementation in the watershed.

Consideration for 303(d) Delisting: Turkey Creek will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2012-2021. Therefore, the decision for delisting will come about in the preparation of the 2022-303(d) list. Should

modifications be made to the applicable water quality criteria during the ten-year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may be adjusted accordingly.

Incorporation into Continuing Planning Process, Water Quality Management Plan and the Kansas Water Planning Process: Under the current version of the Continuing Planning Process, the next anticipated revision would come in 2013, which will emphasize implementation of WRAPS activities. At that time, incorporation of this TMDL will be made into the WRAPS. Recommendations of this TMDL will be considered in the Kansas Water Plan implementation decisions under the State Water Planning Process for Fiscal Years 2013-2021.

January 16, 2014

References

Barnes, P., Kansas State University. 2011. Personal Correspondence referencing Little Arkansas WRAPS water quality data.

Heiskary, S., 2008, Relation of Nutrient Concentrations and Biological Responses in Minnesota Streams: Applications for River Criteria Development, March 2008, Minnesota Pollution Control Agency, 66pp.

Juracek, K.E., 2000, Estimation and Comparison of Potential Runoff-Contributing Areas in Kansas Using Topographic, Soil and Land-Use Information, USGS. Water Resources Investigations Report 00-4177, 55pp.

Kansas Department of Health and Environment. 2010. Methodology for the Evaluation and Development of the 2010 Section 303(d) List of Impaired Water Bodies for Kansas. Available online at http://www.kdheks.gov/tmdl/download/2010_303_d_Methodology.pdf . Accessed on February 17, 2012.

Kansas Surface Water Quality Standards and Supporting Material found at: www.kdheks.gov/water/download/kwqs_plus_supporting.pdf . Accessed on February 20, 2012.

Little Arkansas Watershed Restoration and Protection Strategy Water Quality Data; 2008-2010. National Agricultural Statistic Service, available online at http://www.nass.usda.gov/Statistics_by_State/Kansas/Publications/Annual_Statistical_Bulletin/index.asp , site accessed on February 17, 2012.

National Land Cover Database, 2001, available online at http://www.mrlc.gov/ , accessed on February 17, 2012.

Perry, C.A., D.M. Wolock and J.C. Artman, 2004. Estimates of Flow Duration, Mean Flow and Peak-Discharge Frequency Values for Kansas Stream Locations, USGS Scientific Investigation Report 2004-5033.

U.S. EPA. 2000. Nutrient Criteria Technical Guidance Manual: Rivers and Streams. U.S. Environmental Protection Agency, Washington, D.C.. EPA-822-B000-002.

Appendix A. Registered and Permitted Animal Feeding Operations in the Turkey Cr Watershed.

KS Permit #	County	Animal Total	Permit Type	Animal Type	WLA (lbs/day)
N-LAMP-6371	Mcpherson	150.00	Application	Beef	0
A-LAMP-MA03	Mcpherson	30.00	Certification	Dairy	0
A-LAMP-MA02	Mcpherson	40.00	Certification	Dairy	0
A-LAMP-BA17	Mcpherson	30.00	Certification	Beef	0
A-LAMP-MA01	Mcpherson	35.00	Certification	Dairy	0
A-LAHV-MA05	Harvey	100.00	Certification	Dairy	0
A-LAMP-M026	Mcpherson	20.00	Permit	Dairy	0
A-LAMP-B003	Mcpherson	451.00	Permit	Beef,Horses	0
A-LAMP-M022	Mcpherson	87.00	Permit	Dairy	0
A-LAMP-S032	Mcpherson	4800.00	Permit	Swine	0
A-LAMP-M002	Mcpherson	220.00	Permit	Dairy	0
A-LAMP-S015	Mcpherson	950.00	Permit	Swine,Beef	0
A-LAMP-S030	Mcpherson	2000.00	Permit	Swine	0
A-LAMP-S029	Mcpherson	3500.00	Permit	Swine	0
A-LAMP-F004	Mcpherson	7300.00	Permit	Turkeys	0
A-LAMP-M032	Mcpherson	150.00	Renewal	Dairy	0
A-LAMP-M005	Mcpherson	336.00	Renewal	Dairy	0

Appendix B. Mass Balance Scenarios for the 75% and 50% Flow Exceedance Condition detailing the loads in Turkey Creek reaching SC533. Concentrations for Turkey Creek above the Dry Turkey Creek confluence were calculated from the WRAPS sampling data for Running Turkey Creek for the respective flow conditions. The McPherson WLA assimilates 10.21 lbs/day at the 75% flow exceedance condition and 8.82 lbs/day at the 50% flow exceedance condition.

Low Flow 75%				
Current Condition				
	Flow (cfs)	Concentration (mg/L)	Load (lbs/day)	% of Load
McPherson WLA	3.09	1.50	25.06	
McPherson Load Reaching SC533	2.10	1.31	14.85	99.32
Turkey above Dry Turkey Confluenc	0.17	0.11	0.10	0.68
SC533 Turkey	2.27	1.22	14.95	100.00

Median Flow 50%				
	Flow (cfs)	Concentration (mg/L)	Load (lbs/day)	% of Load
McPherson WLA	3.09	1.50	25.06	
McPherson Load Reaching SC533	3.02	0.99	16.18	86.58
Turkey above Dry Turkey Conf	1.72	0.27	2.51	13.42
SC533 Turkey	4.74	0.73	18.69	100.00