LOWER ARKANSAS RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Water Body: **Cowskin Creek**
Water Quality Impairment: Biological Nutrient Impairment bundled with pH
Revision to TMDL Originally Approved August 9, 2000

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Middle Arkansas–Slate **County:** Sedgwick

HUC 8: 11030013

HUC 11 (HUC 14s)**:** **010** (010, 020, 030, 040)

Drainage Area: 150.2 square miles above SB346

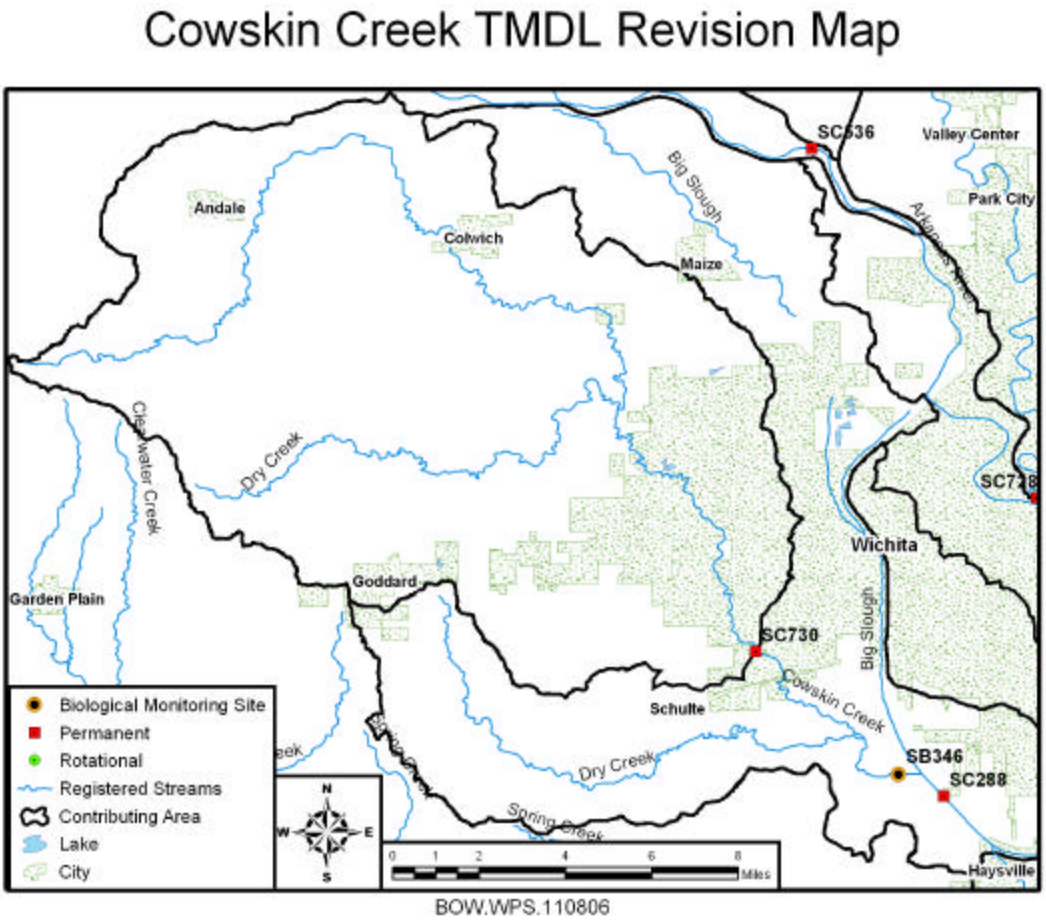
Main Stem Segments: 12, 13, 14; starting at the confluence with the Big Slough River; Headwaters near Andale, in Sedgwick County.

Tributary Segments: Big Slough (11)
Dry Creek (15)
Dry Creek (16)

Designated Uses: Expected Aquatic Life Support; Primary Contact Recreation; Domestic Water Supply; Food Procurement; Ground Water Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use for Main Stem Segments

Impaired Use: Expected Aquatic Life Support on Main Stem Segments.

Water Quality Standard: Nutrients--Narrative: 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. (KAR 28-16-28e(c)(2)(B)).
pH range 6.5-8.5 for Aquatic Life Support Use (KAR 28-16-28e(d))



(Figure 1- General area map of the watersheds contributing to the monitoring stations covered in this TMDL.**)**

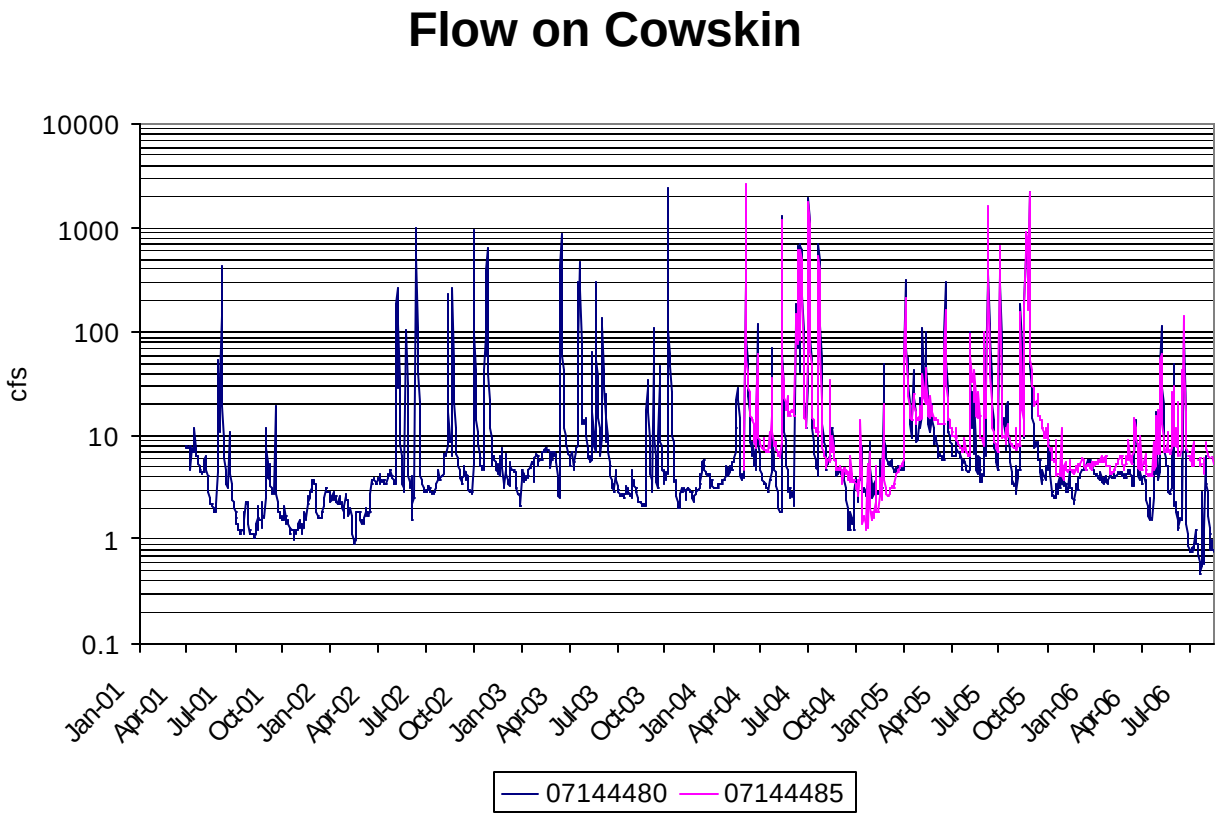
2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Monitoring Sites: SB346, SC730 and SC 288

Period of Record Used: 1990 to 2004

Flow Record: Entire record of USGS Gage 07144480 (April 1, 2001-Current) and USGS Gage 07144485 (March 1, 2004-Current), Figure 2; Flow record from October 1, 2005 to current is provisional and subject to change

Flow Conditions: 07148880 Average Flow = 31.8 cfs, Median Flow = 4.3 cfs
07148885 Average Flow = 45.0 cfs, Median Flow = 7.7 cfs



(Figure 2- Daily average flow on Cowskin Creek as measured by USGS gaging stations.**)**

Current Conditions: See Appendix A for a full explanation of the biotic indexes used by KDHE.

Parameter	**Historical Average & Range (1990 - 2005) for biological data**
Kansas Biotic Index (KBI)	2.75 (2.50-3.30)
Macroinvertebrate Biotic Index (MBI)	4.65 (4.18 -5.61)
% Ephemeroptera, Plecoptera, and Trichoptera (EPT) Taxa	41 % (12 - 66 %)
EPT Taxa present	10 (6-15)

(Table 1- Biological monitoring metrics at SB346.**)**

On this stream segment, the average KBI is partially supporting (KBI >2.6) and MBI indicates that aquatic life support is partially impaired (MBI between 4.51 and 5.39). Seven of thirteen surveys resulted in MBI values over 4.5, and the other half were under 4.5. One KBI score was nonsupporting, three were fully supporting, and the remaining nine were partially supporting. Five of thirteen surveys had fully supporting EPT percentages (>48%), however only two surveys met the full support criteria (>12) for number of taxa present.The collective results indicate that the biotic community at SB346 is impaired, and that Cowskin Creek continues to exceed viable conditions for full support of aquatic life use support.

Cowskin Creek has been monitored since 1985 at Station 288 and since 2001 at Station 730. Table 2 displays average values for certain parameters at both stations for various periods of time. The years 2004-2006 coincide with the period when Wichita's Northwest Plant No. 3 began discharging to Cowskin Creek. Nitrogen appears to be low in the water column while total phosphorus is fairly high, but indicating decreases over time. Additionally, there is a marked decrease of 30-35% in total phosphorus concentrations between the upstream station and the downstream station. The upstream station 730 has seen an average increase in total phosphorus since 2004, although the differences are not statistically significant. Nitrate and phosphorus were higher in samples collected by USGS on a downstream reach of Cowskin Creek over 1962-1970, averaging 6.4 mg/l of nitrate and 5.1 mg/l of phosphorus.

Temperatures have been higher in recent samplings and increase in the downstream direction. Dissolved Oxygen has been high on average, there have been only two instances of DO below 5 ppm at Station 288. Levels of pH are normal on average, but there have been 20 instances of pH levels rising over 8.5 with half of the samples taken in 1994 and 2001 having high pH. Only two high pH levels have been recorded at the upstream Station 730 over 2001-2006.

Total Suspended Solids and Turbidity measurements have been lower in the downstream direction and in recent years. This might indicate deposition in the channel below Station 730 and dryer conditions from 2004 on. Levels of BOD appear to be typical and Total Organic Carbon has increased slightly in recent years. There is a marked decrease in TOC downstream.

Station	NH3	NO3	TP	PO4	Temp	DO	pH	TSS	Turb	BOD	TOC
288											
1985-2003	< 0.1	0.65	0.321	< 0.25	15.7	10.4	8.2	99	52	4.58	5.54
2001-2003	< 0.1	0.63	0.273	< 0.25	19.3	11.8	8.3	90	46	3.46	5.54
2004-2006	0.12	0.36	0.253	< 0.25	19.1	11.1	8.1	57	40	----	5.80
730											
2001-2003	< 0.1	0.35	0.386	< 0.25	17.5	9.7	8.0	95	74	4.82	7.4
2004-2006	0.15	0.34	0.425	0.27	17.1	8.8	7.8	62	45	----	8.17

(Table 2- Average values of selected parameters along Cowskin Creek.**)**

Since USGS gaging station 07148880 came online in 2001, thirty samples have been taken. Fifteen of those samples can be viewed as runoff samples with flows over the median flow of 4.3 cfs. Eight samples were baseflow or dry-weather samples taken at flows below 2.9 cfs. These low flow samples are of interest because of the impact of Wichita's wastewater plant. Four of the samples were taken in 2001-02, the other four were taken over July 2003 to the summer of 2006. Table 3 displays the parameter values at the two stations before and after Wichita #3 began discharging. Impacts are mostly apparent at the upstream station after 2004. Some in-stream assimilation, deposition or uptake of phosphorus is hinted by its decrease at the downstream station.

Station	NH3	NO3	TP	PO4	Temp	DO	pH	TSS	Turb	BOD	TOC
288											
2001-2002	< 0.1	0.75	0.219	< 0.25	20.5	10.0	8.3	63	29	2.8	6.20
2003-2006	< 0.1	0.30	0.232	< 0.25	26.8	12.8	8.2	37	27	----	4.82
730											
2001-2002	< 0.1	< 0.1	0.231	< 0.25	20.0	9.3	8.2	41	15	3.46	6.26
2003-2006	< 0.1	0.13	0.422	0.28	25.0	9.0	7.9	47	28	----	7.67

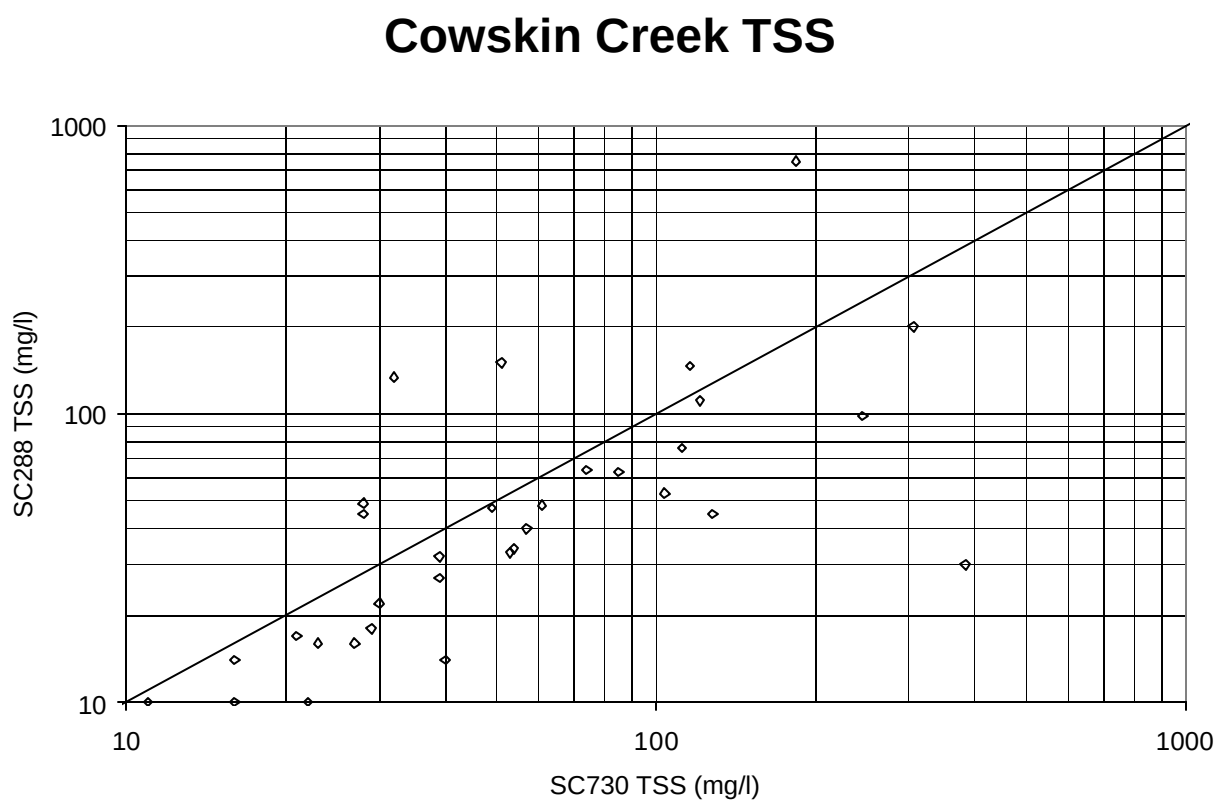
(Table 3- Average parameter values on Cowskin Creek before and after Wichita #3 began discharging.**)**

As part of its NPDES permit, Wichita is required to monitor stream conditions above and below its outfall for Wastewater Plant #3. Table 4 indicates the average upstream and downstream values for nutrients, DO and solids from approximately 40 samples taken over 2003-2006. There is no apparent impact from the wastewater plant, except some increase in total phosphorus and TKN. Average discharge from the plant over this time was about 0.5 MGD or 0.77 cfs, comprising about 15-25% of the flow seen at the downstream USGS gage. Of the ten instances of deficient DO below the outfall, nine were associated with similar conditions above the outfall and DO conditions improved downstream in four cases.

Location	NH3	NO2	NO3	TKN	TP	TSS	DO	# of Samples with DO < 5
Upstream	0.28	0.07	1.10	2.14	0.45	85	6.9	13
Downstream	0.23	0.06	0.99	2.26	0.53	73	7.4	10

(Table 4- Average concentrations above and below the outfall of Wichita Plant #3.**)**

There is a progressive decrease in nitrogen and phosphorus between the vicinity of the treatment plant and the downstream KDHE stations. TSS also decreases in a downstream direction. Decreases in nutrients are likely indicative of biological uptake in the stream channel. Decreased TSS is maybe a sign of deposition. Figure 3 plots the TSS values from concurrent periods at Stations 730 and 288. A majority of the time, there is less TSS in the water column at Station 288 downstream, again hinting at some deposition in the downstream channel.



(Figure 3- Cowskin Creek TSS values at two KDHE stations.**)**

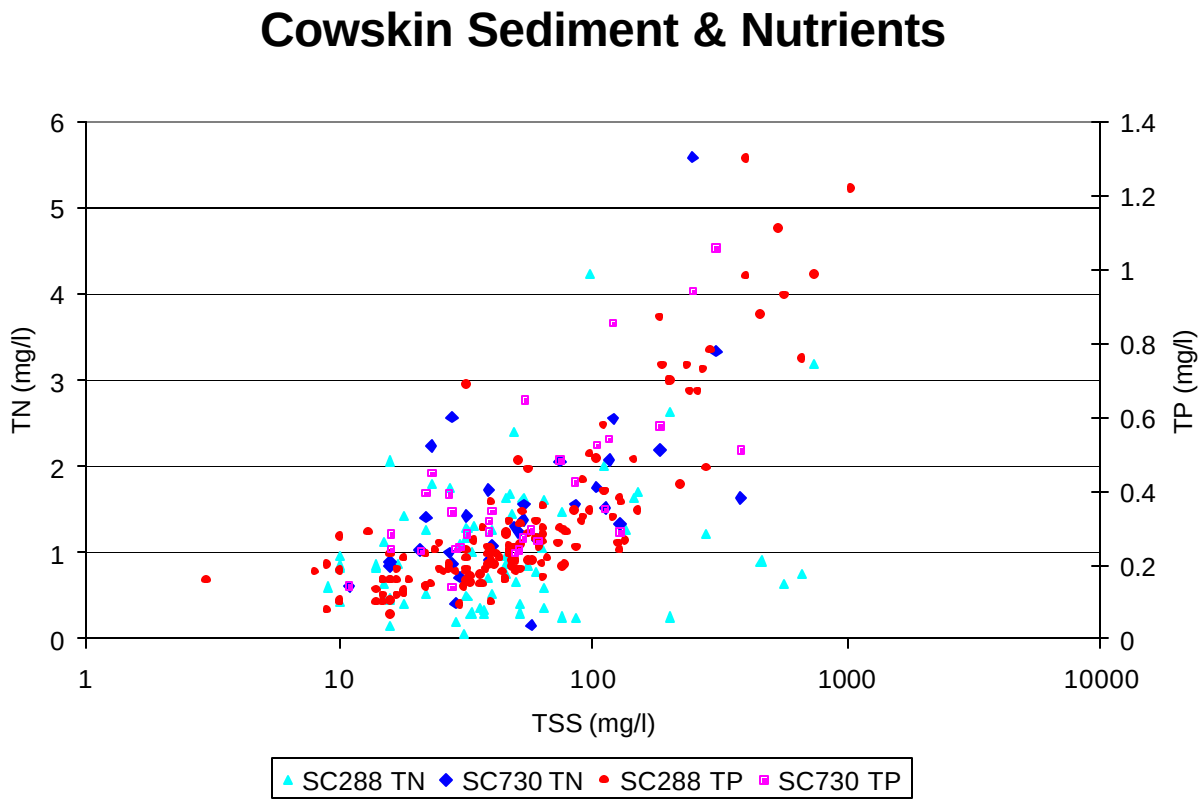
Fifteen of the samples collected since 2001 occurred during higher flows. Table 5 displays the parameter values for the samples collected under runoff conditions. Phosphorus, sediment and organic matter are notably higher under these high flow conditions than what is seen at baseflow. Additionally, there continues to be the decrease in concentrations in the downstream direction. Dissolved oxygen

continues to be adequate and pH is slightly depressed from the levels seen at low flow. Two of the fifteen samples at Station 288 were slightly above 8.5 pH.

Station	NH3	NO3	PO4	TP	Temp	DO	pH	TSS	Turb	TOC
288	0.11	0.44	< 0.25	0.317	19.9	10.5	8.1	108	55	5.82
730	0.15	0.45	< 0.25	0.479	17.9	8.2	7.7	116	89	8.15

(Table 5- Cowskin Creek water quality data collected under runoff conditions since 2001.**)**

Nutrient concentrations in Cowskin Creek were plotted as a function of total suspended solids (Figure 4). With the unusual exception of total nitrogen at SC288, it appears that nutrient concentrations are strongly linked to suspended solids transport. This suggests that elevated nutrient concentrations are a function of runoff conditions as well as point source discharges.



(Figure 4- Nutrient concentrations measured by KDHE in Cowskin Creek as a function of total suspended solids. The record for total nitrogen is shorter than that of total phosphorus due to a change in analytical procedures.**)**

There are numerous stressors that likely are impacting the in-stream biological communities detrimentally. Among those are:

1. Excessive nutrients. Phosphorus levels in the stream are high, even above the outfall of Wichita Plant #3. There is some apparent assimilation in nutrients as water moves downstream as noted by the decreases in average nitrogen and phosphorus levels at downstream stations. However, nutrients likely remain at sufficiently high levels to trigger biological response, given that pH levels, an indicator of photosynthetic activity have been chronically high throughout the period of record at Station 288.

2. Excessive sediments. TSS and Turbidity levels are high at locations along Cowskin Creek, but decrease in a downstream direction. This decrease may be associated with deposition of sediments introduced into the creek by runoff from agricultural and urbanized lands. Anecdotal observations by Wichita stream survey personnel have noted excessive silt throughout the stream channel. This silt may cover available habitat such as riffles and degrade in-stream biological communities that rely on diverse and abundant stream substrates.

3. Altered hydrology and riparian area. The continued urbanization of the watershed will increase peak flows and further diminish baseflow support of the stream. As natural baseflows decrease, flows will become more dependent upon the discharges from wastewater treatment plants such as Wichita #3 and the proposed #4 plant. Increased peak flows will render the channel unstable and disrupt existing habitat. Loss of riparian areas will contribute to the degradation of the stream system and provide near-source supplies of sediments to be carried by higher flows and deposited at downstream locations.

Desired Endpoint for Cowskin Creek for 2006 - 2013

The use of biological indices allows assessment of the cumulative impacts of dynamic water quality on aquatic communities present within the stream. As such, these index values serve as a baseline of biological health of the stream. Sampling occurs during open water season (April to November) within the aquatic stage of the life cycle of the macroinvertebrates. As such there is no described seasonal variation of the desired endpoint of this TMDL. The endpoint would be average MBI value of 4.5 or less over 2006-2013.

Achievement of this endpoint would be indicative of full support of the aquatic life use in the stream reach. While the narrative water quality standard pertaining to nutrients is utilized by this TMDL, there is no direct linkage between MBI values and nutrient levels. A number of factors may contribute to the occasional excursion in index values above 4.5. These include flows, adequate habitat and stream modifications. The link between MBI values and nutrient levels on Cowskin Creek remains qualitative at this phase of the TMDL.

The pH endpoint for this system will be water with less than the upper pH criteria (8.5).

3. SOURCE INVENTORY AND ASSESSMENT

NPDES: The existing TMDL for Cowskin Creek included loadings from the Maize wastewater plant. While the facility discharges to Big Slough and its wastewater eventually enters Cowskin Creek above Station 288, Maize does not impact the biological monitoring Station (SB346) located above the confluence with Big Slough. Five discharges currently exist within the drainage as summarized in Table 6. A proposed wastewater facility is envisioned near Mid-Continent Airport. Plant #3 has nutrient removal technology in place to treat its wastewater. Table 7 compares Plant #3 effluent quality over 2005-06 with other dischargers in the region.

The three smaller municipalities have lagoon systems. Goddard is currently in the planning phase to construct an activated sludge mechanical plant (0.8 MGD), which should adequately meet the wastewater treatment needs of their growing population. Population projections through 2020 indicate all four cities will experience 15-25% growth.

Westar operates two electrical generating stations at the lower and upper reaches of Cowskin Creek. These two stations, operated as peaking plants, discharge cooling water and cooling tower blowdown into a series of ponds, wetlands and ditches before their effluent reaches Cowskin Creek. While both facilities discharge relatively large amounts of water (Table 6), neither loads excessive nitrogen nor phosphorus in their wastewater (Table 7). As such, these facilities will be viewed by this TMDL as providing a dilution base to Cowskin Creek, but are not contributors to excessive nutrient loading, nor the biological impairment.

The ethanol plant sporadically discharges larger volumes of wastewater than the typical flows entering its lagoon and pond system.

Facility	NPDES #	KS Permit #	Type	Receiving Stream	Design Flow (MGD)	2005 Flow (MGD)	2005-6 BOD	2005-6 TSS
Wichita #3	KS0095681	M-AR94-OO03	Activated Sludge	Cowskin Creek	2.0	0.5	3 mg/l	2 mg/l
Abengoa Bioenergy	KS0081329	I-AR24-PO02	Aerated Lagoon	Cowskin Creek via Trib	0.035	0.16	44 mg/l	33 mg/l
Colwich	KS0090956	M-AR24-OO02	3-Cell Lagoon	Cowskin Creek	0.187	N/A	21 mg/l	46 mg/l
Andale	KS0092223	M-AR03-OO01	4-Cell Lagoon	Cowskin Creek via Trib	0.13	N/A	7 mg/l	6 mg/l
Goddard	KS0024791	M-AR37-OO01	4-Cell Lagoon	Cowskin Creek via Dry Creek	0.38	N/A	24	58
Proposed Wichita #4	N/A	N/A	Activated Sludge	Cowskin Creek	3.0	N/A	N/A	N/A
Westar – Gordon Evans	KS0000604	I-AR24-PO01	Cooling Water Blowdown w/ Ponds	Upper Cowskin Creek	2.031	2.19	N/A	N/A
Westar – Murray Gill	KS0000621	I-AR94-PO13	Cooling Water Blowdown w/ Ponds	Upper Cowskin Creek	2.50	1.75	N/A	N/A

(Table 6- Summary of dischargers to Cowskin Creek.**)**

Nutrient/Facility	Wichita #3	Wichita #2	Derby	Abengoa	Gordon Evans	Murray Gill
Tot. Kjeld. N	2.08 mg/l	2.6 mg/l	4.06 mg/l	6.75 mg/l	<2.0 mg/l	<2.0 mg/l
Nitrate (+ NO2)	3.76 mg/l	22.2 mg/l	3.79 mg/l	13.8 mg/l	2.67 mg/l	1.82 mg/l
Tot. Phosphorus	1.84 mg/l	3.4 mg/l	1.29 mg/l	3.03 mg/l	0.20 mg/l	0.21 mg/l

(Table 7- Comparison of regional wastewater nutrient concentrations in 2005-06.**)**

Both the City of Wichita and Sedgwick County have Stormwater NPDES permits and urban stormwater programs. As part of their permits, the urban areas are to put in place at least one Best Management Practice to address the pollutants for any TMDLs that may fall within their jurisdiction. The Sedgwick County permit is tied to TMDLs for Cowskin Creek. Wichita has a Phase One permit and has established its stormwater management program that continues to evolve toward addressing issues along Cowskin Creek.

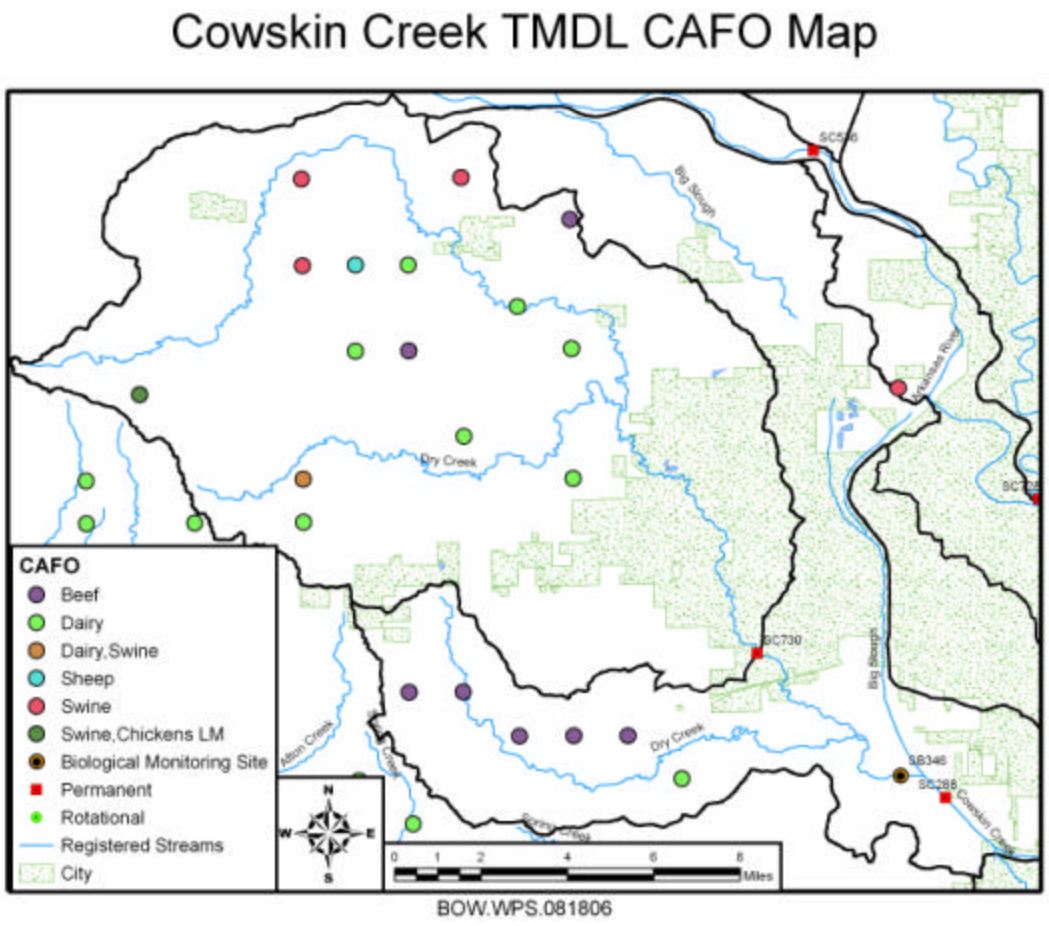
Elevated pH (>8.5) has been observed at SC288 (20 of 101 samples, 1990-2006) during all seasons. No point sources contribute excessively alkaline water to this stream (average pH- Abengoa- 7.9, Andale- 7.8, Colwich- 8.0, Goddard- 8.0, Murray Gill- 7.6, Gordon Evans- 7.6, Wichita Plant #3- 7.0). Since Wichita Plant #3 went online (May 1, 2003) only one pH exceedence has occurred (November 11, 2003- pH 8.8) out of 24 samples. pH appears to rise in response to low flow, elevated

nutrient water.

Livestock Waste Management Systems: Twenty-five operations are permitted within the watershed upstream of SB346, accounting for a potential of up to 5,843 animal units (Table 8, Figure 5, Appendix B). A majority of those operations are dairy (10). There are eight cattle, one sheep, four swine, and one swine/chickens LM operations in the Cowskin Creek watershed. All permitted livestock facilities have waste management systems designed to minimize runoff entering their operations or detaining runoff emanating from their areas. Such systems are designed for the 25 year, 24 hour rainfall/runoff event, which would be indicative of flow durations well under 10 percent of the time. The actual number of animal units on site is variable, but typically less than permitted numbers.

	Number of operations	Authorized Animal Units
Beef	8	1585
Chicken	1	2064
Dairy	10	1370
Sheep	1	50
Swine	5	774

(Table 8- Summary information of all permitted confined animal feeding operations upstream of SB346. Appendix B contains a detailed listing of all facilities within the watershed.**)**

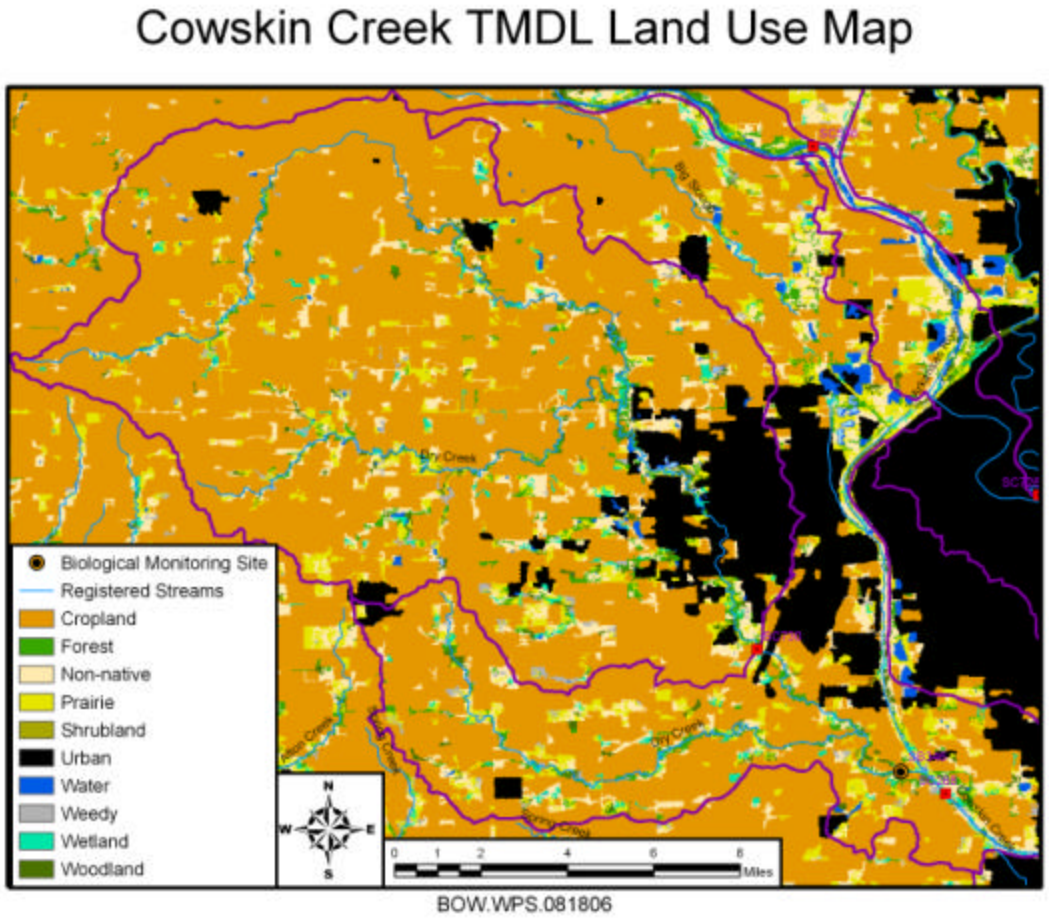


(Figure 5- Confined animal feeding operations permitted upstream of SB346.Permit details in Appendix B.**)**

Land Use: The Kansas GAP dataset was used to analyze land use in the watershed (Table 9, Figure 6). Future conditions in the watershed will likely see more urbanization, with projections of 47% of the watershed developed by 2030.

Cropland	67%
Urban	12%
Non-native	8%
Prairie	6%
Forest	3%

(Table 9- Major land use types in the watershed. Total does not equal 100 due to minor other uses.**)**



(Figure 6- Land use in the Cowskin Creek watershed and surrounding areas.**)**

On-Site Waste Systems: A number of residents within Sedgwick County are in rural settings without sewer service, relying instead on on-site waste systems. Failing septic systems contribute nutrient loadings. The sporadic conditions of partial support and the near-full support condition overall seem to indicate a lack of persistent loadings from such systems on any grand scale. However, population projections for the Sedgwick County indicate substantial growth in rural population to the year 2020, suggesting that proliferation of on-site systems will be occurring in the watershed. Extension of the Wichita sanitary sewer system may bring service to unsewered areas in the northern and eastern drainage

of Cowskin Creek, thereby reducing this potential source.

Contributing Runoff: The watershed has an average soil permeability of 1.9 inches/hour according to NRCS STATSGO data base. Runoff would be produced under storms ranging in duration from one to six hours, having a recurrence interval of five, ten or twenty five years. Runoff is chiefly generated as infiltration excess with rainfall intensities greater than soil permeabilities. Generally, 90 percent of the watershed would generate runoff under dryer conditions. Moderate or wet conditions (larger storms) would see runoff contributed from 98 percent of the watershed. With future urbanization, runoff volumes and peaks are expected to increase into Cowskin Creek.

Background Levels: Most of the woodland in the watershed is adjacent to Cowskin Creek and Dry Creek. Leaf litter falls into the streams and decomposes increasing the oxygen demand. Small amounts of phosphorus are contributed from the watershed soils. Nitrogen loads may be contributed from the atmosphere.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

The linkage between indices of biotic integrity and nutrient loading was originally developed based on observed biochemical oxygen demand stressors and known toxicity of ammonia to aquatic life. However, given the level of wastewater treatment above SB346 those concerns are not the contributing elements for the observed macroinvertebrate community structure. Instead, it is believed that the less than fully supporting designations at SB346 arise out of a more complicated linkage between overall elevated nutrient levels and in-stream sediment conditions.

Point Sources: The original TMDL allocated wasteloads to Andale, Goddard, Colwich, Maize, Abengoa-High Plains and Wichita #3. This allocation process relied upon a high degree of in-stream assimilation of upstream loads resulting in ambient concentrations seen at Station 288 and was done to ascertain whether there was adequate assimilative capacity for the additional wasteload of Wichita #3. As noted previously, Maize does not impact the biological monitoring site on Cowskin Creek and its low effluent volume, distance from Cowskin Creek and historically low nutrient levels render it a non-factor for addressing the impairments seen on the creek. Similarly, CAFOs do not discharge to Cowskin Creek and have a WLA of 0 lbs/day.

This revised TMDL will establish wasteload allocations based upon technology performance to remove nutrients from the various treatment types used by dischargers in the watershed. Previous studies have indicated that average TP and TN values from well-operated lagoon systems are 2 mg/l and 7 mg/l, respectively. The Kansas Nutrient Reduction Plan anticipates that typical biological nutrient removal at mechanical plants can achieve 1.5 mg/l TP and 8 mg/l TN, as annual averages.

The performance data from Wichita #3 indicate an average of 1.88 mg/l TP and 5.8 mg/l TN, therefore the expected quality of the effluent coming from the plant in the future will be 1.5 mg/l TP and 8 mg/l TN, again as annual averages. Similar performance will be expected with the proposed plant #4. Abengoa will have similar limits as a lagoon system, but its design flow will reflect its average actual flow of 0.16 MGD. Table 10 lists the Wasteload Allocations for the current and future dischargers to Cowskin

Creek. These allocations should, after in-stream assimilation, result in average phosphorus and nitrogen concentrations at Station 288 of 0.250 mg/l and 2 mg/l, respectively. Current BOD and TSS limits present in NPDES permits will continue to be in force for these dischargers.

Wasteload allocations for the Westar facilities were based on maximum projected wastewater flows and maximum phosphorus and nitrogen concentrations seen over 2003-2005, which were still significantly less than most other dischargers to Cowskin Creek. Annual average concentrations and loads are expected to be much less than those presented by this TMDL.

Facility	Design Flow (MGD)	Effluent TP Conc. ppm	TP WLA lbs./day	Effluent TSS mg/l	Effluent TSS lbs./day	Effluent TN Conc. ppm	TN WLA lbs./day
Wichita #3	2.0	1.5	25.1	30	500	8.0	133.7
Abengoa Bioenergy*	0.16	2.0	2.7	80	106	7.0	9.4
Colwich	0.187	2.0	3.1	80	124	7.0	10.9
Andale	0.13	2.0	2.2	80	86	7.0	7.6
Goddard	0.8	1.5	10.0	80	200	8.0	53.6
Proposed Wichita #4	3.0	1.5	37.6	30	751	8.0	200.5
Gordon Evans	2.4	0.30	6.0	30	600	6.0	100
Murray Gill	2.5	0.50	10.4	30	625	6.0	125

(Table 10- Wasteload allocations for Cowskin Creek dischargers. *Abengoa is allocated for a projected design flow corresponding to their current average discharge. **)**

These Wasteload Allocations at the outfalls of the NPDES dischargers to Cowskin Creek will decrease in the downstream direction because of in-stream assimilation. The expectation is the wasteloads will result in average nitrogen and phosphorus concentrations of 2.0 and 0.2 mg/l at Station 288. Therefore, the Wasteload Allocations at Station 288 assigned to these wastewater dischargers will be the product of their design flows and the desired nitrogen and phosphorus concentrations (Table 11). The long term historic flows for Cowskin Creek above Haysville have been estimated by Perry, et al (2004). The TMDL assumes that flows up to the 75th percentile flow were wastewater discharges. Therefore, flows greater than median flow were a combination of wastewater and runoff from urban and rural drainages. The dischargers in the Cowskin Watershed are anticipated to increase their design flows to 11.18 MGD or 17.29 cfs. This increases the historic flows by 10 cfs.

percentile	est flow	flow - ww	new ww	future flow	TN LC	TN WLA	TN MS4	TN LA	TP LC	TP WLA	TP MS4	TP LA	TSS LC	TSS WLA	TSS MS4	TSS LA
90	2.65	0	17.29	17.29	186.7	186.7	0.0	0.0	18.7	18.7	0.0	0.0	1.4	1.4	0.0	0.0
75	6.86	0	17.29	17.29	186.7	186.7	0.0	0.0	18.7	18.7	0.0	0.0	1.4	1.4	0.0	0.0
50	16	9.14	17.29	26.43	285.4	186.7	46.4	52.3	28.5	18.7	4.6	5.2	7.1	1.4	2.7	3.0
25	35.3	28.44	17.29	45.73	493.9	186.7	144.4	162.8	49.4	18.7	14.4	16.3	12.3	1.4	5.1	5.8
10	82	75.14	17.29	92.43	998.2	186.7	381.4	430.1	99.8	18.7	38.1	43.0	25.0	1.4	11.1	12.5

(Table 11- Load Capacities, Wasteload Allocations and Load Allocations for Nitrogen, Phosphorus and TSS at Monitoring Site 288.**)**

The load capacity for nitrogen, phosphorus and TSS is determined as the product of the new flow and the desired concentrations of 2.0 mg/l, 0.2 mg/l and 100 mg/l, respectively. Wastewater comprises all the flow at the 90th and 75th percentiles, therefore, Wasteload Allocations make up the total load

capacities at those flows. Because wastewater is treated to produce low TSS (~30 mg/l), the load capacity and Wasteload Allocation at those two flow conditions were based on a concentration of 30 mg/l. Facilities will continue to maintain pH of less than 8.5 in their effluent.

The Wichita and Sedgwick County NPDES permits for stormwater (MS4) should include conditions to direct Best Management Practices toward insulating Cowskin Creek from the impacts of increased runoff and sediment transport. Therefore, practices in runoff reduction and retention, riparian area management, stream buffer development, street cleaning and residential fertilizer management should be incorporated into the city and county stormwater management plans. The area currently served by the Wichita MS4 is 21.25 square miles, or 14% of the watershed. The 2030 Wichita Functional Land Use Guide projects and additional 49.5 square miles will be included in the Urban Growth Area. This urbanization will increase the proportion of developed land in the watershed to 47%.

Therefore, the Wasteload Allocation assigned to MS4 permits will be 47% of the permissible load over the Wasteload Allocations of the discharging NPDES facilities (Table 11). This is determined by taking 47% of the difference between the load capacity and NPDES Wasteload Allocation for nitrogen, phosphorus and TSS.

Non-Point Sources: As indicated by the data collected by Wichita above its #3 plant, there are high nutrient and sediment loads coming from the upper Cowskin Watershed. While nutrients may be a factor contributing to the impairment seen in the downstream biological community, data and anecdotal observations indicate that sediment plays a key role. As indicated earlier, there is a direct relationship between heightened nutrient levels and sediment concentrations. Therefore, the primary allocation of loads for non-point sources will concentrate on reduction of sediment levels in the stream. Current TSS concentrations during runoff conditions exceed 100 mg/l and total phosphorus levels are over 400 ppb.

With the application of Best Management Practices to curtail erosion, bank instability and sediment transport, the expected concentrations for nitrogen, phosphorus and TSS should remain below an average of 2.0 mg/l, 0.2 mg/l and 100 mg/l, respectively, under runoff conditions at Monitoring Site 288. The permissible load allocation for non-point sources will be 53% of the difference between load capacity and NPDES facility Wasteload Allocation (Table 11). No load allocation is designated for low flows because those flows are dominated by wastewater.

Defined Margin of Safety: Given the variable nature of the MBI values seen on this stream, additional biological measures are necessary to assure indications of good aquatic community health. Therefore, the defined Margin of Safety for this TMDL will be a proportion of EPT individuals making up at least 55% of the sample population when MBI values are 4.5 or lower. This will ensure that the majority of aquatic macroinvertebrate population is composed of pollution intolerant taxa. This measure may also correlate with the availability of adequate habitat in the stream to support such a community. The pH margin of safety is implicit in the nutrient limits. Because pH exceedences are not the result of excessively alkaline wastewater discharge, the margin of safety is defined by the significant reductions in nutrients which feed biological processes. Recent monitoring data suggest that conditions have changed and pH exceedences are no longer impairing this water. Further reductions in nutrients, as set in this TMDL, will allow this trend to continue.

State Water Plan Implementation Priority: Because Cowskin Creek is in a mixed rural-urban setting, subject to increased pressure of development and because Cowskin Creek is a major tributary to the Arkansas River below Wichita, this TMDL will be a **High Priority** for implementation. While additional monitoring, source assessment and definition of the relationship between aquatic community response and nutrient loading are studied, the emphasis of this TMDL will be improved point-source performance in nutrient removal and reducing the nonpoint and urban stormwater contributions of sediment and nutrients in the watershed.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Middle Arkansas–Slate Subbasin (HUC 8: 11030013) with a priority ranking of 6 (**Highest Priority** for restoration work).

Priority HUC 11s and Stream Segments: The north and west portions of the Cowskin drainage should be the priority focus of implementation of agricultural production BMPs. Segments 12, 13, 14 constitute the main streams which reflect biological impacts from watershed activities. The eastern portion of the watershed will emphasize urban stormwater control and reductions.

5. IMPLEMENTATION

Desired Implementation Activities

1. Implement necessary soil sampling to recommend appropriate fertilizer applications on cropland.
2. Maintain necessary conservation tillage and contour farming to minimize cropland erosion.
3. Install necessary grass buffer strips along streams.
4. Reduce activities within riparian areas.
5. Install proper manure storage.
6. Implement necessary nutrient management plans to manage manure application to land.
7. Monitor wastewater discharges for excessive nutrient loadings.
8. Implement appropriate urban best management practices to reduce the impact of stormwater on the receiving streams.
9. Evaluate removal of non-permited obstructions in the channel of Cowskin Creek.

Implementation Programs Guidance

NPDES - KDHE

a. Monitor effluent from wastewater systems to determine their nutrient contributions and ambient concentrations of receiving streams.

b. Ensure proper monitoring, permitting, and operations of municipal wastewater systems to reduce nutrient discharges.

c. Ensure plans for the northwest Wichita WWTP #4 incorporate nutrient reduction technologies.

d. Implement applicable sediment and nutrient BMPs through the stormwater permits of Wichita and Sedgwick County.

Nonpoint Source Pollution Technical Assistance - KDHE

a. Support Section 319 demonstration projects for reduction of sediment runoff from agricultural activities as well as nutrient management.

b. Provide technical assistance on practices geared to establishment of vegetative buffer strips.

c. Provide technical assistance on nutrient management in vicinity of streams.

d. Assist evaluation of stormwater quality from urbanized areas of watershed.

Environmental Field Services - KDHE

a. Work with Department of Wildlife and Parks and the City of Wichita to assess stream habitat and other factors impacting the aquatic community throughout Cowskin Creek.

Local Environmental Protection Program - KDHE

a. Support inspection of on-site wastewater systems to minimize nutrient loadings

Water Resource Cost Share & Non-Point Source Pollution Control Programs - SCC

a. Apply conservation farming practices, including terraces and waterways, sediment control basins, and constructed wetlands.b. Provide sediment control practices to minimize erosion and sediment and nutrient transport

Riparian Protection Program - SCC

a. Establish or reestablish natural riparian systems, including vegetative filter strips and streambank vegetation.

b. Develop riparian restoration projects

c. Promote wetland construction to assimilate nutrient loadings

Buffer Initiative Program - SCC

a. Install grass buffer strips near streams.

b. Leverage Conservation Reserve Enhancement Program to hold riparian land out of production.

In-Stream Obstructions - KDA

a. Evaluate the status of in-stream obstructions, including low water crossings and dams.

b. Determine if removal of non-permitted structures is justified.

c. As determined necessary, oversee the removal of non-permitted in-stream obstructions.

Extension Outreach and Technical Assistance - Kansas State University

a. Educate agricultural producers on sediment, nutrient and pasture management

b. Provide technical assistance on buffer strip design and minimizing cropland runoff

c. Encourage annual soil testing to determine capacity of field to hold phosphorus

Time Frame for Implementation: Pollutant reduction practices should have been installed within the priority subwatersheds since 2001 based on the original TMDL. Gradual implementation, including the portion of the watershed within Wichita, should occur over 2007-2013. Monitoring of wastewater and receiving stream quality should continue with the renewal of permits. Improved operations of existing wastewater systems and incorporation of nutrient treatment in Plant #4 should be made by 2011.

Targeted Participants: Primary participants for implementation will likely be agricultural producers operating within the western drainage and the city of Wichita to the east. Initial work over 2007-2011 should include an inventory of activities in those areas with greatest potential to impact the stream, including, within a mile of the stream:

1. Total rowcrop acreage
2. Cultivation alongside stream
3. Fields with manure applications
4. On-site wastewater discharges to stream
5. Condition of riparian areas
6. Presence of livestock along stream
7. Uncontrolled entry points for urban runoff
8. Impervious area generating increased runoff

Updated inventory of local needs should be conducted in 2007-2008 to identify such activities. Such an inventory would be done by local program managers with appropriate assistance by commodity representatives and state program staff in order to direct state assistance programs to the principal activities influencing the quality of the streams in the watershed during the implementation period of this TMDL.

Municipal point sources will initiate monitoring and subsequently treat effluent to reduce nutrient loading once EPA guidance and numeric criteria are in place. Some assessment of stormwater quality coming from urbanized areas of the watershed will be needed to direct any appropriate stormwater management practices.

Milestone for 2011: The year 2011 marks the next period for TMDL revision and assessment in the Lower Arkansas Basin. At that point in time, adequate implementation should be complete which are directly tied to responsible activities contributing to the nutrient and sediment impairment. Additionally, biological data from Cowskin Creek over 2006-2011 should not indicate trends of reduced support of the aquatic community.

Delivery Agents: The primary delivery agents for program participation will be KDHE permitting programs working with the point source dischargers, particularly the City of Wichita, the Sedgwick County conservation district for programs of the State Conservation Commission, and the Natural Resources Conservation Service. Producer outreach and awareness will be delivered by Kansas State Extension and agricultural interest groups such as Kansas Farm Bureau and Kansas Livestock Association and grain crop associations. On-site waste system inspections will be performed by Local Environmental Protection Program personnel for Sedgwick County.

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. 2-1915 empowers the State Conservation Commission to develop programs to assist the protection, conservation and management of soil and water resources in the state, including riparian areas.

4. K.S.A. 75-5657 empowers the State Conservation Commission to provide financial assistance for local project work plans developed to control nonpoint source pollution.

5. 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.

6. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*.

7. 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 in implementation.

Funding: The State Water Plan Fund 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 watersheds 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 a **High Priority** consideration.

The State Revolving Loan Fund is operated through the Municipal Program at KDHE and provides low interest loans for wastewater treatment improvement. Since its inception, $128 million in loans have been made to municipal dischargers in the state. The Non-Point Source Pollution Control Fund of the State Conservation Commission distributes $2.8 million annually to the 105 Conservation Districts to implement non-point source abatement practices, including repair and replacement of faulty septic systems and riparian area improvements.

Effectiveness: Nutrient control has been proven effective through conservation tillage, contour farming and use of grass waterways and buffer strips. The key to success will be widespread utilization of conservation farming and waste management within the watersheds cited in this TMDL.

Technology exists for nitrogen and phosphorus removal and can be placed in wastewater systems with proper planning and design.

Should voluntary participation significantly lag below expectations over the implementation period or monitoring indicates lack of progress in improving water quality conditions from those seen over 1990-2005, the state may employ more stringent regulations on nonpoint sources in the watershed through establishment of a Critical Water Quality Management Area in order to meet the desired endpoints expressed in this TMDL.

6. MONITORING

As numeric nutrient criteria become established, KDHE will continue to collect seasonal biological samples from Cowskin Creek for at least three years over 2007 - 2011 and an additional three years over 2012-2016 to evaluate achievement of the desired endpoint. Monitoring of nutrient content of wastewater discharged from treatment systems will be expected under new and reissued NPDES and state permits, including ambient monitoring above and below the facilities.

Additional source assessment needs to be conducted and local program management needs to identify its targeted participants of state assistance programs for implementing this TMDL. This information should be collected in 2007-2011 in order to support appropriate implementation projects and corrective actions.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Lower Arkansas Basin were held in Hutchinson on June 7, 2006. An active Internet Web site was established at http://www.kdhe.state.ks.us/tmdl/ 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 the TMDLs of the Lower Arkansas Basin will be held on September 13, 2006 in Hutchinson. The public record will be held open until September 30, 2006.

Basin Advisory Committee: The Lower Arkansas Advisory Committee met to discuss the TMDLs in the basin on June 7, 2006 in Hutchinson.

Milestone Evaluation: In 2011, an evaluation will be made as to the degree of achievement of the four biological metrics for Cowskin Creek and relationships with ambient nutrient levels in the streams. Subsequent decisions will be made regarding the implementation approach at that time.

Consideration for 303(d) Delisting: The stream will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2006-2013. Therefore, the decision for delisting will come about in the preparation of the 2014 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 might 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 will come in 2006 which will emphasize implementation of TMDLs. At that time, incorporation of this TMDL will be made into the document. Recommendations of this TMDL will be considered in Kansas Water Plan implementation decisions under the State Water Planning Process for Fiscal Years 2007-2011

Revised June 29, 2007

Appendix A: KDHE Biological Monitoring Metrics

MBI- Macroinvertebrate Biotic Index: Developed to assess the impact of oxygen demanding nutrients and organic enrichment on macroinvertebrate populations. Has a wider range of possible scores than the KBI, but the research basis for the larger number of values is lacking. Has more generalization into higher taxanomic units than the KBI. Includes many insect genera and species and other common macroinvertebrates, such as leaches, worms, snails, bivalves, flatworms, and crayfish; some of the insect species scored in the KBI are not scored in the MBI.
Scoring Range: 1 (intolerant)-11 (tolerant)
Fully Supporting- = 4.5
Partially Supporting- 4.51-5.39
Non-Supporting- = 5.4

KBI- Kansas Biotic Index: Reported here as the Nutrient Oxygen Demand component. Developed specifically for Kansas insects belonging to the 10 orders of insects known to occur in Kansas, this metric has six potential categories of impairment- Nutrient Oxygen Demand, Agricultural Pesticides, Heavy Metals, Salinity, Suspended Sediments and Solids, and Persistent Organic Compounds. However, Steve Cringan is not aware of any previous use, or verification of, the non-nutrient tolerance values. Species were assigned tolerance values and the composite score for the site is the abundance weighted average tolerance score for the population collected.
Scoring Range: 0 (intolerant)-5 (tolerant)
Fully Supporting- = 2.6
Partially Supporting- 2.61-2.99
Non-Supporting- = 3.0

EPT- Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies): The simple sum of the number of species collected belonging to these three orders. EPT are widely recognized as relatively intolerant to pollution, and generally the presence of greater numbers (both diversity and abundance) of these species is considered indicative of higher water quality.
Fully Supporting- = 13
Partially Supporting- 8-12
Non-Supporting- = 8

EPT % Abundance: The percentage of all individuals collected belonging to these three orders. Large populations of a few species may swing this metric to fully supporting when the EPT index registers a partial or non-supporting condition. This metric does not measure diversity in community structure.
Fully Supporting- = 48%
Partially Supporting- 31-47%
Non-Supporting- = 30%

Appendix B: Confined Animal Feeding Operation Permits in the area covered by this TMDL

Permit #	Total Head	KS Authorized Head	Federal Authorized Head	Federal Permit #	Animal Type	Size	Longitude	Latitude
A-ARSG-P001	49200	2064	480	KS0095052	Swine,Chickens LM	Swine300-999,1000-9999	-97.65280	37.72832
A-ARSG-BA04	400	400	400		Beef	300-999	-97.50854	37.78714
A-ARSG-LA01	500	50	50		Sheep	0-299	-97.58051	37.77177
A-ARSG-BA01	150	150	150		Beef	0-299	-97.56265	37.74311
A-ARSG-BA09	200	200	200		Beef	0-299	-97.56250	37.62847
A-ARSG-BA11	170	170	170		Beef	0-299	-97.48912	37.61384
A-ARSG-BA17	400	400	400		Beef	300-999	-97.50725	37.61388
A-ARSG-BA22	100	100	100		Beef	0-299	-97.54429	37.62854
A-ARSG-BA05	100	75	100		Beef	0-299	-97.52541	37.61378
A-ARSG-BA10	90	90	90		Beef	0-299	-97.52541	37.61378
A-ARSG-S009	200	80	80		Swine	Swine0-299	-97.54507	37.80128
A-ARSG-M042	100	140	140		Dairy	0-299	-97.58046	37.74292
A-ARSG-S011	740	224	200		Swine	Swine0-299	-97.59830	37.77159
A-ARSG-M023	100	140	140		Dairy	0-299	-97.54411	37.71434
A-ARSG-S005	900	360	360		Swine	Swine300-999	-97.59845	37.80071
A-ARSG-M015	80	112	112		Dairy	0-299	-97.59789	37.68553
A-ARSG-M038	200	280	280		Dairy	0-299	-97.47091	37.59959
A-ARSG-M030	40	56	56		Dairy	0-299	-97.50801	37.74379
A-ARSG-M040	100	140	140		Dairy	0-299	-97.54411	37.71434
A-ARSG-M027	208	110	100		Dairy,Swine	0-299,Swine0-299	-97.59796	37.69998
A-ARSG-M031	100	140	140		Dairy	0-299	-97.56273	37.77189
A-ARSG-M041	80	112	112		Dairy	0-299	-97.50756	37.70032
A-ARSG-M033	100	140	140		Dairy	0-299	-97.52612	37.75792