LOWER ARKANSAS RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody/Assessment Unit: Little Cow Creek
Water Quality Impairment: Nitrogen (Ammonia/Nitrate)

1. INTRODUCATION AND PROBLEM IDENTIFICATION

Subbasin: Cow Creek

Counties: Rice and Ellsworth

HUC 8: 11030011

Ecoregion: Central Great Plains, Rolling Plains and Breaks (27b)

Drainage Area: Approximately 72.0 square miles

Main Stem Segments: WQLS: **2** (Little Cow) starting at the confluence with Cow Creek in central Rice County and traveling upstream to headwaters in north-central Rice County (**Figure 1**).

Tributary Segments: Salt Cr (21)

Designated Uses: Expected Aquatic Life Support, Primary Contact Recreation "C" and Groundwater Recharge for Main Stem Segment. Tributary segments designated uses are Expected Aquatic Life Support and Primary Contact Recreation "B" for Salt Creek

2002, 2004, 303(d) Listing: Cow Creek Basin streams – Little Cow Creek (Segment 2)

Impaired Use: Expected Aquatic Life Support and Groundwater Recharge

Water Quality Standard: In surface waters designated for the groundwater recharge use, water quality should be such that, at a minimum, degradation of groundwater quality does not occur (KAR 28-16-28e(C)(5)). Ammonia (as N) criteria are pH and temperature dependent and provided in tables 1c, 1d and 1e of KAR 28-16-28e(d). For example, chronic aquatic life criterion for pH at 7.6 and temperature at 20 is 2.79 mg/L. Nitrate (as N): 10 mg/L (KAR 28-16-28e(c)(3)(A)): Domestic Water supply criteria are provided in table 1a of KAR 28-16-28e(d).

Nutrients – Narratives: The introduction of plant nutrients into streams, lakes or wetland 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)(A)).

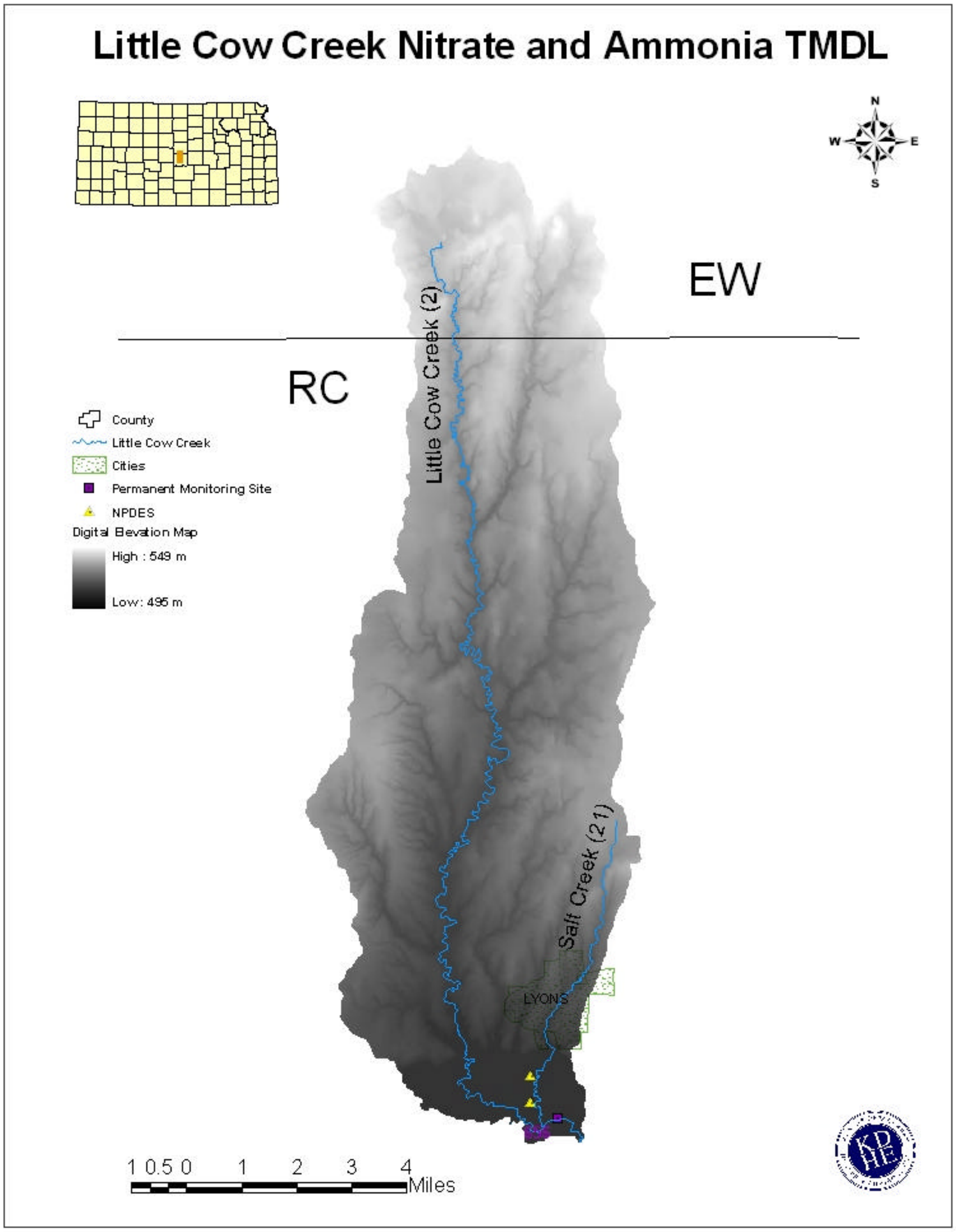

Figure 1. A DEM map of Little Cow Creek watershed.

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 2004 303(d): Not Supporting Aquatic Life and Groundwater Recharge

Monitoring Site: Ambient Stream Water Quality Monitoring Station (Site 656).

Period of Record Used: 1992 – 2005 for Station 656.

Flow Record: Cow Creek near the city of Lyons (USGS Station 07143300; 1970 – 2005) was used to estimate flow in the Little Cow Creek watershed based on the proportional drainage area (Perry et al., 2004).

Long Term Flow Conditions: Median Flow = 1.1 cfs; 7Q10 = 0.1 cfs; 10% Exceedance Flow = 13.7 cfs, 95% Exceedance Flow = 0.2 cfs.

Current Conditions: Since loading capacity varies as a function of the flow present in the stream, this TMDL represents a continuum of desired loads over all flow conditions, rather than fixed at a single value. Sample data for the sampling sites were categorized for each of the three defined seasons: Spring (Apr – Jul), Summer-Fall (Aug – Oct) and Winter (Nov – Mar). High flows and runoff equate to lower flow durations; baseflow and point source influences generally occur in the 75-99% range. A load curve was established for the nitrate domestic water supply criterion by multiplying the flow values along the curve by the applicable water quality criterion and converting the units to derive a load duration curve of pounds of nitrate per day. This load curve represents the TMDL since any point along the curve represents water quality for the standard at that flow. Historic excursions from the water quality standard are seen as plotted points above the load curve. Water quality standards are met for those points plotting below the applicable load duration curve.

Ammonia: Figure 2 and **Table 1** show monthly and seasonal ammonia concentration averages for ambient KDHE stream monitoring station 656, respectively. In general, seasonal ammonia averages were similar during 1992 – 2005. The maximum seasonal concentrations were 12.87 mg N/L in spring, 13.41 mg N/L in summer-fall and 23.27 mg N/L in winter.

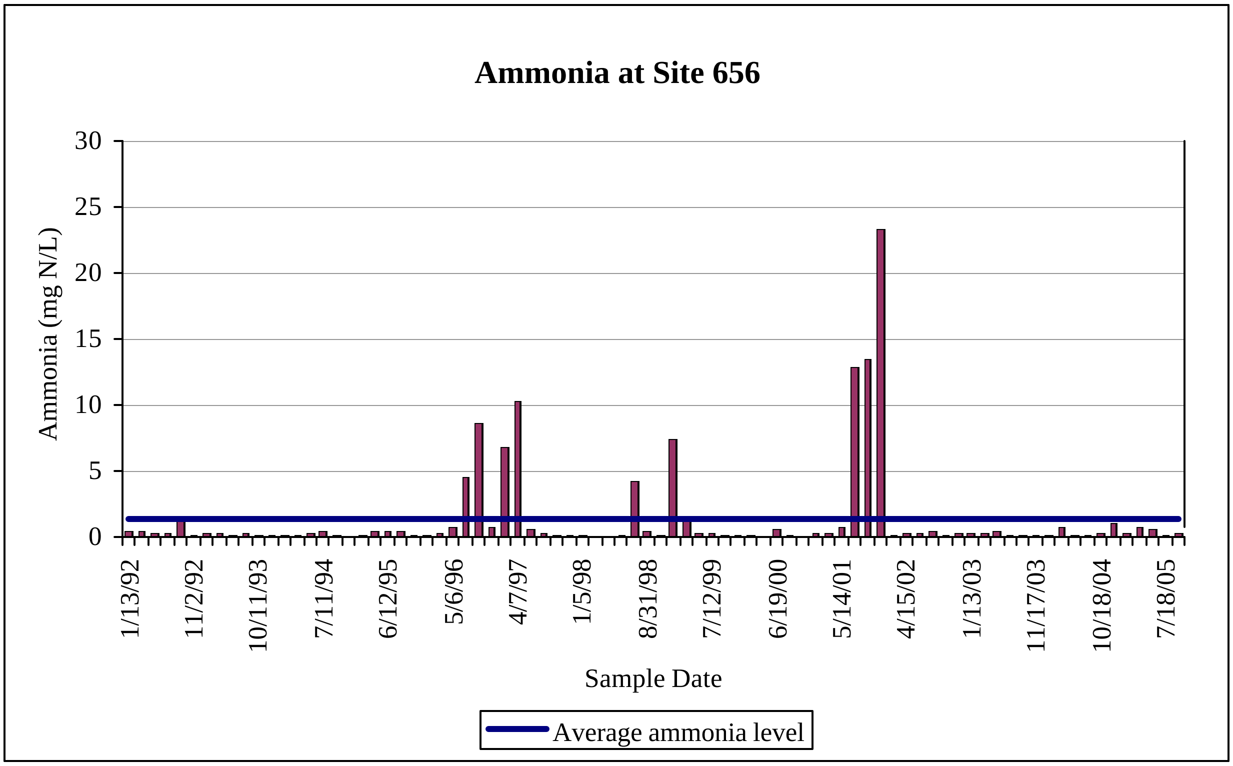

Figure 2. Ammonia concentrations at Site 656 during 1992 – 2005.

Table 1. Seasonal ammonia values at Site 656 during 1992 – 2005.

Season \ Parameter	Average (mg N/L)	Standard Error (mg N/L)	Minimum (mg N/L)	Maximum (mg N/L)
Spring	1.43	0.58	0.02	12.87
Summer-Fall	1.33	0.76	0.03	13.41
Winter	1.35	0.72	0.02	23.27
Average	*1.37*	*0.40*	*0.02*	*23.27*

Deviations between the ambient ammonia concentration and Chronic Aquatic Life Criteria at Site 656 are shown in Figure 3. There were a total of nine ammonia violations observed during the period from 1992 – 2005. The percentage of ammonia exceedance over the criteria in the spring months was 14%, whereas relatively low ammonia exceedances occurred in the summer-fall (10%) and winter (9%) months, respectively (**Table 2**). Over the period of ambient water quality record, most of the ammonia exceedance incidences were noted during the flow conditions ranging between 25-50% flow exceedance (1.1 – 3.2 cfs).

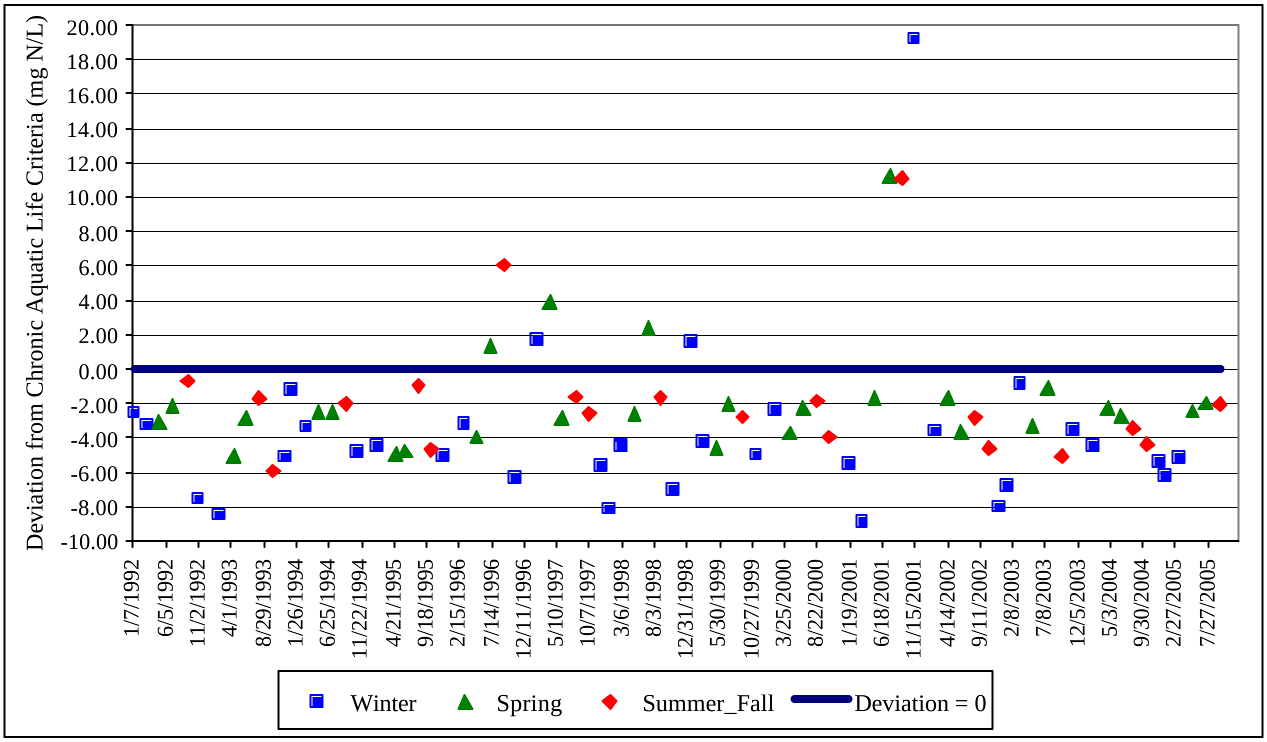

Figure 3. Deviations of ammonia concentrations from the Chronic Aquatic Life Criteria.

Table 2. Number of samples above the Chronic Aquatic Life Criteria by flow exceedance.

Flow / Season	Number of samples above the Chronic Aquatic Life Criteria						
	0 to 10%	10 to 25%	25 to 50%	50 to 75%	75 to 90%	90 to 100%	Cum. Freq
Spring	0	0	2	1	1	0	4/28 = 14%
Summer/Fall	0	0	1	1	0	0	2/20 = 10%
Winter	0	0	3	0	0	0	3/34 = 9%

Nitrate: Figure 4 and **Table 3** show monthly and seasonal nitrate (NO_3) concentration averages for KDHE ambient stream monitoring station 656, respectively. In general, nitrate concentration averages were lower in the spring months when the streamflows were elevated, and high concentrations were often found during the remainder of the year. The maximum concentrations were 19.84, 19.80 and 20.39 mg N/L for spring, summer-fall and winter, respectively.

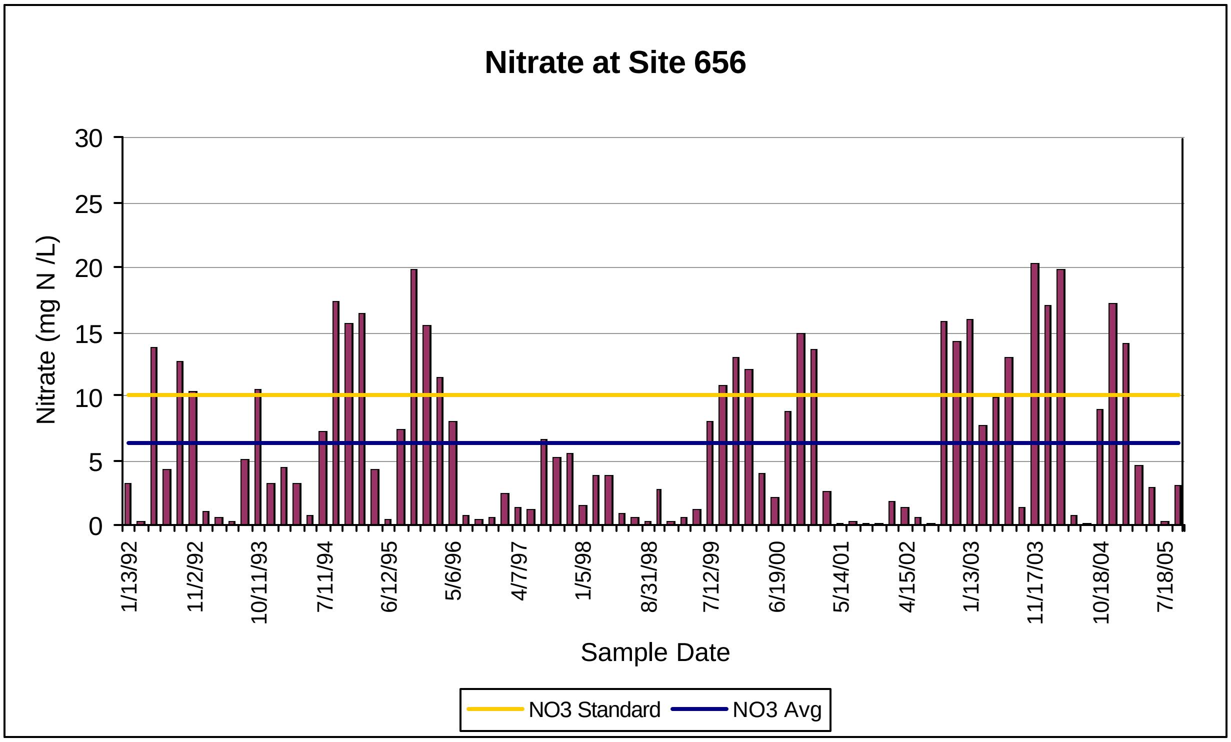

Figure 4. Nitrate concentrations at Site 656 during 1992 – 2005.

Table 3. Seasonal nitrate values at Site 656 during 1992 – 2005.

Parameter / Season	Average (mg N/L)	Standard Error (mg N/L)	Minimum (mg N/L)	Maximum (mg N/L)
Spring	3.90	0.95	0.17	19.84
Summer-Fall	7.51	1.41	0.13	19.80
Winter	7.69	1.11	0.08	20.29
Average	*6.35*	*0.68*	*0.08*	*20.29*

The percentage of nitrate exceedance over 10 mg N /L during the spring months was 11%, whereas relatively high nitrate exceedances occurred during the summer-fall (35%) and winter (41%) months, respectively (**Table 4**). Over the period of ambient water quality record, nearly all the nitrate exceedance incidences were noted during low flow conditions, in particular for the flow ranging between the 50-75% flow exceedance, where the design flow (0.55 MGD = 0.85 cfs) for City of Lyons wastewater treatment plant would fall within. This clearly indicates that wastewater effluent was the major point source affecting nitrate levels measured at the Little Cow Creek Monitoring Station located just about 1.5 miles downstream from the treatment plant. The desire endpoints for this Little Cow Creek Watershed TMDL is to 1) ensure nitrate level always less than 10 mg N/L, and 2) achieve average total N of 8 mg/L annually and thus nitrate levels at Sites 656 and 522 would be less than 10 mg N/L.

Table 4. Number of samples above the nitrate standard of 10 mg N /L by flow exceedance.

Season \ Flow	Number of samples above the nitrate standard						
	0 to 10%	10 to 25%	25 to 50%	50 to 75%	75 to 90%	90 to 100%	Cum. Freq
Spring	0	0	0	1	1	1	3/28 = 11%
Summer/Fall	0	1	0	4	1	1	7/20 = 35%
Winter	0	0	0	12	2	0	14/34 = 41%

3. SOURCE INVENTORY AND ASSESSMENT

NPDES: There is one NPDES municipal permitted wastewater plant within the watershed (**Figure 5**) that could contribute significant ammonia and nitrate loads to downstream of the Little Cow Creek watershed. The Lyons – Little Cow Creek facility relies on an oxidation ditch system to treat its wastewater. The plant underwent upgrades in 2003, which were completed on August 16, 2004. The daily maximum limit during 2003 – 2007 (issued in 2002) for ammonia is 9.4 mg N/L, with monthly permit limits of 8.4 mg N /L for Jan, Feb, Nov and Dec, and 5.1 mg N/L for Mar, Apr, May and Oct, 4.3 mg N/L for June, 3.1 mg N/L for July, 2.7 mg N/L for August, and 3.8 mg N/L for Sept. The permit [NPDES #KS0022730 (M-AR56-OO01)] expires at the end of 2007 and has a design flow of 0.55 MGD.

Table 5 shows ammonia concentrations before and after the upgrade at the Lyons WWTP facility, ambient ammonia concentrations measured at Site 656, and background ammonia levels observed at Site 657 within the Cow Creek watershed. Before the upgrade, the average ammonia level was 5.02 mg N/L at the Lyons WWTP and the corresponding ammonia level at Site 656 was 1.24 mg N/L. After the upgrade, the ammonia levels significantly decreased to 0.91 mg N/L at the Lyons WWTP and 0.42 mg N/L at Site 656 ($p < 0.05$). According to the ambient ammonia records at Site 656, the occurrence of nine ammonia violations at the Little Cow Creek all happened before the upgrade of the plant. Based on monthly Discharge Monitoring Reports (DMRs) from the Lyons wastewater treatment plant, these nine violation incidents were strictly related to the treatment operation prior to upgrade, i.e., sludge was held in the oxidation ditch longer than it should have been and therefore ammonia was not removed. The average background ammonia level at Site 657 is 0.10 mg N/L during 1992 – 2005, which is much lower than Lyons effluent and Site 656 downstream of the Lyons WWTP. This clearly indicates that ammonia discharged from the plant has a significant impact on downstream ammonia levels, and thus suggests that the plant should closely maintain proper operations to protect downstream water quality in Little Cow Creek.

Table 5. Characteristics of Lyons – Little Cow Creek wastewater treatment plant and ammonia levels at Sites 656 and 657.

NPDES Permit #/ Federal Permit #	Segment	Design flow	Before upgrade		After upgrade		Background
			Site 656	Lyons WWTP	Site 656	Lyons WWTP	Site 657
KS-0022730 M-AR56-OO01	Little Cow Cr (2)	0.55 MGD (0.85 cfs)	1.46	5.02	0.42	0.91	0.10

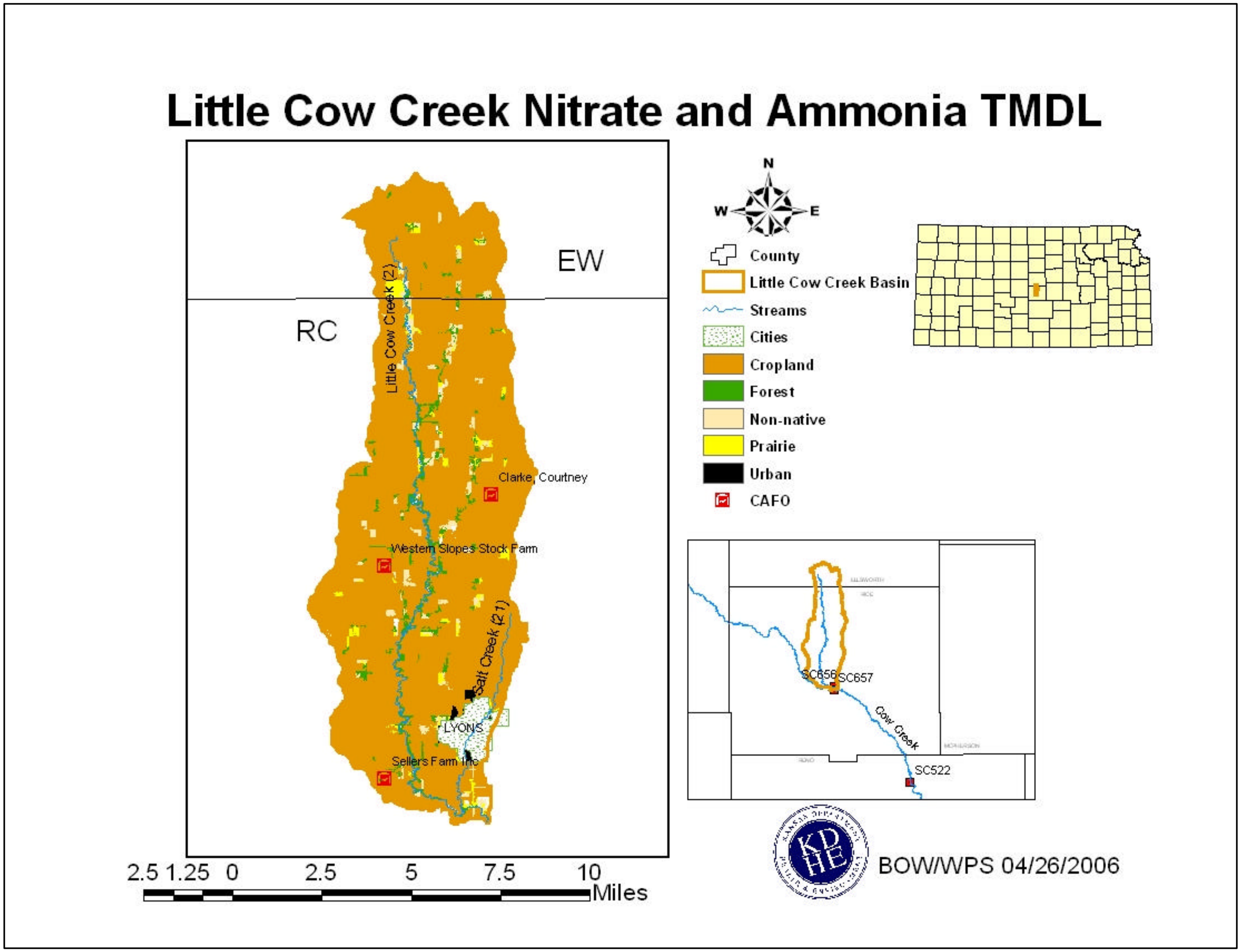

Figure 5. A watershed map of Little Cow Creek

Unlike ammonia, nitrate showed a different flow-concentration relationship at Site 656 during 1992 – 2005 (**Figure 6**). Nitrate excursions tended to appear during low flow conditions (> 50% flow exceedance) and showed a seasonal pattern. Typically, high nitrate values were noted in the winter months, decreased in the spring and then increased in the summer-fall months. Average nitrate concentrations were 15.32 mg N/L for the winter, 5.59 mg N/L for the spring and 7.60 mg N/L for the summer-fall.

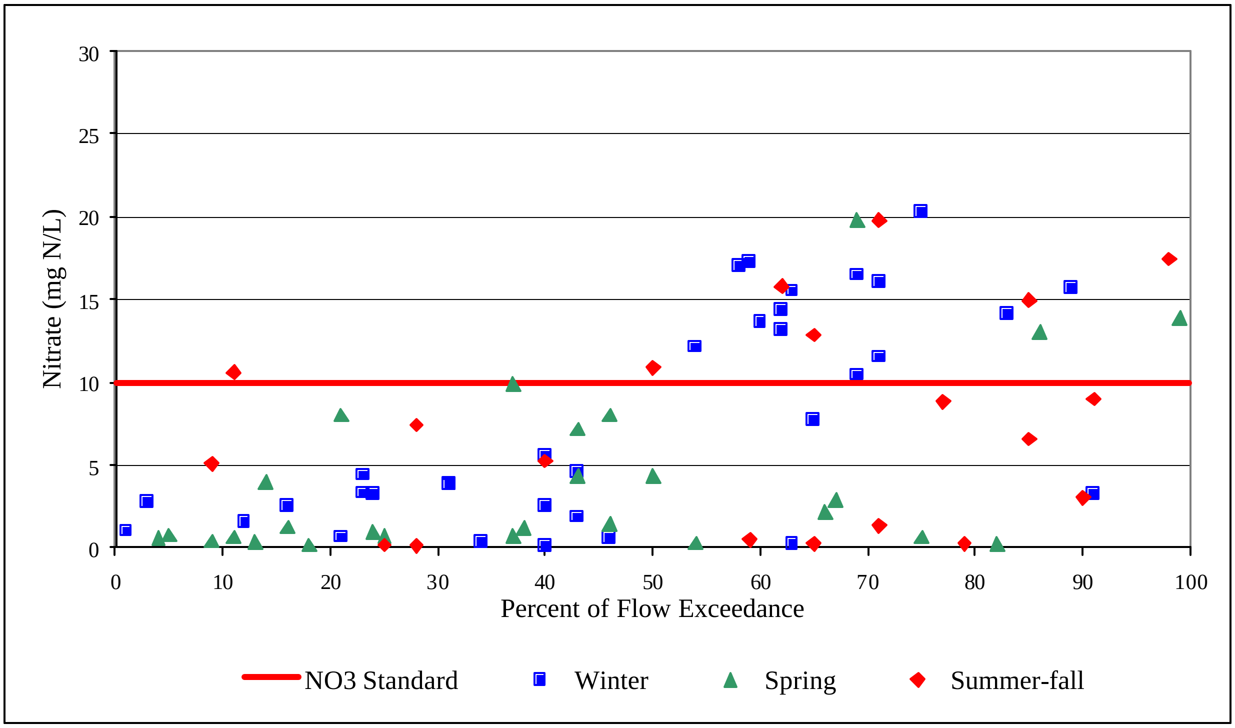

Figure 6. Seasonal nitrate distribution as percent of flow exceedance at Site 656.

Results of nitrate analysis for Lyons and Site 656 indicated that variations of nitrate values at Site 656 corresponded well with effluent nitrate (**Figure 7**). With the exception of high flow conditions, which stream nitrate values were diluted by storm runoffs, nitrate concentrations consistently increased at Site 656 as effluent nitrate increased. However, no statistical differences were noted for nitrate levels at Site 656 before and after the plant upgrade. **Table 6** summarizes nitrate, nitrite, organic N and total N concentrations before and after the upgrade at the Lyons wastewater treatment plant.

As mentioned earlier, the Lyons wastewater treatment plant uses an oxidation ditch system to treat wastewater from the city. In general, there are two treatment steps involved in removing nitrogen; aerobic conditions (which provide dissolved oxygen to the microbes to convert ammonia to nitrate) and anoxic conditions (which the microbes use oxygen from nitrate). The former uses mineralization (ammonification and nitrification), a biological process to release inorganic N (ammonia and nitrate) through the decomposition of organic compounds while the latter (anoxic conditions) converts the released inorganic N forms into N gases through denitrification. The treatment processes are dependent upon the presence and absence of dissolved oxygen in the system. If the system has high dissolved oxygen levels, the denitrification process will be suppressed and results in elevated nitrate concentrations in the effluent. Time series analysis for nitrate data at Site 656 clearly indicated that seasonal patterns existed, with high nitrate values occurring in the winter months and low nitrate values in the spring. These periodical and temporal patterns suggest that aeration rates used at the Lyons plant in the winter months are causing a saturation of oxygen in the system and therefore reduce the efficiency of nitrate removal in the treatment process.

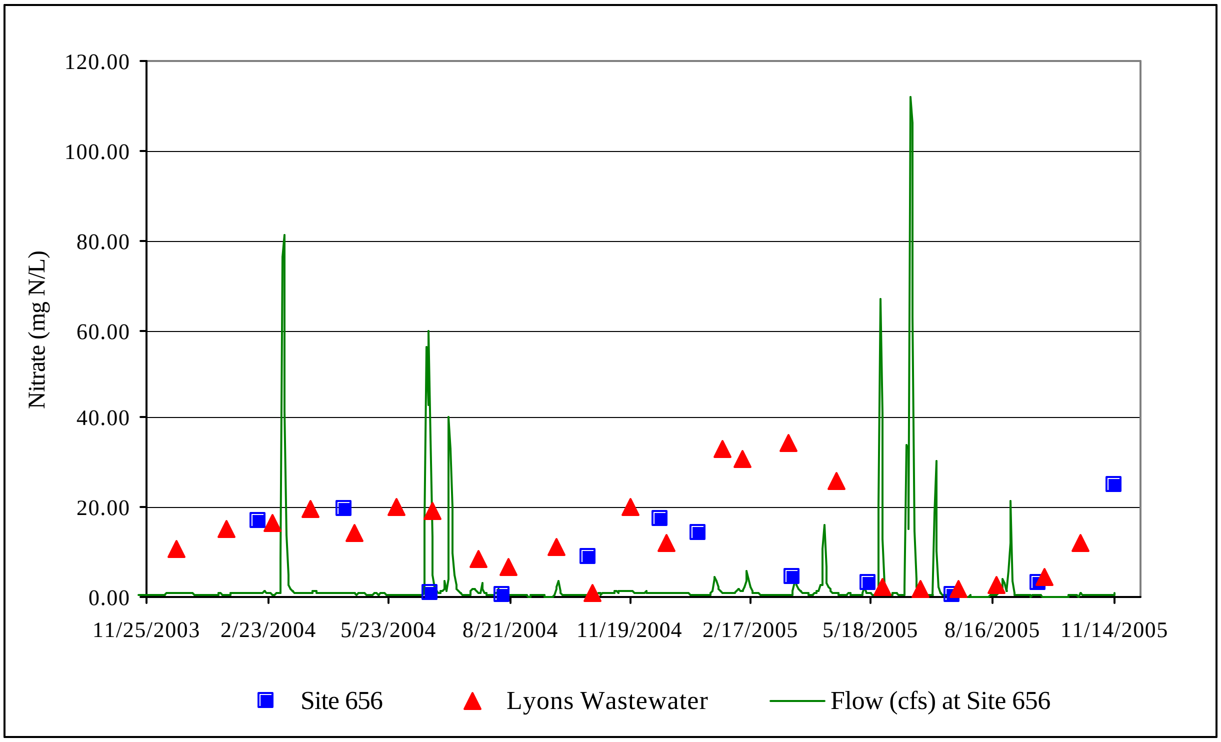

Figure 7. Nitrate concentrations at Lyons – Little Cow Creek facility and Site 656.

Table 6. Comparison summary of nitrate, nitrite, organic N and total N before (N = 19) and after (N = 14) upgrading the wastewater treatment plant for Site 656 during 2003 – 2005. The plant upgrade was completed on August 16, 2004. No statistical differences were noted at the confidence level of 0.05.

Upgrade	NO_3 (mg N/L)	NO_2 (mg N/L)	Organic N (mg N/L)	Total N (mg N/L)
Before	14.85	0.13	2.97	19.33
After	13.82	0.68	1.69	17.11

It is interesting to note that the effluent from the Lyons wastewater treatment plant affected nitrate values not only at Site 656 but also at Site 522, which is located about 32 miles downstream from Site 656 (**Figure 8**). Data analysis revealed that during 1992 – 2005, nitrate levels at Site 522 increased accordingly as nitrate values increased at Site 656 when its streamflow values were greater than 0.85 cfs (**Figure 9**). The flow of 0.85 cfs is the design flow of the Lyons sewage treatment plant.

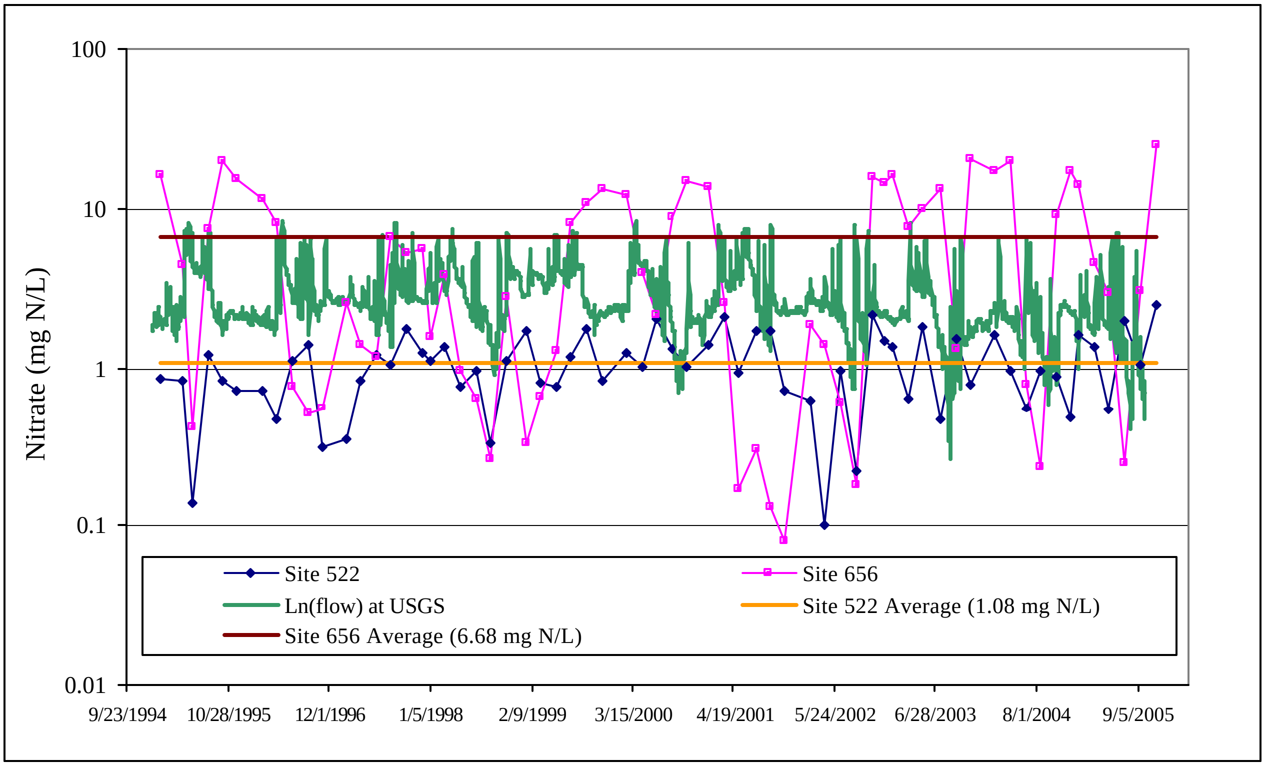

Figure 8. Nitrate concentrations in relation to flow (USGS-07143300) Sites 522 and 656.

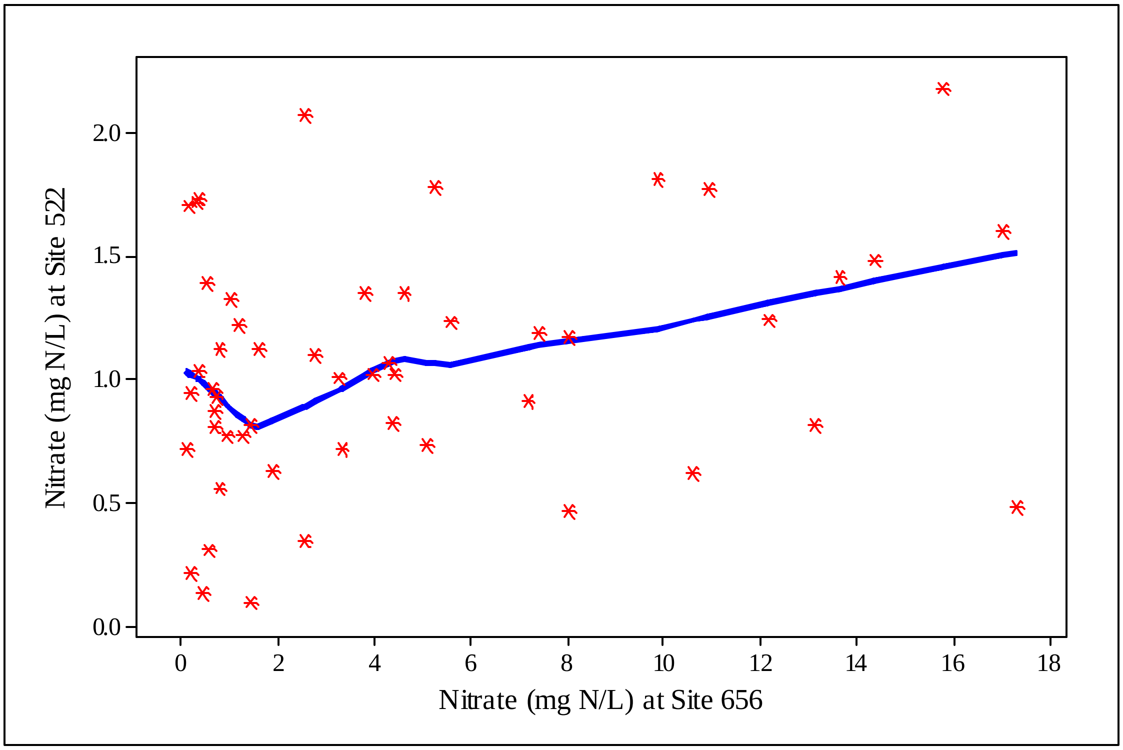

Figure 9. Nitrate relationship between Sites 522 and 656 for flow values greater than 0.85 cfs.

Figure 10 illustrates the relationship between nitrate in the effluent from Lyons and the resultant downstream ambient nitrate concentrations in spring and summer-fall. Significant nitrate reduction between the two sites was observed ($r^2 = 0.76$, $p < 0.10$), suggesting that hydrologic influence and biological nitrate assimilation and/or uptake occurred within this 1.5-mile stream course. However, very little hydrologic impact and/or biological transformation was observed in the winter months because of cold weather.

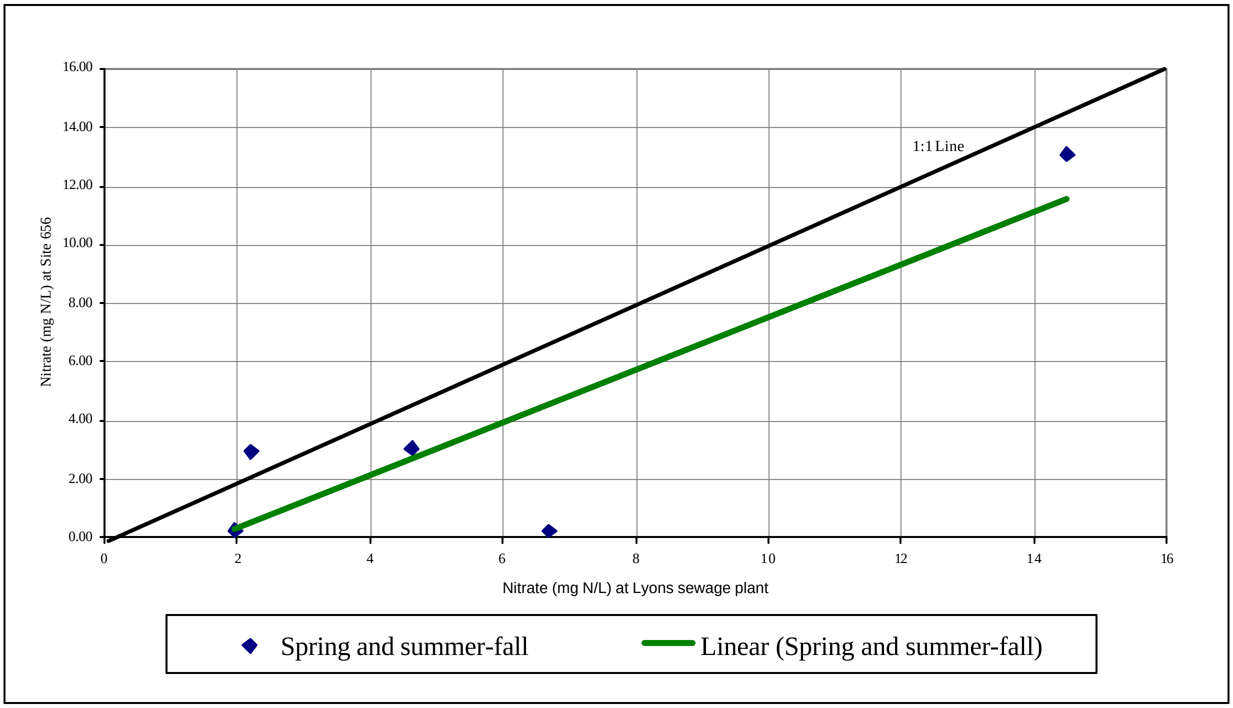

Figure 10. Relationship between stream and effluent nitrate concentrations during 2003 – 2005.

Livestock Waste Management Systems: Three animal feedlot operations are registered, certified or permitted within the watershed (**Table 7**). These facilities (2 beef and 1 dairy) are primarily located in the central and southern portions of the watershed (**Figure 5**). One of these facilities (NPDES#: A-ARRC-C004) is of sufficient size to warrant NPDES permitting. A new NPDES permit was issued by KDHE on Feb 10, 2006 with conditions ensuring adequate retention of livestock wastewater and management of livestock manure to prevent runoff of pollution to Little Cow Creek. All of these permitted livestock facilities have waste management systems designed to minimize runoff entering their operation or detaining runoff emanating from their facilities. In addition, they are designed to retain a 25-year, 24-hr rainfall/runoff event as well as an anticipated two weeks of normal wastewater from their operations. Typically, this rainfall event coincides with streamflow that is less than 1-5% of time. Therefore, events of this type, higher flows that are infrequent and of short duration, are not the types of flows associated with the ammonia and nitrate problems in the Little Cow Creek watershed. The owners are required to maintain the water level of a waste lagoon at a sufficient level below the lagoon berm (e.g., 3-6 ft) to ensure retention of runoff from the feedlot from such intense, local storm events.

Though the total potential number of animals is 12,460 head in the watershed, the actual number of animals at the feedlot operations is typically less than the allowable permitted number. Wasteload allocations for these facilities are listed in **Appendix A**.

Table 7. Characteristics of three confined animal operations in Little Cow Creek Watershed

Permit #	Area (acre)	Type	Head
A-ARRC-C004	114.7	Beef	12,000
A-ARRC-B004	2.1	Beef	400
A-ARRC-M003	< 1	Dairy	60

Land Use: The predominant land use is cultivated cropland, which accounts for 89% of the total land area in the watershed. Urban area, such as residential, commercial and industrial uses, comprises 2% of the watershed. Approximately 4% of the land is occupied by Ash-Elm Hackberry floodplain forest, whereas 2% is non-native grassland. The area under the Conservation Reserve Program (CRP) only accounts for 0.2% (96 acres) of the entire watershed. There are about 3,444 acres of riparian area (30 m buffer along the stream system) in the watershed, most of which is categorized as cropland (75%). Ash-Elm Hackberry floodplain forest, mix prairie and non-native grassland account for about 12%, 3% and 6%, respectively. Urban areas occupy another 2% of the riparian area and approximately 0.5% of this stream buffer area is CRP (17 acres).

On-Site Waste Systems: According to the 2000 census data from the U.S Census Bureau, the population of the entire watershed was 4,178 people, of which 3,732 people live within the city limits of Lyons. As a result, the watershed population density is relatively high (56 person/sq. mile) when compared to the density of Rice County (14 people/sq. mile). Based on the 1990 census data, about 23% of the households in Rice County are on septic systems. The comparisons of urban/Rural communities between the 1990 and 2000 data clearly indicated that while the majority of people lived in the rural areas in 1990, most of the population lived inside the city limits a decade later (**Table 8**). Though many houses are currently connected to a public sewage system, failing on-site systems can contribute significant nitrogen (ammonia and nitrate) loadings, given the low flows associated with the excursions in the watershed.

Table 8. Summary of urban and rural community comparisons between 1990 and 2000 (the decennial data was from the U.S. Census Bureau).

Type	Description	1990†	2000
Urban	Inside urbanized areas	0	0
	Inside urban clusters (Outside urbanized areas†)	3,688	6,097
Rural	Farm	562	693
	Non-farm	6,360	3,971

Contributing Runoff: The Little Cow Creek watershed is a sub-basin of the Cow Creek watershed that has an average soil permeability of 1.8 inches/hour according to NRCS

STATSGO data base. About 79% of the Cow Creek watershed produces runoff even under relatively low (1.5"/hr) potential runoff conditions. Under very low (<1"/hr) potential conditions, this area is greatly reduced to 14.5%. Runoff is generated as rainfall intensities exceed soil permeabilities. As the watersheds' soil profiles become saturated, excess overland flow is produced. Generally, storms producing less than 0.5"/hr of rain will generate runoff from only 5% of this watershed, chiefly along the stream channels.

Background Levels: Certain amount of nitrogen loading may be associated with natural biogeochemical transformations. The nitrogen contributions may come from soils, wildlife, streamside vegetation or streambed sediment. However, these environmental background nutrient levels should result in minimal loading to the stream systems, below the levels of violating water quality standards.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

As mentioned earlier in Section 3, the nine ammonia excursions were all associated with effluent discharge from the Lyons wastewater treatment plant prior to upgrade. The plant completed its upgrade on August 16, 2004, and since then no ammonia excursions have been identified. The daily maximum ammonia limit in NPDES permit is 9.4 mg N/L in 2003 – 2007.

Point Sources: Chronic Aquatic Life Criteria (with Early Life Stages of Fish Absent) for total ammonia are pH and temperature dependent. To address the temporal effect on ammonia toxicity in Little Cow Creek, Waste Load Allocations (WLAs) were calculated based on two seasons; cold season (winter; Nov – Mar) and warm season (spring and summer-fall; Apr – Oct). The average monthly permit limits used were 3.1 mg N/L for warm season and 8.4 mg N/L for cold season. Based on the winter discharge limit of 8.4 mg N/L, the WLA of 38.59 lbs N/day for the cold season can be assigned to Lyons at the outfall of its Little Cow Creek sewage plant. As for the warm season, 3.1 mg N/L of ammonia is allowed to the stream. Thus, the WLA of 14.24 lbs N/day for the warm season is assigned to the Lyons treatment plant. Regardless of seasonal differences, the maximum allowable ammonia load to the stream is 43.19 lbs N/day, which is based on the permitted maximum daily concentration of 9.4 mg N/L.

As for nitrate, approximately 96% of the concentrations higher than the water quality standard occurred during low flow conditions and 74% of which were within the 50-75% flow exceedance range (**Table 14**). Therefore, reduction in nitrate loadings within the watershed will focus streamflow conditions below the design flow for the Lyons wastewater treatment plant. Nitrate reduction applied to the Lyons treatment plant will directly benefit to lowering nitrate levels in Little Cow Creek.

Nitrate, nitrite, organic nitrogen, and total nitrogen concentrations at the Lyons wastewater treatment plant are summarized in **Table 6.** **Figure 11** shows the maximum nitrate and total nitrogen loads at Site 656 during 1992 – 2005. A maximum nitrate load level is defined by the 10 mg N /L criterion whereas the actual TN loads are based on the average TN level in 2000 – 2005. The Kansas Surface Water Nutrient Reduction Plan calls for a 30% reduction in TN across the state with minor WWTP facilities of improved treatment at operations. With improved operations, existing facility at Lyons would achieve effluent with TN concentrations below 8 mg/L. The average total nitrogen level in Lyons effluent after the upgrade is 17.11 mg N/L. Over the same period, nitrate levels average 13.82 mg N/L, which accounts for about 80% of the total nitrogen. The goal is to reduce nitrate in Little Cow Creek to 10 mg/L or less and total N to 8 mg/L to protect groundwater recharge use and enhance biological conditions. In the future if existing treatment operations do not sufficiently reduce TN and elevated TN levels at Site 522 impair aquatic life, expansion and installation of biological nutrient removal (BNR) technology at the Lyons wastewater treatment plant may be necessary. The expectation of using BNR is to achieve an annual average effluent value of 8 mg N/L for total nitrogen.

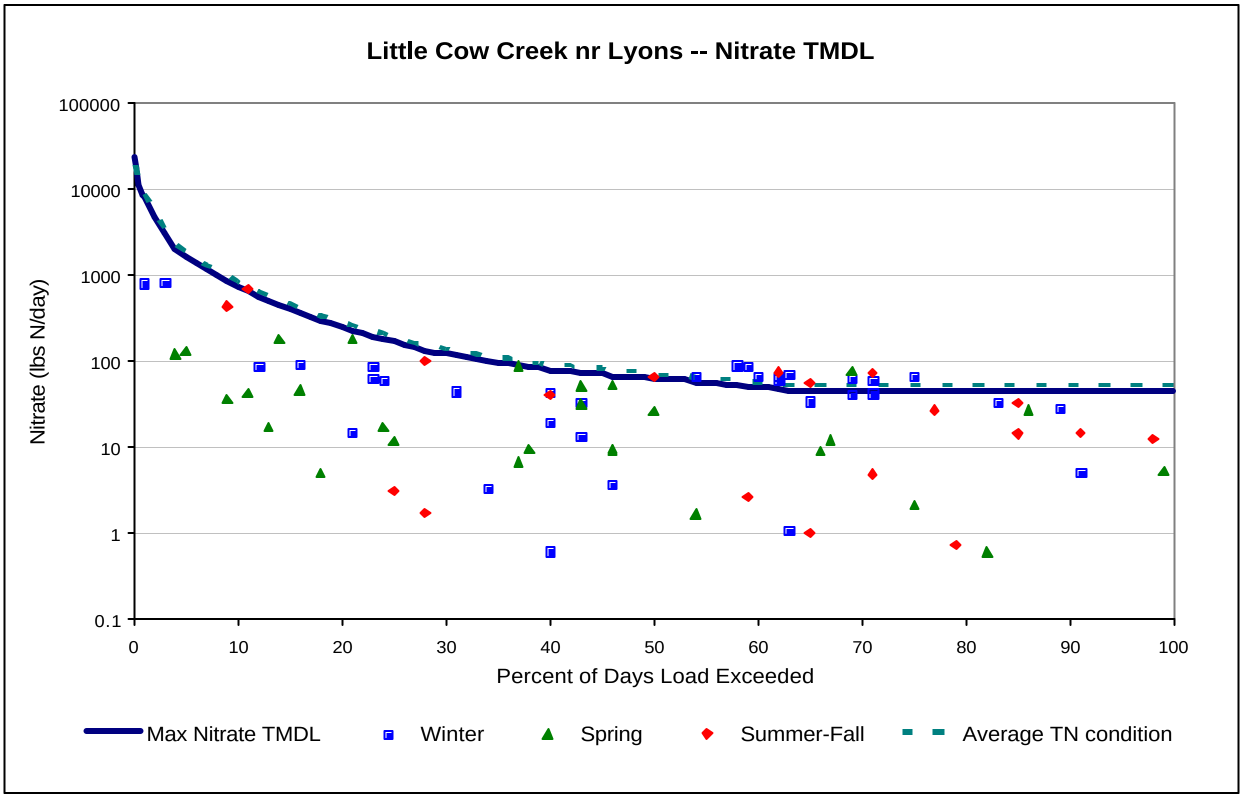

Figure 11. Seasonal total nitrogen and nitrate loading at Site 656 during 1992 – 2005.

Figure 12 displays the nitrate TMDL and its components, based on installation of biological nutrient removal (BNR) technology, as related to Little Cow Creek at Site 656. The BNR limit of the nitrate level that can be discharged to the stream is set to 6.46 mg N/L. In other words, 53% reduction in nitrate levels is required to reach the proposed set-point (8 mg/L as TN) from the current conditions in order to meet water quality goals to protect groundwater and enhance stream biological conditions. The wasteload allocation of 29.68 lbs N/day should be assigned to Lyons at the outfall of its Little Cow Creek plant. Because there is downstream hydrologic influence and assimilation of nitrogen that occurs along the lower reach of Little Cow Creek below the treatment plant, the expected nitrate level at Site 656, that receives the effluent nitrate concentration of 6.46 mg N/L at upstream 1.5 miles, is 4.32 mg N/L. Therefore, the allowable wasteload allocation to the monitoring station is set at 19.85 lbs N per day. These wasteload allocation calculations are strictly based on the design flow (0.85 cfs) of the Lyons wastewater treatment plant.

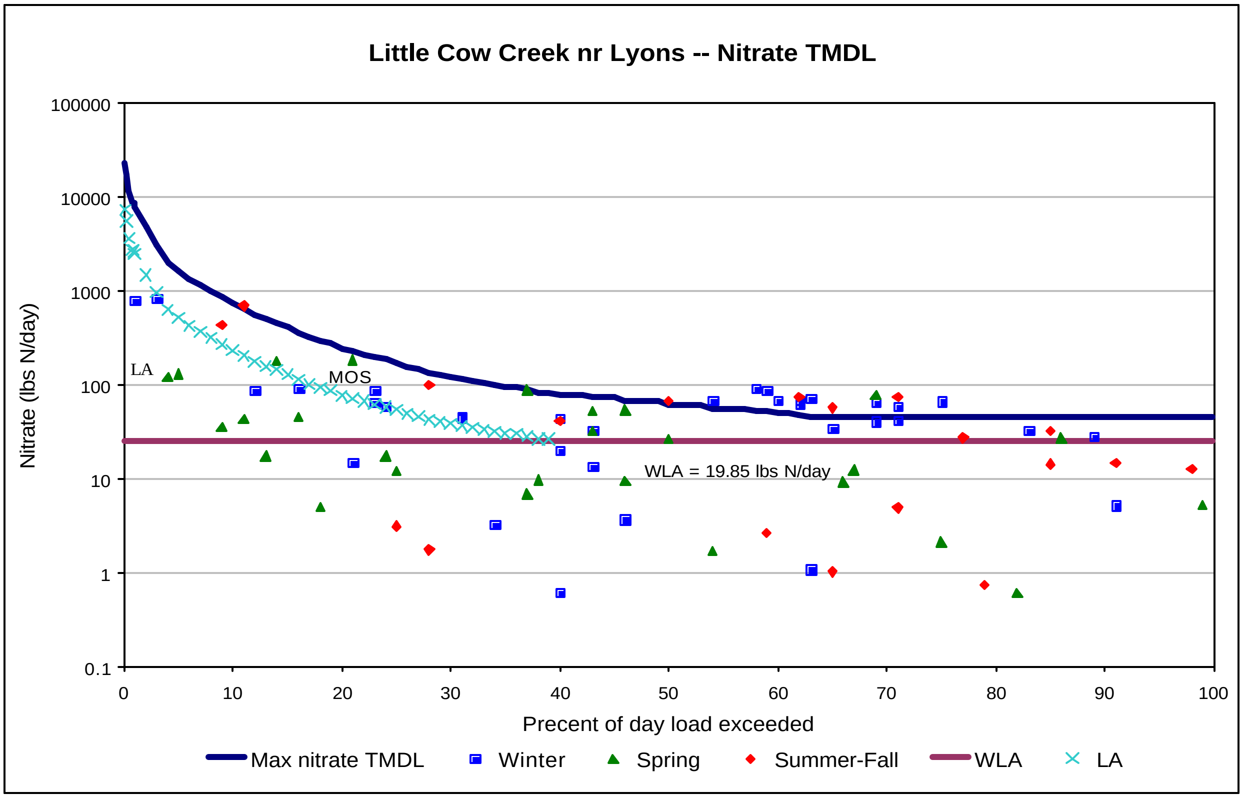

Figure12. Nitrate TMDL and its load allocation components as well as seasonal loading at Site 656 during 1992 – 2005 (MOS and LA represent margin of safety and load allocation, respectively).

Any non-discharging and CAFO/AFO facilities will have a wasteload allocation of zero because they will not discharge to Little Cow Creek (Appendix A). Should future wasteloads increase in the watershed and discharge into the impaired segment, the wasteload allocation will be revised by increasing the critical flow volume and if necessary, adjusting the current load allocation to tradeoff loads with these new point source dischargers. The limits set for TN in this TMDL may require the installation and operation of BNR processes at the City of Lyons.

Non-Point Sources: The water quality samples collected from the Little Cow Creek indicate that nitrate excursions primarily occurred under low flow conditions. Such conditions are not indicative of non-point pollution influences, although some seepage from faulty septic systems might enter Little Cow Creek. However, the volume of seepage would likely be small as compared to the typical effluent discharge from the Lyons wastewater treatment plant. Therefore, the load allocation assigned responsibility for maintaining nitrate loads at Site 656 below 3.15 mg N/L on average under runoff condition exceeded less than half of the time. **Figure 12** displays the load capacity and wasteload allocation for Little Cow Creek. Load allocations at the 25th and 10th percentile of flow are 54 lbs/day and 233 lbs/day, respectively.

Defined Margin of Safety: The Margin of Safety is explicit and is established by setting allocations for the primary source of total nitrogen to the creek at an annual average of 8 mg N/L and this includes reducing nitrate to approximately 5.4 mg N/L, 46% lower than the water quality criterion of 10 mg N/L. Since Little Cow Creek flows are predominantly effluent from Lyons, this MOS approach will ensure attainment of the water quality standards.

State Water Plan Implementation Priority: This watershed has some problems associated with nitrate and other nutrients and therefore has short- and long-term consequences for its designated uses. Because of significant influence from the Lyons wastewater treatment plant on downstream water quality, the possibility of meeting the TMDL endpoints by operational changes and installation of BNR at the plant to achieve nutrient reduction goals deferred to the future, this TMDL will be a Medium Priority for implementation.

United Watershed Assessment Priority Ranking: This watershed lies within the Lower Arkansas River Basin (HUC 8: 11030011) with a priority of 27 (Medium Priority for restoration work).

5. IMPLEMENTATION

Desired Implementation Activities

1. Provide WWTP operator training to reduce nutrient loads in its effluent discharging to Little Cow Creek.
2. Repair or replace or remove faulty septic systems in the vicinity of Little Cow Creek.
3. Improve riparian conditions along Little Cow Creek.
4. Abate any CAFO or agricultural non-point source and/or urban storm-water contribution of nutrients to Little Cow Creek.
5. Plan for future upgrade of the Lyons wastewater treatment facility to meet 2011 TMDL needs if WWTP operational training does not prove adequate to reduce TN.

Implementation Programs Guidance

NPDES – Bureau of Water, Technical Services Section – KDHE

a. Provide on-site operator training and education to City of Lyons' staff in BNR treatment processes to reduce nutrient loads in the effluent discharging to Little Cow Creek over 2007-2011.
b. Establish an average annual limitation of 8 mg/L for total nitrogen for the Lyons WWTP in 2012 once training is complete.
c. Issue renewed NPDES permit(s) for the Lyons WWTP in 2013 with a schedule of compliance requiring upgrades to meet TMDL needs if operator training and education does adequately reduce nitrate levels.

NPDES – Bureau of Water, Municipal Program Section – KDHE

a. Receive and review necessary engineering reports and design documents for treatment plant upgrades to achieve nutrient reduction.
b. Coordinate funding opportunities with City of Lyons' staff and elected officials.
c. Require construction upgrade of Lyons WWTP as necessary to achieve nutrient reduction goals.

Watershed Management Section (Bureau of Water) – KDHE

a. Support on-going implementation conducted under Watershed Restoration and Protection Strategy for Rice County.
b. Provide technical assistance on practices geared to small livestock operations which minimize impact to stream resources.
c. Provide technical assistance on nutrient management to minimize chemical fertilizer impact to stream resources and vegetative buffer development in the vicinity of the stream.

Livestock Waste Management Section (Bureau of Water) – KDHE

a. Ensure waste lagoons for animal feeding operations have adequate capacity to minimize spills.
b. Ensure disposal of livestock waste on land application is distant from Little Cow Creek.

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

a. Apply conservation farming practice, including terraces and waterways, sediment control basins, and constructed wetlands within the watershed.
b. Provide sediment control practices to minimize erosion and sediment and nutrient transport from cropland and grassland in the watershed.
c. Repair faulty septic systems located adjacent to Little Cow Creek and its main tributaries.

Riparian Protection Program - SCC

a. Establish or restore natural riparian systems, including vegetative filter strips and streambank vegetation along Little Cow Creek and its tributaries.
b. Develop riparian restoration projects along targeted stream segments, especially those areas with baseflow.
c. Promote wetland construction to assimilate nutrient loadings.
d. Coordinate riparian management within the watershed.

Buffer Initiative Program - SCC

a. Install vegetative buffer strips along Little Cow Creek and its tributaries.

Time frame for Implementation: The year 2008 marks the renewal period for the NPDES permit at the Lyons facility. At that point in time, a schedule of compliance will be issued to establish timelines necessary for operator training to meet the final total nitrogen limits by 2013. Plans to upgrade the plant will occur in 2013 if limits are not met.

Targeted Participants: Primary participants for implementation will be public works personnel from the City of Lyons and Environmental Program personnel for Rice County.

Milestone for 2011: The year 2011 marks the end point of operator training at Lyons. At that point in time, nitrate levels should be well below 10 mg/L.

Delivery Agents: KDHE staff in the Technical Services and Municipal Program Sections will provide WWTP operator training classes and develop the appropriate permits, schedules of compliance and review of plans. Review of technical information and studies will be made by KDHE staff of the Technical Service Section and the Bureau of Environmental Field Services.

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 to -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 State Conservation Commission 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 State Conservation Commission to provide financial assistance for local project work plans developed to control non-point 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*.

9. The *Kansas Water Plan* and the Lower Arkansas River 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 Revolving Loan Fund is operated through the Municipal Program at KDHE and provides low interest loans for wastewater treatment improvement. Since its inception, $750 million in loans have been made to municipal wastewater treatment facilities 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 faculty septic systems and riparian area improvement.

Effectiveness: Denitrification techniques with mechanical treatment plants have been very effective in reducing nitrate concentrations in wastewater effluent. Likewise, biological nutrient removal has also been proven to be effective in reducing nitrogen and phosphorus concentrations in effluent, for example at the Garden City WWTP facility.

6. MONITORING

KDHE will continue to collect bimonthly samples during 2006 – 2015 at Station 656 in order to assess the impairment driving this TMDL. Based on that sampling, the priority status of 303(d) listing will be evaluated in 2016. Should impaired status be seen over 2006 – 2011, the desired endpoints under this TMDL will be refined and more intensive sampling may need to be conducted under specified seasonal low flow conditions over the period 2012 – 2016 to assess progress in this TMDLs implementation.

7. FEEDBACK

Public Meetings: An active Internet site was established at http://www.kdheks.gov/tmdl/public.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 the TMDL of the Lower Arkansas Basin was held in Hutchinson, KS on September 13, 2006.

Basin Advisory Committee: The Lower Arkansas Advisory Committee met to discuss the TMDLs in the basin on March 8, June 7, and October 12, 2006.

Discussion with Interest Groups: The staff of Municipal Programs of Kansas Department of Health and Environment met to discuss the implications of this TMDL with the City Manager at the City of Lyons on May 8th, 2006.

Milestone Evaluation: The 2006 – 2010 bimonthly data will be evaluated in 2011 and consideration will be made as to the need for upgrading the Lyons – Little Cow Creek wastewater treatment plant with biological nutrient removal. Additionally, any implementation activities that have occurred within the watershed and developed areas of Lyons and the levels of nitrogen seen in lower Little Cow Creek will be assessed. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed. At present, Lyons' WWTP operations need to be improved and enhanced in order to achieve the desired endpoints.

Consideration for 303(d) Delisting: The stream will be evaluated for delisting under Section 303(d), based on the monitoring data in 2006 – 2015. Therefore, the decision for delisting will come about in the preparation of the 2016 303(d) list. Should modifications be made to the applicable water quality criteria during the intervening 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 (CPP), the next anticipated revision will come in 2007 which will emphasize revision of the Water Quality Management Plan. At that time, incorporation of this TMDL will be made into the CPP. Recommendations of this TMDL will be considered in *Kansas Water Plan* implementation decisions under the State Water Planning Process after Fiscal Years 2007 – 2015.

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Bibliography

Perry, C.A., D.M. Wolock and J.C Artman, 2004. Estimate of flow duration, mean flow, and peak-discharge frequency values for Kansas Stream locations. USGS Scientific Investigations Report 04–5033; 651 p.

Appendix A. Wasteload allocation for WWTP and CAFO facilities.

Facility	Permit #	Wasteload Allocation (lbs N/day)
WWTP		
Lyons	KS-0022730 (M-AR56-OO01)	29.68
CAFO		
Beef (total head:12,000)	A-ARRC-C004	0
Beef (400)	A-ARRC-B004	0
Dairy (60)	A-ARRC-M003	0