LOWER ARKANSAS RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody/Assessment Unit: Sand Creek
Water Quality Impairment: Nitrate

1. INTRODUCATION AND PROBLEM IDENTIFICATION

Subbasin: Little Arkansas

Counties: Harvey and Marion

HUC 8: 11030012

Ecoregion: Central Great Plains, Wellington-McPherson Lowland (27d), and Flint Hills (28)

Drainage Area: Approximately 95.2 square miles

Main Stem Segments: WQLS: **4** (Sand Cr) starting at the confluence with Little Arkansas River in southern Harvey County and traveling upstream to headwaters in south-western Marion County (**Figure 1**).

Tributary Segments: Mud Cr (16)
Beaver Cr (26)

Designated Uses: Expected Aquatic Life Support, Primary Contact Recreation "B" and Food Procurement Use for Main Stem Segment. Tributary segments designed uses are Expected Aquatic Life Support and Secondary Contact Recreation "b" for Mud and Beaver Creeks.

2002, 2004, 303(d) Listing: Lower Arkansas River Basin streams -- Sand Creek (Segment 4)

Impaired Use: Expected Aquatic Life Support

Water Quality Standard: Nitrate (as N): 10 mg/L (KAR 28-16-28e(c)(2)(A)): Domestic Water supply criteria are provided in table 1g 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)).

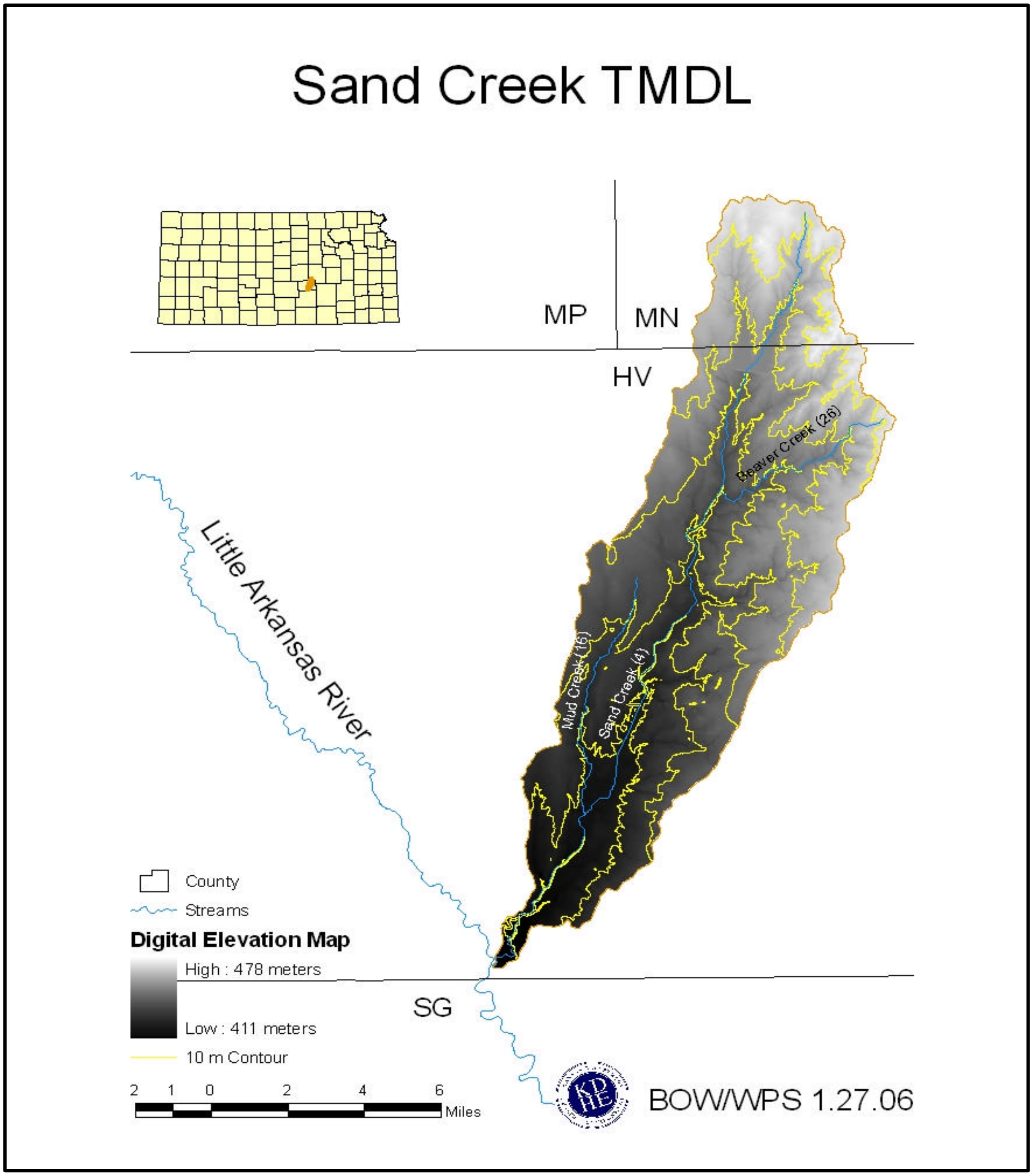

Figure 1. A DEM map of Sand Creek watershed.

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

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

Monitoring Site: Ambient Stream Water Quality Monitoring Station (Site 535) near Newton.

Period of Record Used: 1990 – 2006 for Station/Site 535 (4-yr rotational monitoring site).

Flow Record: Little Arkansas River near the city of Newton (USGS Station 07143665; 1973 – 2006) and USGS Water Resources Investigation Report 01-4142 (Estimated Flow – Duration Curves for Selected Ungaged Sites in Kansas) were used to estimate flow in the Sand Creek watershed.

Long Term Flow Conditions: Median Flow = 7.8 cfs; 10% Exceedance Flow = 61.4 cfs, 95% Exceedance Flow = 3.5 cfs

Current Conditions: **Figure 2** and **Table 1** show monthly and seasonal average nitrate concentration for KDHE ambient stream monitoring station Site 535, respectively. In general, seasonal average nitrate values were higher in summer/fall (9.61 mg N/L) than in spring (4.43 mg N/L) and winter (6.82 mg N/L). The seasonal maximum concentrations were 13.09 mg N/L in spring, 14.29 mg N/L in summer-fall and 12.51 mg N/L in winter.

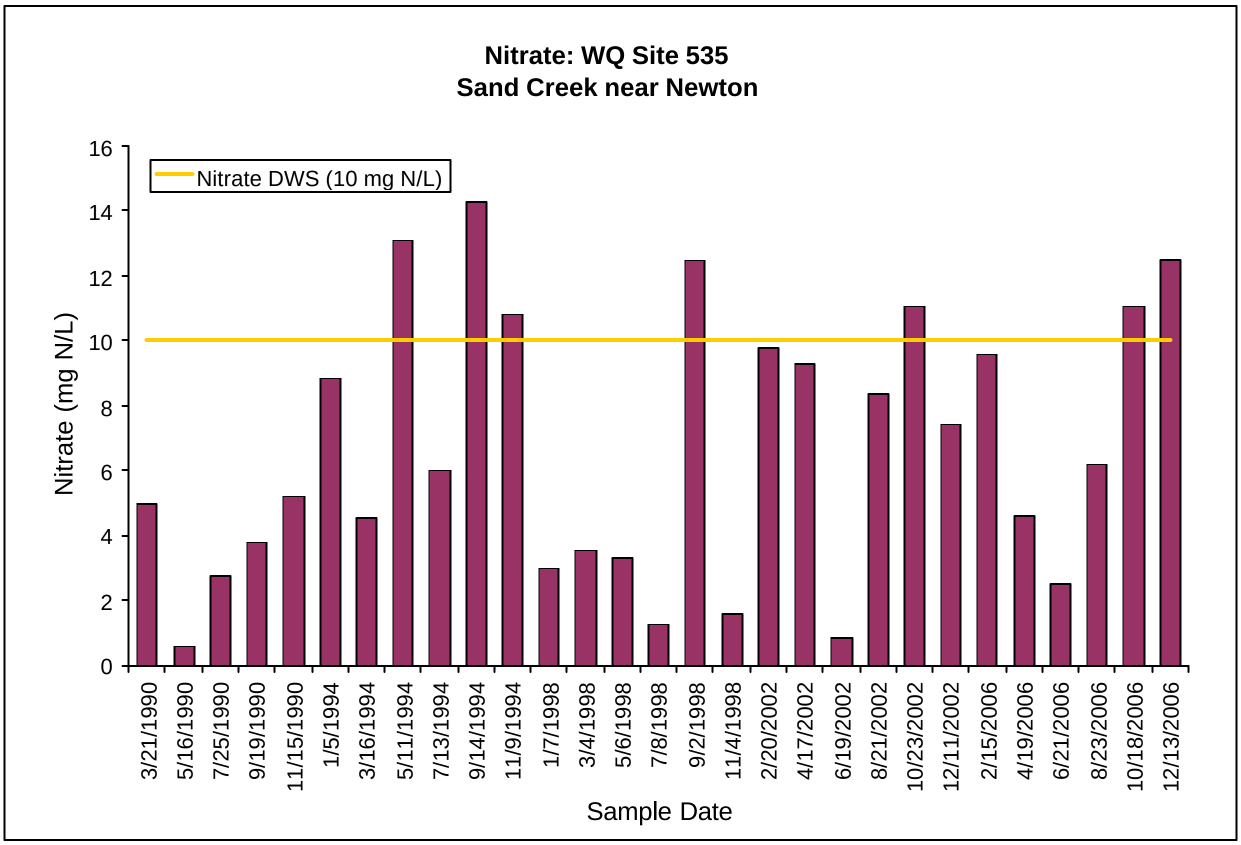

Figure 2. Nitrate concentrations at Site 535 during 1990 – 2006.

Table 1. Seasonal nitrate values at Site 535 during 1990 – 2006.

Parameter / Season	Average (Median) (mg N/L)	Standard Error (mg N/L)	Minimum (mg N/L)	Maximum (mg N/L)
Spring	4.43 (3.05)	1.28	0.58	13.09
Summer-Fall	9.61 (11.06)	1.39	3.79	14.29
Winter	6.82 (6.30)	1.00	1.59	12.51

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% exceeded flow range. A load curve was established for the nitrate domestic drinking water standard (DWS) 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 nitrogen 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 (**Figure 3**).

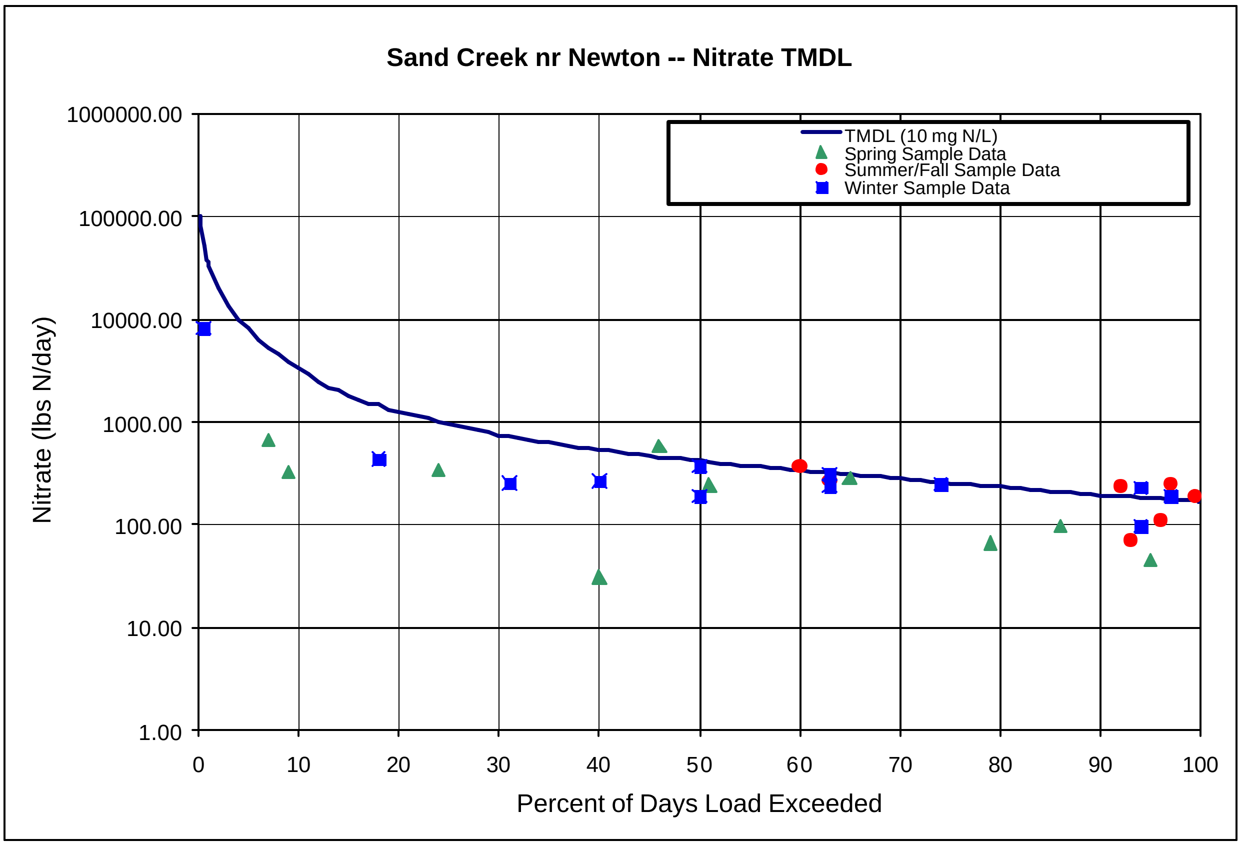

Figure 3. Seasonal nitrate loading at Site 535 during 1990 – 2006.

There were a total of seven nitrate excursions (or violations) recorded during the period from 1990 – 2006. The percentage of nitrate exceedance over the criteria in the summer/fall months was about 57%, whereas relatively low nitrate exceedances occurred in the spring (10%) and winter (17%) months, respectively (**Table 2**). Over the period of ambient water quality record, most of the nitrate exceedance incidences were noted during the flow conditions ranging between 90-100% flow exceedance.

Table 2. Number of samples above the nitrate criteria (10 mg N/L) by flow exceedance.

Flow / Season	Number of samples above the Aquatic Life Criterion						
	0 to 10%	10 to 25%	25 to 50%	50 to 75%	75 to 90%	90 to 100%	Cum. Freq
Spring	0	0	1	0	0	0	1/10 = 10%
Summer/Fall	0	0	0	1	0	3	4/7 = 57%
Winter	0	0	0	0	0	2	2/12 = 17%

A watershed comparison approach was taken in developing this TMDL. The Emma Creek watershed (monitoring site 534) has similar land use characteristics to the Sand Creek watershed, is of similar size and is located west of the Sand Creek watershed in the Little Arkansas River Basin. The relationship of nitrate to ammonia, total phosphorus (TP), total suspended solids (TSS), dissolved oxygen (DO), biochemical oxygen demand (BOD) and water temperature were used in the comparison. **Table 3** summarizes those water quality data for the samples taken on the same day for the two sites of interest. As indicated in **Table 3**, high nitrate values were typically associated with high TP readings at Site 535 and often appeared during the low flow conditions, suggesting that nitrate excursions or violations were point sources related.

Table 3. Comparison summary of percent of flow exceedance and selected water quality parameters for Sites 535 and 534 during the period from 1990 to 2006. ND indicates the parameter levels not detected by their associated laboratory instruments. The overall average values were calculated using the half of the instrument detection levels for ND values.

Date	% flow	Nitrate		Ammonia		Total P		TSS		BOD		DO		Temperature	
	Exceed	535	534	535	534	535	534	535	534	535	534	535	534	535	534
3/21/1990	40.0	4.99	1.04	0.87	0.44	2.40	1.85	27	72	10.3	4.1	4.9	8.6	10	9
5/16/1990	40.0	0.58	2.50	0.06	0.49	2.07	2.01	100	240	6.3	13.6	5.6	3.4	18	20
7/25/1990	79.0	2.77	0.06	0.67	0.02	2.95	0.91	64	34	9.1	2.9	2.3	5.2	22	20
9/19/1990	93.0	3.79	0.01	0.94	0.08	1.74	0.87	92	48	9.8	4.4	3.4	6.3	18	16
11/15/1990	94.0	5.19	0.00	0.34	0.03	4.54	0.75	19	16	4.3	2.0	3.4	6.4	9	10
1/5/1994	50.0	8.84	1.58	0.05	ND	1.64	0.21	2	2	2.4	1.9	12.5	12.5	0	0
3/16/1994	50.0	4.57	0.30	0.12	0.08	1.94	0.58	29	13	5.7	5.0	7.3	7.9	7	7
5/11/1994	**46.0**	**13.09**	**0.56**	**0.07**	**0.55**	**2.05**	**0.90**	**72**	**72**	**9.2**	**7.3**	**5.1**	**5.8**	**16**	**16**
7/13/1994	51.0	6.00	0.62	0.04	0.08	1.67	0.78	96	168	4.5	5.6	4.9	6.4	22	21
9/14/1994	**97.0**	**14.29**	**0.07**	**ND**	**0.18**	**3.40**	**0.93**	**40**	**76**	**3.1**	**4.2**	**5.5**	**4.3**	**22**	**19**
11/9/1994	**97.0**	**10.82**	**0.04**	**ND**	**0.11**	**2.97**	**0.72**	**29**	**32**	**2.4**	**5.5**	**6.7**	**7.1**	**9**	**6**
1/7/1998	18.0	2.99	3.20	0.13	0.09	0.56	0.47	28	35	4.1	2.9	11.5	11.9	2	2
3/4/1998	31.0	3.54	1.49	ND	0.05	0.90	0.40	20	4	5.5	2.2	11.1	12.4	4	3
5/6/1998	24.0	3.32	2.33	0.18	0.04	0.87	0.53	76	60	5.2	3.7	7.5	8.0	18	17
7/8/1998	7.0	1.27	1.02	ND	0.09	0.74	0.94	155	430	4.2	4.4	5.5	6.1	28	26
9/2/1998	**92.0**	**12.48**	**0.21**	**0.05**	**0.03**	**3.20**	**0.63**	**56**	**96**	**2.6**	**3.0**	**4.7**	**6.2**	**24**	**24**
11/4/1998	0.5	1.59	1.85	ND	0.02	0.58	0.51	152	82	ND	ND	9.6	9.7	10	10
2/20/2002	63.0	9.79	0.91	0.08	0.02	2.07	0.28	14	9	4.0	1.9	9.3	11.5	9	9
4/17/2002	65.0	9.30	0.49	ND	0.63	2.00	1.12	38	41	5.5	4.3	6.1	7.6	20	21
6/19/2002	9.0	0.85	0.66	ND	0.10	0.79	0.66	93	67	5.0	4.7	7.2	7.1	22	22
8/21/2002	63.0	8.37	0.13	ND	0.12	3.96	0.88	51	35	5.9	4.9	5.3	6.6	25	25
10/23/2002	**60.0**	**11.07**	**1.28**	**ND**	**ND**	**2.72**	**0.44**	**21**	**60**	**4.2**	**2.9**	**8.9**	**9.9**	**10**	**9**
12/11/2002	63.0	7.41	0.58	ND	ND	1.70	0.43	10	5	3.3	1.6	10.7	11.9	5	5
2/15/2006	74.0	9.57	0.52	ND	ND	2.46	0.44	11	10	2.6	1.4	12.2	12.3	5	5
4/19/2006	86.0	4.61	ND	ND	ND	2.40	1.10	20	5	5.6	4.1	5.8	7.9	15	14
6/21/2006	95.0	2.52	ND	0.11	ND	1.50	1.34	43	15	5.8	4.4	5.5	7.5	24	24
8/23/2006	96.0	6.20	-	ND	-	2.36	-	47	-	5.7	-	5.6	-	25	-
10/18/2006	**99.5**	**11.06**	**-**	**ND**	**-**	**3.50**	**-**	**41**	**-**	**4.8**	**-**	**7.5**	**-**	**13**	**-**
12/13/2006	**94.0**	**12.51**	**-**	**ND**	**-**	**3.18**	**-**	**12**	**-**	**2.8**	**-**	**11.9**	**-**	**5**	**-**
Exceed. Ave		*12.19*	*0.43*	*0.04*	*0.18*	*3.00*	*0.72*	*39*	*67*	*4.2*	*4.6*	*7.2*	*6.7*	*14*	*15*
Overall Ave		*6.67*	*0.82*	*0.15*	*0.13*	*2.17*	*0.80*	*50*	*66*	*5.0*	*4.0*	*7.2*	*8.1*	*14*	*14*

Desired Endpoint of Water Quality at Sand Creek:

The short-term endpoint for this TMDL will be to achieve Kansas Water Quality Standard of 10 mg/L to fully support the attainable Domestic Water Supply use on Sand Creek. The long-term endpoint will be to reduce the total nitrogen by 55%, in accordance with the Kansas Surface Water Nutrient Reduction Plan through installation of Biological Nutrient Removal technology. The long-tem endpoint will result in a downstream nitrate concentration below the criterion. Seasonal variation is accounted for by this TMDL, since the TMDL endpoint is sensitive to stream flow with the higher flow usually occurring in the spring and lower flows in the summer/fall and winter seasons. To reach this endpoint, this TMDL will concern itself with reducing nitrogen loads from wastewater sources in the watershed for the critical flow of concern.

3. SOURCE INVENTORY AND ASSESSMENT

NPDES: Though there are eleven NPDES permitted facilities within the watershed (**Figure 4**), only two municipal wastewater treatment plants (Newton and Walton) discharge to Sand Creek and contribute significant nitrate loads that could affect downstream water quality at Site 535 (**Table 4**). The Newton – Sand Creek facility, upgraded in 1993, relies on a trickling filter followed by an activated sludge process treatment system to treat its wastewater with a nitrification process and is considered the primary nitrate source to Sand Creek. The design flow of this treatment plant is 3 MGD (4.67 cfs). All facilities are listed in **Appendix A**.

Table 4. Characteristics of municipal permitted wastewater treatment plants located upstream from Site 535 in the Sand Creek Watershed.

WWTP	Permit #	Stream Reach	Segment	Design Flow	Type	Permit Expired
Newton	M-LA13-IO01	Sand Creek	4	3.00 mgd	Trickling Filter	12–31–2007
Walton	M-LA17-OO01	Sand Creek	4	0.0379 mgd	3-Cell Lagoon	7–31–2007

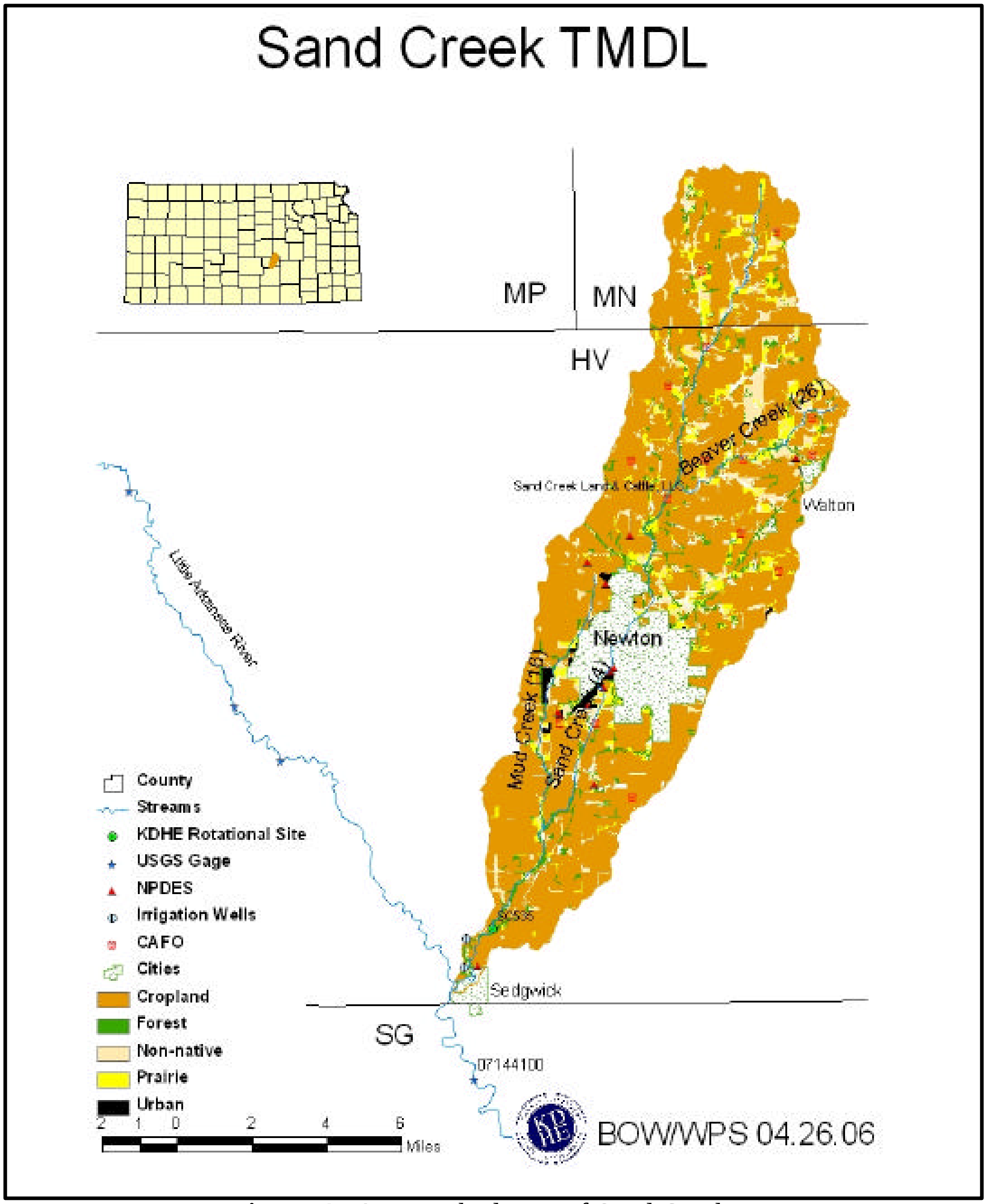

Figure 4. A watershed map of Sand Creek.

The selected seasonal effluent water quality values are shown in **Table 5**. Nitrate concentrations in the outflow are typically over the nitrate criterion as a result of nitrification process at the Newton plant. As can be seen in **Figure 5**, nitrate excursions at Site 535 tended to appear during low flow conditions (> 50% flow exceedance) after the plant upgrade and generally showed a seasonal pattern (**Figure 6**). Typically, high nitrate values were noted in the summer/fall and winter months when stream flows were lower. This is the tradeoff in removing toxic ammonia from the effluent via nitrification.

Table 5. Seasonal summary of selected effluent water quality parameters measured at Newton – Sand Creek wastewater treatment facility during the period from 2000 to 2006.

Newton WWTP facility	Average (Median)	Maximum	Minimum
Spring (Apr-Jul)			
TN (mg/L)	17.91 (18.05)	26.54	9.21
Ammonia (mg N/L)	0.13 (0.02)	1.75	0.01
Nitrate (mg N/L)	15.85 (15.70)	24.40	7.40
TP (mg/L)	3.12 (3.35)	4.75	0.50
Summer/Fall (Aug-Oct)			
TN (mg/L)	19.20 (19.48)	28.89	10.78
Ammonia (mg N/L)	0.30 (0.03)	4.10	0.01
Nitrate (mg N/L)	16.48 (16.60)	26.40	5.05
TP (mg/L)	3.61 (3.87)	4.45	2.13
Winter (Nov-Mar)			
TN (mg/L)	18.34 (18.26)	26.85	10.02
Ammonia (mg N/L)	0.75 (0.08)	14.35	0.01
Nitrate (mg N/L)	15.81 (15.95)	23.80	8.40
TP (mg/L)	3.99 (4.03)	6.07	1.92

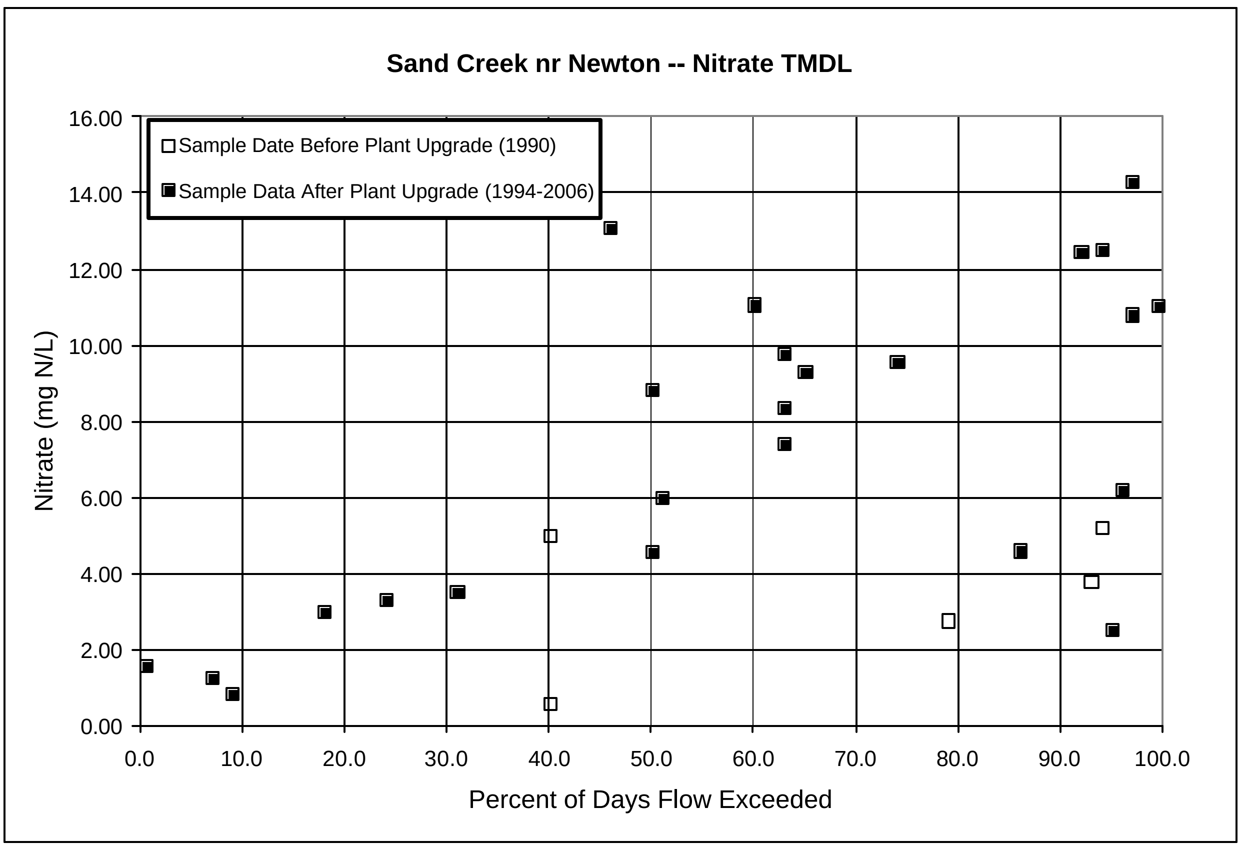

Figure 5. Nitrate distribution before and after plant upgrade as percent of days flow exceedance at Site 535.

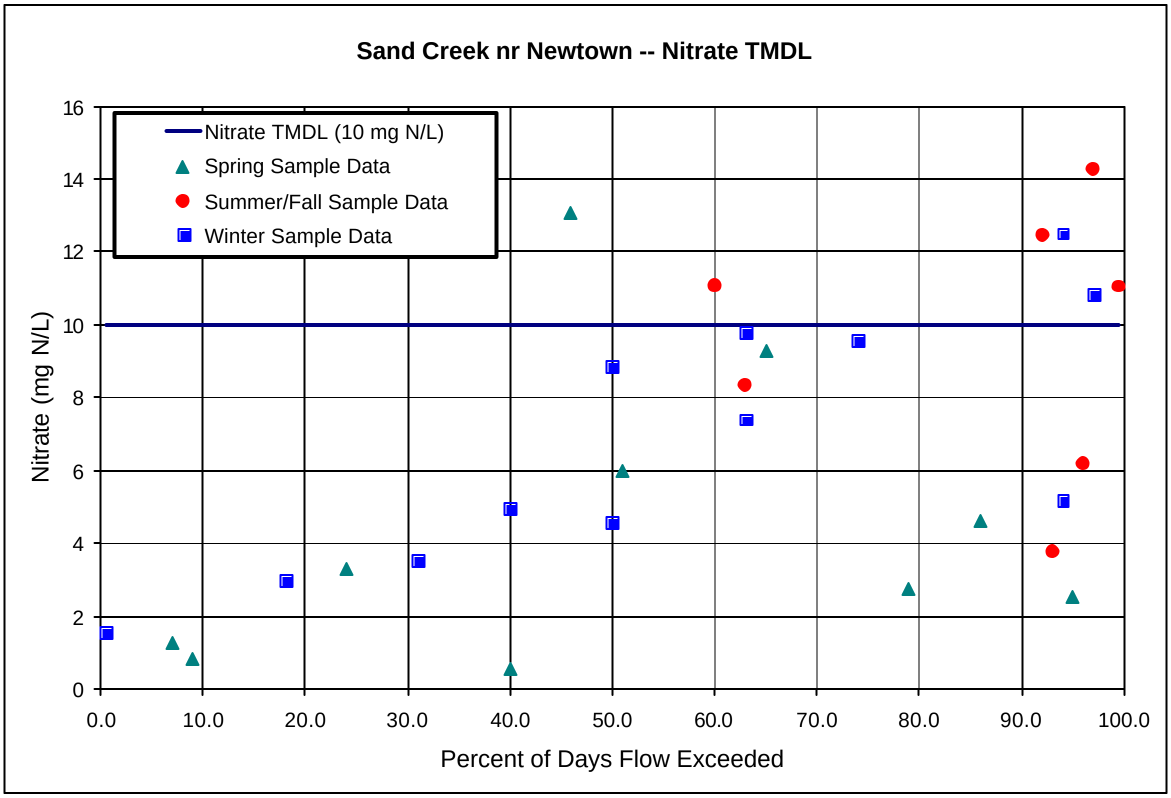

Figure 6. Seasonal nitrate distribution in relation to percent of flow exceedance at Site 535.

Figure 7 illustrates the relationship between nitrate in the Newton's effluent and the resulting downstream ambient nitrate concentrations, and flow conditions in 2002 and 2006. Typically, flow conditions greatly regulated nitrate assimilation reduction along the 12.5-mile stream course between Newton WWTP and Site 535. As the percent of days flow exceedance decreased, the nitrate ratios (Site 535:Newton's effluent) increased, with the exception of two excursion events in 2006.

Because the average percent of days flow exceedance was about 61% during 1990 – 2006, nitrate ratios between 60-80% of day flow exceedance were selected to derive a representative of instream nitrate assimilation and/or uptake trend (**Figure 8**). A significant nitrate reduction was found with the 12.5-mile stream course. Average stream nitrate/effluent nitrate ratio was 0.49, ranging from 0.41 to 0.53 as the percent of days flow exceedance occurred between 63% and 74%.

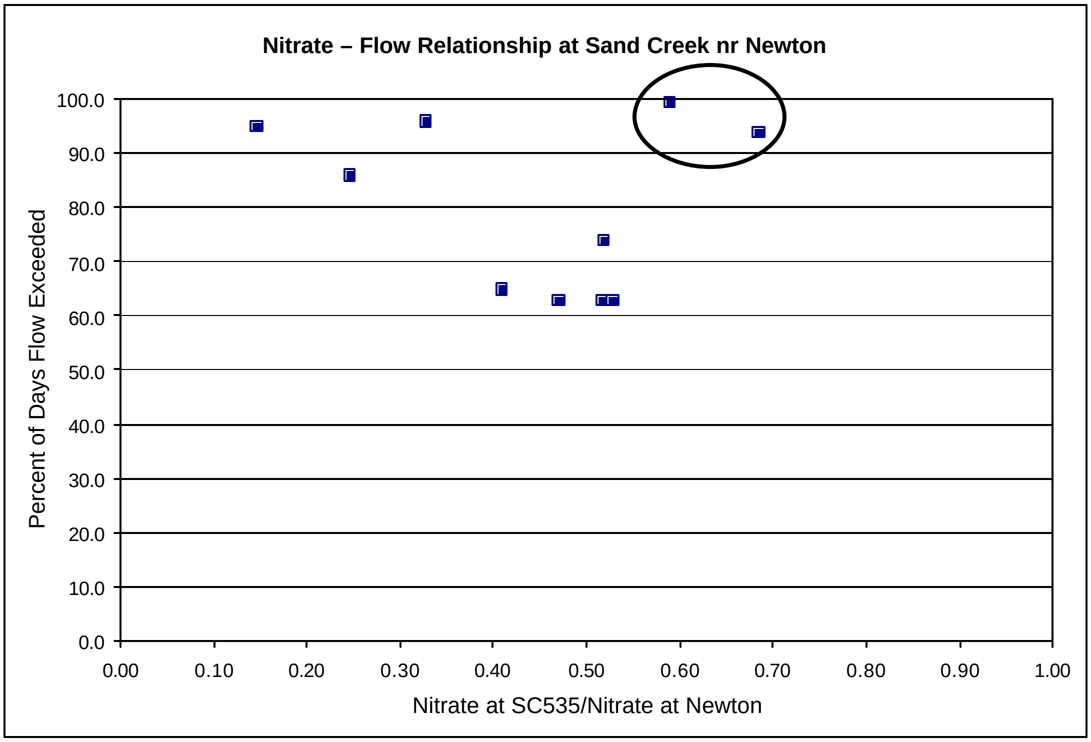

Figure 7. The relationship between nitrate in the Newton's effluent and the resulting downstream ambient nitrate concentrations, and flow conditions in 2002 and 2006. Two events circled were nitrate excursions in 2006.

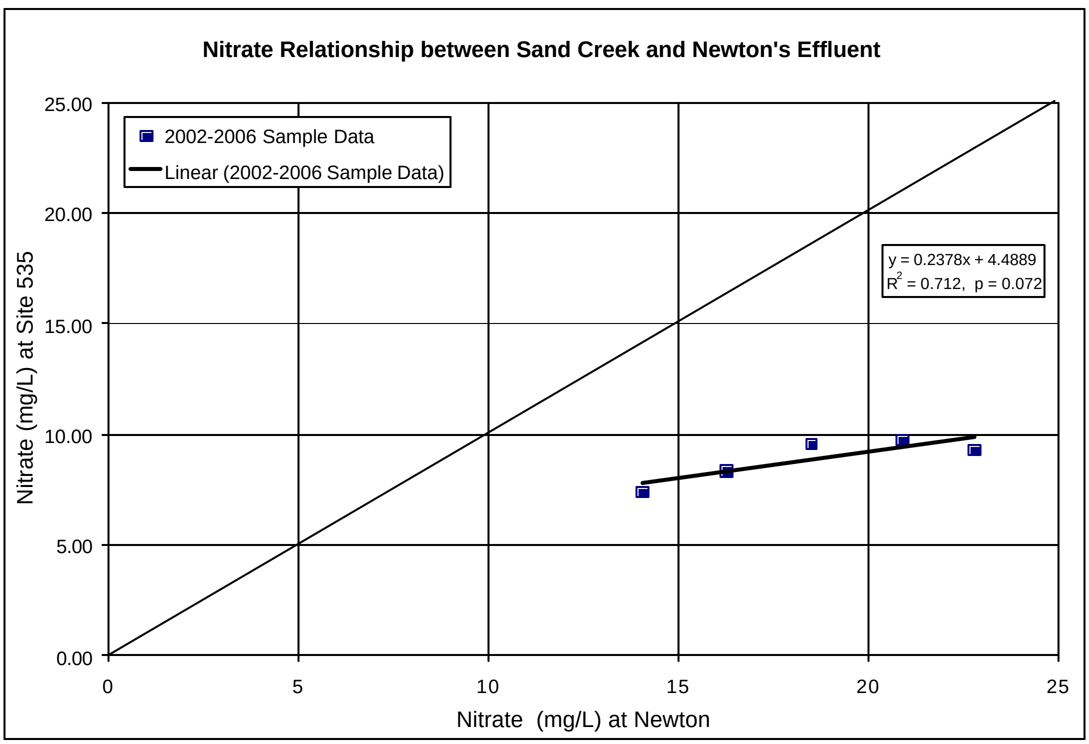

Figure 8. Nitrate relationship between Sand Creek and Newton's effluent in 2002 – 2006.

Land Use: The predominant land use is cultivated cropland, which accounts for 70% of the total land area in the watershed. Urban area, such as residential, commercial and industrial uses, comprises 7% of the watershed. Approximately 3% of the land is occupied by Ash-Elm Hackberry floodplain forest, whereas 6% is tall grass prairie. The area under the Conservation Reserve Program (CRP) only accounts for about 4% (2,207 acres) of the entire watershed. There are about 3,612 acres of riparian area (30-meter buffer along the stream system) in the watershed and the cropland occupies 41% of the total riparian buffer area. Ash-Elm Hackberry floodplain forest, mix prairie and non-native grassland account for about 9%, 2% and 8%, respectively. Urban areas occupy another 5% of the riparian area and approximately 6% of the stream buffer area is CRP (205 acres). The riparian-related land use information was derived from KDHE rivershed data.

Livestock Waste Management Systems: Fifteen confined animal feedlot operations are registered, certified or permitted within the watershed. Four of these facilities (2 beefs, 1 swine and 1 dairy) are located within the 30-meter buffer area along the streams (**Table 6**), and of which two facilities are located at the main stems (**Figure 4**). One facility (Permit No. A-LAHV-C004) is of sufficient size to warrant NPDES permitting. The permitted livestock facilities have waste management systems designed to minimize runoff entering their operation or detain 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 exceeds 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 nitrate (and/or ammonia) excursions in the Sand Creek watershed. Requirements of maintaining the water level of a waste lagoon at a sufficient depth (e.g., 6 ft) below the lagoon berm ensures retention of the runoff from such intense, local storm events. Though the total potential animals are 5,980 heads in the watershed, of which 3,580 heads are within the 30-meter riparian buffer area. However, the actual number of animals is typically less than the potential number.

Table 6. Characteristics of four animal feedlot operations in Sand Creek Watershed.

Permit #	Stream Segment	Type	Head
A-LAHV-C004†	Sand Creek	Beef	2,000
A-LAHV-SA06†	Sand Creek	Swine	200
A-LAHV-BA17	Unnamed tributary to Sand Cr.	Dairy	980
A-NEMN-BA32*	Unnamed tributary to Sand Cr.	Beef	400

*(Note: † indicates the animal feedlot operations are located within the 30-meter riparian buffer from the stream main stems. * Although identified as a Neosho Basin facility, any discharge from the facility would flow to Sand Creek.)*

On-Site Waste Systems: According to the 2000 census data from the U.S Census Bureau, the population of the entire watershed was 21,413 people, of which 17,190 people live within the city limits of Newton. As a results, the watershed population density is relatively high (206 people/sq. mile) when compared to the density of Harvey County (61 people/sq. mile). County-wise estimation indicated that there was an approximately 15% increase in population since 1990 (**Table 7**). Based on the 1990 census data, about 15% of household in Harvey County are on septic systems. Though many houses are currently connected to a public sewer system, failing on-site systems might contribute significant nitrogen (nitrate and ammonia) loadings via groundwater, given the low flows associated with the excursions in the watershed.

Table 7. Summary of urban and rural community comparisons between 1990 and 2000 for Harvey County (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†)	19,712	22,599
Rural	Farm	1,739	1,461
	Non-farm	9,577	8,089

Contributing Runoff: The Little Arkansas River Basin's average soil permeability is 2.8 inches/hour according to NRCS STATSGO data base. About 82% of the watershed produces runoff even under relative low (1.5"/hr) potential runoff conditions. Under very low (< 1"/hr) potential conditions, this potential contributing area is greatly reduced (74%). Runoff is chiefly generated as infiltration excess with rainfall intensities greater than 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 4% 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

Eighty percent of the nitrate excursions occurred during low flow conditions and 60% of which were within the 90-100% flow exceedance range (**Table 2**). Therefore, reduction in nitrate loadings within the watershed will focus under the critical flow condition defined by the design flow for the Newton wastewater treatment plant. Nitrate reduction applied to the treatment plant will directly benefit to lowering nitrate levels in Sand Creek.

Figure 9 shows the nitrate TMDL and its components as they relate to Site 535. A maximum nitrate load level is defined by the 10 mg N /L criterion but actual conditions should remain well below those levels through implementation of nutrient reduction at the Newton plant

Point Sources: Based on the assessment of pollutant sources, the distribution of nitrate excursions from the water quality standard at Site 535 by flow and season and relationship of those effluent levels to in-stream flow conditions, the Newton plant is seen as the primary contributing factor to the nitrate excursions in the watershed.

The Kansas Surface Water Nutrient Reduction Plan calls for nutrient reduction in total nitrogen for major dischargers (> 1 MGD) through installation of Biological Nutrient Removal (BNR) technology at the treatment plants. The expectation of using BNR is to achieve an annual average effluent value of 8 mg N/L of total nitrogen. The average nitrate level in Newton effluent over 2000 – 2006 was 15.99 mg N/L and total Kjeldahl nitrogen levels averaged 2.38

mg/L (average nitrite level was 0.05 mg N/L). On average, total nitrogen levels from the Newton plant were 18.42 mg/L. The BNR nutrient reduction to 8 mg/L of total nitrogen equates to a 57% reduction, which at worst would comprise 6.94 mg N/L of nitrate (and 0.02 mg N/L of nitrite). The design flow of the two point sources (4.70 cfs) redefines the lowest flow seen at Site 535 (75% exceedance). Therefore, the wasteload allocation of 174.0 lbs N/day should be assigned to Newton at the outfall of its Sand Creek plant. Because there are hydrologic influence and downstream assimilation of nitrogen that occur along the lower reach of Sand Creek below the treatment plant, the expected nitrate level at Site 535, after receiving the effluent nitrate concentration of 6.94 mg N/L upstream 12.5 miles, is estimated to be reduced 49% to 3.38 mg N/L. Therefore, the allowable wasteload allocation at the monitoring station is reduced to 84.7 lbs N per day. These wasteload allocation calculations are strictly based on the design flow (4.64 cfs) of the Newton wastewater treatment plant. A wasteload allocation of 2.2 lbs N/day for Walton WWTP is calculated based on its designed flow (0.0379 MGD) and average TN concentration (7 mg/L) for lagoon systems in Kansas and assuming all TN is nitrate (**Appendix A,** written communication with Mike Take, BOW, KDHE). This wasteload, upstream of Newton, is assumed to be assimilated before reaching Site 535.

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 current load allocations to tradeoff loads with these new point source dischargers. All existing non-discharging facilities and CAFO/AFO facilities will have a Wasteload Allocation of zero since they should not discharge to Sand Creek (**Appendix A**).

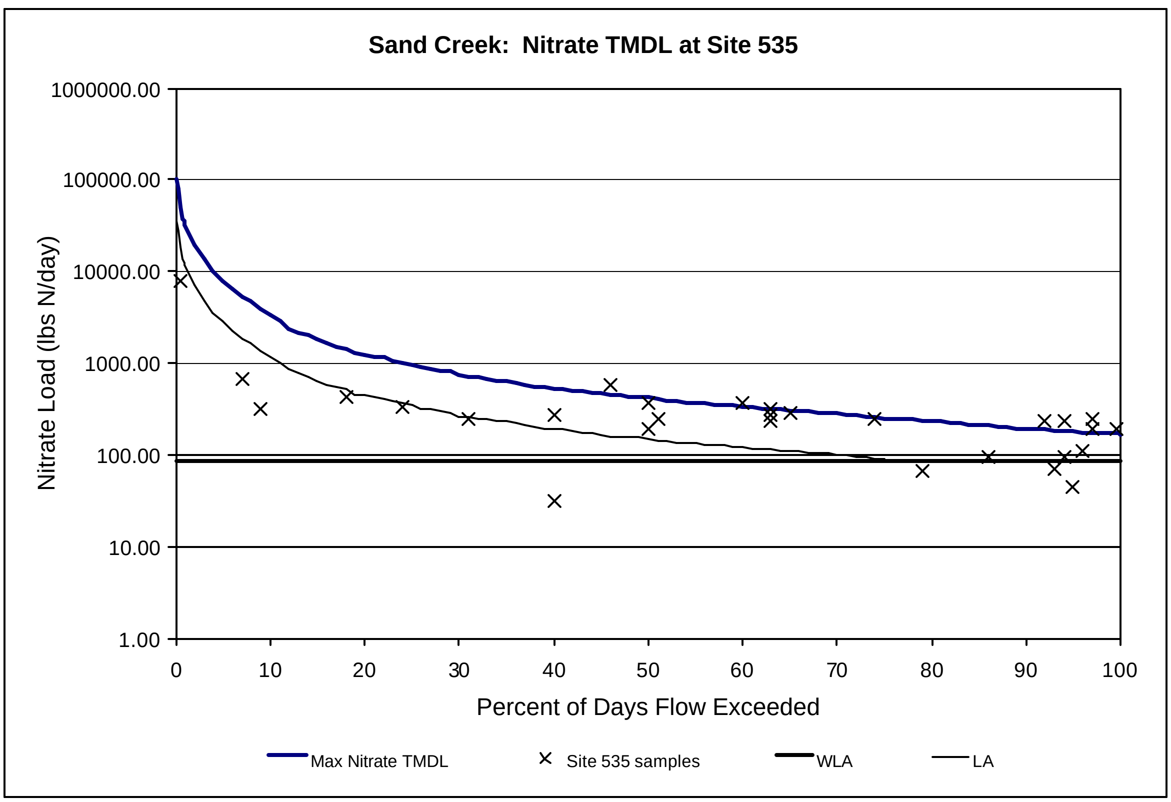

Figure 9. Nitrate TMDL and its load allocation components at Site 535 during 1990 – 2006 (WLA and LA represent wasteload and load allocation, respectively).

Non-Point Sources: Though the water quality samples collected from the Sand Creek indicate that nitrate excursions primarily occurred under low flow conditions and directly related to the effluent discharged from Newton wastewater treatment plant, there are several nitrate excursion incidents associated with non-point source pollution. Although some seepage from faulty septic systems might enter Sand Creek, the volume of seepage would likely be small as compared to the typical runoff events. Therefore, the load allocation assigned responsibility for maintaining nitrate loads at Site 535 based on average concentration of 3.58 mg N/L on average during runoff conditions exceeded less than half of the time. The Load Allocation at 50%, 25%, and 10% exceedance flow is 150.7, 341.7 and 1186.1 lbs N/day, respectively (**Figure 9**).

Defined Margin of Safety: The Margin of Safety is explicit and is established by setting allocations for the primary source of nitrate to the creek at an annual average of 6.94 mg N/L, 30% lower than the water quality criterion of 10 mg N/L. The expected long-term average total nitrogen concentrations discharged by the Newton – Sand Creek plant is 8 mg/L. The ambient nitrate levels seen at Site 535 would average 3.38 mg N/L, about 67% less than the criterion.

State Water Plan Implementation Priority: This watershed has some problems associated with nitrate and dissolved oxygen, and therefore has short- and long-term consequences for its designated uses. Because of significant influence from the Newton wastewater treatment plant on downstream water quality and possible installation of BNR at the plant to achieve nutrient reduction goals, this TMDL will be a High Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Little Arkansas Basin (HUC 8: 11030012) with a priority ranking of 14 (High Priority for restoration work).

5. IMPLEMENTATION

Desired Implementation Activities

1. Upgrade operations at the Newton wastewater treatment facility to reduce nutrient loads in its effluent discharging to Sand Creek.
2. Repair or replace or remove faulty septic systems in the vicinity of Sand Creek.
3. Improve riparian conditions along Sand Creek.
4. Abate any agricultural non-point source or urban storm-water contribution of nutrients to Sand Creek.

Implementation Programs Guidance

NPDES - Municipal Program – KDHE

a. Issue renewed NPDES permit for Newton with schedule of compliance directing any operational training on treatment plant upgrades, including biological nutrient removal, that are necessary to reduce long-term, average nitrogen loading in order to meet water quality standards.
b. Evaluate influence of nutrient levels in Newton wastewater on downstream nutrient levels monitored at Station 535.
c. Once, treatment upgrades are in place and operating, establish an average annual limit of 8 mg/L for total nitrogen for the Newton – Sand Creek plant.

d. Review and approve necessary plans and specifications for treatment plant upgrades in order to achieve nutrient reduction.

Watershed Management Program – KDHE

a. Support on-going implementation conducted under Watershed Restoration and Protection Strategy for Harvey County within the Little Arkansas River Basin.
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.

Technical Services Program – KDHE

a. Provide opportunities for training Newton wastewater personnel on operations that will reduce the total nitrogen in the effluent.

Livestock Waste Management Program – KDHE

a. Ensure that confined animal feeding operations do not discharge waste or wastewater to Sand 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 wetland 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 Sand Creek and its main tributaries.

Riparian Protection Program – SCC

a. Establish or restore natural riparian systems, including vegetative filter strips and streambank vegetation along Sand 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 Sand Creek and its tributaries.

Time frame for Implementation: The year 2008 marks the renewal period for the NPDES permit at the Newton facility. At that point in time, a schedule of compliance will be issued to establish timelines necessary for plant upgrades to meet the final total nitrogen limits in 2013.

Targeted Participants: Primary participants for implementation will be public works personnel of Newton and Environmental Program personnel for Harvey County.

Milestone for 2011: The year 2011 marks the third cycle of TMDL development in the Lower Arkansas River Basin. At that point in time, any necessary plant upgrades should be planned for construction.

Delivery Agents: KDHE staff in the Municipal Program Section will 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, $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 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 proved to be effective in reducing nitrogen and phosphorus concentrations in effluent, for example at the Garden City plant.

6. MONITORING

KDHE will continue to collect bimonthly samples in 2010 at rotational Station 535 in order to assess the nitrate levels under this TMDL. Ongoing WRAPS sampling by Kansas State University will occur on Sand Creek over 2007 – 2010. Synoptic-intra-watershed sampling by USGS will occur at these locations on Sand Creek over 2007 – 2008. Based on these samplings, the status of impairment will be evaluated in 2012. Should impaired status continue, sampling in 2014 will be used to assess the status of Sand Creek after any upgrades at Newton are complete.

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 Engineer from the City of Newton on March 8, 2006.

Milestone Evaluation: In 2011, evaluation will be made as to the progress in upgrading the Newton - Sand Creek wastewater treatment plant with biological nutrient removal. Additionally, any implementation activities that have occurred within the watershed and developed areas of Newton and the levels of nitrogen seen in lower Sand Creek will be assessed. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

Consideration for 303(d) Delisting: The stream will be evaluated for delisting under Section 303(d), based on the monitoring data in 2010. Therefore, the decision for delisting will come about in the preparation of the 2012 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 2008 – 2011.

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Bibliography

Studley, S.E., 2001. Estimated flow-duration curves for selected ungaging sites in Kansas. USGS Water-Resources Investigations Report 01-4142; 90 p.

Appendix A. Wasteload Allocation (WLA) for WWTP and CAFO facilities. Although two facilities, indicated by *, are located in another basin, they discharge to Sand Creek and the Little Arkansas Subbasin.

Facility	Permit #	Wasteload Allocation (lbs N/day)
WWTP		
Newton (Major facility)	M-LA13-IO01	174.0
Walton (Minor facility)	M-LA17-OO01	2.2
Minor facility	C-LA13-NO08	0
Minor facility	C-LA13-NO09	0
Minor facility	C-LA13-NO10	0
Minor facility	I-LA13-NO03	0
Minor facility	I-LA13-NO05	0
Minor facility	I-LA13-NO06	0
Minor facility	I-LA13-NO08	0
Minor facility	I-LA13-NO09	0
Minor facility	I-LA13-PO01	0
CAFO		
Beef (Total head: 400)	A-LAHV-BA02	0
Beef (100)	A-LAHV-BA04	0
Beef (450)	A-LAHV-BA06	0
Beef (50)	A-LAHV-BA07	0
Beef (50)	A-LAHV-BA12	0
Beef (980)	A-LAHV-BA17	0
Beef (2,000)	A-LAHV-C004	0
Dairy (120)	A-LAHV-M011	0
Swine (400)	A-LAHV-S032	0
Swine (300)	A-LAHV-S036	0
Swine (250)	A-LAHV-SA05	0
Swine (200)	A-LAHV-SA06	0
Beef (180)	A-LAMN-BA03	0
Beef (400)	A-NEMN-BA32*	0
Beef (100)	A-WAHV-BA08*	0