ARKANSAS RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody/Assessment Unit: Arkansas River
Water Quality Impairment: Biology

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Gar-Peace Creek, Cow Creek

HUC 8: 11030010 and 11030011

HUC 11 (HUC 14s**):** 020-(010, 020) and 030-(080)

Ecoregion: Central Great Plains

Drainage Area: At USGS Gage 07143330: Total Drainage Area- 38,910 sq miles, Contributing Drainage Area- 31,724 sq miles
Included in this TMDL: 107 sq miles

Main Stem Segment: Arkansas River upstream from Haven to the junction with Salt Creek (segment 3 and the part of segment 1 upstream from Haven)

Included Tributaries: Original Channel of Cow Creek (1755)

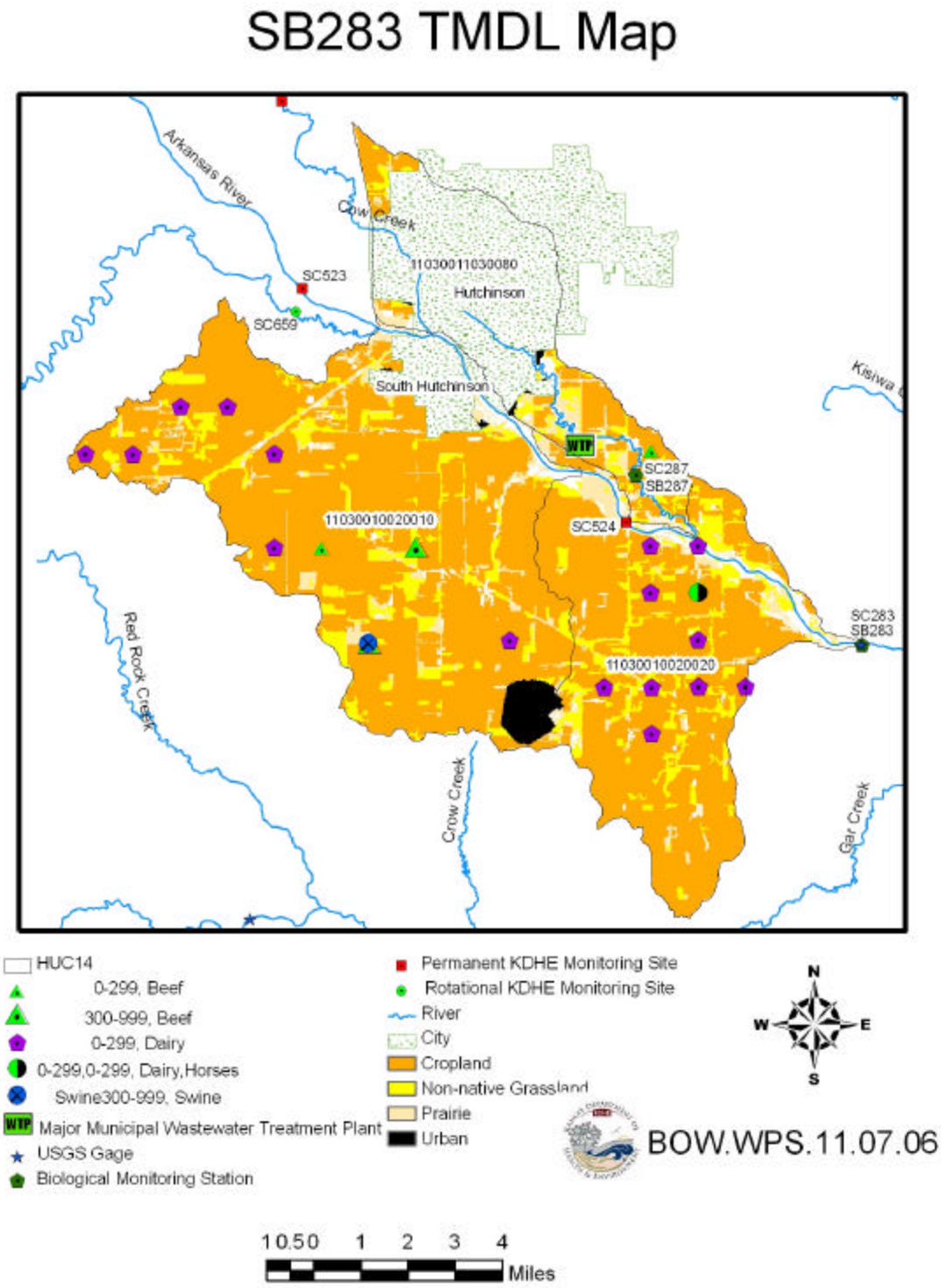
Upstream Contributing Waters Not Included in this TMDL:

Cow Creek (11030011, Segment 1)
Salt Creek (11030010, Segment 7)
Arkansas River (11030010, Segment 4)

Designated Uses: Special Aquatic Life Support, Primary Contact Recreation (B), Secondary Contact Recreation (a), Drinking Water Supply, Food Procurement, Groundwater Recharge, Irrigation Water, Industrial Water, Livestock Water.

Impaired Use: Special Aquatic Life Support on segments 1 and 3 of the main stem

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)(A)).



(Figure 1- Map of the Arkansas River basin near Hutchinson. The mainstem of the Arkansas river is the impaired water.**)**

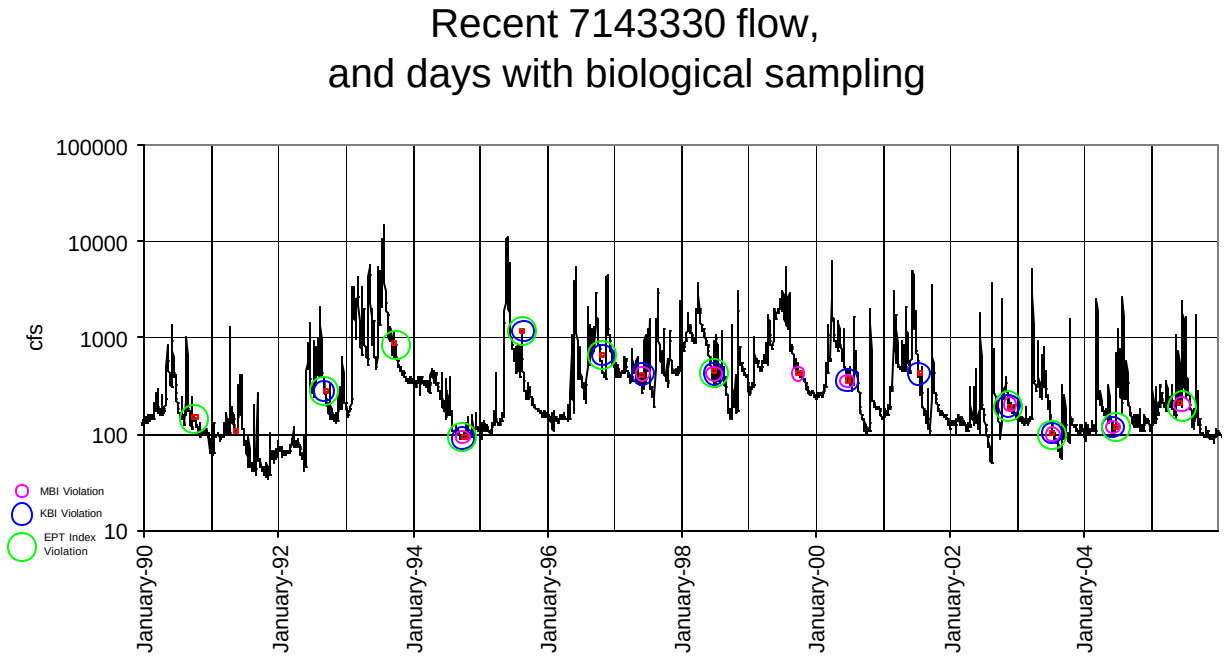
2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for designated use under 2004 303(d): Partially Supporting

Monitoring Sites: Chemistry: Station 524 Arkansas River below Hutchinson, Station 287 Cow Creek below Hutchinson; Biology: Station 283 near Hutchinson Upstream Contributions monitored by Station 522 on Cow Creek, Station 523 on the main stem of the Arkansas upstream from Hutchinson, Station 659 on Salt Creek**.**

Period of Record Used: Chemistry: Total Nitrogen 2000-2005 at SC524 and SC287, all other chemistry 1990-2005; Biology: 1990-2005 (16 biological samples)

Flow Record: USGS Gaging Station on the Arkansas River near Hutchinson-07143330 (Percentile Ranking: 10/01/1970, Figure 2- Most recent 15 year flow record)



(Figure 2- Fifteen year flow record, with sampling dates and biological metric violations.**)**

Current Conditions:

Four biological metrics were examined to determine the level of biological impairment at SB283; MBI, KBI-NO, EPT Index and EPT % (see Appendix A for a detailed explanation of the metrics), Table 1. Each of the four parameters had some years with less than fully supporting designations, though EPT % had the least, four of twenty-four, with the most recent occurring in 1994. Consistent exceedences of the MBI indicator began happening in 1997, and have

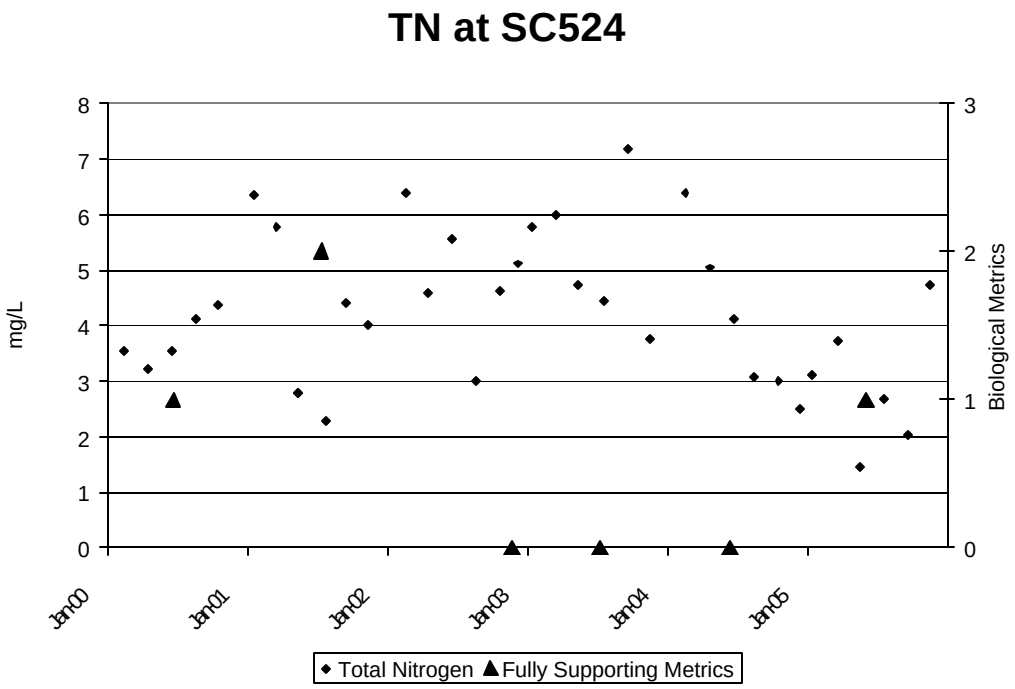
continued through the most recent sampling year with the exception of 2001. KBI violations and EPT Index exceedences have occurred consistently throughout the period of record. These measure different aspects of community structure as indicated by the lack of relationships or consistency among themselves year-to-year.

Sampling Date	TAXA RICHNESS	SAMPLE COUNT	MBI	KBI-NO	EPT INDEX	EPT%ABUNDANCE
7/27/1982	41	163	4.48	2.69	13	51
10/5/1983	39	145	5.05	2.91	9	22
5/24/1984	36	110	4.96	2.92	13	41
8/29/1985	49	202	4.66	2.8	13	52
10/22/1986	33	123	4.25	2.6	12	45
5/21/1987	35	166	4.19	2.57	13	60
7/28/1988	49	244	4.38	2.66	16	54
10/5/1989	36	117	4.4	2.59	10	49
10/3/1990	41	155	4.4	2.63	11	50
5/15/1991	40	135	4.17	2.57	13	53
9/10/1992	41	183	4.02	2.62	10	56
9/22/1993	28	160	4.03	2.43	12	74
10/7/1994	37	139	4.9	2.57	10	25
8/18/1995	30	137	4.39	2.63	12	73
10/17/1996	18	160	4	2.65	9	81
5/30/1997	35	284	4.55	2.8	15	79
6/26/1998	36	297	4.93	2.88	11	54
9/30/1999	50	305	4.52	2.55	17	63
6/21/2000	49	414	4.93	2.77	15	61
7/12/2001	41	243	4.17	2.78	14	71
11/21/2002	21	241	4.84	3.06	10	60
7/8/2003	28	164	4.92	2.82	10	59
6/10/2004	37	235	5.01	2.78	11	63
6/3/2005	33	311	4.92	2.48	12	52
Average	36.79	201.38	4.54	2.70	12.13	56.17
Supporting			12	8	10	20
Partially Supporting			12	15	14	2
Non-Supporting			0	1	0	2

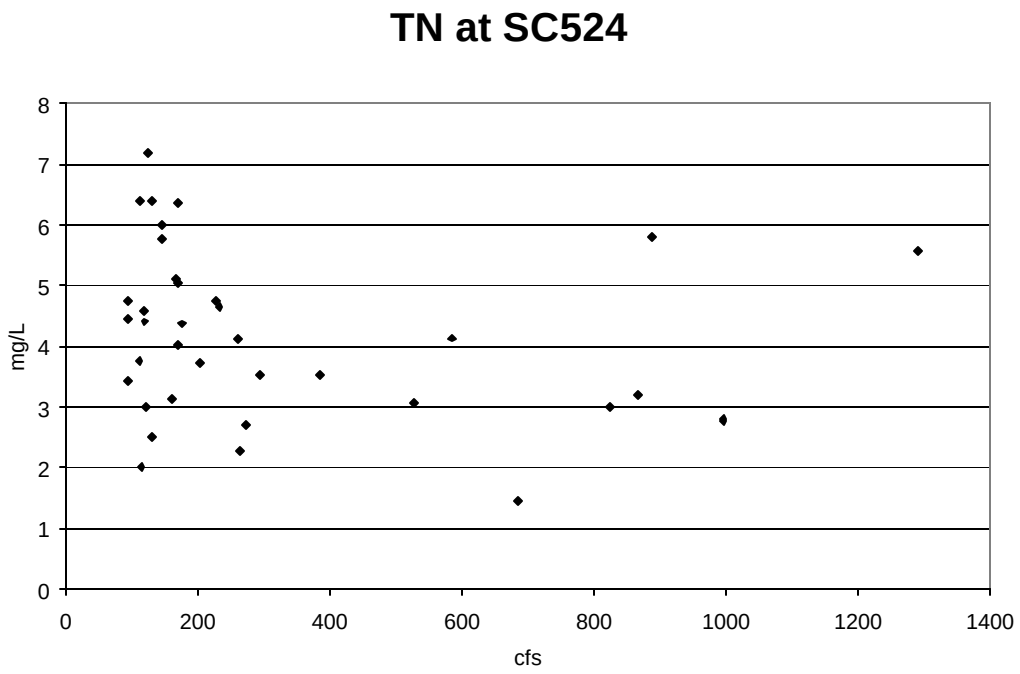
(Table 1: Biological Monitoring Metrics at SB283 over the period of record.**)**

Nutrient concentrations were plotted against flow for SC524 and against date for SC524 and SC287. The period of record for total nitrogen is shorter, and plots of dissolved inorganic nitrogen and soluble reactive (ortho) phosphorus were rejected following Dodds (2003): "Another potential problem with using inorganic nutrient pools to represent trophic state and nutrient availability ratios arises because concentration values are in units of mass per unit volume, and cannot be used with certainty to estimate supply (i.e., turnover rate of the nutrient pool, expressed either in mass per unit volume per unit time or simply as per unit time) to organisms without information on uptake and remineralization."

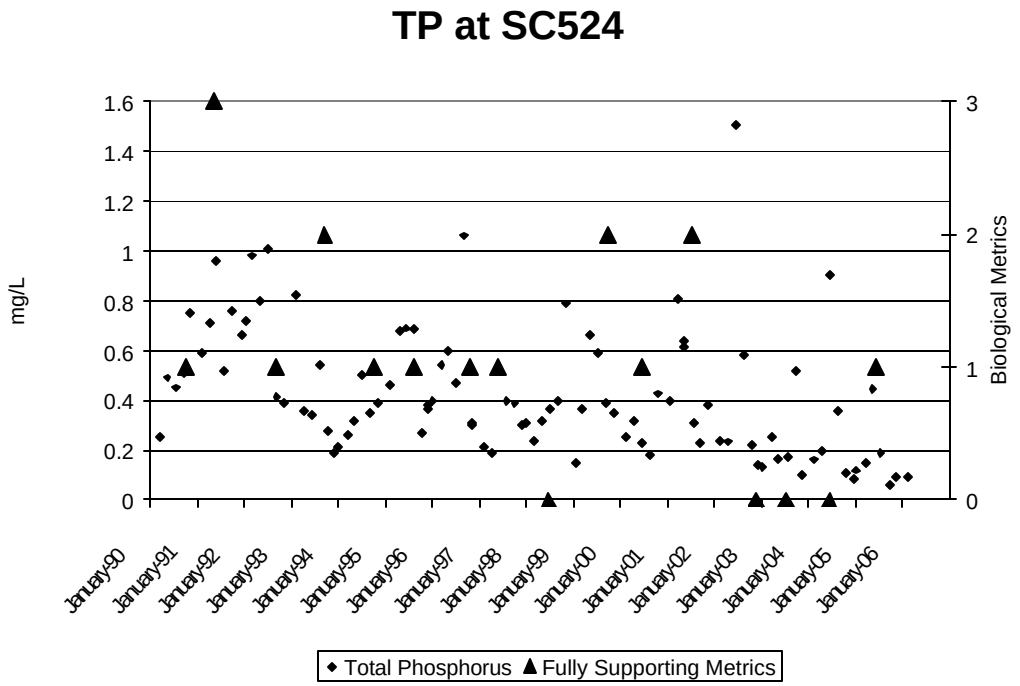
Elevated concentrations of some nutrients are known to be associated with some point sources, however, agricultural runoff can contain highly elevated concentrations of inorganic nutrients, making it difficult to accurately predict the source of a pollutant in streams draining large land areas. Further difficulty arises because nutrients introduced by point sources will change forms as biological uptake and processing occur.



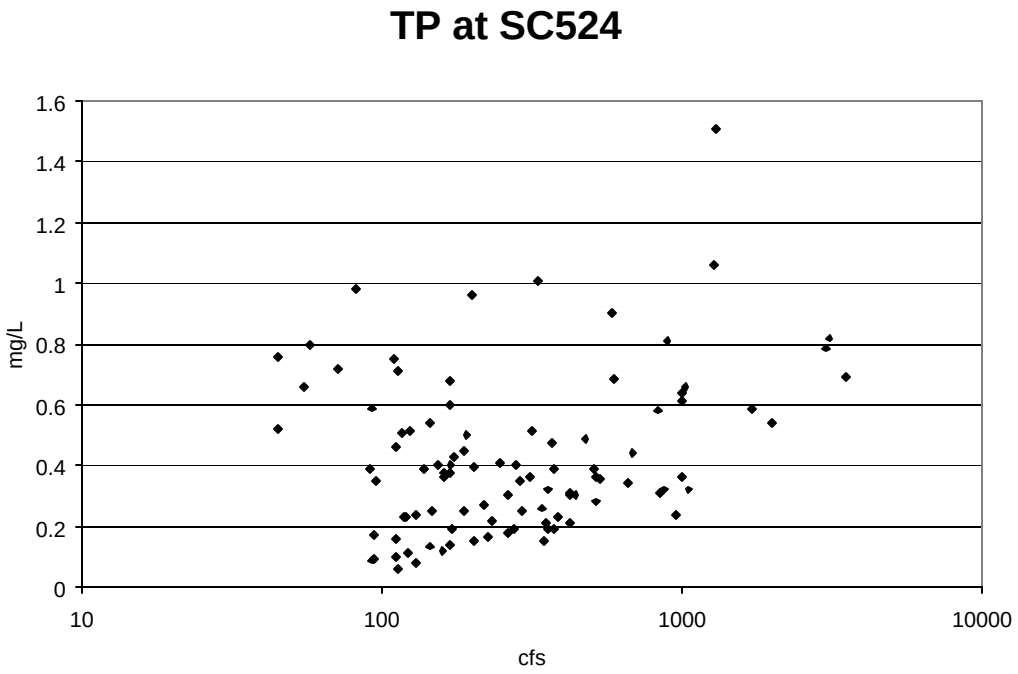
(Figure 1- Total Nitrogen calculated from Total Kjeldahl Nitrogen and oxidized nitrogen at SC524 downstream from Hutchinson by date. MBI, KBI-NO, and EPT Index are summed for fully supporting designation on the secondary axis.**)**



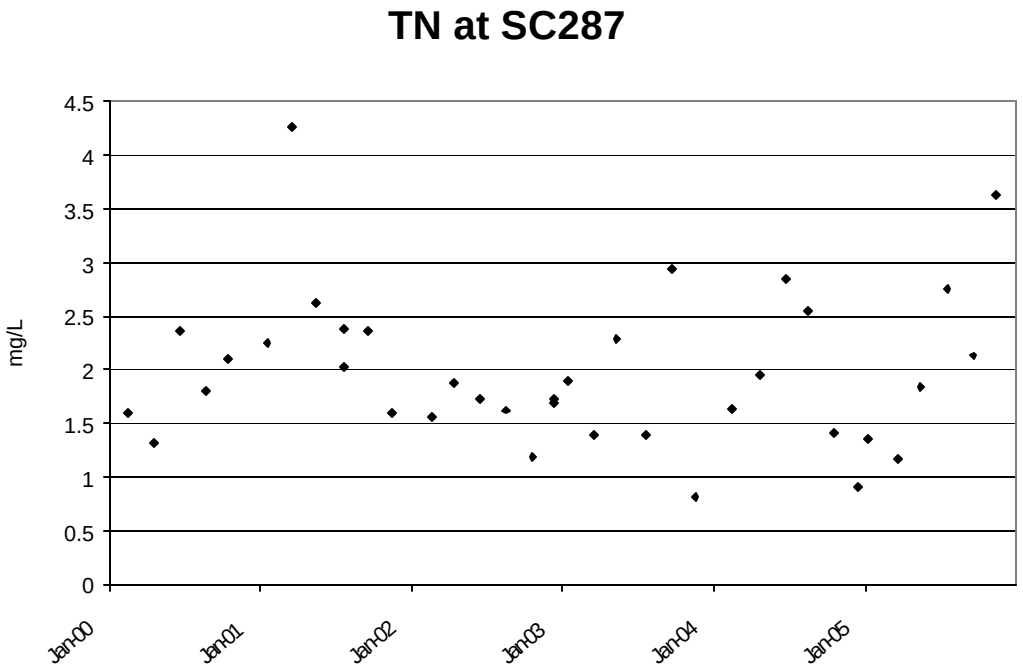
(Figure 2- Total Nitrogen calculated from Total Kjeldahl Nitrogen and oxidized nitrogen at SC524 downstream from Hutchinson by flow at USGS gage 07143330.**)**



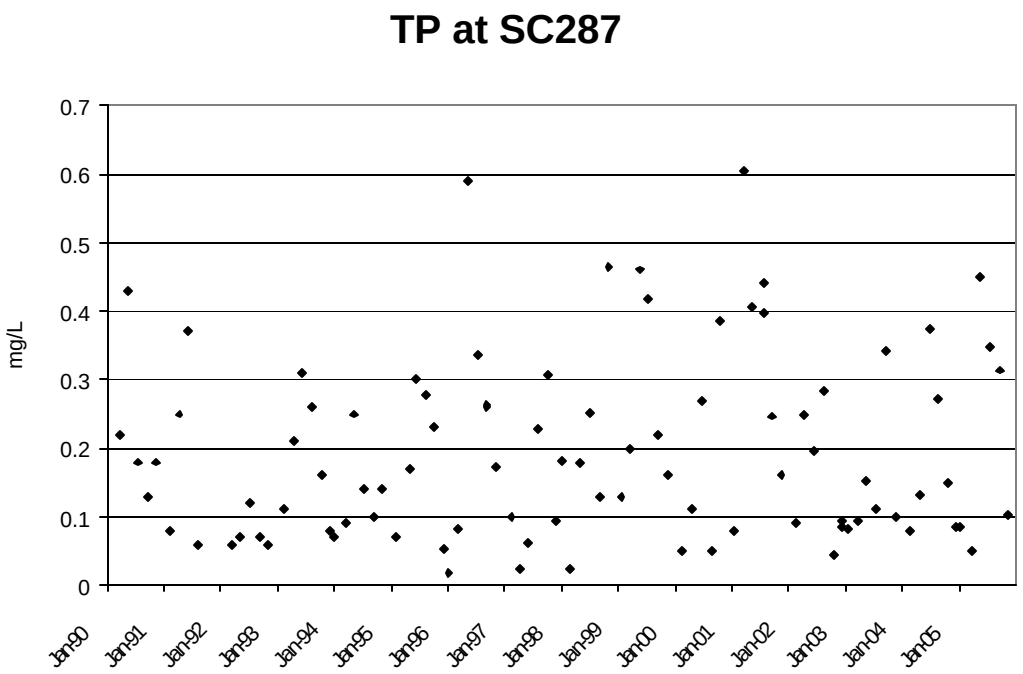
(Figure 3- Total Phosphorus at SC524 downstream from Hutchinson by date. MBI, KBI-NO, and EPT Index are summed for fully supporting designation on the secondary axis.**)**



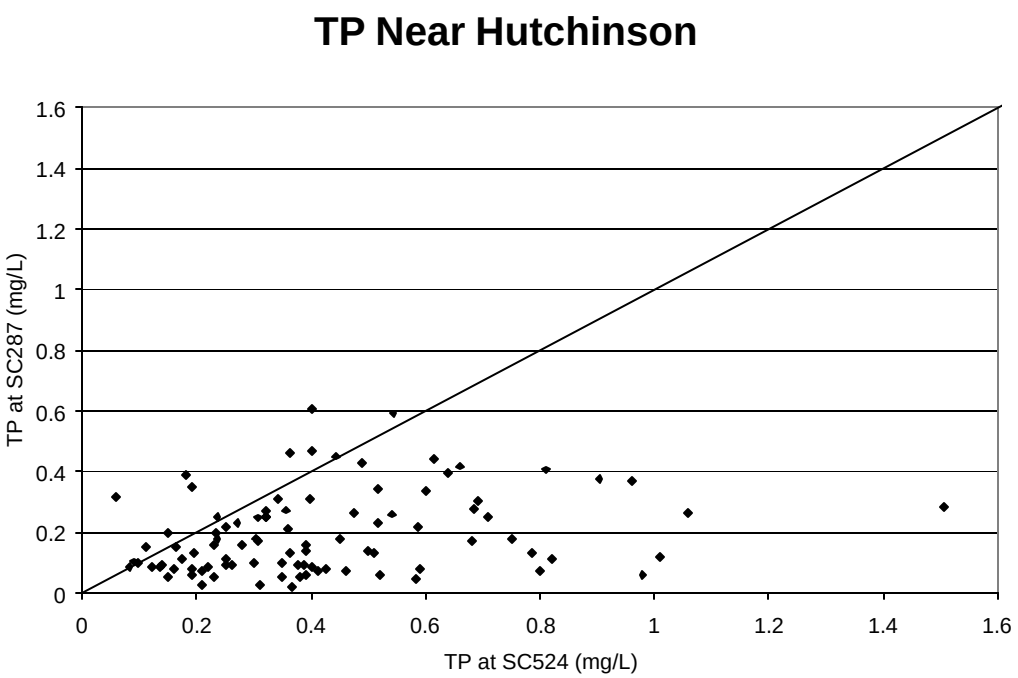
(Figure 4- Total Phosphorus at SC524 downstream from Hutchinson by flow at USGS gage 07143330.**)**



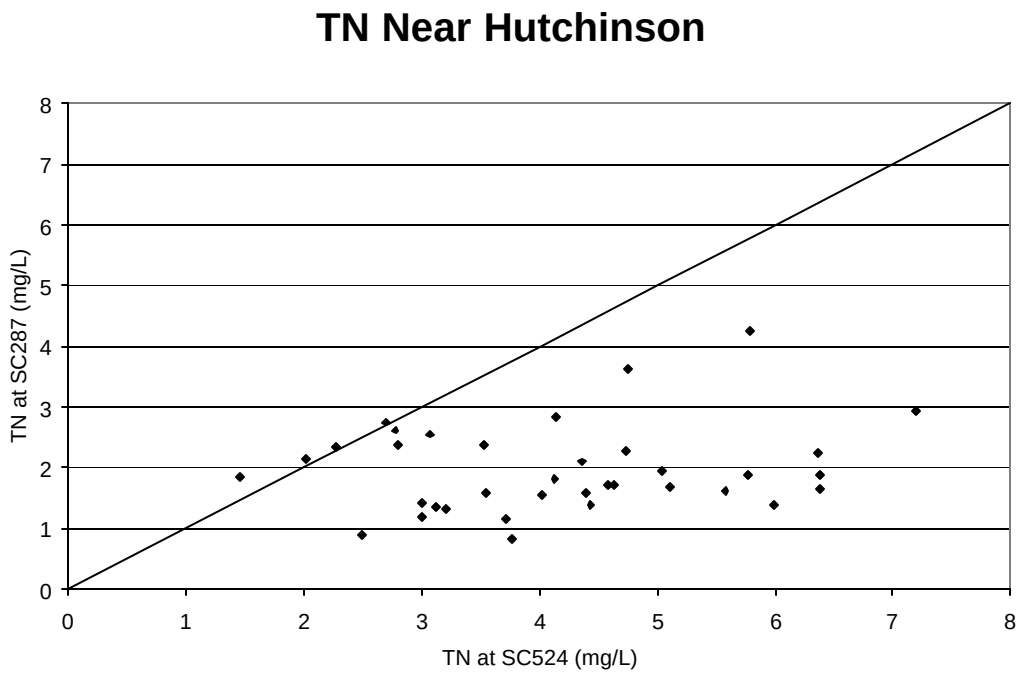
(Figure 5- Total Nitrogen calculated from Total Kjeldahl Nitrogen and oxidized nitrogen at SC287 downstream from Hutchinson by date.**)**



(Figure 6- Total Phosphorus at SC287 downstream from Hutchinson by date.**)**



(Figure 7- Contributions of Total Phosphorus from the original channel of Cow Creek, measured at SC287, are generally lower than the concentrations in the main stem of the Arkansas River, as measured at SC524. 1-to-1 line shown for comparison purposes.**)**



(Figure 8- Contributions of Total Nitrogen from the original channel of Cow Creek, measured at SC287, are generally lower than the concentrations in the main stem of the Arkansas River, as measured at SC524. 1-to-1 line shown for comparison purposes.**)**

Desired Endpoint for Arkansas River near Hutchinson 2011-2014:

The desired endpoint for this system will be a macroinvertebrate community registering fully supporting designations for all four metrics. Achievement of this endpoint will be indicative of full support of the aquatic life use designation for this stream reach. To achieve this endpoint, and meet the narrative criteria for the prevention of nutrient enrichment, a set of nutrient concentration goals that should allow this stream to fully support aquatic life should be established. Because of the influence of upstream sources, and reflecting the relative uncertainty over the exact level of nutrient enrichment that can occur while still fully support aquatic life, this TMDL will be staged and adjusted for flow conditions.

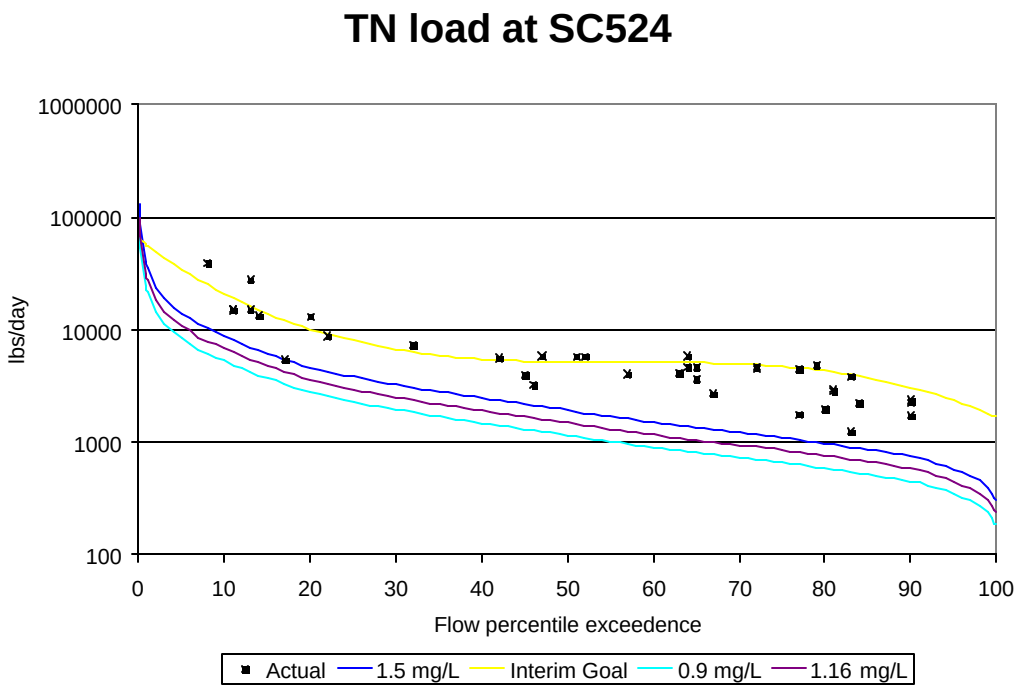
Periphyton and algae growth is greatest in aquatic environments under conditions of high light availability, elevated nutrient concentrations, and stable, low flows. During high flow events bedload moves, particularly in sandbottom streams like the Arkansas River, and dislodges benthic algae and periphyton, preventing the accumulation of large mats. Nutrient loads at moderately elevated flows are also of less concern, because they tend to move quickly downstream at rates that exceed the uptake capacity of benthic primary producers. For this reason, the desired endpoint for median and higher flows will be to reduce the current nutrient load by 30%. For low flows, however, an alternate endpoint is needed.

In order to account for seasonal availability of nutrients at low flow, median and lower quartile (25%) values of spring and summer TN and TP from Streams with Ecoregion V – Subregion 27 were selected and averaged. Only values associated with seasons of predominantly low flow

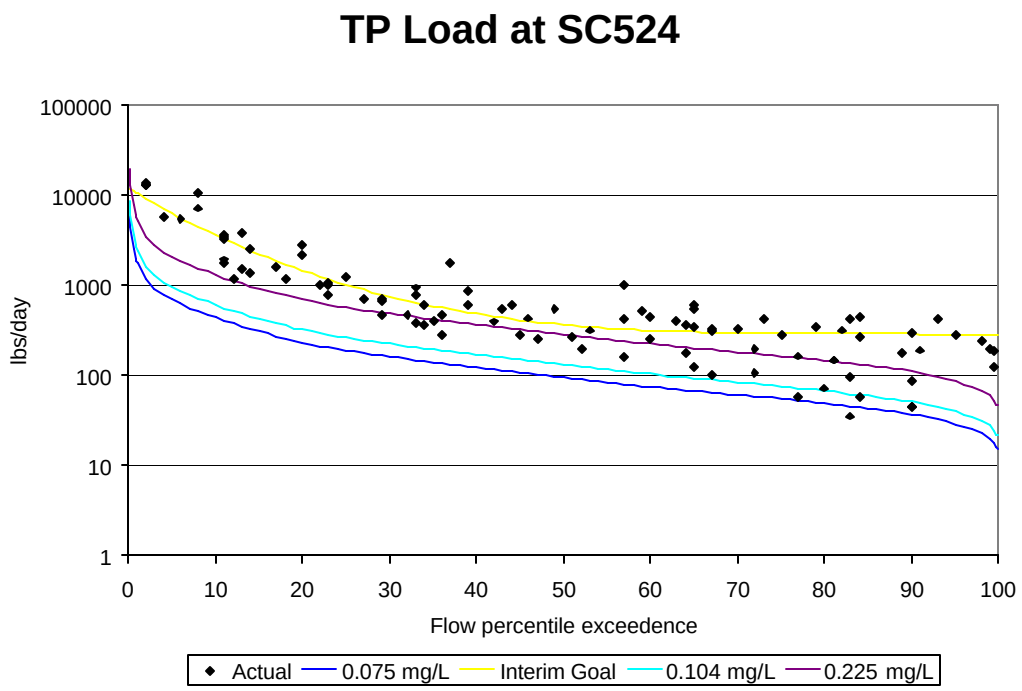
(monthly flows below the long-term monthly average flow) were selected. The resulting averages serve as the Stage-Two endpoints of this TMDL and range from 0.9-1.16 mg/L for TN and 104-225 µg/L for TP. These ranges lie under the suggested levels for TN and over the suggested levels for TP recommended by Dodds for streams at the mesotrophic-eutrophic threshold (1.5mg/L TN; 75 µg/L TP). Load duration curves were established using the endpoint ranges and the Dodds values.

Current TN and TP samples were translated into instantaneous loads and plotted against the percent flow duration for the flow occurring on that date of sampling. A regression of these instantaneous loads and the percent flow duration was derived using a cubic equation as the best fit line. The current load curve, which shall be the interim goal, represents the existing condition of nutrient enrichment along the Arkansas River below Hutchinson. Achievement of the TMDL will mean future loads will fall within the range of TN and TP values typical of Subregion 27 streams. Initial implementation will concentrate on flows below the median flow at Hutchinson.

The low-flow Stage-One endpoint for total phosphorus was calculated, and is 320 µg/L for SC524 and 150 µg/L for SC287. The overall Stage-One endpoint will be to reduce total nitrogen and total phosphorus below current average loads, as noted above. Reductions of nutrient concentrations beyond these levels should prevent the production of undesirable quantities or kinds of aquatic life, including algae and periphyton, with a concurrent restructuring of the macroinvertebrate community to one that is composed primarily of high water quality species and meets KDHE indicators for full support designations.



(Figure 9- Load Duration Curve for SC524 Total Nitrogen, with current loading, interim goal (=10^(4.8-(0.000006*(flow percentile^3)+(0.00102*(flow percentile^2)-(0.0578*(flow percentile))), Sub-Region 27 background concentrations, and background concentrations proposed by Dodds.**)**



(Figure 10- Load Duration Curve for SC524 Total Phosphorus, with current loading, interim goal(=10^((4.08-(0.000003*(flow percentile^3))+(0.000728*(flow percentile^2))-(0.0592*flow percentile))), Sub-Region 27 background concentrations, and background concentrations proposed by Dodds.**)**

3. SOURCE INVENTORY AND ASSESSMENT

Upstream Contributions: Nutrient concentrations flowing into the main stem of the Arkansas River from upstream typically exceed the goals established in this TMDL. Upstream contributions are summarized in Tables 2 and 3. Summary statistics were calculated for samples collected from 2000 forward, the period for which Total Kjeldahl Nitrogen has been collected allowing a calculation of total nitrogen. Total phosphorus from upstream sources were calculated based on the entire monitoring period, 1990-2005.

TN (mg/l)	Average	Median	Maximum	Minimum
SC523	3.41	3.37	5.18	0.80
SC522	2.59	2.44	6.80	0.56
SC523 Mar.- Oct. Low Flow	3.38	3.37	4.29	2.45
SC522 Mar.- Oct. Low Flow	2.50	2.52	3.13	1.63

(Table 2- Contributions of Total Nitrogen, as calculated from Total Kjeldahl Nitrogen plus oxidized inorganic nitrogen, at upstream monitoring stations.**)**

TP (mg/l)	Average	Median	Maximum	Minimum
SC523	0.25	0.17	2.34	0.02
SC522	0.43	0.35	0.062	2.20
SC523 Mar.- Oct. Low Flow	0.12	0.09	0.35	0.02
SC522 Mar.- Oct. Low Flow	0.43	0.40	1.30	0.16

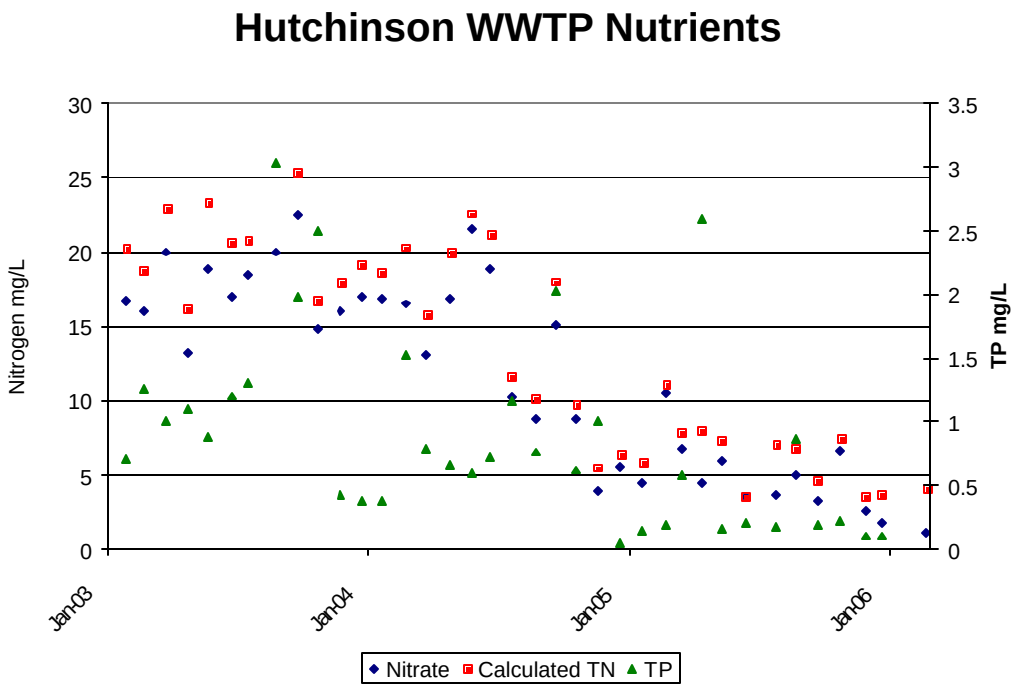
(Table 3- Contributions of Total Phosphorus at upstream monitoring stations.**)**

Land Use: The Kansas GAP dataset was used to analyze land use patterns in the watershed. Most of the watershed is cropland (65%), urban (13%) and grassland (18%), with limited other uses, results are summarized in Table 4.

Land Use Type	Category	Percent
Cropland	Cropland	65%
Woodland and Forest	Forest	4%
CRP	Non-native	10%
Mixed Tallgrass Prairie	Prairie	6%
Urban	Urban	13%

(Table 4- Land Use in the TMDL area.**)**

NPDES: The city of Hutchinson operates a permitted wastewater treatment system with a design flow of 8.3 million gallons per day (MGD). The city of South Hutchinson operates a 2.0 MGD facility on the south side of the river. Current operations average a daily discharge of 4.72 MGD and 0.64MGD respectively. Recent upgrades at the large facility are reflected in substantially lower effluent nitrate and phosphorus concentrations, seen in Figure 11. For the most recent twelve months total nitrogen concentrations averaged 5.81 mg/L, nitrate concentrations averaged 4.02 mg/L and total phosphorus concentrations averaged 0.51 mg/L. The nitrogen reduction is directly attributable to their biological nutrient removal, however current treatment processes are not designed to remove phosphorus. The low phosphorus concentration is due to chemical removal, instituted for odor control and treatment plant biology needs. The South Hutchinson facility has relatively high nutrient concentrations, for the most recent twelve months: TN-9.0 mg/L, NO_3-8.0mg/L, TP-8.2 mg/L. Other NPDES permitted dischargers exist within the area covered by this TMDL, but do not have total nutrient monitoring requirements. These other facilities are not likely to contribute significantly to the nutrient loads seen at SC524. Their WLA is described in Appendix C.



(Figure 11- Effluent monitoring data reported pursuant to NPDES permit requirements for the Hutchinson Municipal Wastewater Treatment Plant. Major upgrades were completed during 2004, resulting in substantially lower nutrient concentrations.**)**

CAFO: There are 26 known confined animal feeding operations in the drainage. The dominant type is a small (less than 300 animals) dairy, with limited beef, a single small swine and a single small horse operation. A summary of the operations by size and animal type is included in Table 5, details in Appendix B, locations are marked in Figure 1.

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.

Type	Size	Number Present*
Dairy	0-299	20
Beef	0-299	3
Beef	300-999	2
Horses	0-299	1
Swine	300-999	1
* one facility has a joint permit, 26 total permits		

(Table 5- Summary of all confined animal feeding operations within the TMDL area.**)**

Background Levels: EPA publication 822-B-01-014 Ambient Water Quality Criteria Recommendations: Information Supporting the Development of State and Tribal Nutrient Criteria Rivers and Streams in Nutrient Ecoregion V provides tables of estimated background nutrient concentrations within the Central Great Plains. Total nitrogen background concentrations range from 0.71-0.84 mg/L; total phosphorus background concentrations are 0.09 mg/L.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

This TMDL is downstream from over 30,000 square miles of drainage, and as such is strongly dependent on upstream nutrient reductions for full compliance. A combination approach of USGS gages and USGS estimates of flow (Perry, et al., 2004) was used to calculate the approximate average flow contribution of upstream tributary segments. Results are summarized in Table 6.

Source of Flow	Percentage Contribution at 07143330
Arkansas River at Junction with Salt Creek	60%
Cow Creek	10%
Salt Creek	2.5%
Hutchinson WWTP	5%
Area in this TMDL	22.5%

(Table 6- Relative proportions of the flow as seen above SC524 by source.**)**

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 SB283 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 SB283 arise out of a more complicated linkage between overall elevated nutrient levels and involves in-stream benthic colonization by periphyton and other aquatic primary producers.

Point Sources: The city of Hutchinson has significantly reduced their nutrient loading with recent plant upgrades and other wastewater treatment at their large plant. Following guidance within the Kansas Surface Water Nutrient Reduction Plan, their limits shall be total nitrogen not to exceed 8 mg/L and total phosphorus not to exceed 1.5 mg/L; resulting in a wasteload allocation of 315 lbs per day TN and 59 lbs per day TP. Current operations at the Hutchinson facility produce effluent that is cleaner than these limits, and the city is encouraged to continue meeting current effluent concentrations. Current concentrations at the South Hutchinson facility exceed KDHE municipal treatment plant guidance, and reductions will be needed to meet the load limits there. Those limits are total nitrogen not to exceed 8 mg/L and total phosphorus not to exceed 1.5 mg/L; resulting in a wasteload allocation of 49 lbs/day TN and 8 lbs/day TP. The Reno County Sewer District wasteload allocation is based on their 0.02 mgd design flow and the assumed 2 & 7 mg/l technology limits for phosphorus and nitrogen from lagoons.

Nonpoint Sources: The continuation of elevated nutrient loads at SC524 after the upgrades at the Hutchinson WWTP confirms that regional, nonpoint sources contribute to the observed concentrations of nitrogen and phosphorus in the Arkansas River. Because the exact reduction in

nutrients required to return SB283 to a fully supporting designation can only be estimated, this TMDL will be staged and flow adjusted. Nonpoint sources of nitrogen and phosphorus will be reduced during flow events greater than median flow by 30% over the current mean; that is, average TN will be less than 2.9 mg/L, and TP will be less than 0.29 mg/L.

The initial endpoint for flows less than median will be a reduction of TN and TP to less than the range of regional values for spring and summer low flows reported in Tables 2 and 3. Criteria for high flow events will reflect the need for landscape level best management practices to interact with the dilution effect of greater quantities of water.

Low flow loading within the area covered by this TMDL is likely affected by groundwater, which may have accumulated nutrients that require longer mitigation periods to reduce than surface runoff. The ultimate endpoint for low flows will be lower than for high flows, reflecting the relative importance of low flow periods for benthic primary production, however the time period for these reductions is necessarily longer.

As mentioned previously, nutrient loads observed at SC524 are impacted by the nutrients entering the area covered by this TMDL, as measured at SC522 and SC523. Therefore, we will also set an expected concentration of 0.1mg/L TP and 1.0 mg/L TN for those stations, reflecting background concentrations expected to be present. Levels exceeding these goals shall be regarded as guidance for future TMDL development for these stations in 2011.

Defined Margin of Safety: The calculation and use of multiple biological metrics provides a margin of safety that aquatic life support has been fully attained, and the designated use has been restored. A consistently compliant suite of scores for KBI-NO, MBI and EPT Index will be regarded as the requisite criteria for this TMDL. Fully supporting scores for these metrics will stand as evidence that plant nutrients entering the river from artificial sources have been controlled and are preventing the accelerated succession or replacement of aquatic biota and the production of undesirable quantities or types of aquatic life

State Water Plan Implementation Priority: Because additional assessment will be needed to determine the relationship between aquatic community response and nutrient loading, and because Hutchinson has recently completed a wastewater treatment plant upgrade that substantially reduced nutrient concentration in their outfall, this TMDL will be a **Medium Priority** for implementation. During this stage, the emphasis of this TMDL will be on monitoring the macroinvertebrate community at SB283 and reducing upstream nutrient concentrations entering these segments at low flow.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Arkansas Gar-Peace (11030010) subbasin with a priority of 19, high priority for restoration work.

Priority HUC 11s and Stream Segments: Because in-stream denitrification rates decline logarithmically with increasing flow, priority for additional nutrient reduction efforts will be on the lands adjacent to the main stem river and the tributary segment included in this TMDL. Emphasis shall be on implementing best management practices for nutrient reduction in both agricultural and urban areas.

5. IMPLEMENTATION

Desired Implementation Activities

1. Monitor wastewater discharges for long-term nutrient loadings
2. Repair or replace or remove faulty septic systems in the area
3. Improve riparian conditions along the Arkansas River and its tributaries.
4. Implement necessary soil sampling to recommend appropriate fertilizer applications on cropland
5. Maintain necessary conservation tillage and contour farming to minimize cropland erosion.
6. Install necessary grass buffer strips along low-order streams.
7. Install proper manure storage
8. Implement necessary nutrient management plans to manage manure application to land
9. Abate any urban stormwater contributions of nutrients to the Arkansas River through best management practices
10. Implement urban watershed outreach programs to reduce nutrient loading from Hutchinson stormwater.

Implementation Programs Guidance

NPDES - Municipal Program Sections - KDHE

a. Issue renewed NPDES permits with monitoring of nutrients.
b. Evaluate influence of nutrient levels in Hutchinson wastewater on downstream nutrient levels monitored at Station 524.
c. Establish an average annual limit of 8.0 mg/l for total nitrogen and 1.5 mg/l for total phosphorus for the Hutchinson Wastewater Treatment Plant, while encouraging continuing operations to match current plant performance.
d. Establish an average annual limit of 8.0 mg/l for total nitrogen and 1.5 mg/l for total phosphorus for the South Hutchinson Wastewater Treatment Plant, following the Kansas Surface Water Nutrient Reduction Plan.
e. Review and approve necessary plans and specifications for treatment plant operations in order to achieve nutrient reduction.

Local Environmental Protection Program - KDHE

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

Watershed Management Program - KDHE

a. Support ongoing implementation projects conducted under a Watershed Restoration and Protection Strategy for the Lower Arkansas Basin, including demonstration projects and outreach efforts dealing with erosion and sediment control, stormwater management and practices, pollution prevention, public outreach and studies of water quality impacts of new development.

b. Support septic system inspection, upgrade and repair through the Reno County Local Environmental Protection Program.
c. Provide technical assistance on nutrient management and vegetative buffer development in vicinity of streams.
d. Support aspects of the Reno County and Hutchinson Stormwater Programs, outside the requirements of the Phase II NPDES permit, that promote stream buffers, installation of new and retrofitted stormwater management practices, including Low Impact Development and Best Management Practices, and runoff treatment practices, to mitigate the impacts of impervious area in the watershed.
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Water Resource Cost Share & Nonpoint Source Pollution Control Programs - SCC

a. Apply conservation farming practices, including terraces and waterways, sediment control basins, and constructed wetlands in cropland of unincorporated areas of Reno County lying 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 the Arkansas River and its main tributaries.

Riparian Protection Program - SCC

a. Establish or reestablish natural riparian systems, including vegetative filter strips and streambank vegetation along the Arkansas River and its tributaries.
b. Develop riparian restoration projects.
c. Promote wetland construction to assimilate nutrient loadings.
d. Coordinate riparian management within Hutchinson and in unincorporated Reno County.

Buffer Initiative Program - SCC

a. Install vegetative buffer strips along the Arkansas River and its tributaries.

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

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.

Time Frame for Implementation: Pollutant reduction practices should be installed within the area described in this TMDL by the year 2011. Urban stormwater mitigation programs should commence with the approval of the Hutchinson Phase II NPDES stormwater permit.

The second stage will commence in 2011 when this TMDL will be reviewed in conjunction with the TMDL for the area around Great Bend, and will involve incorporating refined allocations and load reductions including permit limits.

Targeted Participants: Primary participants for implementation will be the city of Hutchinson, residents of the city of Hutchinson and agricultural producers operating within the drainage of the subwatersheds. Initial work in 2007 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

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 sources will continue monitoring and treating effuent to maintain nutrient loading at, or below, levels described in this TMDL.

Milestone for 2011: The year 2011 marks the midpoint of the ten-year implementation window for the watershed. At that point in time, adequate source assessment should be complete which allows an allocation of resources to responsible activities contributing to the nutrient impairment. Additionally, biological data from Arkansas River over 2006-2011 should not indicate trends of reduced support of the aquatic community. Sample data from Arkansas River should indicate evidence of reduced nutrient levels relative to the conditions seen over 1990-2005.

Delivery Agents: The primary delivery agents for program participation will be KDHE Muncipal Program Section, the conservation districts 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 Reno 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 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 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.

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 1990-2006, 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

KDHE will continue to monitor stream chemistry, including total nutrient concentrations at SC524, SC523, SC522, SC659 and SC287. Stream biology macroinvertebrates will continue to be collected at SB283. Wastewater discharges in the area covered under this TMDL will continue to be required to monitor total nutrient concentrations. Prior to 2011 KDHE will evaluate all new biological samples collected and determine if the river is fully supporting aquatic life, as indicated by the suite of metrics identified in the Defined Margin of Safety.

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 was held on September 13, 2006 in Hutchinson. The public record was held open until September 30, 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.

Milestone Evaluation: In 2011, an evaluation will be made as to the degree of achievement of the four biological metrics for the Arkansas River and lower Cow 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

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. 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%

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Perry, C.A., Wolock, D.M., and Artman, J.C., 2004. Estimates of flow duration, mean flow, and peak discharge frequency values for Kansas stream locations, U.S. Geological Survey Scientific Investigations Report 2004-5033.

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Appendix B:

Permit #	Total Head	KS Authorized Head	Federal Authorized Head	Animal Type	Size	TN WLA (lbs/day)	TP WLA (lbs/day)
A-ARRN-BA15	500	250	500	Beef	0-299	0	0
A-ARRN-BA10	525	263	525	Beef	0-299	0	0
A-ARRN-BA04	150	75	150	Beef	0-299	0	0
A-ARRN-BA08	700	700	700	Beef	300-999	0	0
A-ARRN-BA12	800	800	800	Beef	300-999	0	0
A-ARRN-MA10	30	42	42	Dairy	0-299	0	0
A-ARRN-MA14	21	25	27	Dairy	0-299	0	0
A-ARRN-MA07	50	70	70	Dairy	0-299	0	0
A-ARRN-M025	200	280	280	Dairy	0-299	0	0
A-ARRN-M015	100	140	140	Dairy	0-299	0	0
A-ARRN-M047	40	56	56	Dairy	0-299	0	0
A-ARRN-M026	35	49	49	Dairy	0-299	0	0
A-ARRN-M022	35	49	0	Dairy	0-299	0	0

Permit #	Total Head	KS Authorized Head	Federal Authorized Head	Animal Type	Size	TN WLA (lbs/day)	TP WLA (lbs/day)
A-ARRN-M048	40	56	56	Dairy	0-299	0	0
A-ARRN-M049	60	71	76	Dairy	0-299	0	0
A-ARRN-M040	80	112	112	Dairy	0-299	0	0
A-ARRN-M012	35	49	49	Dairy	0-299	0	0
A-ARRN-M046	110	142	142	Dairy	0-299	0	0
A-ARRN-M043	30	42	42	Dairy	0-299	0	0
A-ARRN-M038	50	70	70	Dairy	0-299	0	0
A-ARRN-M010	60	84	84	Dairy	0-299	0	0
A-ARRN-M041	40	56	56	Dairy	0-299	0	0
A-ARRN-M003	140	196	196	Dairy	0-299	0	0
A-ARRN-M044	35	49	49	Dairy	0-299	0	0
247	48	51	61	Dairy,Horses	0-299,0-299	0	0
A-ARRN-S017	2499	1000	1000	Swine	Swine300-999	0	0

Appendix C:

KS Permit #	NPDES Permit #	Facility Name	TN WLA (lbs/day)	TP WLA (lbs/day)	Category
I-AR49-PO08	KS0119733	CARGILL SALT	0	0	Salt
I-AR49-CO10	KS0089320	KRAUSE PLOW CORPORATION, INC.	0	0	Cooling
I-AR49-NP04	KSJ000521	MAST CUSTOM PROCESSING PLANT	0	0	Non-discharging
I-AR82-NP01	KSJ000516	NATIONAL BY-PRODUCTS-S. HUTCHINSON	0	0	Non-discharging
C-AR49-NO04	KSJ000601	PHEASANT ACRES COUNTRY LIVING	0	0	Non-discharging
M-AR49-NO07	KSJ000455	RENO CO. S.D. #201	0	0	Non-discharging
I-AR98-PO01	KS0091715	RENO CO. S.D. #202	1.5	0.5	Wastewater
I-AR49-CO19	KS0091065	TRINITY UNITED METHODIST CHURCH	0	0	Cooling
C-AR82-NO02	KSJ000192	WHISPERING PINES TRAILER COURT	0	0	Non-discharging
I-AR82-PO01	KS0000345	MORTON SALT	0	0	Salt
I-AR82-PO15	KS0098591	FI KANSAS REMIDIATION TRUST	0	0	Groundwater remediation
I-AR49-PO02	KS0001112	IMC SALT, INC.	0	0	Groundwater remediation
I-AR49-PO22	KS0095257	INEEDA LAUNDRY AND DRY CLEANER	0	0	Groundwater remediation
I-AR82-PR01	KSG110043	MID AMERICA REDI-MIX, INC	0	0	Concrete
I-AR49-CO20	KS0091251	SHIELD IND INC.	0	0	Cooling
I-AR49-CO21	KS0095575	TRINITY JUNIOR-SENIOR CATHOLIC SCHOOL	0	0	Cooling