

UPPER ARKANSAS BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody: Arkansas River from Pierceville to Larned Water Quality Impairment: Sulfate

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasins: Arkansas-Dodge City and Arkansas-Pickle

Counties: Finney, Gray, Ford, Edwards and Pawnee

HUC 8's: 11030003 & 4

HUC 11s: Not Applicable

Drainage Area: 6931 miles² between Garden City and Larned

Main Stem Segments: 1 in 1103003 and 11,10 & 6 in 11030004 (Figure 1)

Tributary Segments: None

Designated Uses: All uses including Special Aquatic Life Support and Primary Contact Recreation

1998 303d Listing: Table 1 - Predominant Point and Non-point Source Impacts

Impaired Uses: Domestic Water Supply, Livestock Watering and Groundwater Recharge

Water Quality Standards: Domestic Water Supply: 250 mg/l at any point of domestic water supply diversion (K.A.R.28-16-28e(c) (3) (A)); Livestock Watering: 1000 mg/l (Table 1a of K.A.R. 28-16-28e(d));

In stream segments where background concentrations of naturally occurring substances, including chlorides, sulfates and selenium, exceed the water quality criteria listed in Table 1a of KAR 28-16-28e(d), at ambient flow, the existing water quality shall be maintained, and the newly established numeric criteria shall be the background concentration, as defined in KAR 28-16-28b(f). (KAR 28-16-28e(b)(9)).

In surface waters designated for the groundwater recharge use, water quality shall be such that, at a minimum, degradation of ground water quality does not occur. Degradation shall include any statistically significant increase in the concentration of any chemical contaminant in

ground water resulting from surface water infiltration or injection.
(K.A.R. 28-16-28e(c) (5)).

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 1998 303d: Not Supporting Domestic Water Supply or Livestock Watering

Monitoring Sites: Station 286 near Pierceville, 594 near Ford and 587 near Kinsley

Period of Record Used: 1987--1999

Flow Record: (USGS Stations on Arkansas River at Dodge City (07139500) and Kinsley (07140000)); Recorded daily data 1970 - 1999)

Long Term Flow Conditions: Average Flows from 1970 - 1999: Dodge City, 144 cfs, Kinsley, 135 cfs. Median flows: 35 cfs at Garden City, 0 cfs at Dodge City, 10 cfs at Kinsley; 7Q10 assumed 1 cfs throughout.

Current Conditions: Sulfate concentrations average 1875 mg/l at Pierceville over 1987-1999. Some dilution is seen downstream with averages of 826 mg/l at Ford and 924 mg/l at Kinsley. During the period 1990 to mid-1996 averages were 330 mg/l at Ford and 548 mg/l at Kinsley, reflecting the loss of flow along the Arkansas River in Gray County (Figure 2). The river, in essence, started anew, east of Dodge City during this period and sulfate levels were quite depressed. Discharge of groundwater into the river in Ford and Edwards counties introduces some intrusion of sulfate from Permian deposits below the Ogallala Aquifer north of the river, causing a downstream rise in sulfate levels at the predominant low flows seen during this period. After July 1996, flow conditions along the Arkansas River improved with increased flows coming from the Garden City area and passing through the historic losing stretch around Dodge City (Figure 2). With this increased flow came increased sulfate concentrations as seen throughout the upstream river reaches in Hamilton, Kearny and Finney counties. Average sulfate concentrations from August 1996 to 1999 were 1591 mg/l at Ford and 1504 mg/l at Kinsley (Figure 3). Therefore, the predominant loading of sulfate appears to come from contributions in western Kansas and Colorado.

Desired Endpoint Condition of Water Quality at Stations 594 and 587 over 2005 -2010

While the ultimate goal of a TMDL is attainment of the applicable criteria associated with the water quality standards and designated uses of the segment in question; 250 mg/l in this case, the historic data taken over the range of flows indicates that such a goal may be largely unattainable. Sulfate concentrations at Ford average 230 mg/l at estimated flows below 0.5 cfs, 350 mg/l at flows below 35 cfs and 1680 mg/l at flows above 35 cfs. At Kinsley, flows below 35 cfs average 550 mg/l sulfate and 1550 mg/l above 35 cfs. Under low flow conditions when these reaches

were disconnected from upstream reaches with perennial flow, ground water contributions to the river from northern geologic sources tended to be elevated in sulfate over the 250 mg/l standard. Once the river resumed flow through Finney, Gray and Ford counties, the sulfate levels rose three-fold. Until sulfate levels in the upper reaches are reduced, the likelihood of reaching the water quality standards along these river segments is remote. Should low water availability conditions resurrect the losing reaches of the river in Gray and Ford counties, sulfate levels should return to their pre-1996 levels, which still are above the water quality standard because of natural geologic contributions. Therefore, this TMDL will be phased, with dual Phase One endpoints currently proposed as a function of flow conditions at Kinsley and Ford.

The first endpoint will be to reduce the long term average sulfate concentration below the current average of 1550 mg/l at flows greater than 35 cfs at Kinsley. This endpoint reflects conditions when the river is flowing past Dodge City (Figure 4). A companion endpoint is established at the Ford monitoring site, and reductions below an average of 1680 mg/l are expected (Figure 5). Attaining this reduction should reflect attempts to reduce sulfate levels in the upstream reaches and capitalizing on the historic dilution of levels in a downstream direction.

The second endpoint applies at flows below 35 cfs at Kinsley and reduces the long term average below 550 mg/l at Kinsley and 350 mg/l at Ford. Because of the groundwater influence on the river in this region, the sulfate concentrations remain above the desired standard of 250 mg/l.

Anticipating that some background concentrations will be calculated as future water quality standards and recognizing that the short term will not yield achievement of the 250 mg/l criterion, these dual interim endpoints are established under this Phase. Future water quality standards will be utilized in the second Phase of this TMDL.

3. SOURCE INVENTORY AND ASSESSMENT

NPDES: There are three NPDES permitted wastewater facilities located along the Arkansas River in the vicinity of Dodge City. Cimarron uses a lagoon system to detain its wastewater, any sulfate in its effluent will reflect the sulfate content of its source water supply. Excel also uses detention lagoons and irrigates with its effluent, with discharge to the river confined to winter (off-irrigation season) periods. Monitoring data from its effluent indicates an average of 240 mg/l of sulfate.

DISCHARGER	STREAM REACH	SEGMENT	DESIGN FLOW	EXPIRATION DATE
Excel-Dodge City	Arkansas River	11	3 MGD	2001
Cimarron	Arkansas River	1	0.3 MGD	2001
UtiliCorp Elec	Arkansas River	11	0.05-1.3 MGD	2002

The electric plant, located in Dodge City, uses cooling towers and consequently has concentrations of sulfate which exceed 1000 mg/l routinely. Average concentration of sulfate in

the wastewater leaving the plant over 1996-2000 is 1900 mg/l. The effluent enters two detention lagoons where it is evaporated, seeps into the underlying alluvium or is discharged to the river. Because the plant is a peaking power generator, its operation and its discharge vary widely. Over 1996-2000, discharge from the plant averaged 0.35 MGD, but varied from 0.05 to 1.3 MGD. Given the evaporative loss of the effluent within the two ponds minimizing the volume of wastewater reaching the river, the low ambient concentrations of sulfate seen at low flows at Ford (230-310 mg/l) and the rise in sulfate with increased flow, the impact on the river from the power plant effluent appears to be confined to the Dodge City vicinity.

Irrigation Return Flow: As noted in the analysis of the current situation, large concentrations of sulfate enter the state at Coolidge and continue to be high at Pierceville. Loss of flow in Gray and Ford Counties creates moderate sulfate levels below Dodge City with some elevation in sulfate as the river moves into Edwards County. Once the river resumes flow, particularly past Dodge City, the sulfate levels increase significantly. Surface water irrigation is nil along these stretches of the river, with ground water irrigation predominating agricultural production. As such, there is little to none irrigation return flow downstream from Dodge City. Any excessive excursions of sulfate emanate from sulfate entering these reaches from upstream.

Background Levels: Sulfate has certainly been elevated within the ground water along the river for decades and it is likely that natural levels contributed from the interaction of the Arkansas River with Permian deposits underlying the Ogallala north of the river in Ford and Edwards County contribute to higher sulfate levels at Kinsley.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

The nature of sulfate loading along the Arkansas River reflects decades of natural contributions aggravated by patterns of irrigation water use and reuse along the upstream reaches near the stateline. Resumption of flow around Dodge City has brought about a significant increase in sulfate seen at Ford and Kinsley. Therefore, short term reduction in sulfate loads in this reach of river will be negligible. Improvement in sulfate levels above Garden City should result in gradual lowering of ambient concentrations of sulfate seen throughout these stream reaches. As such, widespread application of this TMDL and its desired endpoints is premature. Therefore, establishment of background levels is appropriate and allocations relative to point and non-point sources are to be made in light of those elevated levels and current contributions.

Point Sources: Unless point sources act to concentrate salts through reuse and evaporation, they will tend to discharge water that is similar in sulfate content to that within their water supplies. Excel's wastewater, discharged primarily in the winter, is of similar magnitude to the 250 mg/l standard and substantially lower in sulfate than the river condition. However, power plants can create effluent with high sulfate levels through evaporative concentrating in cooling towers.

The Wasteload Allocation will reflect the maximum flows coming from the two point sources (4.3 MGD) and a sulfate content consistent with the average seen at low flows (350 mg/l). This

equates to 6.3 Tons per day of sulfate. Individual allocations consider the sporadic discharge from Excel, Excel's lower sulfate content and anticipated evaporative loss from the power plant. Holding to an average 1 MGD at 240 mg/l for Excel, corresponding to an allocation of 1 Ton per day, leaving 5.3 Tons per day to the power plant. This allocation is equivalent to an average flow of 0.85 MGD reaching the river and lowering its average concentration to 1500 mg/l. Over 50 months in 1996-2000, the power plant discharged less than 0.85 MGD 90 percent of the time.

Since upstream water is now passing through Dodge City, the flow of these outfalls will be masked by the receiving flows. Should the river lose water upstream of Dodge City, the wastewater from the Dodge City area could constitute the main constitution of flow in the river, depending on the stream's interaction with the surrounding ground water. This Wasteload Allocation applies to the reach between Dodge City and Ford. No other point source dischargers are present along the reach governed by this TMDL, therefore, the Wasteload Allocation for the other reaches will be zero. Should future point sources be proposed along the river and discharge into the impaired segments, the current wasteload allocation will be revised by adjusting current load allocations to account for the presence and impact of these new point source dischargers.

Non-Point Sources: The primary cause of elevated sulfate throughout these stream reaches is the sulfate level of flow in the Arkansas River flowing past Dodge City and reflects the sulfate levels of the river upstream where surface flow is an perennial event. The sulfate reflects a natural contribution from the geology and soils of the drainage area in the valley aggravated by the historic pattern of irrigation return flow along the river, a non-point source. The Load Allocation will be to reduce the sulfate content of Kinsley flows over 35 cfs over the next ten years. This allocation will be plot as future sampled loads below the TMDL curve (Figure 4).

Defined Margin of Safety: The Margin of Safety is implicit based on the conservative assumption that any anthropogenic loading of sulfate along these stream reaches is estimated to be lower in concentration than the loads calculated under this TMDL reflecting the loads transported by flows originating in the western plains. At higher flows which coincide with the incidence of elevated sulfate, any point source impacts will be masked by upstream non-point and natural contributions. Additionally, the Margin of Safety will be set to protect the low flow regime of this segment against future loadings of sulfate causing increases beyond 350 mg/l at flows below 35 cfs. Therefore, the margin of safety will reflect favorable sulfate conditions when the Arkansas River does not flow at Dodge City which corresponds to a flow at Kinsley below 35 cfs under those conditions. Therefore, the margin of safety will maintain sulfate levels below 350 mg/l at low flow conditions, by withholding 10% of available wasteload allocations from future point sources.

State Water Plan Implementation Priority: This TMDL will be a Medium Priority for implementation because of the influence of upstream sulfate loading entering these stream reaches, the need to establish background levels reflecting the entry of flow with high ambient concentrations, the time needed to establish any sulfate improvements in the upstream reaches and the need to ascertain the fate of wastewater discharge volumes under conditions seen on the

river prior to 1996.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Arkansas-Dodge City and Arkansas - Pickle Subbasins (HUC 8: 11030003 and 4) with a priority ranking of 31 (Medium Priority for restoration work).

Priority HUC 11s and Stream Segments: Because the sulfate impairment is confined to the mainstem of the Arkansas River, priority will be given to Segment 11 as the entry point of high sulfate within water coming from upstream and is the segment where point source discharges are located.

5. IMPLEMENTATION

Desired Implementation Activities

1. Renew necessary state and federal permits and monitor permitted facilities for permit compliance with appropriate effluent limits
2. Establish appropriate background concentrations and confirm designated uses
3. Evaluate improvement in sulfate levels resulting from long term irrigation return flow management above Garden City.

Implementation Programs Guidance

NPDES and State Permits - KDHE

- a. Municipal and industrial permits for facilities along river will be renewed in 2002 with appropriate sulfate effluent limits reflecting background concentrations.

Water Quality Standards and Assessment - KDHE

- a. Confirm designated uses of domestic water supply and livestock watering on stream reaches
- b. Establish background levels of sulfate for Ford and Kinsley monitoring sites

Water Quality Planning - KDHE

- a. Collaborate with Colorado on comprehensive irrigation return flow management plan for reduction in sulfate and selenium loadings

Subbasin Water Management - Division of Water Resources

- a. Evaluate stream-aquifer interaction at low flow conditions at Dodge City.

Timeframe for Implementation: Work on the upstream management of sulfate levels, including that crossing the stateline will commence over 2000-2005. Evaluation of impact of any sulfate control on downstream reaches should occur after 2005.

Targeted Participants: Primary participants for implementation will be KDHE and permitted facilities in the Dodge City area. Otherwise, activity is deferred to that which has to occur along the river above Garden City.

Milestone for 2004: The year 2005 marks the mid-point of the ten year implementation window for the stream segments. At that point in time, some consideration of upstream water quality improvement on downstream reaches should be evaluated. Additionally, sampled data from Station 594 should indicate evidence of reduced sulfate levels at flow conditions relative to the conditions seen over 1987-1999.

Delivery Agents: The primary delivery agents for program participation will be the Kansas Department of Health and Environment.

Reasonable Assurances:

Authorities: The following authorities may be used to direct activities along the river 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.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.
4. The Federal Safe Drinking Water Act empowers KDHE to develop Source Water Protection Assessments and Plans.
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-1803 creates the Water Conservation Projects Fund to be administered by the Kansas Water Office for water conservation and water use efficiency projects in the Upper Arkansas River Basin impacted by the Arkansas River Compact.
7. The *Kansas Water Plan* and the Upper 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.

8. K.S.A. 82a-701, et seq. authorizes the Chief Engineer and the Division of Water Resources to administer water appropriations in the state, including prevention of waste and planning and practicing water conservation.

Funding: The Water Conservation Projects Fund receives a portion of the funds recovered through the litigation over the Arkansas River Compact. The Fund is to be used for projects involving efficiency improvements to canals, water use efficiency devices, tailwater systems of irrigation system efficiency upgrades, monitoring equipment, artificial recharge or water right purchase and maintenance of the Arkansas River channel.

Other protection or planning activities are incorporated within the Upper Arkansas Basin Plan of the *Kansas Water Plan*. The state water planning process, overseen by the Kansas Water Office, coordinates and directs programs and funding toward watersheds and water resources of highest priority. Typically, the state allocates a portion of the \$16-18 million available annually from the State Water Plan Fund to water quality and water conservation projects and programs. While most of this Medium Priority TMDL involves implementation activities after 2005, some monitoring and assessment activities should be considered for funding in the 2002-2005 time period.

Effectiveness: Irrigation return flow controls are difficult to implement, although tailwater management has been practiced in Kansas for decades. The influence of upstream sulfate levels complicates the ability of the state to implement this TMDL. As such, the priority for this TMDL will remain Medium, as the state evaluates downstream benefits from irrigation return flow management in western Kansas and Colorado.

6. MONITORING

KDHE should collect bimonthly samples at Stations 594 and 587 over 2000-2010 in order to assess progress in implementing this TMDL over each of the three defined seasons during the initial implementation period. During the evaluation period (2005-2010), more targeted sampling may need to be conducted under all flow conditions in order to determine the achievement of the desired endpoints of this TMDL. Use of the real time flow data available at the Dodge City and Kinsley stream gaging stations can direct sampling efforts.

Monitoring of sulfate levels in effluent will be a condition of NPDES and state permits for facilities discharging to the Arkansas River.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Upper Arkansas Basin were held

March 8, 2000 and April 24, 2000 in Garden City. 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 Upper Arkansas Basin.

Public Hearing: A Public Hearing on the TMDLs of the Upper Arkansas Basin will be held in Garden City on May 31, 2000.

Basin Advisory Committee: The Upper Arkansas Basin Advisory Committee met to discuss the TMDLs in the basin on October 6, 1999; January 11 and 24, 2000; March 8, 2000;

Discussion with Interest Groups: Meetings to discuss TMDLs with interest groups include:
Associated Ditches of Kansas: October 6, 1999; January 28, 2000; March 8, 2000; and April 24, 2000.
Agriculture: February 28, 2000
Environmental: March 9, 2000

Milestone Evaluation: In 2005, evaluation will be made as to the degree of improvement in water quality in downstream reaches from activities occurring above Garden City. Subsequent decisions will be made on further implementation after 2005.

Consideration for 303d Delisting: The river will be evaluated for delisting under Section 303d, based on the monitoring data over the period 2005-2009. Therefore, the decision for delisting will come about in the preparation of the 2010 303d list. Should modifications be made to the applicable water quality criteria during the ten year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may be adjusted accordingly.

Incorporation into Continuing Planning Process, Water Quality Management Plan and the Kansas Water Planning Process: Under the current version of the Continuing Planning Process, the next anticipated revision will come in 2002 which will emphasize revision of the Water Quality Management Plan. At that time, incorporation of this TMDL will be made into both documents. Recommendations under this TMDL will be considered in *Kansas Water Plan* implementation decisions under the State Water Planning Process after Fiscal Year 2005.

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