# *WATER QUALITY AND USE*

## Beneficial Use Attainment

The Crooked River basin is designated as suitable for aquatic life, fishing, wildlife and livestock watering (MDNR 1986b, MDNR 1995). Aquatic life and fishing are expected to be partially attained, although the numbers and diversity should remain relatively low due to non-point source suspended solids and sedimentation. Occasional low dissolved oxygen in short reaches may be caused by both point and non-point pollution sources. Water quality should be satisfactory for wildlife and livestock watering. (MDNR 1995)

Soil erosion, sediment deposition and turbidity all contribute to aquatic habitat degradation. If erosion, stream channel modification, increasing nutrient inputs, and their related water quality problems continue, beneficial uses will not be attained in the future (MDNR 1986b).

## Chemical Quality of Streamflow

It is probable that the streams in Northwest Missouri were historically prone to reduced water quality from turbidity and sediment due to the nature of the soils in the area. The activities of man, chiefly channelization and poor agricultural practices, have magnified sediment delivery, turbidity and their associated problems in the waters of Northwest Missouri (MDNR 1986b).

Historically, the water quality in the Crooked River basin has been good as Topeka shiners, a species sensitive to poor water quality, were found in the basin as late as 1965. The basin has more bedrock and gravel/cobble substrate, similar to that found in the Ozarks, than most other streams in northwestern Missouri. The lower sections of the basin (primarily the Missouri River flood plain) have been altered through extensive channelization and levees but the upper reaches are relatively undisturbed. The East Fork Crooked River from Millville upstream, rapidly becomes less turbid and rocky substrates become more common. The upper end of the West Fork Crooked River upstream of the Stewart Road/Highway 10 bridge area becomes quite rocky and clear. The mainstem Crooked River from Bluejay Access upstream rapidly clears and becomes Ozarkian in nature with bedrock, numerous gravel shoals and limestone bluffs present. Most of the tributaries above these areas are also clear and have rocky substrates. Localized areas are silty on these streams where channelization, agricultural or developmental activities are occurring. The water in the lower two thirds of the basin becomes progressively more turbid and silt laden. There is no documented quantitative water quality information for the Crooked River basin. However, water quality basin-wide is probably some of the best to be found in Northwest Missouri.

Water quality at low flows deteriorates due to lack of water volume to dilute point and non-point source pollution (MDNR 1986b). Soil erosion, sediment deposition and turbidity all contribute to water quality degradation (MDNR 1986b). Temperatures in excess of 27$^{o}$ C are detrimental to spawning and egg development of many fish (USDA-SCS 1982). Because of shallow water and low flows, this temperature may be exceeded in the Crooked River and its tributaries. Effects from sewage treatment plants are minor in the watershed (MDNR 1995). In general, water quality is good, but low flows and excessive sediment cause problems and threaten to further degrade water quality if current agricultural and developmental activities continue (MDNR 1986b).

## Contaminants, Fish Kills, and Health Advisories

A general fish consumption advisory has been issued for all waters of Missouri, excluding the Ozarks, by the Missouri Department of Health (MDOH) since 1985 (MDOH 1996). The MDOH recommends eating no more than one pound per week of bottom feeding fish such as catfish, buffalo, drum, common carp, suckers and paddlefish from the Crooked River and its tributaries. No consumption advisories apply to bass, sunfish, crappie or walleye (MDOH 1996).

A possible threat to the basin is the increasing number of concentrated animal feeding operations. Manure spills and improper land application of waste residues from these facilities have caused serious water quality problems and fish kills in other river basins in Missouri (MDNR 1996a). The reduced volume of water associated with low base flows could create serious problems for aquatic communities in the Crooked River basin if improper disposal practices at one of these facilities was to occur.

## Water Use

A. Municipal - Population was projected to grow by about 35% over the 20 years from 1980 to 2000 (Skelton 1982). In actuality, population in Ray County only increased by 10% from 1980 to 1998 (U.S. Census Bureau Website).This indicates that pressure to develop water resources in the Crooked River Basin may be lower than anticipated. Municipal water use in the basin is about 737,889,500 million gallons per year (Ray County statistic; DuCharme and Miller 1996). Most municipal water is provided through rural water districts. They get their water primarily from groundwater wells tapping the Missouri River alluvium. These wells usually yield between 500 and 1500 gallons per minute. Millville obtains its water from an alluvial well along the East Fork Crooked River. Groundwater wells outside alluvial areas in the Crooked River basin usually are low yield (less than 5 gallons per minute) and high in chlorides and sulfates. Shallow low yield household wells drilled in glacial drift materials can be suitable for most domestic uses, however undesirable concentrations of nitrate, iron and manganese are commonly encountered in the Crooked River basin area (Detroy and Skelton 1983). Groundwater from deeper, higher yield wells is generally too mineralized (often greater than 10,000 ppm total dissolved solids) to be useable (MDNR 1986b). In general the groundwater does not meet chemical drinking water standards of the U. S. Health Service (Preston 1986).

B. Agricultural - Irrigation has been a relatively minor use of water in the basin with less than 5,000 acres irrigated (Ray County statistic; DuCharme and Miller 1996). The largest agricultural users of water are livestock (100-175 million gallons per year used in Ray County; DuCharme and Miller 1996).

## Point Source Pollution

The primary point source pollution in the Crooked River basin comes from wastewater treatment facilities (WWTF). These are located on a tributary of Brushy Creek (Lawson WWTF), unnamed tributary #8 on the East Fork Crooked River (Polo WWTF), and an unnamed tributary on the West Fork Crooked River (Richmond North WWTF; MDNR 1995). A 0.3 mile reach of Unnamed Tributary #8 was affected by sludge and reduced benthos from the Polo WWTF discharge (MDNR 1995). An unnamed second order tributary was suffering water quality problems as a result of the Richmond North WWTF discharge. Four miles of the West Fork Crooked River were affected by excessive aquatic plant growth and reduction of aquatic life below the Missouri State Highway 13 bridge crossing (MDC 1978). The Richmond North facility was upgraded in 1971 and the water quality was noted as dramatically improved (MDC files). Monitoring by the MDNR over several years indicated that water quality has improved

downstream of the Richmond North WWTF through 1996 (MDNR personal communication). Most of the point source pollution permits issued in the Crooked River basin are located near the towns of Richmond and Henrietta, Missouri in the lower section of the basin (Table 2, Figure wt). Impacts from these sources would be seen primarily in the West Fork Crooked River, tributaries west of the mainstem Crooked River in the Missouri River floodplain and the lower Crooked River from its confluence with the West Fork Crooked River to the Missouri River. Without quantitative water quality information, it is not possible to gauge the impact of these discharges in the Crooked River basin.

Concentrated animal feeding operations (CAFOs) are a growing presence in the basin (12,946 Population Equivalency units (PE) in 1998). This is about three percent of the basin PE's attributable to livestock. A list of all permitted CAFOs in the basin can be found in Table 3 (Figure ca). There is a history of problems with discharges from these operations in other areas of Missouri. Serious impacts on water quality and aquatic organisms in the Crooked River basin would result should an effluent spill occur at one of these facilities.

Household trash (including tires and appliances) was seen in basin streams at several locations. Also noticed were large gullies filled with trash. It appears that dumping in and along basin streams is a common practice.

## Non-Point Source Pollution

The main threat to aquatic resources in the Crooked River basin is sediment from erosion. This particular problem is found throughout the watershed. The estimated sediment yield for the Crooked River basin area was 750 - 1000 tons per square mile per year (Skelton et al. 1982) or about 2.6 tons per acre per year (Anderson 1980). Sheet and rill erosion was estimated to be 18-24 tons per acre per year for tilled land, 5-9 tons per acre per year for pasture and 0.25 to 0.5 tons per acre per year for non-grazed forest lands in the Crooked River basin. Gully erosion in the basin was rated as severe with the yield to streams from this source ranging from 200 - 499 tons per square mile per year (Anderson 1980). In the area, including the Crooked River basin, the source of sediments was estimated to be 74% sheet and rill erosion, 22% gully erosion, 3% streambank erosion and 1% urban development (Anderson 1980). There are concerns with elevated levels of agricultural herbicides, in particular atrazine, during the spring and summer in streams that are used to augment drinking water supplies (MDNR 1996a). As of 1996, there were no municipal surface water drinking supply withdrawals in the Crooked River basin (MDNR 1996b).

Ray County has 160,000 acres that are considered prime farmland (109,000 acres have the caveat "where drained" applied to them). Of this amount, 38,000 acres are on ridgetops with less than a 5 percent slope. The remainder are on alluvial soils associated with the floodplains of the Missouri River and its tributaries (Preston 1986). Alluvial farmland in the basin would be limited, as the floodplain is not very wide until it merges with the Missouri River floodplain. The area where the Missouri River floodplain and the Crooked River floodplain intersect takes in about four miles of the lower Crooked River. This area is very flat, fertile and floodprone. Channelization of the mouth of the Crooked River and several of its floodplain tributaries has been carried out in order to drain and cultivate this area.

The number of livestock in the Crooked River basin is equivalent to a human population of 437,550. This figure was obtained using the Missouri River basin (hydrologic river basin number 10300101) statistic for livestock (2,917,000 Human population equivalency units [PE]) and multiplying it by the percentage of the basin in the Crooked River watershed (15% [2,917,000 PE X .15 = 437,550 PE]). This is about twenty times the size of the basin population (21,971 people in Ray County). The majority (97%) of

livestock are ranging animals and have access to basin streams. Stream bank erosion and excess nutrients are two known problems caused by unrestricted access of livestock.

Coal mining operations were conducted in the Crooked River basin from the 1870's to the 1950's. There were four general areas in the Crooked River drainage that were mined for coal (Figure 5). One was between Polo and Knoxville near the headwaters of the Fire Branch. Another was east of Knoxville just below the confluence of the East Fork Crooked River and Unnamed Tributary # 8. The third area was along the West Fork Crooked River near Richmond. The fourth area was near the mouth of the old Crooked River channel (Detroy and Skelton 1983). Many of these areas can be located in more detail using the 7.5 minute series topographical maps listed in Appendix C. The area of the Crooked River from the confluence of the West Fork Crooked River and mainstem Crooked River to the Missouri River was projected as an area of potential future surface coal mining (Skelton et al. 1982). Most of the Crooked River basin is underlain by surface mineable coal (Detroy and Skelton 1983).

In 1978, several areas in the Crooked River basin were noted as being impacted by non-point source pollution (Figure 5). Using aerial photographs and topographical maps it appears these areas were impacted because of upstream channelization though it was not specifically mentioned. The following reaches were noted as impacted from both sediment and reduced instream habitat: 20 miles of the Crooked River in Caldwell and Ray counties below the road crossing in T55N, R29W, Sec 29, 17 ½ miles of the Crooked River below the Missouri State Highway 13 crossing north of Richmond, and two miles of the Fire Branch in Ray County below the road crossing in T53N, R28W, Sec 3 (MDC 1978).

Table 2. Permitted point source discharges in the Crooked River basin.

| Facility | Facility ID | Location (T-R-S) | Receiving Stream | County |
|---|---|---|---|---|
| Polo WWTF | MO0041238 | 55N-28W-27 | Unnamed tributary #08 | Caldwell |
| Lawson | ND7100444 | 54N-29W-31 | Tributary to Brushy Creek | Ray |
| Lawson WWTF | MOG640003 | 54N-29W-30 | Tributary to Brushy Creek | Ray |
| MFA Agri Service Lawson | MOR240381 | 54N-29W-30 | Tributary to Brushy Creek | Ray |
| Organic Matters Composting | MOG970003 | 53N-27W-03 | Tributary to East Fork Crooked River | Ray |
| Richmond N. WWTF | MO0021822 | 52N-27W-19 | Tributary to West Fork Crooked River | Ray |
| Richmond Quarry | MOG490208 | 52N-28W-19 | Tributary to West Fork Crooked River | Ray |
| Russell & Sons Fertilizer | MOR240418 | 53N-27W-16 | Tributary to East Fork Crooked River | Ray |

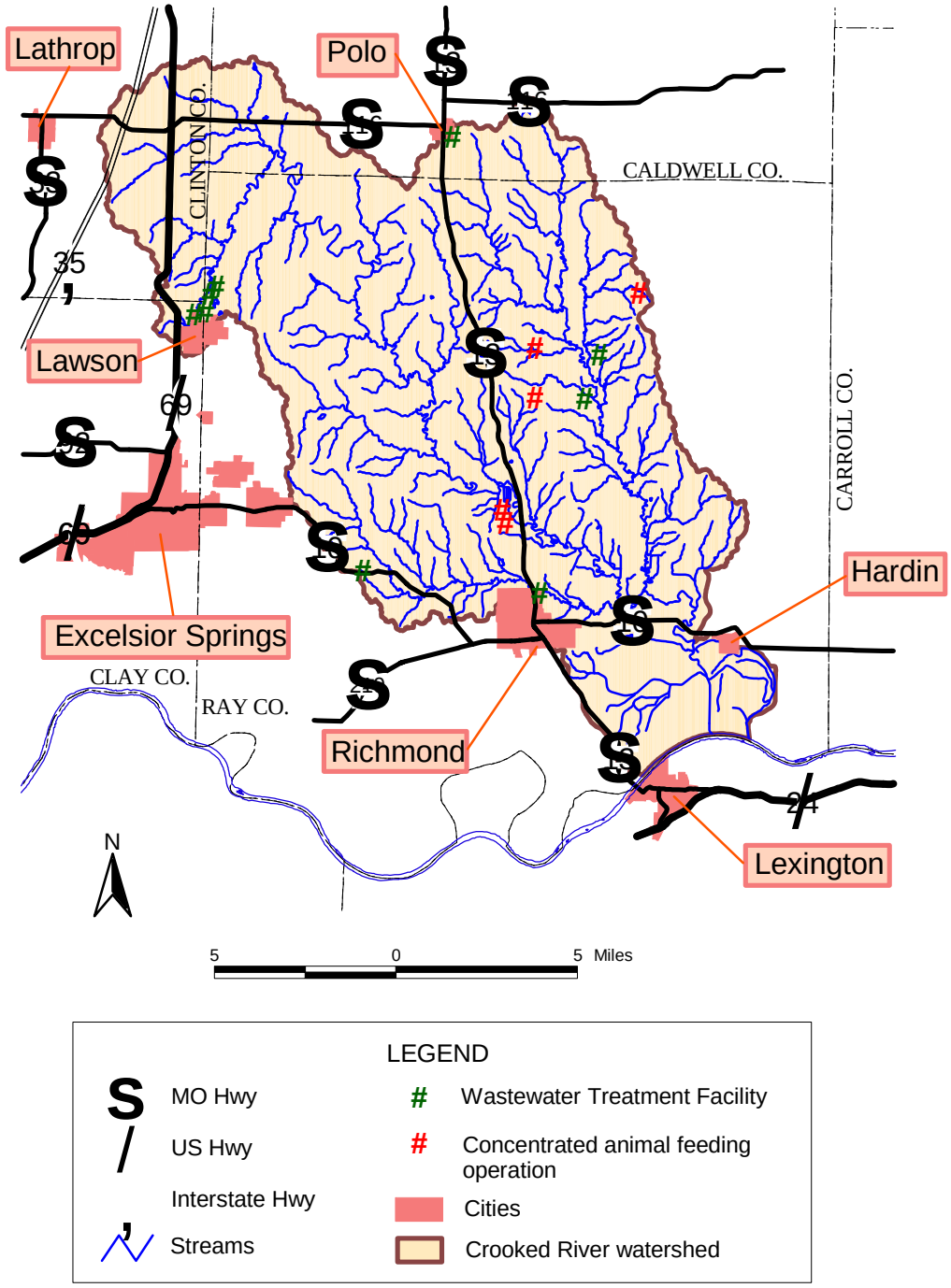


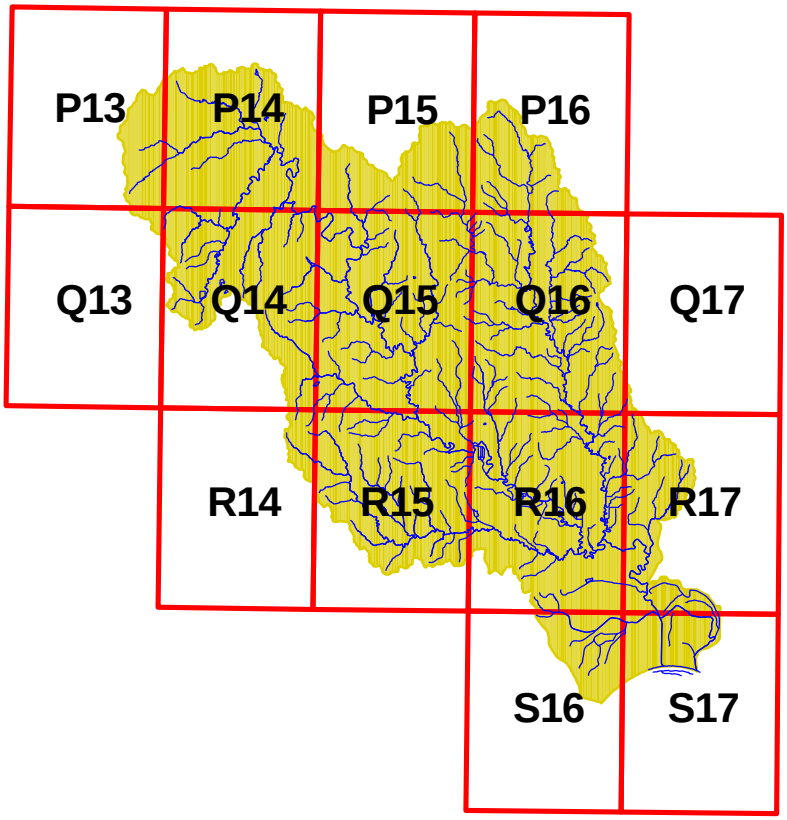

Figure wt/ca. Wastewater treatment facilities and concentrated animal feeding operations within the Crooked River watershed.

Table 3. Permitted concentrated animal feeding operations (CAFOs) in the Crooked River basin.

| Facility | Facility ID | County | Design Pop. Equivalent | Animal Units | Animal Type[1] | Location (T-R-S) |
|---|---|---|---|---|---|---|
| Earl Carter | LA7000362 | Ray | 1056 | 480 | SF | 52N-28W-12 |
| Jerry Miller | LA7103827 | Ray | 4320 | 1920 | SF | 53N-27W-06 |
| Laverne Schlavach | LA7103834 | Ray | 4500 | 2000 | SF | 53N-27W-18 |
| Snead Brothers | LA7100953 | Ray | 2970 | 1350 | SF | 54N-27W-26 |
| Wayne Ulbright | LA7100507 | Ray | 100 | 4 | HS | 52N-28W-01 |

[1] - SF - Swine Finishing, HS - Horse Facility

Appendix C. 7.5 minute series, 1:24,000 scale, USGS topographic map quadrangles and indexing system used in the Crooked River basin.




| 13 | 14 | 15 | 16 | 17 | |
|---|---|---|---|---|---|
| Lathrop (1984) | Elmira (1984) | Polo (1984) | Cowgill (1984) | | **P** |
| Holt (1990) | Lawson (1990) | Knoxville (1979) | Millville (1979) | Stet (1979) | **Q** |
| | Excelsior Springs (1990) | Rayville (1979) | Richmond (1979) | Hardin (1978) | **R** |
| | | | Lexington West (1979) | Lexington East (1978) | **S** |