Minnesota Pollution Control Agency

Minnesota River - Cottonwood River Watershed

Physiography and Description

The 1,284 square mile Cottonwood River Watershed is situated between the Little Cottonwood River Sub-Watershed to the east and the Redwood River Watershed to the west. The watershed drains sections of Lyon, Murray, Cottonwood, Redwood, and Brown counties. The River itself originates in the Northern Glaciated Ecoregion on top of the Coteau des Prairies or "Highland of the Prairies," an impressive morainal plateau and important drainage divide, so named by French explorers. Except for a few isolated wetlands set aside by state and federal agencies, many of the Coteau's wetlands have been drained and converted to cultivated fields. In addition, a large proportion of the Coteau's small creeks and streams have been ditched and straightened, permitting earlier planting and allowing more acres to be placed into production.

Headwaters of the Cottonwood are in the marshes of Rock Lake, in southwestern Lyon County, from which the river wanders on the Coteau for about twenty miles as an intermittent stream. Characterized by landscapes with long northeast facing slopes of moderate steepness, the majority of the Coteau (72%) is classified as having a high water erosion potential. Its well drained, loamy southwestern side sheds water into the Big Sioux River while on the other side of the divide, waters flow across well drained loamy soils and into the Des Moines and Minnesota rivers.

Above Amiret, the Cottonwood, still a very small stream, plunges through a deep, wooded valley and drops 200 feet off the highlands over a distance of approximately five miles. Turning southeast, the river flows along the base of the Coteau's moraines and receives many small tributaries and intermittent streams that also come down the highland's slope. Leaving the base of the Coteau, the Cottonwood enters the Blue Earth Till Plain of the Western Cornbelt Ecoregion. The River then flows east, enters the Minnesota River Valley and flows through a heavily wooded valley to its mouth at New Ulm. Lands within this section of the Blue Earth Till Plain are characterized as being a complex mixture of gently sloping (2-6%) well drained loamy soils and nearly level (0-2%) poorly drained loamy soils. Artificial drainage to remove ponded water from flat and depressional areas is extensive. Water erosion potentials are moderate on much of these lands (46%).

Geology And Land Use

The oldest and deepest rocks of the Cottonwood River Watershed are Precambrian in origin and underlie the entire watershed. These hard, relatively impermeable crystalline rocks are of igneous and metamorphic origins. Overlying the Precambrian rocks are Cretaceous deposits of shale and sandstone, ranging in thickness from over 500 feet in the western part of the watershed to less than 100 feet in thickness in the central and eastern sections of the watershed. Thick glacial deposits cover almost the entire watershed and are predominantly till, an unstratified mixture of clay, silt, sand, and gravel. Beds of sand and gravel exist within the till and are often used for aquifers in the watershed.

Land use within the Cottonwood River Watershed is primarily agricultural, accounting for approximately 84% of the available acres. Corn and soybeans are grown on approximately 92% of cropped lands; small grains, hay, and grasslands enrolled in the Conservation Reserve Program (CRP) make up the majority of the balance. Early 1996 estimates were that approximately 4% of the agricultural acres within the watershed were enrolled in the CRP program, a voluntary federal program that offers annual rental payments to farmers in exchange for planting areas of grass and trees on lands subject to erosion. Crop lands are generally classified as moderately productive (94%).

1996 figures estimated there are roughly one million cattle and three million hogs in the Minnesota River Basin, of which, approximately 30 percent of the cattle and 50 percent of the hogs are raised within the southeastern section of the basin. An additional 30 percent of the cattle and 25 percent of the hogs are located in the southwestern portion of the basin.

Climate

The climate within the Cottonwood River Watershed is continental, with cold dry winters and warm wet summers. Average monthly temperatures range from 11.30 F in Jan. and 72.30 F in July (recorded at Lamberton SW experimental station). An average of twenty six to twenty nine inches of precipitation annually fall within the watershed with more than two thirds of this precipitation normally falling in the five months from May through September. Average annual runoff is estimated at approximately three inches. Over eighty five percent of the precipitation falling within the watershed is returned to the atmosphere through the processes of evaporation and transpiration.

Water Quality

Ground Water

Aquifers throughout the watershed serve two major functions in the hydraulic system; they are sources of water supplies, and they furnish a perennial base of streamflow by ground water discharge.

Water supplies are obtained from wells tapping Pleistocene glacial deposits, Cretaceous sandstone, Cambrian sandstone, and Precambrian crystalline rocks. The most accessible and widely used aquifers are beds of sand and gravel buried in the glacial deposits. Dominant regional ground water flow is northeastward from the topographic high in the southwest toward the Minnesota River. Local flow patterns indicate ground water discharging into rivers and creeks. Most of the Cottonwood River Watershed is an area of ground water recharge, indicated by a decreased in hydraulic potential as depth below land surface increases.

The dissolved solids and water type in surficial aquifers (less than 100 feet deep) depend on mineral composition of the glacial sediment and the solubilities of these minerals, ground water movement, and agricultural pollutants. End moraines having good surface drainage generally contain water having the largest concentration of dissolved solids (>1000 mg/l) which is of the calcium magnesium type. Water from wells completed in sand and gravel and ground moraine deposits are generally of calcium magnesium bicarbonate type, with concentrations of dissolved solids less than 1000 mg/l. Nitrate concentrations greater than 45 mg/l are more frequent in shallow wells affected by infiltration of water through barnyard or feedlot wastes.

Surface Water

The Cottonwood River is somewhat different from the Minnesota River's other three major tributaries running off the Coteau (the Redwood, Yellow Medicine, and Lac Qui Parle rivers); it is longer, larger, and has a greater drainage area with a different drainage pattern in that nearly all of its tributaries are on the south side of the river. There are several reasons for this odd drainage pattern. One reason is the uniform northeastward slope from the crest of the Coteau; another is the presence of a terminal moraine along the north bank of the stream from near Marshal to Sanborn. The position of this moraine indicates that the valley of the Cottonwood was developed along the southwest margin of the Des Moines lobe of the last glacier, at a time when the ice recession was halted and the moraine that parallels the valley was formed. Very few tributaries enter the Cottonwood from the north side; the major one is Sleepy Eye Creek, entering near the upper end of the lower reach on the lowland plain. Nine major creeks outlet to the Cottonwood River and fourteen lakes are contained within the watershed. Wetland drainage has been extensive throughout the portion of the watershed contained within the Blue Earth Till Plain, a Clean Water Partnership grant application for the Cottonwood River Restoration Project states there are currently less than 4,000 acres of wetlands within the watershed. Overall, the Cottonwood River flows about 100 miles and drops a total of 750 feet from Rock Lake to the Minnesota River. Average gradient of the river is seven and one-half feet per mile.

Flooding is a significant problem in the central portion of the watershed. Most of the smaller tributaries have no natural storage; therefore, they cease to flow during droughts, and flood as the result of snowmelt and excessive precipitation.

Today, pollution of surface waters in the Minnesota River's major watersheds is a moderate to severe problem. Constituents of concern often include: suspended sediments, excess nutrients (primarily nitrogen and phosphorus), pesticides, pathogens, and biochemical oxygen demand. High concentrations and loads of suspended sediments and nutrients can often be linked to artificial drainage patterns (ditches, tile, etc.) and wetland reductions. Alone or in combination, these landscape alterations have effectively increased the hydraulic efficiency and magnitude of storm and snowmelt runoff events. Estimates vary, but about 80 percent of the wetlands in the Minnesota River Basin have been drained and converted to other uses. High nutrient levels in lakes and streams often result from over-land runoff across erodible soils.

Eroded soils and the runoff which transport these particles often carry pesticides and excess nutrients to receiving waters. Increased discharges and elevated flood peaks also erode streambanks, destroy shoreline vegetation and deposit sediment on floodplains, in streams, and in downstream receiving waters. Sediment in water often leads to impaired habitat for aquatic life, decreased photosynthetic activity, and reduced recreational quality. Excessive levels of nutrients often promote eutrophication; defined as nutrient rich oxygen poor water. Elevated nutrient levels often promote abundant algal populations which in turn can cause large diurnal fluctuations in dissolved oxygen concentrations (photosynthesis being responsible for daytime highs, respiration for nighttime lows). In addition, algal decomposition is often a major factor responsible for high biochemical oxygen demand (BOD) levels. BOD is the amount of oxygen consumed-biologically and chemically-over a five day period. The BOD test reflects the effect of easily decomposed organic materials on oxygen depletion. Other sources of organic materials include eroded organic materials associated with sediment or manure, and discharges from faulty wastewater treatment plants, and faulty septic systems. The presence of water-borne pathogens is often characterized by determining the population of fecal coliform in water quality monitoring samples. Fecal coliform are a subset of bacterial populations, and generally arise from the fecal excrement of humans, livestock, and water fowl. Common sources of fecal coliform include feedlots, faulty wastewater treatment plants, and faulty septic systems.

Table 4.28: Estimates of Point Source Phosphorus Loads for the Cottonwood River (1996)

7020008	Cottonwood River Watershed				
NPDES# (National Pollutant Discharge Elimination Number)	Permittee	Ave. Annual Flow (MGD)	Discharge Facility	Total Phos. Conc. (mg/L)	Total Phos. Load (lbs./yr.)
MN0031348	LUCAN	0.0096	POTW*-pond	2	58

MN0020524	WANDA	0.0278	POTW (lake)	4	338
MN0052248	STORDEN	0.0011	POTW	4	13
MN0024805	SANBORN	0.0262	POTW-pond	2	159
MN0025151	WABASSO	0.1179	POTW	4	1,433
MN0021776	WALNUT GROVE	0.1177	POTW	4	1,431
MN0025232	WESTBROOK	0.0516	POTW-pond	2	314
MN0023922	LAMBERTON	0	POTW-pond	2	0
MN0021725	TRACY	0.5178	POTW-pond	2	3,148
MN0021962	SLEEPY EYE	0.7323	POTW-pond	2	4,451
MN0023043	CLEMENTS	0.008	POTW-pond	2	49
MN0024953	SPRINGFIELD	0.3158	POTW	4	3,839
MN0030066	NEW ULM	2.2676	POTW	5.4	37,217
MN0061646	OCHS BRICK&TILE SPRINGFIELD	0.2017	quarry	0.1	61
MN0022284	SCHELL AUGUST BREWING CO	0.0854	NCC, RO	1	260
MN0046418	SPRINGFIELD PUBLIC UTILITES	0	power plant	0.1	0
				Total	52375

Table 4.29

Mean Total Phosphorus Concentrations: Cottonwood River		
	Frequency	**Mean Annual TP Concentration (mg/l)**
Cottonwood River	annual	0.235
Cottonwood River	summer only	0.280
Western Corn Belt Ecoregion	annual	0.304
Minnesota River Basin	annual	0.251

Table 4.30

Water Quality Characteristics: Cottonwood River Phosphorus and Total Suspended Sediment	
Cottonwood River Mean Annual Flow Minnesota River Mean Annual Flow	322 cfs 4,266 cfs
Total Phosphorus Estimated TP Load (March - Aug)[a] % of MN R Basin TP Load[b]	61.52 tons 5.21%
Total Suspended Sediment Estimated TSS Load (March - Aug)[a] % of MN R Basin TSS Load[b]	38,473 tons 8.14%

[a] - Estimated by the University of Minnesota's Department of Soil, Water and Climate.
[b] - based on total load contributions to the Minnesota River (point and nonpoint sources)

Table 4.31: Percent Of Cottonwood River Samples That Exceed Water Quality Standards

Parameter	**Percent of Samples Exceeding Assigned Water Quality Limits**		
	Standards	**April - June**	**July - August**
Turbidity	25 NTU	26%	17%
Fecal Coliform	200 org./100 ml	80%	93%

* percent of samples in violation do not meet the frequency of sampling requirements of state law (see above), but representing the percentage of pre-1997 samples collected over the past 30 years which have exceeded 200 organisms/100 ml.

A study conducted between 1967 and 1976 by the U.S. Geologic Survey (Tornes, 1986), found average concentrations of suspended sediments at the mouth of the Cottonwood River to equal 92 mg/l, an average yield of 55.7 tons/ mi2, and a maximum daily yield of 76.5 tons/ mi2. The study further noted that maximum suspended sediment concentrations at most sites in the Minnesota River Basin commonly were high, although the basin wide high, maximum daily concentration recorded during the study period was at the Cottonwood River near New Ulm (3,650 mg/l). The researchers suggested, "the wide fluctuations indicated by the difference between average and maximum concentrations in this relatively flat basin suggest that most sediment is transported after storms erode fine-grained soils exposed by heavy cultivation." In fact, the lower section of the Cottonwood downstream from Sleepy Eye, once running clear with clean stony bottoms, used to support a moderately large smallmouth fishery, the fishery has declined through the years because of increased sediment loads in the stream

Results from twenty one samples collected from the Cottonwood River near New Ulm during the Minnesota River Assessment Project (MRAP) show a pattern similar to that summarized in the USGS report. Although samples were taken during relatively low flow conditions (less than 1800 ft3/second (cfs)), concentrations of suspended solids were markedly higher during periods of highest flow. Two samples collected in the spring of the year also showed nitrate-nitrogen (NO3-N) concentrations greater than the federal drinking water standard of 10 mg/l.)

Additional MRAP findings from water quality data collected from 1993 to 1995 on Mound Creek (USGS, 1990), a small tributary of the Cottonwood, show a positive correlation between streamflow and suspended sediment concentrations. Samples collected during the Brown-Nicollet-Cottonwood Clean Water Partnership monitoring program also found consistently high (greater than 10 mg/l) nitrate concentrations from Mound Creek.

Among the nutrients, phosphorus is a pollutant of major concern to the water quality of the Minnesota River and its tributaries. Any strategy to restore the Minnesota River will require the major watersheds to take part in reducing phosphorus loadings to the main stem. Eventually, through basin management, a basinwide phosphorus loading reduction goal can be established. Through a collaborative process involving local, state and federal government, in addition to watershed residents and other stakeholders, this whole-basin load-reduction goal can be allocated among the 13 major watersheds. Within each major watershed, in turn, the total watershed load-reduction goal can be further allocated among point and nonpoint sources.

In preparation for such a process, several kinds of information on phosphorus pollution sources, concentrations and loads have been collected. This includes an estimate of phosphorus loads from point sources within the major watershed (Table 4.28) together with watershed specific monitoring data on recent phosphorus concentrations, flows, total phosphorus load estimates, ecoregion specific phosphorus values, and basin wide ecoregion weighted phosphorus values (Table 4.29).

As mentioned, livestock feedlots are a major potential source of several pollutants: phosphorus, nitrogen, and pathogens in particular. Considerable progress has been made through the state feedlot program in recent years. Attached is a map (figure 4.09) of feedlots in the Cottonwood River Watershed that have received certificates of compliance, often referred to as feedlot permits *(coming soon)*.

Seasonal patterns often influence flow discharge patterns in the Cottonwood River; the general trend is for flows to increase in spring, peak in late spring to early summer, and decline through late summer. Higher soil moisture contents, undeveloped crop canopies, and lower evapotranspiration rates, are the most likely factors influencing the observed trends. In addition, most of the smaller tributaries within the watershed have no natural storage; therefore, they cease to flow during droughts and flood as the result of snowmelt and excessive precipitation. Generally, the most uniform daily discharges occur just prior to the spring breakup and the least uniform occur during the summer period. The mean annual discharge rate for the Cottonwood River is 322 cubic feet per second (cfs). Flows average 632 cfs from April through June, while lesser flows averaging 190 cfs are the norm from July through August. As with discharge, seasonal patterns of turbidity, and fecal coliform are evident in the Cottonwood River. Levels of these parameters are generally greater for the July through August period than for the April through June period. Monitoring data collected periodically over the last 30 years was compiled and summarized by the University of Minnesota's Department of Soil Water and Climate according to the percent of samples in the entire record that exceed state or federal water quality standards (Table 4.31).

State standards for turbidity are expressed in terms of nephelometric turbidity units (NTU's), which is a measure of light scattered by suspended sediment and organic particles. The State standard for turbidity is exceeded in water with turbidities greater than 25 NTU's. For swimming areas and sewage effluent, state standards for bacteria are exceeded when fecal coliform counts are greater than 200 organisms per 100 ml of water as a geometric mean of not less than five samples in a calendar month, or if more than ten percent of all samples taken during any calendar month individually exceed 2,000 organisms per 100 milliliters. The presence of fecal coliforms indicates recent fecal contamination from warm blooded animals and the possible presence of enteric (intestinal) pathogens.

Recreation

Camping, hunting, fishing, and other outdoor activities can all be found within the Cottonwood River Watershed. In the upper reaches of the Cottonwood River is Lyon County's Garvin Park, located on the Cottonwood's descent off the lope of the Coteau. The park encloses a spreading, wooded valley of steep slopes, and rushing stream, offering camping, picnicking, and trails. In addition, there is a city park on the Cottonwood at Springfield and a wayside park near Sleepy Eye where canoe access is available. The lower section, from the Sleepy Eye wayside down to Flandrau State Park can usually be canoed. It is a scenic trip along a mostly wooded course, especially in the lower gorge reach; however, water levels are not always sufficient for canoeing, especially in late summer. Flandrau State Park at New Ulm memorializes territorial supreme court jurist Charles Flandrau, hero of the defense of New Ulm in the Sioux Uprising. The park includes a swimming pool, camp and picnic grounds, primitive canoe access, and many trails, A dam in Flandrau State Park once impounded Cottonwood Lake, a recreational lake in the park, but since high waters washed out the dam in both 1965 and 1969, it has not been rebuilt. A Redwood County Park is located near Walnut Grove on Plum Creek, a small tributary on the Cottonwood made famous by the books of Laura Ingalls Wilder.

The watershed also contains 6100 acres of state wildlife management areas (WMAs) and fourteen lakes.

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More Information

For questions about the Minnesota River Basin management framework, contact Norm Senjem at 507-280-3592.