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EFFECT OF SILTING ON TREE DEVELOPMENT IN THE FLOOD PLAIN OF DEEP FORK OF THE NORTH CANADIAN RIVER IN CREEK COUNTY

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Deep Fork of the North Canadian river* is a very tortuous stream because the gradient in the valley is low. Runoff water from adjacent upland cannot escape rapidly and floods which frequently occur during the growing season cause serious damage to crops. In order to reduce the flood hazard as much as possible, the channel of Deep Fork in Lincoln County was straightened. This project, according to George L. Gillian, engineer in Lincoln County, was started in August, 1912, and was completed in March, 1923. Reducing the length of the Deep Fork channel in Lincoln County by the construction of the drainage ditch has permitted a portion of the flood water to flow more rapidly. Increasing the velocity of the water creates a condition which is more favorable for the transportation of larger quantities of sediment which will be deposited elsewhere as the rate of flow decreases. A study of soil conditions on the watershed of the Deep Fork Valley indicates that sheet and gully erosion has

*In the remainder of the manuscript this stream will be called Deep Fork.

removed large quantities of surface and subsurface soil from the uplands and that silting of stream channels has occurred in many places.

The channel of Deep Fork in Creek County has not been straightened, consequently, stream flow in this area is retarded as compared with water movement in the straightened channel in Lincoln County and a decrease in the velocity of the water is favorable for the deposition of sediment in the stream bed and on the flood plain when overflow occurs. In some areas, land which was in cultivation fifteen or twenty years ago has been buried beneath five feet of sand. On these areas where coarse textured material has been deposited willow, cotton wood, box elder, and other quick-growing varieties of trees have appeared. The major portion of this type of timber occurs near the stream channel or on areas where a rapid flow of water has deposited sand on land between the bends of the crooked channel.

Under natural conditions, the dominant type of vegetation in the Deep Fork Valley was forest. The most important trees were pecan, burr oak, elm, and ash. The pecan trees produced good yields of nuts when spaced properly and seasons were favorable. Some of these trees were very large but a considerable variation in size occurred because of differences in age, location and soil. At the present time a very high percentage of this timber has been killed in that portion of the flood plain of Deep Fork immediately east of the Creek-Lincoln County line and there is some difference of opinion in regard to the cause of the death of the trees. No damage has occurred in Lincoln County or in the eastern part of Creek or Okmulgee County, consequently, it would appear that flood water could not be the direct cause of this condition. For several years salt water from oil wells has escaped into some of the tributaries flowing into Deep Fork. Since the water in the stream channel contains more salt during periods of normal flow than at flood stage and since a good growth of trees is present along the stream there is little evidence to show that salt in overflow water could cause the death of trees several hundred feet from the stream channel and not destroy the timber growing on the banks of the river. Log jams are numerous in the channel of Deep Fork east of the Creek-Lincoln County line. They decrease the rate of water movement and deflect the current into the brush and woods along the banks. Deposition of sediments which have occurred as a result of this condition have decreased the capacity of the channel, and have also increased the height of the natural levee of sand and silt which occurs normally on each side of streams transporting variable quantities of sand, silt, and clay. The flood plain back of these natural levees has not been elevated as rapidly as the stream bed because smaller quantities of fine silt and clay have been deposited on these areas. Where the natural levees come in contact with the upland they prevent the escape of water collecting behind them, and temporary ponds or a marshy condition develops. Tributaries flowing into Deep Fork from the adjacent upland have also been affected by the silting which has occurred. Water in the channel of these streams must attain a considerable depth before it can flow into Deep Fork, consequently, these valleys have not only been filled with sediment but natural levees have also developed from the edge of the valley to the junction of these tributaries with the larger stream. The combined effect of these cross levees and the natural levee along Deep Fork prevents the escape of flood water collecting behind them. Material suspended in runoff water flowing into these areas settles in the quiet water, and a deep layer of sediment has covered the old surface soil originally present in the valley before this accelerated rate of silting occurred. Figure 1 shows a fence which is nearly covered with clay.

The effect of water standing on the land has also been very disastrous to the trees. Thousands of trees have been killed on an area approximately

four miles in length. In the backwater areas occurring behind the natural levees, the mud which has been deposited is very high in clay content. This material settling around the trees has shut off the movement of the air into the soil, and consequently the roots have died because of anerobic conditions. Dead trees occurring in an area where three feet of red clay has been deposited since the trees started to grow are shown in Figure 2.

An examination of silting in several different locations revealed that two to four feet of clay had been deposited over the original soil in which the majority of the tree roots of the older trees were located. The color of the old surface soil in the valley is brown to dark brown. The sediments which have been deposited on it are red and are easily identified by digging a pit or boring a hole with an auger. Very few dead trees occur on land near the stream. The only explanation which can be offered in regard to this difference in the effect of silting on the development of vegetation is that the sandier material permits flood water to percolate into the subsoil more readily, permitting a satisfactory movement of air, and no damage occurs from waterlogging because of superior surface and internal drainage.

A careful examination of seven soil profiles for toxic substances, such as sodium chloride, which is known to be present in the water in Deep Fork, was also made. The results of these analyses and the depth of recent deposits of sediment are given in Table I.

TABLE I. *Chloride content of soil samples collected from pits which were dug near dead trees in the overflow area along Deep Fork of the North Canadian River. Creek County, Oklahoma.*

No.	Location	Chloride content calculated as sodium chloride in parts per million. Depth in feet 0-1	1-2	2-3	3-4	Depth of Silting in Inches
1.	NW¼, SE¼, Sec. 30, T. 14 N.; R. 7 E.	58	29	0	0	30
2.	NE¼, SE¼, Sec. 31, T. 14 N; R. 7 E.	58	58	0	0	30
3.	Center of SE¼ Sec. 32, T. 14 N.; R. 7 E.	23	17	17	12	42
4.	SW¼, SW¼, Sec. 33, T. 14 N. R. 7 E.	12	12	12	12	45
5.	NE¼, NE¼, Sec. 3, T. 13 N. R. 7 E (Okfuskee Co.)	41	21	12	12	24
6.	SW¼, NE¼, Sec. 33, T. 14 N. R. 7 E.	200	180	120	120	48
7.	NE¼, NE¼, Sec 33, T. 14 N. R. 7 E.	70	40	20	230	48

No salt accumulation has occurred in any of these profiles with the exception of the sample obtained in the fourth foot at location No. 5

Figure 1. Fence in the flood plain of Deep Fork of the North Canadian River covered by silt and clay, south center Section 32, T. 14 N.; R. 7 E., Creek County, Oklahoma.

Figure 2. Trees killed by the deposition of silt and clay on the soil in which root development occurred. Deep Fork of the North Canadian River, Creek County, Oklahoma.

It is quite evident that the salt content of these soils has not been responsible for the death of these trees because the concentration was not high enough to have a toxic effect on plant growth. The clay content of the surface and subsurface layers near the dead trees is very high. Water does not penetrate into this material readily and leaching is a very slow process. If salt had accumulated in the soil as a result of concentration from overflow water it would still be present in the lower part of the soil profile. Soil which appeared white because of the presence of soluble salts was collected from the surface of the ground near dead trees and the total chloride content calculated as sodium chloride was only 187 parts per million.

A large number of trees have also been destroyed in the valley of tributaries coming from adjacent upland and the water occurring in these streams does not contain any appreciable quantity of salt. Since silting has killed trees in these areas it is good evidence that silting combined with the poorly drained condition which it has produced is also the most important factor in the destruction of the forest in the poorly drained portion of Deep Fork Valley. Since a good growth of young trees has developed on recent deposits of silt and clay wherever semi-permanent ponds are absent, this is a good indication that no toxic substances are present in the soil. The roots of young trees varying from a few feet to twenty or thirty feet in height have not been buried by sufficient quantities of silt to kill them and all of these trees are in a vigorous healthy condition. A dense growth of weeds has also occurred wherever surface drainage is good and the plants receive plenty of sunlight. It is quite evident that the water table has been raised in this portion of Deep Fork Valley by the filling in of the stream channel, and the roots of the old trees are submerged at the present time. Seepage water collected in pits which were dug to examine the subsurface condition and in some places the water table is very near the surface of the ground.

The effect of silting on land values in this area would not be serious from the standpoint of future tillage if drainage could be provided to reduce overflow hazards to a minimum, however, the value of the land in the flood plain of the Deep Fork in this area will continue to be very low until the various factors which cause a decrease in the velocity of the stream and subsequent silting of the channel and flood plain can be corrected.