THE ROLE OF WETLANDS IN PROVIDING FLOOD CONTROL BENEFITS

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The flood control value of wetlands is not completely understood, but there is growing evidence that they can play an important role in flood reduction. Storage of runoff in wetlands averages about 12 inches per wetland-surface acre and can be four times that amount. It is important to note that water from drained wetlands is that part of runoff that man can control. With an average annual loss of crops, transportation facilities and property of $100,000,000 in North Dakota[1], even a small reduction in flooding can result in substantial social and economic benefits.

The recent major flood events in North Dakota's Souris and Red River Basins have been linked to flood plain development, wetland drainage, changes in land use and a "wet cycle". All these factors can influence the degree of flooding. This paper will discuss wetland drainage, and, to a lesser extent, changes in land use.

The role of wetlands in controlling runoff has not been fully determined but the indications are that it is substantial. In North Dakota's Devils Lake Basin, there originally were 111,000 acres of wetlands in three major watersheds. By 1975 over half of these wetlands had been drained. The severity of flooding problems have now been compounded in the lower basin.[2]

In another study involving the Pembina River Basin in North Dakota, two time periods were studied in which both had nearly equal precipitation. One time period was from 1904-1932 and the other from 1945-1970. Annual flows were significantly higher in the second period with approximately 54,100 acre-feet of additional annual runoff. During the second time period, 23,720 acres of wetlands had been drained. Although this would have amounted to 27 inches of increased runoff per surface-acre of wetlands drained, it was felt that this figure may be high since there were also changes in land use. A flood storage potential of 12 inches per wetland-acre was thought to be more correct since this figure represented an average over many drainage areas. The study concluded that good land management and restoration of drained wetlands could have reduced runoff by an average of 54,100 acre-feet annually.[3]

In the Charles River Basin in Massachusetts, the Corps of Engineers recommended the acquisition of 8,500 acres of wetlands with nearly 36,000 acre-feet of storage.[4] The justification for this proposal was that a 40 percent reduction in wetlands along the Charles River would result in a 2 to 4 foot increase in the flood stage which would cause an additional 12 million dollars in damages. Those 8,500 acres of wetlands along the Charles River had a value, for flood purposes alone, of $647,000 per year, or $75 per acre per year. This plan had a benefit/cost ratio of 2:1. This ratio was based on the loss of 30 percent of the storage capacity of the wetlands by 1990. In estimating the damages which would result from a given amount of wetland loss, each additional 10 percent reduction in wetland acreages caused a disproportionate increase in the amount of damages. The problem becomes compounded as development occurs in the former wetlands. Minor floods start producing major flood damages.

In Minnesota, wetlands in the Thief River Wildlife Management Area and the Agassiz National Wildlife Refuge help to significantly reduce flooding in downstream areas. In the spring of 1979, these two units had approximately 5,000 cfs inflow, while outflow was approximately 1,400 cfs. The water storage capacity of these two wildlife areas reduced the flood peak at Grand Forks, North Dakota, by about one-half foot and at Crookston, Minnesota, by one and one-half foot.[5] This reduction was especially important because when some of the dikes in the Grand Forks area were within inches of being overtopped by record flows.

Recent studies at J. Clark Salyer National Wildlife Refuge, in the Souris River Basin in North Dakota, indicate that the effects of wetland drainage on flooding are significant. One study area with 205 acres of natural, undrained wetland basins, had inflow of 109 acre-feet. But only 46 acre-feet were measured as outflow. The basins retained all of the runoff from within the 5 square-mile block and also reduced stream inflow by 53 percent. By contrast, in a drained study block 46 acre-feet entered the block but outflow was 74 acre-feet. The storage capacity of wetlands in this study area were eliminated by artificial drainage, and stream flow increased 61 percent. The study concluded that drained wetlands contributed more to streamflow than undrained wetlands, despite some significant differences in other land-use practices and suggested that wetland drainage is the most important land-use practice with a bearing on flood problems.[14]

Data from studies of other areas support the idea that wetland drainage contributes significantly to flooding. In the Stone Creek Watershed, of North Dakota's Souris River Basin, nearly 50 percent of the total volume of runoff is estimated to be due to wetland drainage.[14] In the Souris Basin, there are 200,000 acres of drained wetlands. If they had been able to retain a minimum of 1 foot of water in drained wetland basins during the 1979 flood when 585,000 acre-feet of water passed down the Souris near Westhope, North Dakota, then 200,000 acre-feet (more than one-third) could have been retained on the land rather than contributing to downstream flooding.[14]

In Canada, the Tatagwa Lake Drain and Yellowgrass Ditch were recently opened to the Souris River.[7] These watersheds were previously noncontributing drainage basins. In 1975, the recorded flow of the Souris River, near Sherwood, North Dakota, was 388,800 acre-feet. Of this amount, 87,300 acre-feet of water (nearly 22 percent of the recorded flow) came from the Tatagwa Lake Drain and Yellowgrass Ditch. These are only two recent examples of drainage in Canada. Undoubtedly, closure of previously non-contributing drainage basins would reduce flows.

The engineering practices of the U.S. Geological Survey (USGS) in Wisconsin recognize the importance of wetlands when calculating the magnitude of flood discharges.[8] Conger's formula relates to the flow of flood water

(Q) to a certain value (A) times the percent of marsh or lake area. (A) depends on the tributary area, slope of stream and other drainage basin characteristics. Conger used 13 watershed characteristics, other than rainfall and area, and wetlands were the second most important landscape feature. The wetlands were statistically significant in reducing flows for all flood frequencies.

There have been conflicting discussions about the capacity of wetlands to retain large quantities of runoff since their storage capacity appears to be fixed. Data are being compiled which show they can store large amounts of water. As part of a planning effort in the Devils Lake Basin, the surcharge capabilities of wetlands are being explored.[9] Data developed thus far indicates that almost 2 acre-feet of water could be stored per wetland-surface acre. Thus, a 15-acre wetland could have a storage capacity of 30 acre-feet of water. An average over many quarter-section samples was 1.83 acre-feet of storage per wetland acre. Given the large acreage of wetlands in the basin, these can provide substantial water storage unless they are drained. In another example, an Soil Conservation Service (SCS) official noted over 300 wetlands in the spring of 1979 (previous fall and current spring conditions were wet) and found only seven where water had left the basin via surface flow.[10]

At the present time there is a gap in our knowledge about the hydrology of wetlands. Much of this lack of information stems from the fact that there are many different types of wetlands with separate hydrologic characteristics. Some may be tied directly to the ground water, others may be perched, some may have very large watersheds, others, due to the large amounts of emergent vegetation, may have a higher evapotranspiration rate. Another related problem stems from our inability to differentiate the source of water in downstream flood flows. Is it induced or natural runoff from upland sources or does it come from drained wetlands? A better understanding of all these factors is needed.

Another important part of the flooding issue is farmland drainage on upland areas. The USGS has looked at drainage in the Antelope Creek area of eastern North Dakota.[11] Virtually all of that watershed has been artifically drained directly into the creek. After reviewing the legal drains in some selected eastern counties in the Red River Valley, the situation at Antelope Creek is not unique. Richland County alone has 78 legal drains with total channel capacities of almost 7,500 cfs. The land has lost much of its water retention capability. This water retention capability, while it might have been able to store only an inch or two of water, is important when the thousands of square miles that have been drained are considered. The water is shunted quickly into field drains, to the road ditch, and then the river or stream. Time lag of this procedure can be from hours to a week or more depending on such things as temperatures, rainfall at the time of runoff, topography, and ice-blocked culverts. Some hydrologists will argue that this type of drainage contributes little to downstream flood peaks, and in some cases can depress them, while others will contend that the flood threat has been increased significantly. Much of their discussion centers around where the drainage is occurring in the watershed. Drainage in the lower watershed may actually reduce stream levels by evacuating water quickly so that water coming from the undrained upper basin will not be added to water from the lower basin.[12] Drainage in the upper watershed, on the other hand, may synchronize with peak runoff from the undrained lower watershed, thus increasing the flood peaks. If both are drained, the situation is worse. The problem is that downstream landowners get the major impacts of the flood. They either get flood water earlier when water from the lower watershed is added to the current spring flows, or at a higher level later on.

Farmland (as opposed to wetland) drainage has an effect on flooding. SCS engineering data indicate the 10 year precipitation event could be controlled on the land if good land treatment measures were initiated.[13] Many variables come into play, including soil type, soil moisture conditions, frost conditions, and rate of runoff. In order to achieve these results sound management techniques would have to be employed including grassed waterways, stubble mulch, contour farming and terracing. Even with good land treatment, large volumes of runoff can still occur in the spring if the ground is still frozen.

In conclusion, the preservation/restoration of wetlands can be important in a flood reduction plan. Storage can average about 12 inches per surface-acre of wetlands and can be four times that amount. Sound land-use practices in certain instances can further reduce runoff and resultant flood flows by controlling the 10-year precipitation event. Implementation of these two concepts could go a long way in reducing flood damages and relating problems.

Whatever the flood reduction potential achieved by wetland protection, 2 percent, 10 percent, or 20 percent, the important point is that it is a percentage that man can control. We have no control over a rapid melt, spring rains or heavy snows, but we can control the impact of drainage and poor land use. By protecting existing wetlands, restoring drained wetlands, and practicing good land use, we can expect to gain a significant measure of flood control and reduce the escalating economic losses.

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