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1954 Aggradation Survey In Garrison Reservoir Missouri River - North Dakota

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1954 AGGRADATION SURVEYS
IN GARRISON RESERVOIR

By

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Introduction: Aggradation ranges were sounded and bed material samples were taken in Garrison Reservoir, 7-16 July 1954, and visual inspection of deposits was made during a low reservoir stage 6 October 1954, for the purpose of obtaining data on the volume, location and characteristics of sediment deposited in the reservoir since storage began. The reach investigated extended from the dam to range 22, which was upstream from the influence of backwater caused by the maximum pool level experienced prior to the time of the surveys and was about 90 miles from the dam. A map of Garrison Reservoir, Figure 1, shows the location of aggradation ranges. Mileage and distance between ranges is shown in Table 1.

Reservoir Operation: Closure of Garrison Dam and diversion of unregulated flow through the outlet works was accomplished 15 April 1953. This caused a slight backing up of the water behind the dam which was most noticeable during the 1953 June rise. Regulated storage in the reservoir began 1 December 1953. Garrison Reservoir inflow, outflow and pool elevation hydrographs for the period from closure to time of survey and reconnaissance are shown in Figures 2 and 3. It will be noted in Figure 3 that the ranges were sounded in July when the pool was at a high level (Elev. 1738.5-1739.0) which had been preceded by three peak inflow periods. It is believed that redistribution of sediment deposits prior to the survey was negligible. The reconnaissance in October was made during a low pool

level when over-bank deposits were exposed at the head of the pool.

Sediment Deposits: The original and resurvey profiles of 16 aggradation ranges, numbers 22 through 34 are shown in Figures 4 through 7. The original surveys were made over the period 1949 to September 1953 by land survey methods and by sounding pole in the river channel section before the reservoir started to fill. The resurvey was made, 7-16 July 1954, with echo-sounding equipment. It is interesting to note that on ranges 25, 26 and 27, the surface of deposits is level in a portion of the old channel while on all other ranges the surface is quite irregular. Deposition was also greatest at these three ranges. Maximum deposition of about 20 feet was measured at the channel thalweg on range 27. Maximum increase in average bed elevation of about 6 feet was observed at range 26. Major deposition was found in the river channel with almost no measurable deposition on the over-bank. The inflow hydrograph, Figure 3, shows a peak inflow during 30 June to 3 July 1954 with pool elevations from 1734.5 to 1737.5. Sediment deposition reached its maximum elevation of 1728 at range 25 and elevation 1723.5 at range 26 (see Figure 5) at about the time of this maximum inflow. It appears from these data that deposition in the delta at the head of the pool occurs at depths of about 8 to 13 feet below pool level. Deposition on each range is indicated in column 9, Table 3, which shows the difference between the area of the original range profiles and the resurvey profiles shown in Figures 4 through 7. The computed segmental volume of deposition is shown in column 10, Table 3. The table shows maximum deposition occurred at range 26. Total deposition in the reservoir, mostly over the seven-month period, December 1953 to July 1954, is computed to be about 50,000 acre-feet. It was estimated for the

Garrison Definite Project Report, 1946, that the loss in storage in Garrison Reservoir would be approximately 48,000 acre-feet per year.

The water surface profile at the time of the resurvey and the thalweg, average channel and average overbank profiles for the original survey and the resurvey are shown in Figure 8. The profiles show the thalweg and channel to have increased in elevation at range 24 while the tabulation of deposition area on the range profile, column 9, Table 3, shows that scour has occurred at this range. The range profile, Figure 5, shows that this scour is in the form of bank cutting which does not affect the thalweg or average channel elevation. Examination of range profiles in Figures 5 through 7, reservoir profiles in Figure 8 and the tabulation of deposition area on range profile, column 9, Table 3, show that deposition has occurred in the reservoir from the dam to range 25, while upstream from range 25 deposition and scour have alternately occurred as is commonly observed in the natural river. Deposition occurred from the dam to range 25 because the head of the pool where deposition normally occurs moved up this reach of river while the reservoir was being filled.

The change in suspended sediment grain size as it enters the reservoir and bed sediment grain size through the reservoir as affected by sediment deposition are shown in Figure 9. Also shown is the river-bed material grain size existing through the same reach before operation of the reservoir started. The grain size data were obtained from analysis of suspended and bed sediment samples taken in the river channel at each range.

A reconnaissance was made 6 October 1954 of overbank deposits at the head of the pool which were exposed when the pool was drawn down about 17 feet below the maximum elevation reached in July 1954. In all cases where

timber and brush were adjacent to the river channel, the maximum deposition was near the channel bank with practically none at a distance of 200-300 feet from the bank. Where a range line was cleared through the timber, deposition on the cleared line, in most cases, was in the same quantity and location as that in the adjacent timber area. The materials deposited on the overbank from range 25 downstream were mostly silt and clay according to visual observations. The deposits in the river channel were also mostly silt and clay as shown in Figure 9. Less deposition was found on open areas where flow was unobstructed than in the edge of timbered areas where flow was retarded. Timber along the edges of the river channel tends to guide the flow into the reservoir, which accounts in part for little or no deposition at any great distance back from the channel. Dried deposits on overbank areas are shown in the photographs, Plates 1 and 2. Unconsolidated deposits are shown in Plate 3 and 4.