INDICATIONS OF STREAMBED DEGRADATION IN THE WILLAMETTE VALLEY

By

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FOREWORD

The Water Resources Research Institute at Oregon State University has provided the administrative coordination for this study. It is Institute policy to make available the results of significant water-related research conducted in Oregon's Universities and Colleges. The Institute neither endorses nor rejects the findings of the authors of such research. It does recommend careful consideration of the accumulated facts by those individuals concerned with the study of recognized problems.

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ABSTRACT

A brief study of possible streambed elevation changes in the Willamette Basin was made to develop techniques for such analysis and to make a preliminary assessment of the extent of any indicated problems of streambed degradation and their likely causes. Records from 11 gaging stations were subject to a "specific gage" analysis to detect changes in rating curve characteristics. Supplemental information from flood records, aerial photographs, maps, and other sources was then used to attempt an explanation for any indicated changes in the specific gage curves at each station. Several characteristics which might be shown by specific gage curves were developed from general considerations and compared with the curves at the given sites in order to interpret changes.

The main-stem Willamette River and nearby portions of some tributaries are subject to water stage lowering, although other streams in the basin are not. Streambed degradation along the main-stem Willamette is approximately 1 foot per decade and may be due to several factors, such as natural geological events, sand and gravel removal, bank stabilization, and watershed changes. However, upstream dams do not appear to have had much effect to date on changes in specific gage for the main-stem Willamette River. The lower McKenzie River is locally subject to severe streambed degradation which has amounted to 6 feet in 26 years.

KEY WORDS

Bedload, Channels, Degradation, Erosion, Gravel, Hydraulics, Hydrology, Rivers, Scour, Sediment transport, Streambed, Waterways

STATEMENT OF THE PROBLEM AND ITS IMPORTANCE

A wide segment of the public believes that the majority of human activities have detrimental effects upon streams. More specifically, it is commonly held that dams, sand-and-gravel removal operations, and man-caused watershed changes have had adverse effects on the streambeds of several Western rivers, including those in Western Oregon.

In the first two instances, the common suppositions are (a) that sand and gravel supplies have been intercepted by the dams and by gravel removal operations, and (b) that sediment transport relations have been altered by dams and gravel operations such that the nearby streams are subject to general channel erosion and streambed lowering (degradation). However, with few exceptions, these suppositions have not been carefully documented. Water resource agencies responsible for gathering streamflow data at established gaging stations are generally aware of such situations. But their principal concern may be limited to the periodic necessity of lowering the datum planes and staff gages at such locations. This is illustrated at the McKenzie River gaging station near Coburg, for which conflicting statements exist from several groups about severe degradation of the streambed and for which a 6-foot degradation in the last 16 years has been determined by the author (1).

With respect to watershed changes, common suppositions are (a) that clearing of originally-forested lands for agriculture, forest harvesting and urbanization has increased the relative amount of direct storm runoff and thus the capability of flowing water tocarve the landscape and to transport sediment, and (b) that this devegetation of the drainage basin has greatly increased the amount of land erosion and led to increased channel sedimentation. These suppositions are only partially documented, primarily from studies of forest harvesting. Because local circumstances vary, it is not generally statable whether the changed availability of sediment and changed capability of a stream to transport sediment result in a new long-term equilibrium state, in long-term channel degradation, or in long-term aggradation (raising of streambed level). Because revegetation of cleared forest lands occurs, transient shifts rather then permanent changes may be associated with some forms of watershed usages.

Documentation of the long-term degradation, aggradation, or equilibrium of streambed levels in Western Oregon is essential if soundly based decisions are to be made regarding many aspects of water resources management and use of adjacent lands. For example, decisions to permit or deny commercial sand-and-gravel removal from streams are routinely made by several state natural resources agencies which must decide what the short-term and long-range effects of such removal might be.

Knowledge of the present tendencies for changes or stability of streambed level near such operations and of the factors which influence changes in streambed level would significantly influence decisions on such permit applications.

As another example, boundaries of private and public property along some Oregon streams are fixed by the line of "ordinary high water" or "ordinary low water." In such cases and for some channel cross-sectional configurations, these lines may be significantly altered if the long-term streambed level is changing. Decisions regarding bank protection works likewise may differ if it is known that the general level of the streambed is changing over time. Designs for footings and foundations of water-related structures such as bridges are influenced by streambed elevations. Consequently, any non-equilibrium of the long-term streambed level must be taken into account at the design stage so as to avoid having to do this later by means of protective maintenance measures.

The alteration of a river's hydrologic regime which occurs after a dam and reservoir have been constructed on it and the intercepted sediment supply may have a marked influence on alluvial channels downstream from such projects. Such influence is most severely evidenced in the immediate vicinity of the dam and diminishes with distance downstream. Backwater effects in the channel upstream from the reservoir are often significant in altering hydraulic relationships and sediment transport there. Therefore, anticipating the long-term streambed and bank stability or changes near dams is important for planning and related decision-making.

STUDY OBJECTIVES

The objectives of the reported investigation were:

1. to determine the existence, extent, and rate of streambed degradation which may be occurring at selected points on principal rivers of Western Oregon; and

2. to identify the potential causes of such degradation wherever it might occur.

This project was proposed as a one-year study in order to develop the analytical and interpretative techniques required and to apply them to determine if a widespread or local problem of streambed degradation exists in Western Oregon. The study was thus to be selective rather than comprehensive. It was intended as a basis for future, detailed study, in order to examine the implications of man's activities upon channel stability throughout the Willamette River Basin and other Oregon streams. This future work would also explore methods and policies which might be used by regulatory agencies and resource users in order to properly know the bounds of protection or exploitation possible in given rivers of the state without upsetting the sediment regime. But first, the preliminary study described here was necessary to provide adequate techniques and an assessment of the problem at selected sites.

ACHIEVEMENT OF STUDY OBJECTIVES

The first objective of the study was achieved within the intended selective limits. Suitable analytical techniques were developed and applied so that the existence, extent, and rate of streambed degradation could be determined. However, the number of stations subjected to such analysis was small and was restricted to those within the Willamette-Sandy River Basin. This precluded generalization of the findings except in a tentative manner.

The second objective of the study was only partially achieved. The short project time and a change in project personnel midway through the project did not leave sufficient opportunity to adequately explore the causes of streambed degradation at each study site. Nevertheless, potential causes were identified in a more general manner and progress was made in developing interpretative techniques.

STUDY AREA

The Willamette-Sandy River Basin encompasses an area of Western Oregon exceeding 12,000 square miles. The basin and its main drainage system are shown in Figure 1.

The Willamette Valley lies between the Coast Range, to the west, and the Cascade Range, to the east. The valley extends southward to a region where the two ranges converge at the Calapooya Mountains and northward to the Columbia River. The valley may be described in geological terms as a structural depression or downwarp with hills of moderate relief in places separating broad alluvial flats (2). The valley floor consists of lake deposits and other consolidated and unconsolidated alluvium deposited and reworked during various stages of the Pleistocene and Recent periods. The valley is surrounded by resistant volcanic and sedimentary rocks which also extend beneath the alluvial fill comprising the valley floor. The edges of the valley are covered by alluvial fans.

The Willamette River has a general northward course. It has numerous tributaries from both the Coast Range and the Cascade Range, the drainage areas of the former streams being considerably smaller than

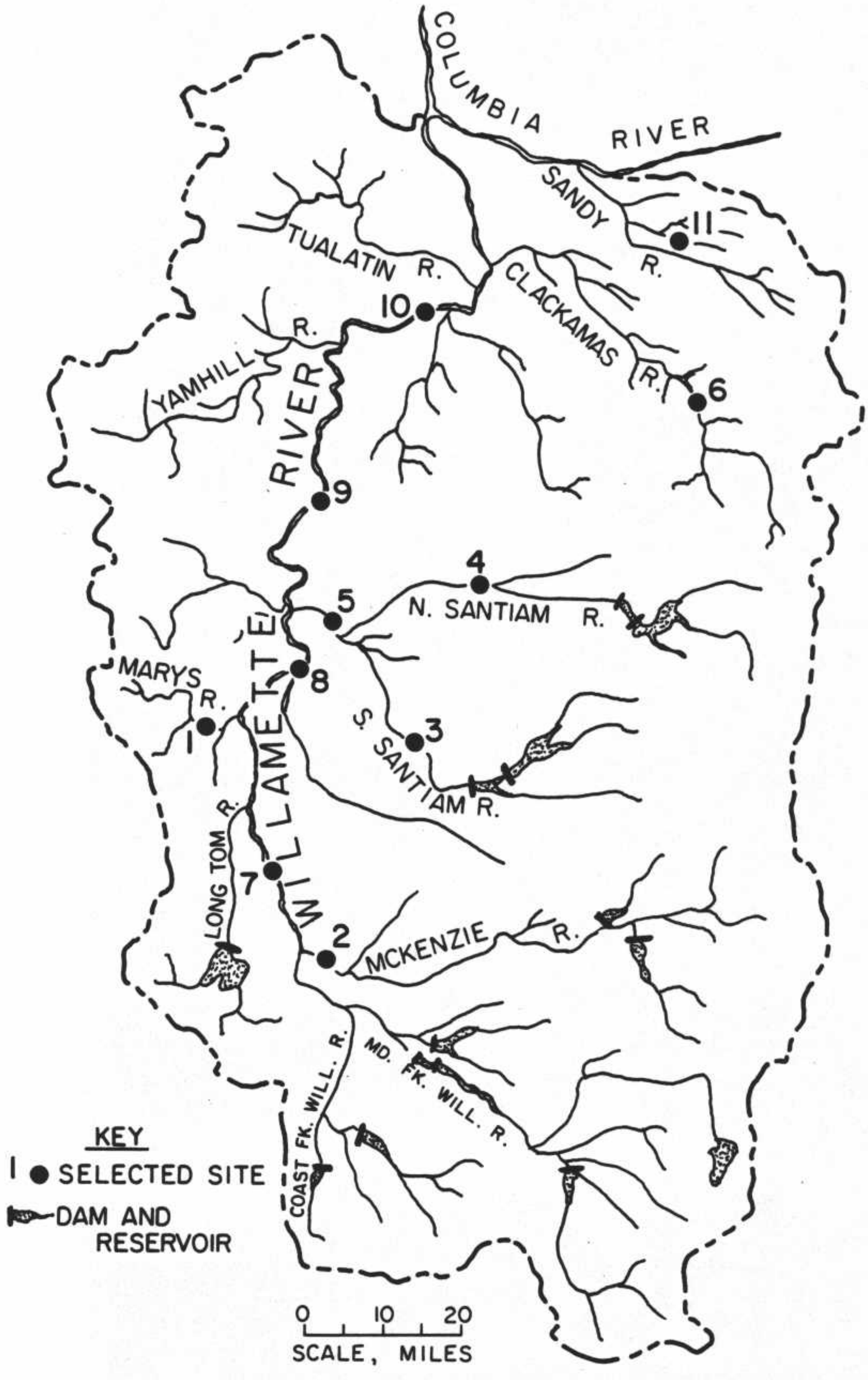

Figure 1. Locations of study sites in the Willamette and Sandy Basins.

those for the latter streams (see Figure 1). The river and its main tributaries (in their lower reaches) have broad flooplains and meander belts. These tend to be larger in the southern two-thirds of the valley (south of study site 9 in Figure 1) than nearer to the basin outlet, where the rivers are somewhat more confined by the adjacent topography.

The Willamette Basin, where most of Oregon's population resides, has experienced greater usage of water-related resources involving dams, reservoirs, and the commercial removal of sand and gravel from waterways than have other parts of Oregon. This trend is expected to continue into the future, with an associated growth in demand for basic resources.

Because of the potential severity of problems for the Willamette River and its tributaries, streams in the Willamette Basin and the adjacent Sandy Basin were selected for examination in this study. A necessary assumption in doing this was that the existing usage of the streams and adjacent lands in the basin has been continued for sufficient duration that some of the effects of such usage upon the streambed levels would be apparent.

Eleven sites were eventually chosen for study after a preliminary look at over 100 study sites. The locations of the selected sites are shown in Figure 1. The stations names and other general data are presented in Table 1.

The criteria met by the chosen study sites are as follows:

(a) each site has had a U.S. Geological Survey (USGS) gaging station at the location for at least 20 years;

(b) the streamflow records for these gaging stations are concurrent during a 20-year timespan;

(c) the streamflow records at the stations are continuous, excluding brief interruptions, during the concurrent period;

(d) the rating curves for these gaging stations are conveniently available in published form;

(e) the channel at and in the general vicinity of the site is alluvial in character;

(f) the stations are well-distributed over the basin; and

(g) the stations include the main-stem Willamette River and several tributaries.

Figure 2 shows the concurrent periods used for the analysis of streambed degradation. The base period common to all stations except the Willamette River at Wilsonville (site 10) is from the 1945 water year to the 1965 water year (21 years). Only eight years of data were

TABLE 1. GENERAL DATA FOR SELECTED STUDY SITES

Site No.	USGS Gaging Station name and number		Drainage area square miles	Period of continuous record, years (1)	Period of record analyzed, water years	1971 datum of gage, feet MSI (2)	Selected discharges for full period, cfs (3)		
							Min.	Avg.	Max.
1	Marys R. Near Philomath	14-1710	159	since 1940	1941-65	224	0.6	468	13,600
2	McKenzie R. near Coburg	14-1655	1,337	since 1944	1945-65	392	1,080	5,840	88,200
3	S. Santiam R. at Waterloo	14-1875	640	since 1923	1935-65	370	61	2,905	95,200
4	N. Santiam R. at Mehama	14-1830	655	since 1921	1935-65	602	254	3,342	76,600
5	Santiam R. at Jefferson	14-1890	1,790	since 1939	1941-65	200	260	7,798	197,000
6	Clackamas R. above three Lynx Cr.	14-2095	479	since 1921	1935-65	1,092	324	1,971	68,200
7.	Willamette R. at Harrisburg	14-1660	3,420	since 1944	1945-65	290	1,990	12,450	210,000
8.	Willamette R. at Albany	14-1740	4,840	since 1894	1935-65	167	1,870	14,470	266,000
9	Willamette R. at Salem	14-1910	7,280	since 1923	1935-65	106	2,470	23,490	348,000
10	Willamette R. at Wilsonville	14-1980	8,400	since 1948	1949-56	0	3,600	28,580	339,000
11	Little Sandy R. near Bull Run	14-1415	22	since 1919	1935-65	720	8	145	5,320

(1) Excluding brief interruptions.
(2) To nearest foot.
(3) From start of period of record through the 1971 water year.

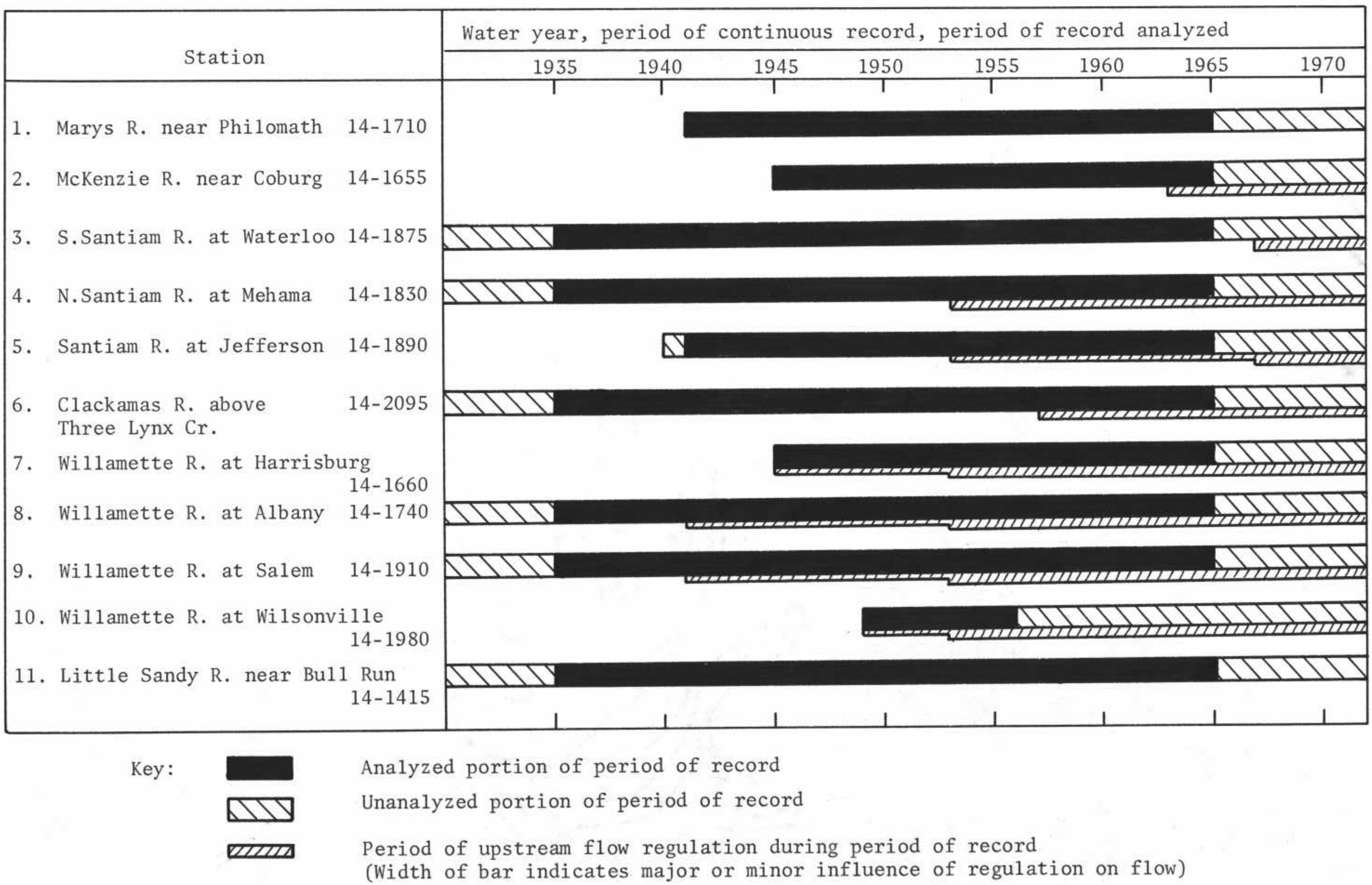

Figure 2. Periods of record analyzed for study sites.

analyzed for the Wilsonville site (1949 - 1956 water years, inclusive) because of its more recent installation than for the other 10 sites and because the rating curves for later years were not available in published form. Nevertheless, the station was included because it is on the main-stem of the Willamette River. For 6 of the sites a concurrent period of 31 years was analyzed (1935 - 1965 water years, inclusive) and for 8 of the sites the concurrent period was 25 years (1941 - 1965 water years, inclusive).

Figure 2 also shows the periods during which upstream flow regulation exists for each site. The earliest flood control project in the Willamette Basin, Fern Ridge Reservoir on the Long Tom River (see Figure 1), had only a limited effect on flood discharges in the main-stem Willamette River after completion in 1941. In the late 1940's two additional reservoirs, located on the Coast Fork Willamette River and one of its tributaries (see Figure 1), added their influence to the main-stem Willamette. By the mid-1950's, flood control projects had been added on the North Santiam River and Middle Fork Willamette River (Figure 1). Another was added to the Middle Fork Willamette River in 1961.

After 1965, five additional projects were completed on differing dates. To avoid too much confusion in interpretation of results, it was decided to terminate the base period of analysis at 1965 and not include any influences of these last dams. On the Clackamas River, the upstream flow regulation which began in 1956 was for hydroelectric power purposes. In all cases, it has been assumed that reservoir regulation carried out at the several storage projects had the effect of reducing peak discharges and "blunting" the hydrographs in downstream channels, thus altering sediment transport relationships.

STUDY PROCEDURE

The basic approach used to study streambed degradation involves adaption of the "specific gage" technique described by Blench (3) for determining if a stream is "in-regime" (in dynamical equilibrium among the many factors which influence a stream's behavior) in the vicinity of a gaging station. Blench defines specific gage as the staff gage elevation for a specific discharge (e.g., 100,000 cfs) as determined from the rating curve applicable to the station at a particular time. When this is determined over a period of years for several specific discharges and is plotted, the resulting family of curves shows whether or not the channel near the gaging station is in-regime. If the curves neither rise nor fall consistently, the channel is assumed to be in-regime. Therefore, a consistent pattern for rising or falling specific gages may be assumed to describe some feature of channel change, such as streambed aggradation or degradation.

The daily discharge records at gaging stations which are published annually as surface water records by the USGS are normally accompanied by tabulated rating curve information. This includes select stages and corresponding discharges over the range of flows to which each rating curve applies. When more than one rating curve applies during the period covered by the report, dates of applicability are given for each tabulated curve.

The initial step in the analysis procedure was to obtain the published rating curve data from the surface water records of the USGS.

The second step was to plot the several rating curves for a station on graph paper, connecting the published points with straight lines. This gave a quick visual impression of any changes which might have occurred for the "control points" of rating curves at a station. Figure 3 illustrates this procedure for part of the record at study site 2, the McKenzie River near Coburg.

If there was only a slight change in the rating curve over time, the resulting graph of superimposed rating curves was awkward to work with. An alternative approach was to tabulate the rating curves instead of graphing them. Either approach was satisfactory in preparation for the next step of the analysis. The only drawback to tabulation of rating curves, instead of graphing them, was that the published values did not consistently use the same stages or discharges, making it difficult to set up a compact tabulation.

The third step in the analysis was to choose a few specific discharges for further analysis. To do this, the rating curve data were examined and a high discharge was selected which was defined by nearly all the rating curves so that no extrapolation of rating curves was required. This precluded use of infrequent large flows of record, as most rating curves would require extrapolation. In the same manner, a low flow was selected. Then one or more intermediate flows were also chosen.

In the fourth step, the stages for each selected flow at a station were determined and tabulated from each rating curve. This is illustrated in Table 2 for the data shown in Figure 3. If the rating curve data were in tabulated form rather than on graphs, linear interpolation of tabulated values was used whenever necessary.

The fifth step of the analysis procedure was to plot the specific gage curves -- stage versus time for each of the selected discharges -- for each station. This is illustrated in Figure 4 for the data of Figure 3 and Table 2. Figure 4A shows complete details of this step and Figure 4B shows a simplification. In Figure 4A, light vertical lines denote the ends of periods for each rating curve. The heavy horizontal lines identify the appropirate water stage

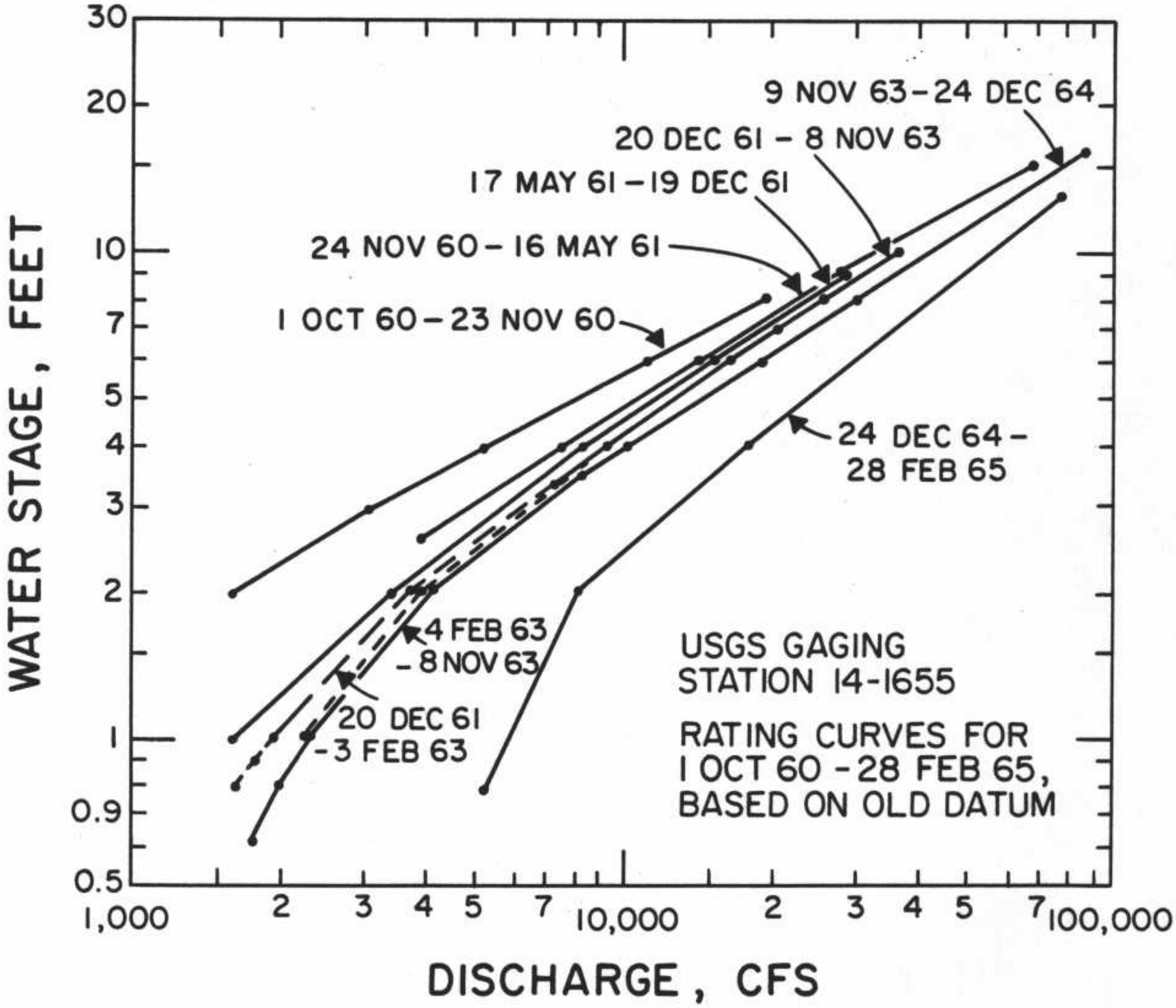

Figure 3. Shifting rating curves at study site 2 during part of the analysis period.

Table 2. STAGES AT SPECIFIED DISCHARGES FOR STUDY SITE 2 DURING PART OF THE ANALYSIS PERIOD

Rating Curve	Water stages, feet[1], at the specified discharges, cfs							
Dates	2,000	4,000	5,000	7,000	10,000	20,000	30,000	50,000
1 Oct 60 - 23 Nov 60	2.3	3.4	3.9	4.7	5.7	8.0	-[2]	-
24 Nov 60- 16 May 61	-	2.6	3.0	3.8	4.7	7.4	9.5	12.6
17 May 61- 19 Dec 61	1.2	2.2	2.6	3.5	4.5	7.1	-	-
20 Dec 61- 3 Feb 63	1.0	2.1	2.5	3.2	4.2	6.7	8.7	-
4 Feb 63 - 8 Nov 63	0.8	2.0	2.4	3.2	4.2	6.7	8.7	-
9 Nov 63 - 24 Dec 64	0.8	1.9	2.3	3.0	4.0	6.2	8.0	11.1
24 Dec 64- 28 Feb 65	-	-	(0.7)[3]	1.5	2.4	4.3	6.1	9.0

1 Based on old USGS datum.
2 - indicates that flow is outside range of rating curve.
3 Estimated by short extrapolation of rating curve.

for each selected discharge during the valid period for each rating curve. Finally, the dashed lines describe the trend for each selected discharge during the full period shown in Figure 4A. Because a specific gage curve such as shown in Figure A can become cluttered with overlapping lines, it was decided to simplify the curves which present results for the full period of analysis.

This is partially illustrated in Figure 4B. Rather than showing the time span for each rating curve and horizontal lines for each specific gage during that interval, these specific gage increments were plotted as points at the middle of the appropriate rating periods. These points were then connected by straight lines. A further simplification was ultimately used in developing the final specific gage curves --- representative water stages for each water year (rather than rating curve period) were determined for each selected discharge and used to plot the curves. If more than one rating curve was applicable during a water year, the specific gage values were weighted in proportion to the times for which they were valid.

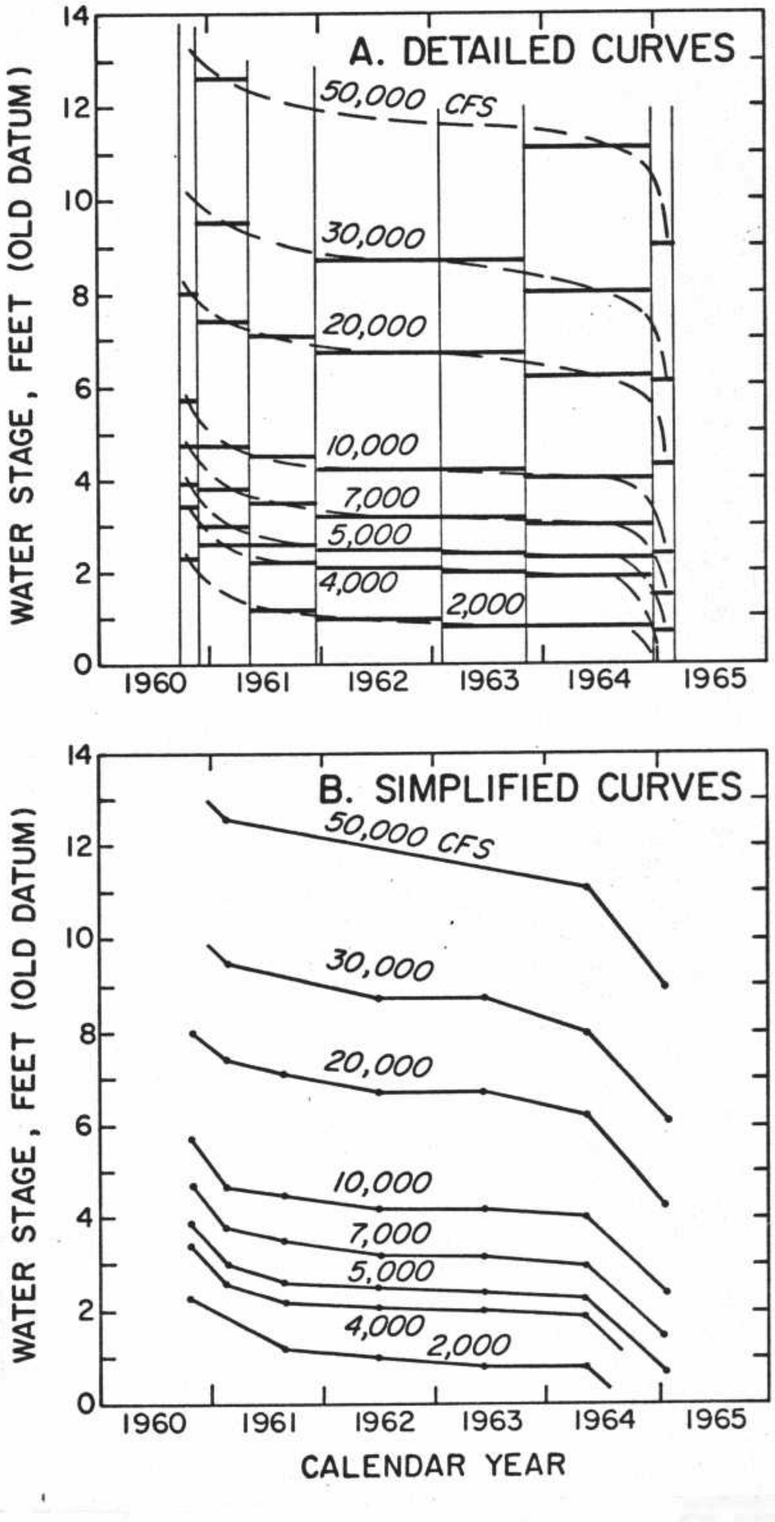

Figure 4. "Specific gage" curves for study site 2 during part of the analysis period.

The sixth step in the analysis procedure was to identify the trends shown by the specific gage curves for each study site. This permitted a judgement as to whether or not the streambed level and other influences over the rating curve at each site were in long-term equilibrium. The interpretation of trends and their causes is discussed in the following section of this report.

The final step in the analysis was to examine the available information about each site in detail in order to support all judgments and interpretations made from the specific gage curves. From this step, sounder findings and conclusions were to be reached than from the curves alone. The available information included flood records for the streams, aerial photographs covering many study sites, revetment and bridge construction reports, dredging and sand-and-gravel removal records, reports on dam construction, and site visits.

GENERAL ASPECTS OF SPECIFIC GAGE CURVE INTERPRETATION

To date, it appears that specific gage curves have been used primarily as a powerful but somewhat insufficient test to determine whether or not a river is in-regime and to show changes of regime. If the trends shown by the several specific gage curves at a gaging station can all be described by parallel horizontal lines, even though data for the individual years fluctuate randomly about such lines, then the river is interpreted to be in-regime. This means that the many hydrologic and hydraulic factors which govern the river's behavior near that station continue to have the same combined effect over an extended period of years, even if some individual factors may change. Also, there is a dynamic equilibrium or balance implied over time even though cyclical, periodic and random fluctuations occur.

It is conceivable but unlikely that significant factors influencing the stage-discharge relationship (rating curve) for a station might undergo progressive changes in such a manner that they compensate for each other and leave the stage-discharge relationship and specific gage curves unaltered over time. This could happen, for example, by exactly compensating changes in channel width and channel roughness near the station.

More likely, however, is the situation where changing factors over time alter part or all of the rating curve for the station. This, in turn, causes one or more of the specific gage curves which cover the common flow range at the station to depart from the parallel, horizontal line relationship. Such departures from the dynamic equilibrium situation may involve only the small flows, only the large flows, only the intermediate flows, some other combination of flows, or all flows.

The resulting possibilities for the specific gage curves are numerous: parallel or non-parallel trend lines which slope downward or upward with time trend lines with abrupt breaks or abrupt changes in slope, etc.

The common features which might be displayed by trend lines fitted through gage curves are illustrated in Figure 5, where 11 situations are given. By combination of these situations for either the same time period or for consecutive time periods, a large number of further situations can be illustrated which should include all likely trends for specific gage curves at a station.

Figure 5A illustrates the specific gage trend for a river that is in-regime, as already described.

Figure 5B depicts parallel trend lines for a progressive lowering of specific gage at a uniform rate. This could occur if there is a continuous general lowering of the controls affecting the rating curve over its full range of stages. One cause for this situation might be streambed degradation of the river reach in the vicinity of the gaging station, such that section or channel control of the rating curve at lower flows and section or channel control of the rating curve at higher flows are similarly affected. Another cause for this situation might be the progressive widening of the river reach and increasing of cross-sectional area at a given water stage due to continuous bank erosion.

Both of these causes could result from an imbalance between the sediment supply from upstream and the ability of the river to transport sediment through the reach where the gage is located. In one instance the bank may be more resistant than the bed of the stream, so that the excess river energy is devoted to channel deepening. In the other case, the converse may be true and channel widening instead occurs. Intermediate combinations could yield the same specific gage curves.

Figure 5C shows parallel trend lines for a progressive raising of specific gage at a uniform rate. This could occur if there is a continuous general raising of the controls affecting the rating curve over its full range of stages. Thus, this case is opposite to that shown in Figure 5B. Possible causes include an imbalance between the supply of sediment from upstream and the ability of the river to transport sediment through the reach, with the supply exceeding the transport ability so that streambed aggradation occurs. A progressive growth of bank vegetation during the period, increasing the hydraulic flow resistance at all stages in a similar manner, might also yield the curves of Figure 5C. Or the continued dumping of debris along the river banks over the period might conceivably affect the specific gage curves in the indicated manner.

Figure 5D describes a stability of specific gage at high and intermediate flows but a progressive lowering of specific gage at lower flows which becomes greater as the flow rate diminishes. These non-parallel

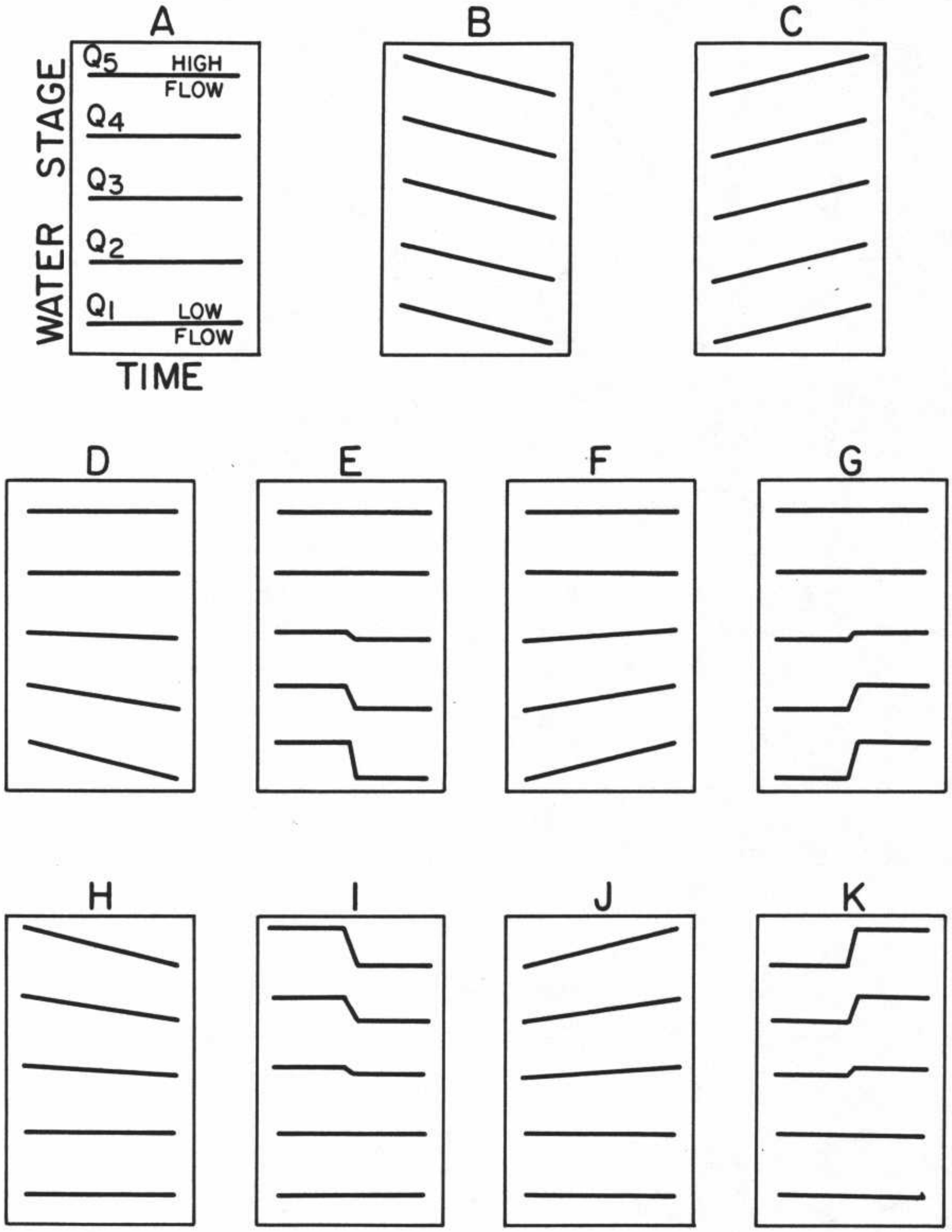

Figure 5. Common situations shown by specific gage trend lines.

trend lines indicate an equilibrium of factors controlling the high-flow relations and a progressive change of one or more factors controlling the low-flow relationships, such that the changing conditions become masked as the flow rate and water stage increase. A gradual lowering of local section control without any change in channel flow may be involved for a river subject to the former at low flows and the latter at high flows. This could involve gradual degradation of the local section control, which might be a gravel bar or riffle across the stream at or just downstream of the gaging station. It could also involve the gradual shift of location for the section control, as with a gravel bar slowly migrating farther downstream below the gaging station.

Figure 5E portrays a situation somewhat like that in Figure 5D, except that the change of conditions affecting low flows occurs during a relatively short period, rather than progressively, and this change is preceded and followed by stability of specific gage at all discharges. An abrupt lowering of section control for the gaging station or an abrupt shift downstream of the location of the section control might result from the transport of bed material during a flood. Human activities such as sand-and-gravel removal at the section control or the removal of an old artificial section control (such as a small weir or sill across the channel), if not followed by further channel alterations or stream readjustments to the new conditions, might yield the specific gage curves shown in Figure 5E.

Figure 5F, like Figure 5D, shows stability of specific gage at high and intermediate flows but a progressive change of specific gage at lower flows which becomes greater as the flow rate diminishes. In this case, however, a gradual raising of local section control (rather than lowering) is indicated. Analogous with Figure 5D, this could involve the gradual aggradation of the local section control or the gradual upstream shift of location for the section control, closer to the gaging station, as by a migrating gravel bar.

Figure 5G bears the same relation to Figure 5F that Figure 5E bears to Figure 5D. A relatively abrupt change of conditions is shown that affects low flows but is masked as the flow rate increases and that is preceded and followed by stability of specific gage at all discharges. In this case, an abrupt raising of section control or abrupt upstream shift (closer to the gaging station) of the location of the section control might be involved.

Sediment transport during a flood, not followed by subsequent local streambed changes near the gaging station, could account for this. Human activities also might yield such specific gage curves, such as by construction of low weir or low gravel dike in the river which remains intact during the period portrayed. Low-level construction, such as the footing or riprap for a pier or abutment or the low-flow construction of the channel, could also result in specific gage curves like those of Figure 5G. In-stream construction activities would also have this effect but a further change in specific gage at low flows could be expected at the end of the construction period when equipment and temporary dikes or cofferdams are removed.

Figure 5H describes a stability of specific gage at low-to-intermediate flows and progressive lowering of specific gage at high flows which becomes greater as the flow rate increases. Stability of local section control and channel control influencing the lower flows is indicated. However, the channel control affecting higher flows (or, conceivably, a different section control governing high flows and located downstream of the low-flow section control) is shown to be subject to a progressive change. This might be due to continued bank erosion over time which is not matched by deposition elsewhere within the reach affecting the gaging station. Or some long-term widening of the channel may be occurring due to regular removal of material from along the stream banks.

Figure 5I shows a situation somewhat like that in Figure 5H, except that the change of conditions affecting high flows occurs during a relatively short period, rather than progressively, and this change is preceded and followed by stability of specific gage at all discharges. Abrupt bank erosion, vegetation removal, sweeping away of a debris accumulation, or other change which increases the size or capacity of the high-water channel during a flood might account for these specific gage curves, as might channel shifts over a short time which increase the size of the effective high water channel. Human activities which might yield these specific gage curves include short-term sand-and-gravel removal from bars and banks which are normally exposed at low-to-intermediate flows or floodway channel improvements which are made over a relatively short period, including bank clearing and excavation for riprap protection.

Figure 5J, like Figure 5H, shows stability of specific gage at lower flows but a progressive change of specific gage at higher flows which becomes greater as the flow rate increases. In this case, however, a gradual raising of specific gage (rather than lowering) is indicated. Analogous with Figure 5H, this could involve aggradation or upstream migration of a high-flow section control located downstream of the low-flow section control, the long-term dumping of material along the banks or in the high-water channel, sediment deposition in the high-water channel, or the encroachment of vegetation on the banks and in high-water portions of the channel.

Figure 5K bears to Figure 5J the same relation that Figure 5I bears to Figure 5H. A relatively abrupt change of conditions is shown that affects high flows but not low flows and that is preceded and followed by stability of specific gage at all discharges. An abrupt raising or upstream shift of high-water section control located downstream of the low-flow section control might be involved, either due to a flood or to human activities such as in-channel construction.

Channel shifts which close off a formerly open part of the high-water channel during a short time could yield this result, such as the blockage of the entrance to an old meander loop by deposition of a gravel bar at its entrance during a flood. Abrupt narrowing of the high water channel could also accomplish this, as by levee construction to block off and protect part of a stream's former floodway which constricts a river and its floodway outside of the low-flow channel. With so many interpretations of specific gage curves possible, as shown by the discussion of Figure 5, any conclusive identification of the causes for the specific gage patterns at a given location requires extensive "detective work". The "evidence" is available from several sources.

Flood records and hydrograph information for each station will pinpoint those periods when the hydraulic conditions are suitable to produce rapid changes in the channel. Major floods are prime causes of rapid channel change, but intermediate-sized floods in greater number over the years may have a similar long-term influence. The correspondence of one or more floods to abrupt changes in specific gage permits a partial explanation of channel change but must by supplemented by further evidence.

Aerial photographs of the stream at and near each study site which span a period of years and include a variety of flow rates are particularly useful in determining channel changes and suggesting possible causes. Changes in channel width, bank condition, high-flow channel condition, low-flow channel condition, bars and riffles, and other features are generally quite apparent from comparison of a sequence of photographs. Human activities in or along the stream can often be detected, particularly the more-significant large scale activities such as sand-and-gravel removal, bridge construction, channelization works, and channel or bank encroachments. The changes noted from an adequate sequence of photographs may be found to correspond to either abrupt or gradual changes in specific gage. If the photographs are inadequate in area covered or number and frequency of photographs available spanning the study period, they nevertheless may indicate some of the possible causes which must be confirmed from other information.

Site visits are an essential supplement to any other information available regarding channel changes. Details not clearly shown by photographs can be checked; the alluvial materials comprising the channel can be examined closely to determine such information as particle size range and degree of cementation or cohesiveness; the types of flow controls, both section and channel, can be inspected more closely; the size of recent deposits or extent of fresh erosion may be checked; and the quantity and manner of gravel removal may be better estimated.

Several types of records also help to identify the causes for changes in specific gage at a station. Construction agencies and construction supervision agencies of federal, state and local government will have records of dam and bridge construction and of channel improvement works, including the dates for such construction and plans showing how it was accomplished. These often can be correlated with particular trends in the specific gage curves. State regulatory agencies will have records of aggregate removal from streams which show the dates, locations, and amounts of material involved. These likewise can be related to features shown by the specific gage curves.

RESULTS AND INTERPRETATIONS

Specific Gage Curves for Study Sites

The specific gage curves for the 11 study sites are presented in Figures 6 - 16. To allow for changing datum planes at a few stations, the water stages are plotted using the 1971 datum plane at each station except site 11 (Figure 16), where such usage would cause the stages to be negative in magnitude. In some of the figures the ordinate axis is broken at one or more points so that water stages for all figures could be plotted to the same scale. Dashed lines shown in some of the figures indicate years for which the rating curves were not readily available or periods for which the rating curve did not include the specific discharge within its range. The dashed lines connect the consecutive periods for which data were available, without any attempt to estimate what the intervening water stages might have been for the given specific discharges.

The rating curve data from which these specific gage curves were prepared are tabulated in the appendix for the 11 study sites.

Indicated Water Stage Trends

Some general trends are apparent at each site describing water stage stability for the selected discharges during the analysis period. Such trends shown by the specific gage curves of Figures 6 - 16 are summarized in Table 3.

Comparison of the trends noted in Table 3 with the location map (Figure 1) reveals a systematic behavior among the study sites. Sites 1, 3, 4, 6 and 11 did not experience a notable departure from the "in-regime " or "dynamical equilibrium" conditions which influence stage-discharge relationships. These sites are away from the main-stem Willamette River and are, except for site 1, along the edge of the valley floor.

Sites 2, 7, 8, 9,and 10 experienced definite lowering of water stage at each selected flow and are on or close to the main-stem Willamette River on the valley floor. Site 5 experienced definite lowering of water stage over part of its flow range and occupies, geographically, an intermediate location between the other two groups of sites.

The above comparison yields two highly significant tentative findings: (1) water stage lowering is primarily associated with the main-stem Willamette River and nearby portions of some tributaries; and (2) the main-stem

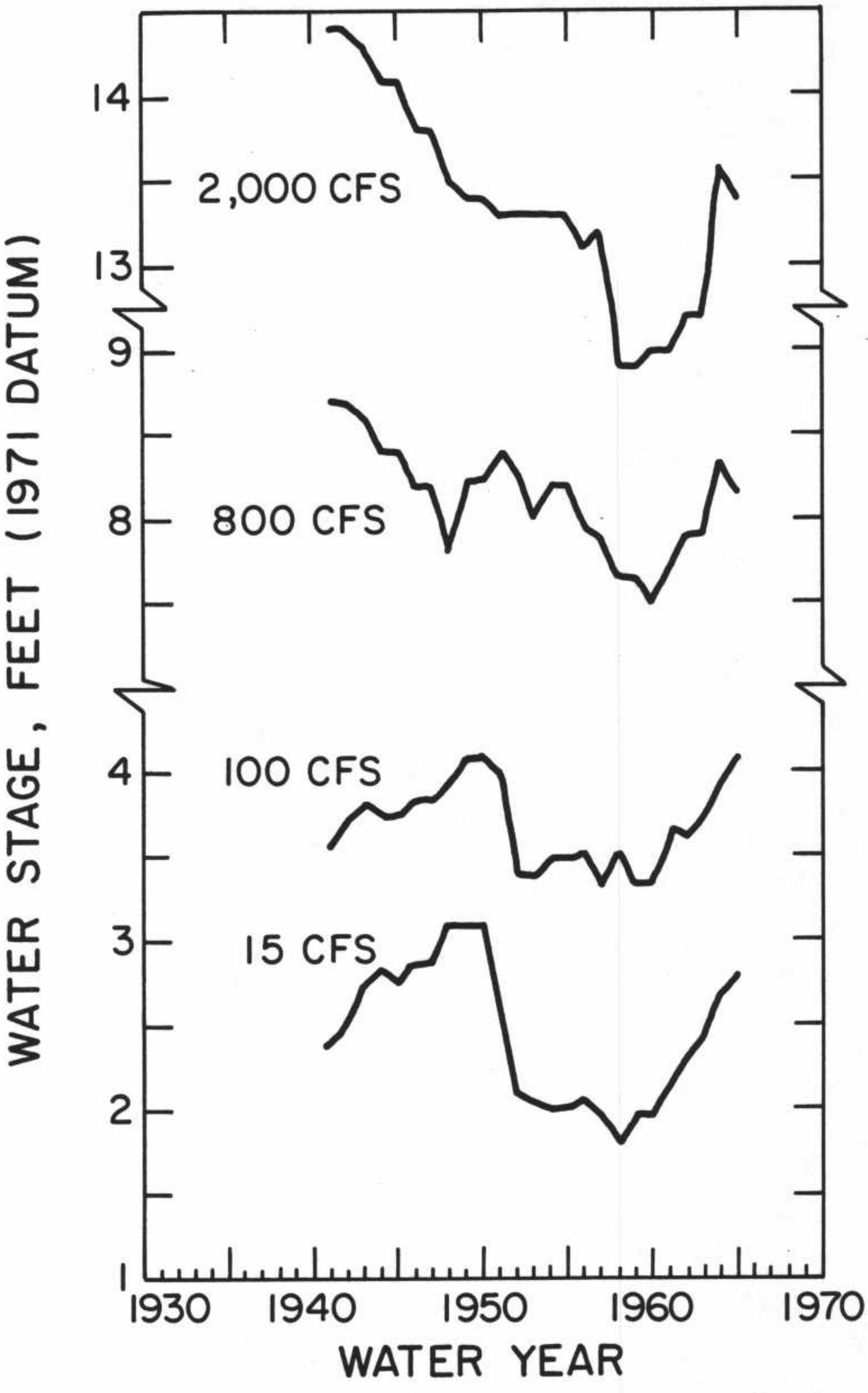

Figure 6. Specific gage curves for study site 1, Marys River near Philomath.

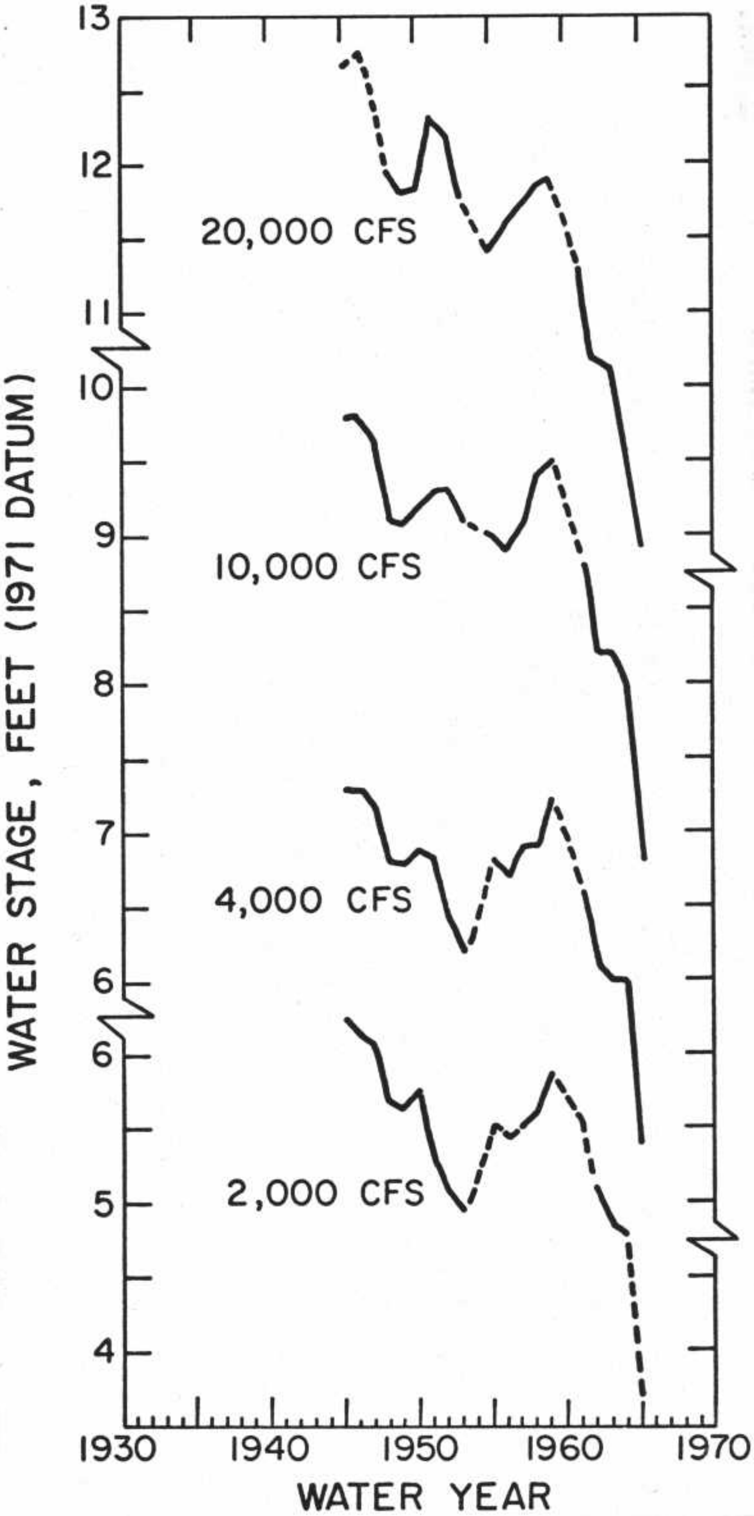

Figure 7. Specific gage curves for study site 2, McKenzie River near Coburg.

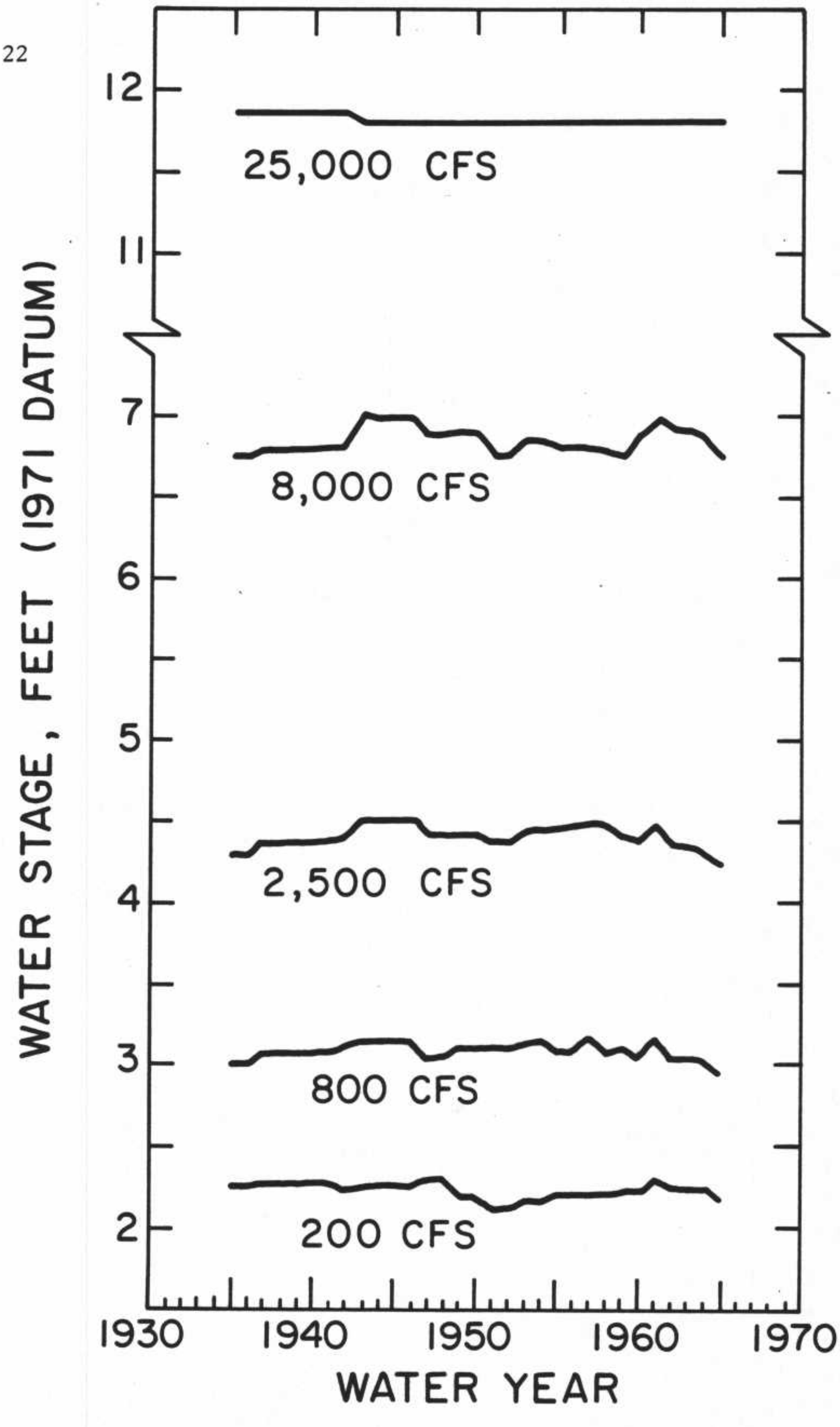

Figure 8. Specific gage curves for study site 3, South Santiam River at Waterloo.

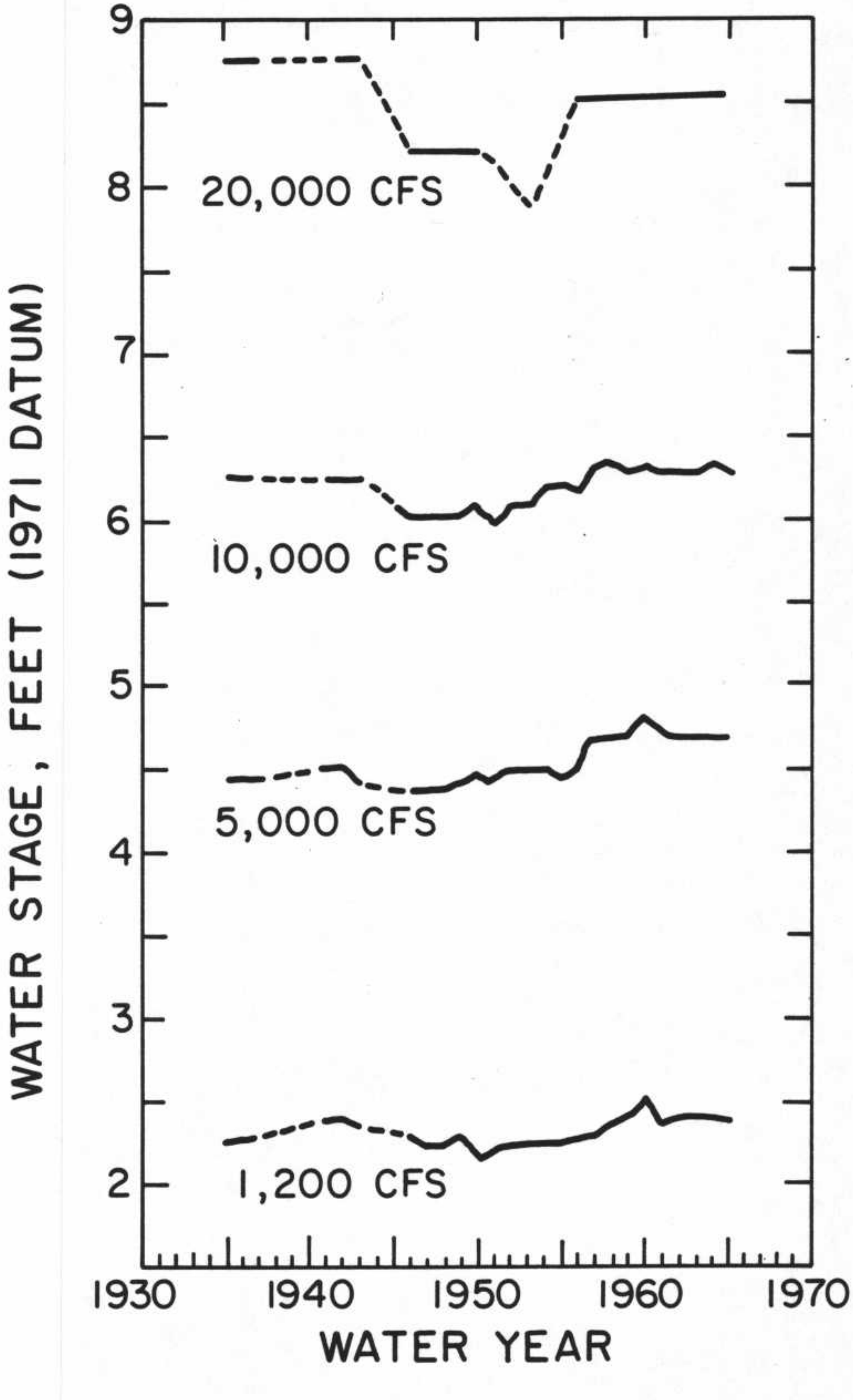

Figure 9. Specific gage curves for study site 4, North Santiam River at Mehama.

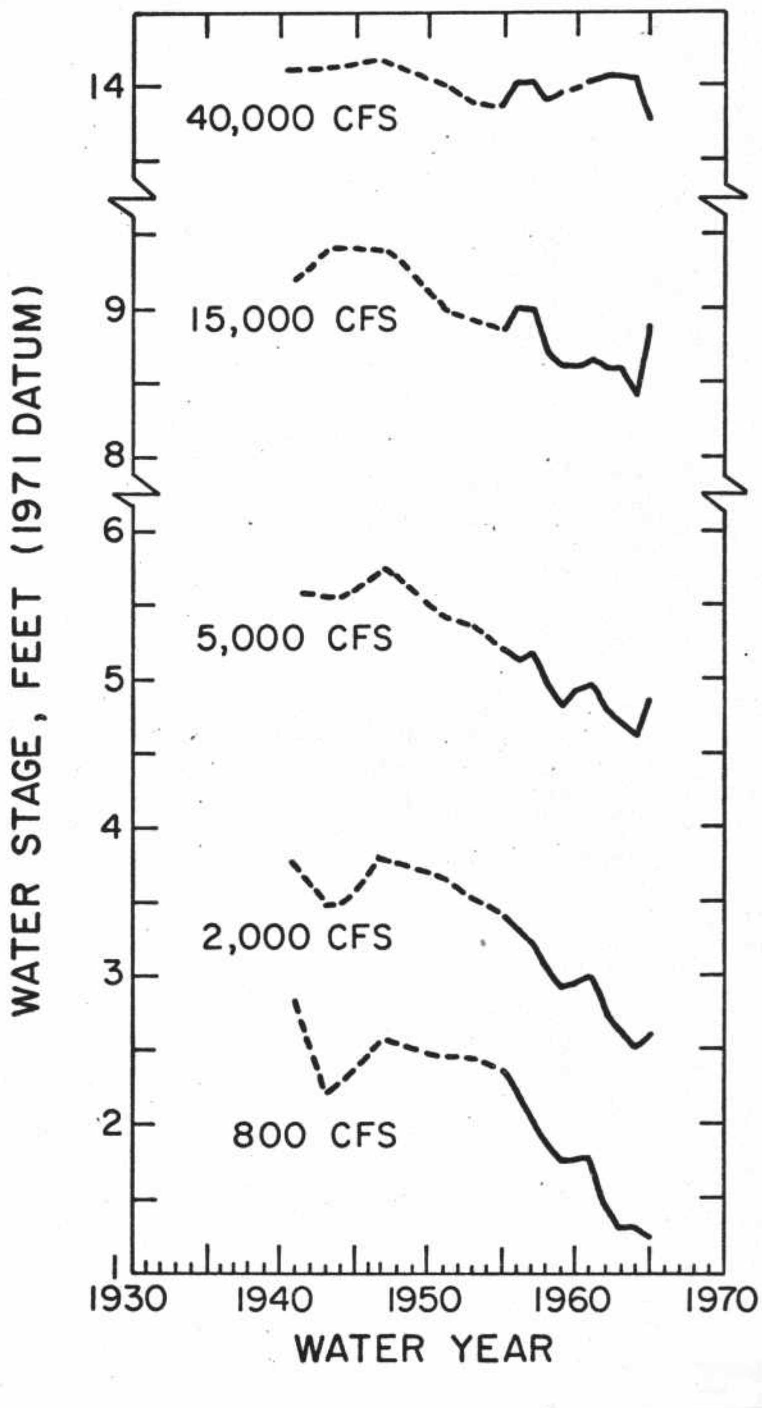

Figure 10. Specific gage curves for study site 5, Santiam River at Jefferson.

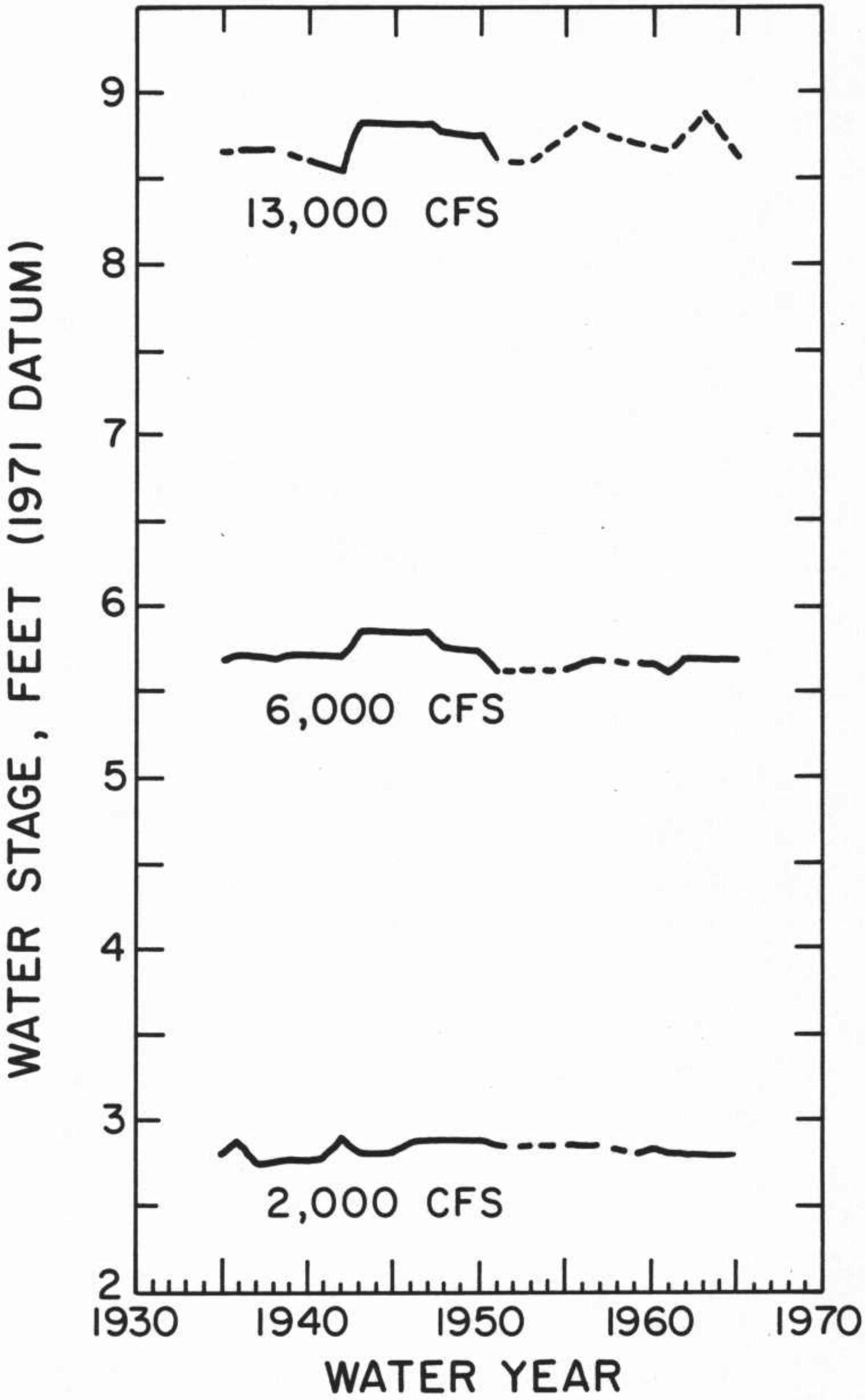

Figure 11. Specific gage curves for study site 6, Clackamas River above Three Lynx Creek.

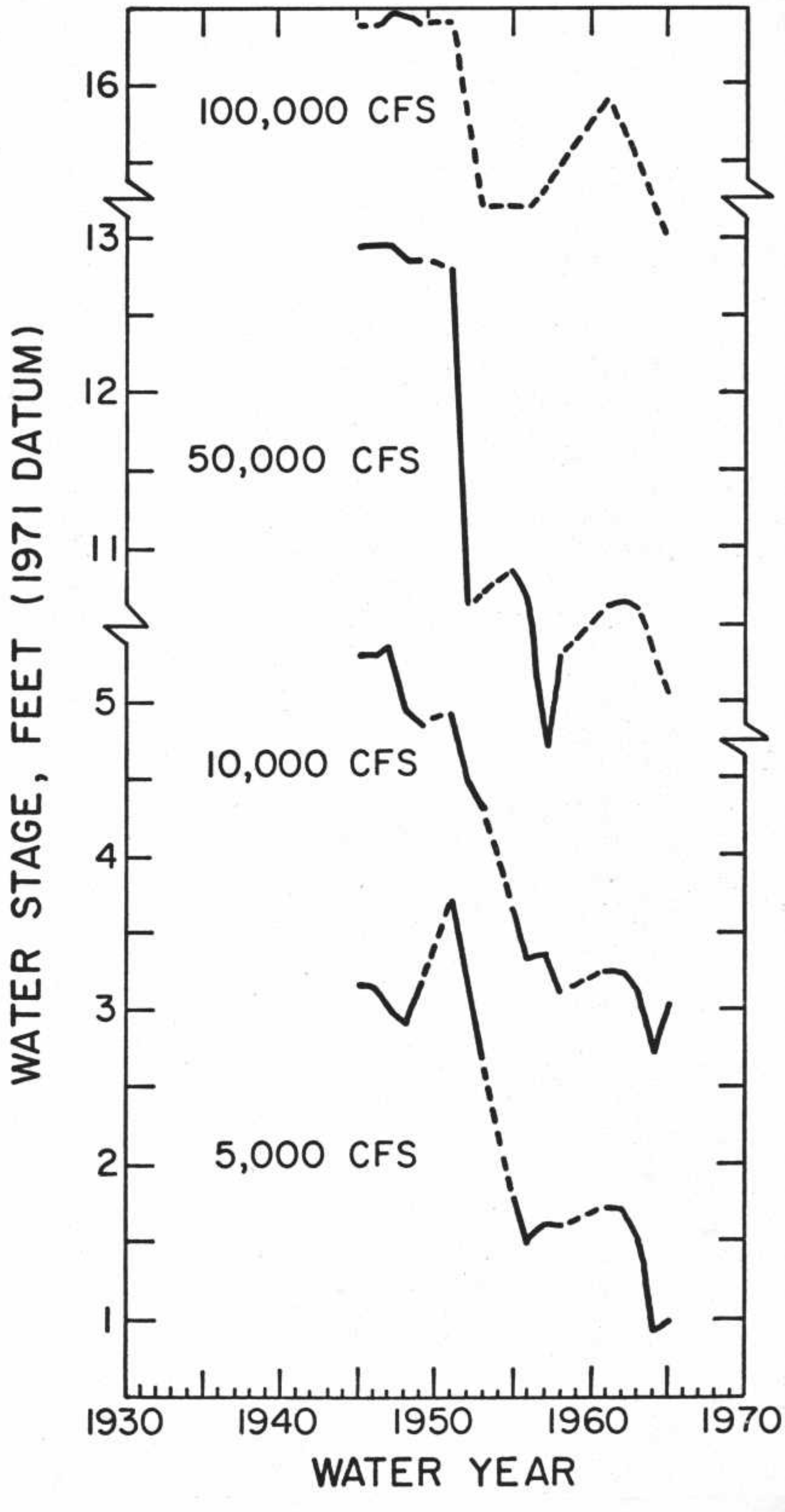

Figure 12. Specific gage curves for study site 7, Willamette River at Harrisburg.

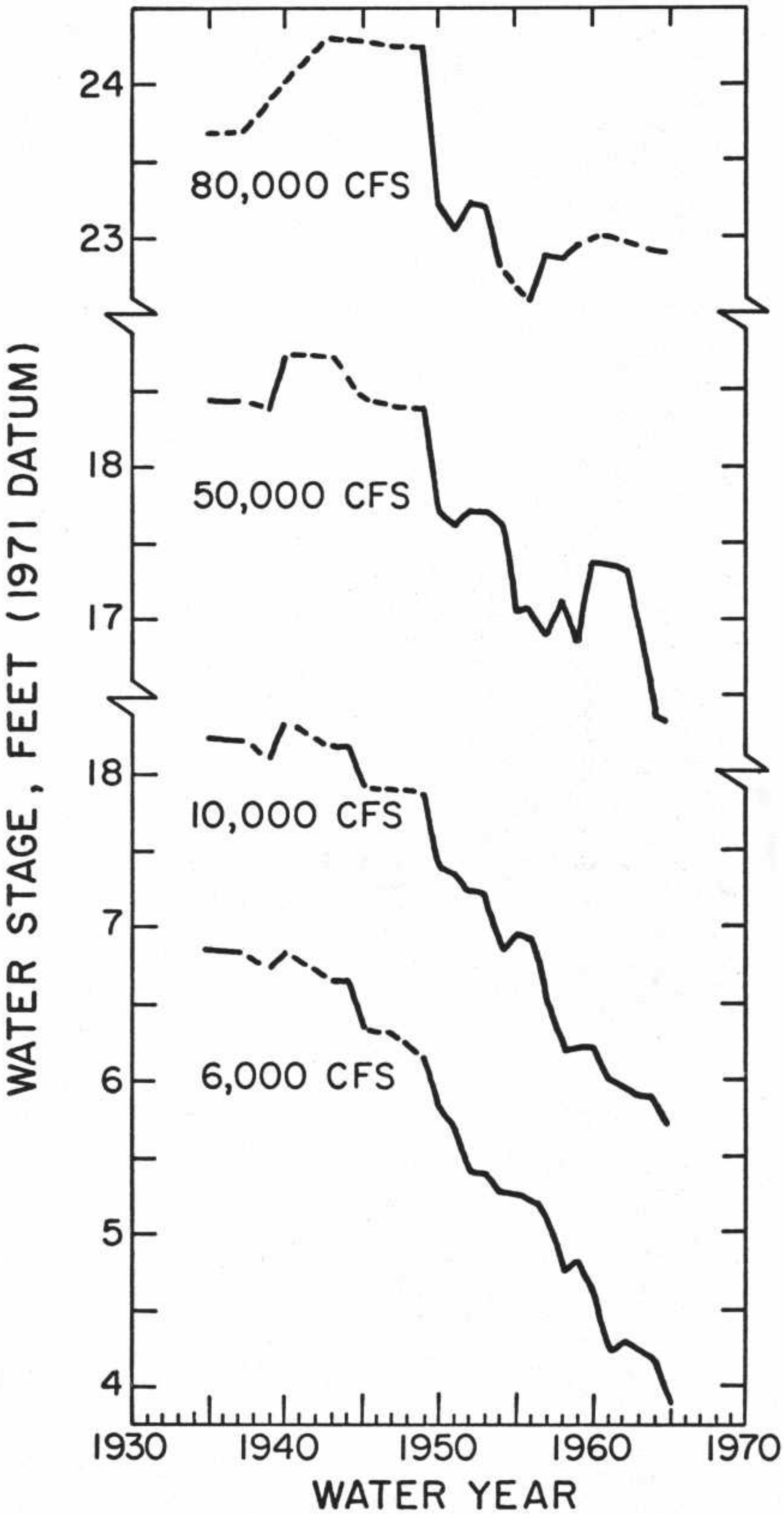

Figure 13. Specific gage curves for study site 8, Willamette River at Albany.

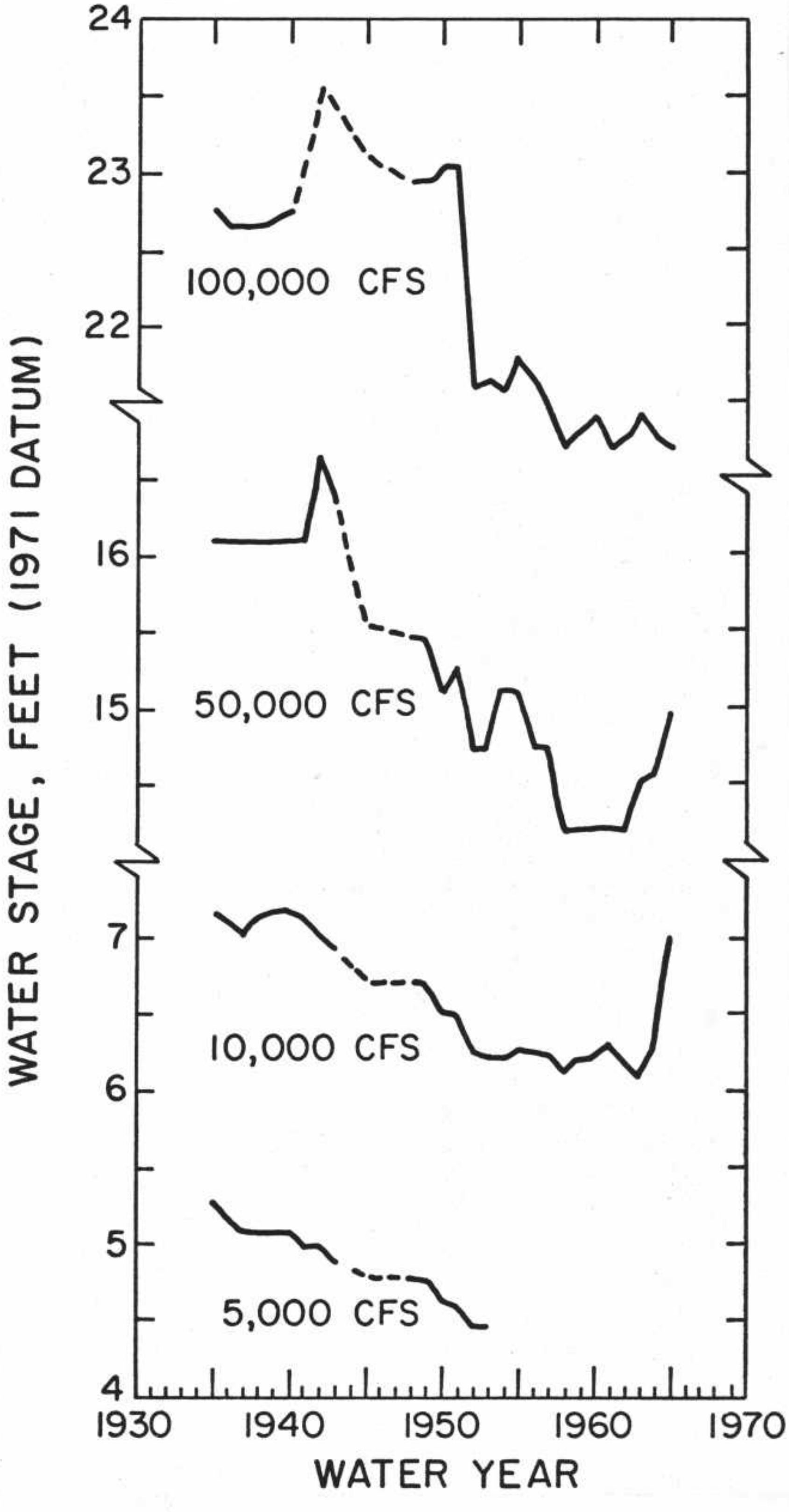

Figure 14. Specific gage curves for study site 9, Willamette River at Salem.

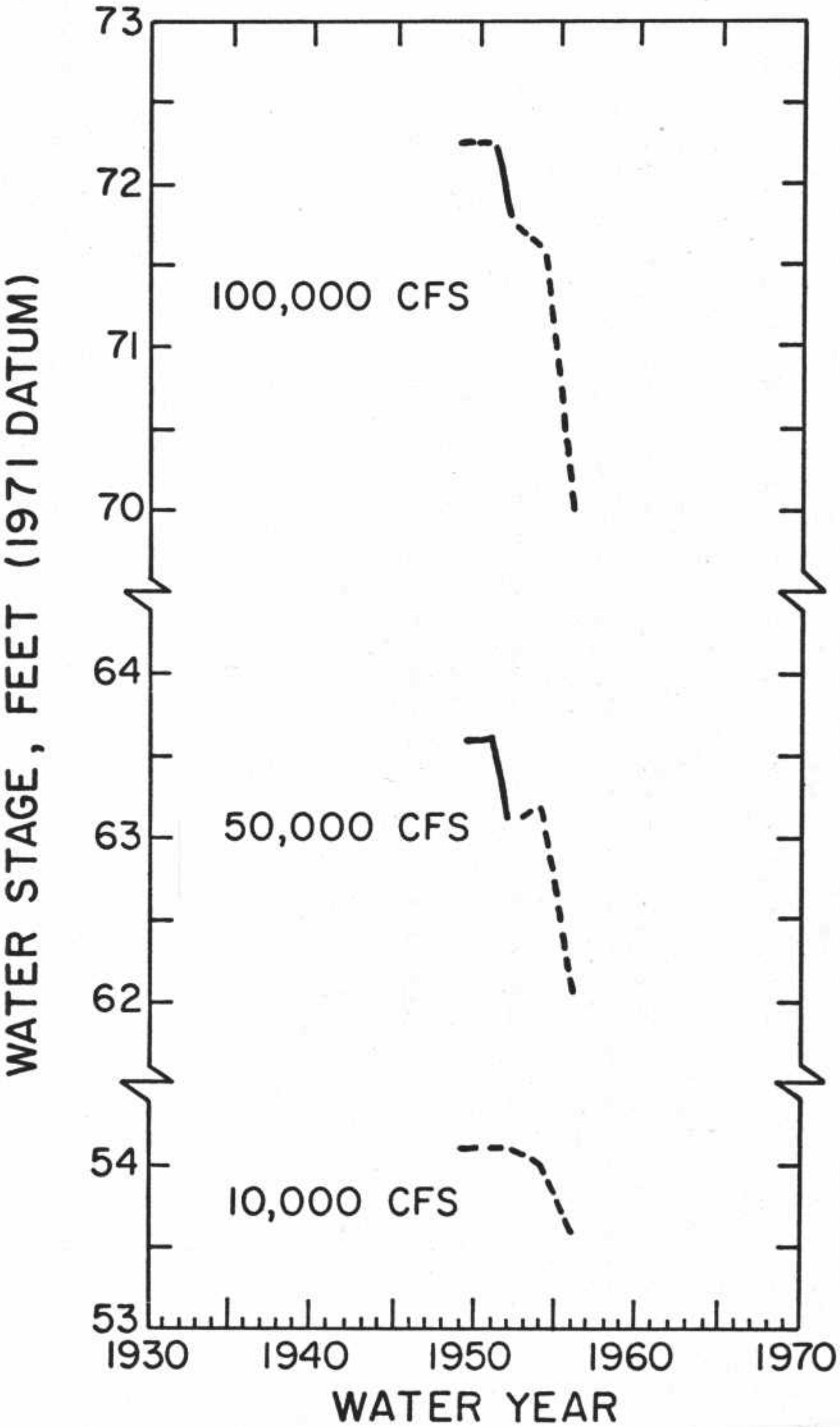

Figure 15. Specific gage curves for study site 10, Willamette River at Wilsonville.

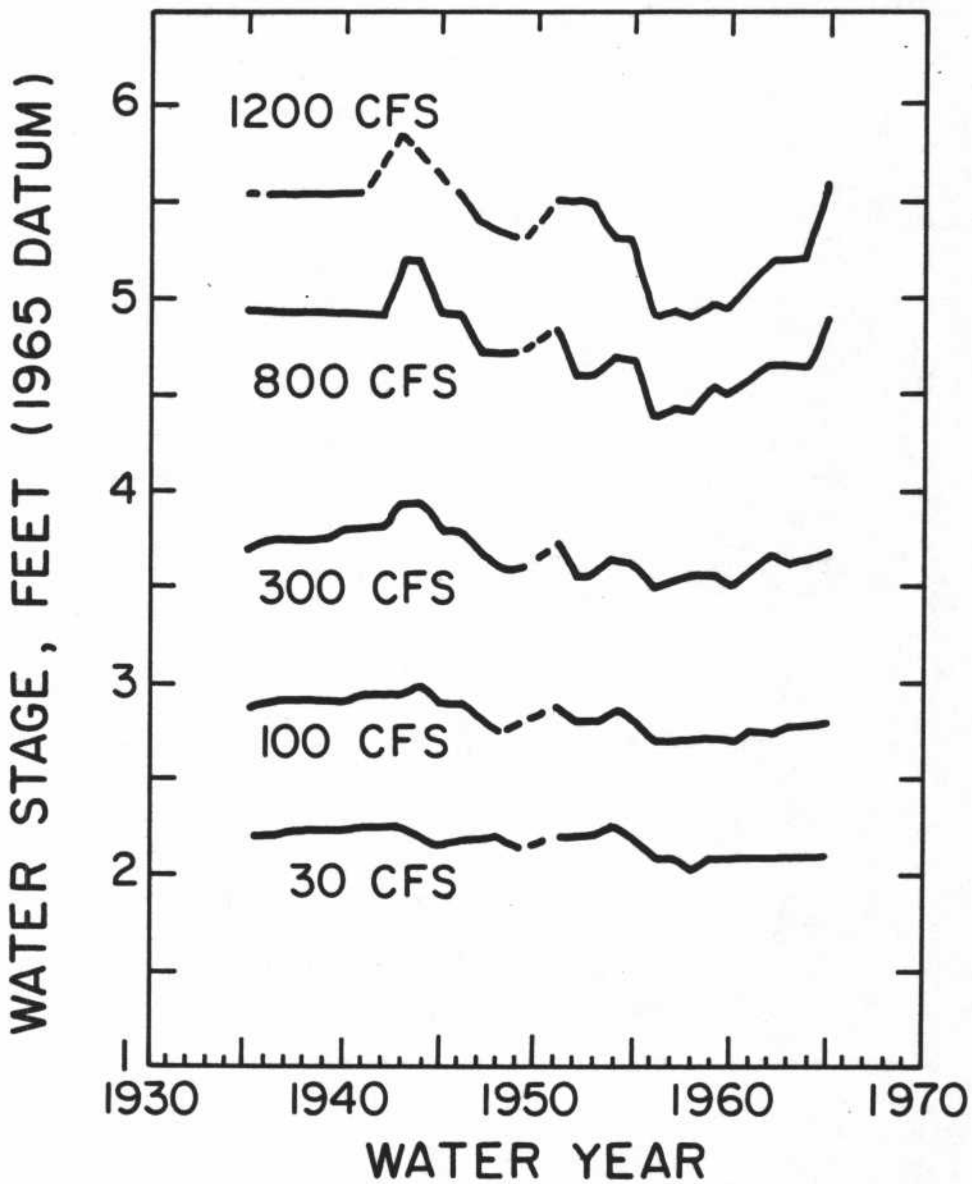

Figure 16. Specific gage curves for study site 11, Little Sandy River near Bull Run.

TABLE 3. TRENDS OF WATER STAGE SUGGESTED BY SPECIFIC GAGE CURVES

Study Site		General trend of water stage shown by specific gage curves representing the analysis period
1	Marys R. near Philomath	Perhaps a slight lowering, more evident for large flows than for small flows.
2	McKenzie R. near Coburg	Definite lowering, evident for all stages.
3	S. Santiam R. at Waterloo	Very constant conditions.
4	N. Santiam R. at Mehama	Constant conditions over period but some variability for large flows.
5	Santiam R. at Jefferson	Definite lowering evident for small and intermediate flows but fairly constant conditions for largest flows analyzed.
6	Clackamas R. above Three Lynx Cr.	Very constant conditions.
7	Willamette R. at Harrisburg	Definite lowering, evident for all stages.
8	Willamette R. at Albany	Definite lowering, evident for all stages.
9	Willamette R. at Salem	Definite lowering, evident for all stages.
10	Willamette R. at Wilsonville	Definite lowering, evident for all stages.
11	Little Sandy R. near Bull Run	Constant conditions for small and intermediate flows but some lowering for larger flows.

Willamette River is not in-regime or is not in dynamical equilibrium in the sense noted above. It should be remembered, however, that only 11 stations were analysed and that the first finding is therefore not extensively supported.

DISCUSSION OF SPECIFIC GAGE CURVES

Marys River Near Philomath

Principal activities in the drainage basin above this study site relate to agriculture and forestry. The lower basin, particularly in and near Philomath, has been subject to urbanization during the 25-year analysis period. This has undoubtedly had some effect on storm runoff rates. But no significant reservoir regulation occurs upstream of this site nor has aggregate removal from the stream been of any great consequence.

The channel near the site meanders in a floodplain setting. Trees overhang and line the channel and occasionally fall into the channel due to local scour around the tree roots. Brush grows along and in the channel and, like fallen trees, can have a constricting effect upon flows. Bars of sand and small gravel occur locally in the channel and can shift their locations in response to changing hydraulic conditions. Compared to other streams analyzed, the Marys River is relatively deep and narrow with a flat gradient.

The general trend for specific gage curves at this site during 1941 - 1965 has been a possible slight lowering of specific gage, more evident for large flows than for small flows (see Figure 6).

The reasons for the shapes of the specific gage curves may be speculated. It seems likely that the fluctuating stages shown by the specific gage curves principally reflect changes in the detailed character of channel and bank vegetation (both growing and fallen) and of the gravel bars near the gaging site. The lowering trend for specific gage at higher flows could reflect accelerating storm runoff from upstream urban areas over the study period and an associated increase in bank erosion and channel widening. On the other hand, long term bank clearing for farming and cattle grazing along the stream may also be a cause for the indicated trend. The reversal of trend in the early 1960's could be related to newly fallen trees and other debris in the channel. Or it could reflect a 50-foot downstream shift in the location of the water stage recorder on October 1, 1961, and bridge construction at the old recording site a couple of years later. This speculation regarding the factors affecting the specific gage curves at this station was not confirmed, due to insufficient time.

McKenzie River Near Coburg

The drainage basin above this site is primarily forested hills and mountains. Some agriculture is practiced in valleys of the lower reaches of the river and its tributaries. Urbanization has occurred in these latter areas during the study period. Flood control and hydropower regulation of the river is moderate and most of the reservoir operations only became effective near the end of the analysis period (since 1963).

Irrigation water has been diverted from the river for many years at an intake about 100 feet downstream from the gaging station.

Bank revetments have been constructed along the river upstream and downstream of the station over the years. Sand and gravel have been removed at locations above and below the station. An old railroad bridge and country highway bridge span the river at the gaging station and during the latter part of the analysis period twin bridges for an interstate highway were built at this location.

The channel near this study site consists of coarse gravels, boulders, and sand with finer-sized materials in the banks. Partly because of bank-stabilizing revetments, much of the river's present meandering activities are confined within its banks, although bank erosion also occurs.

The general trend for specific gage curves at this site during 1945 - 1965 has been a definite lowering of specific gage, clearly evident for all stages (see Figure 7). This lowering progressed at a greater rate during the last quarter of the analysis period than during the earlier years.

Aerial photographs spanning the period of 1956 - 1968 were examined to identify changes in channel configuration and related hydraulic behavior. The most significant change noted was a progressive shift in flow strength from the left side of the channel to the right side near the gaging station, with considerable rearrangement of gravel bars in the channel throughout the river reach near the station. Bridge construction and related revetment construction and sand-and-gravel removal during the middle of this period must have had an important influence on these shifts of channel pattern. But these would not explain the lowering of specific gage over the longer study period which goes back almost 15 years earlier.

An old line of piles extended across the river downstream of the gaging station many years ago and apparently served as a summer-time stoplog diversion dam to allow an irrigation district to withdraw water for its canals. The structure was eventually abandoned and the pilings were gradually destroyed by the river until only two or three now remain. It is conceivable that these had a stabilizing effect upon the stream gradient until their progressive destruction allowed the river to degrade the bed. In this case, a large sand-and-gravel removal operation half a mile or more downstream of this structure may be suspect of causing such degradation. It is also conceivable that the structure may have initially raised the stream gradient near the gaging station artificially, through gravel deposition behind the structure, and now the stream is attempting to return to its former gradient. There was insufficient time to pursue these ideas further during this study.

The specific gage curves for this station are influenced by many factors, as has been noted above. The considerable change in specific gage shown in Figure 7 approaches 3 feet during the analysis period and one may assume that the trend continues after the end of the period (this is indeed the case -- an additional 3 feet of specific gage lowering has occurred!). From all information examined to date, it appears that the channel is undergoing degradation of its streambed, whatever the cause may be.

Santiam River Study Sites

Three locations were picked to represent the Santiam River basin, one each on the north and south branches of the river and one downstream of the confluence of these branches.

The drainage above the stations on the North and South Santiam River is primarily forested hills and mountains with limited agriculture and urbanization. Agriculture and associated urban centers occupy the valley near and below these sites. Detroit reservoir has significantly altered flows on the North Santiam River above the Mehama study site since 1953 (roughly the last half of the analysis period at that site), some of this influence being felt also at the Jefferson site, below the confluence of the two branches. The extent of bank protection works and of sand-and-gravel removal from the Santiam River near the study sites was not accurately determined, due to time limitations on the project. Also, there was no time for a careful field inspection or examination of aerial photographs for these three sites.

The specific gage curves covering 1935 - 1965 for the South Santiam River at Waterloo and for the North Santiam River at Mehama both depicted general trends for constant conditions over the analysis period, with some variability from year to year at each specific gage (Figures 8 and 9). The specific gage curves covering 1941 - 1965 for the Santiam River at Jefferson, below the confluence of the two branches, displayed a trend toward lowering of specific gage for small and intermediate flows and fairly constant conditions at the largest flow analyzed (Figure 10).

The specific gage curves for the Santiam River at Jefferson may describe a gradual lowering or downstream shift of section control which influences the low and intermediate flows (see discussion of Figure 5D). An alternative possibility is also suggested because this station is in the Willamette Valley floodplain a short distance from the Willamette River i.e., there is a general streambed lowering which affects all discharges but is not evident at high stages due to backward effects from downstream. For example, if the Willamette River is degrading, this may affect adjacent portions of tributaries but these effects may only be evident in the absence of backwater from the Willamette River.

The specific gage curves for the North Santiam River at Mehama indicate that the large upstream reservoir does not appear to be degrading the river channel at this location.

Clackamas River Above Three Lynx Creek

The general trend for specific gage curves at this site during 1935 - 1965 has been for very constant conditions, with only slight fluctuations in stage from year to year (see Figure 11). Little additional information was obtained about the site during the study period, so adequate interpretation of the specific gage curves is not possible.

Main-stem Willamette River Study Sites

The floor of the Willamette Valley is roughly 25 miles wide by 100 miles long, the relatively flat alluvial area broken in many places by hills and buttes. The main-stem Willamette River forms at the south end of this valley where the Coast and Middle Forks join (see Figure 1). Most of the 187-mile channel of the main-stem Willamette River is braided or meandering and flows through a poorly defined floodplain about 2 to 3 miles wide with many irregular alluvial terraces. The floodplain is characterized by many cutoff meanders, oxbow lakes, braided and distributing channels, and sloughs (4). It widens at the confluence of major tributaries but is elsewhere restructed in many places by bedrock outcroppings and bluffs.

At the southern end of the valley, the river and its floodplain are only a few feet below the general level of the valley floor. But between study sites 9 and 10, the river begins flowing in a well defined single channel with high banks and continues to do so downstream to Willamette Falls, a basaltic intrusion across the valley just upstream of the mouth of the Clackamas River (see Figure 1). In many places here, the river and its flood plain are entrenched 50 to 100 feet below the general level of the valley floor. In comparison, most tributaries have narrow meandering valleys that are entrenched 10 to 50 feet below the level of the valley plain (4).

The channel gradient for the main-stem Willamette River flattens from about 6 feet per mile upstream of the mouth of the McKenzie River (see Figure 1) to about 4.5 feet per mile near site 7, to about 2.5 feet per mile near sites 8 and 9, and to about 0.5 feet per mile near site 10. The very flat slope between Willamette Falls and a point not far upstream of site 10 is due to the backwater effect of Willamette Falls.

Presently the entire main-stem Willamette River is subject to reservoir regulation, although there are no dams or similar structures across the main-stem channel (other than a stoplog weir along the crest of Willamette Falls). Significant regulation of flood flows did not occur until the early 1950's. In the last few years (after the end of the analysis period in 1965), summer low flows have been significantly increased by reservoir regulation operations. Intervening tributary channels between dam and the main-stem Willamette provide a buffer for some of the effects caused by these impoundments.

Sand-and-gravel removal is common at numerous locations along the main-stem Willamette and the lower reaches of many of its tributaries. This has been a principal source for construction aggregates for many decades.

A minimum-draft navigation channel has been maintained over the years by the U.S. Army Corps of Engineers as far upstream as Albany (site 8 in Figure 1). Dredged gravel has generally been spoiled along the river banks. Bank revetments have been constructed at many locations over the past 25 or more years.

The valley floor was largely converted from woods and forests to agricultural usage during the last half of the 19th century and early in this century. During the analysis period the principal change in land use, therefore, has been caused by urban encroachment upon agricultural land. Above the valley floor, forest products represent the principal form of land exploitation and have done so since long before the analysis period.

The four chosen study sites along the main-stem Willamette River are well distributed along the channel's length (no other gaging stations exist on the main-stem, or they would have been included also). The specific gage curves at each site showed a definite trend of lowering specific gage that was clearly evident at all stages (see Figures 12 - 15). However, part of the indicated trend at site 10 (Figure 15, Willamette River at Wilsonville) can be explained by a 4.5-mile shift downstream in the location of the gaging station at the start of the 1955 water year, but with retention of the same datum plane for measuring water stages. Because the precise slope of the water surface in this 4.5-mile reach was not available at different discharges, no estimate has been made of the amount of specific gage lowering due to this known change.

For the 1945 - 1965 analysis period common at 3 of the 4 sites or for the 1949 - 1956 period common at all 4 sites it may be estimated that the main-stem Willamette was subject to lowering specific gage at an average rate of about 1 foot per 10 years over the wide range of discharges examined. Data for the two sites for which a 30 year analysis period was available showed that the general trend existed over the full period, although the rate of lowering was less during the first 10 years (which included the drought years of the 1930's).

Chronological comparison of USGS quadrangle maps, of other maps, and of aerial photographs taken every 2 to 4 years over the last 30 years clearly shows the continual changes in configuration and location of the main-stem Willamette River. These have occurred from the upper end of the main-stem Willamette to a reach between sites 9 and 10 where the river becomes deeply entrenched. From that point downstream to Willamette Falls the plan-view configuration of the river has remained stable over the past 100 years since the earliest reliable maps were made.

Natural changes in stream configuration over a 30-year period would be expected to have a visible effect upon specific gage curves. However, if other changes are not also involved, it seems reasonable that the long-term trend would remain that of unchanging specific gage, even though considerable fluctuations in year-to-year values may be noted. Therefore, more than natural channel change is involved in the behavior of the main-stem Willamette River.

The argument that upstream dams intercept sediment and cause downstream river reaches to mine their bed and banks and to degrade is often valid elsewhere and bears consideration in the case of the main-stem Willamette. If this were the situation, one would expect that the specific gage curves would have changed more rapidly over time as more dams were completed. But this does not appear to be the case in Figures 12-15. Also, one would not expect any change in specific gage due to dams prior to their construction period! Yet changes occurred before dams and reservoir regulation became significant in the Willamette Basin. Furthermore, the analysis of site 4 indicated little effect of a large upstream impoundment upon the specific gage curves in that tributary of the main-stem Willamette. Therefore, dams cannot be viewed as a major contributor to the lowering of specific gage along the main-stem Willamette River.

Sand and gravel removal from the channel of the main-stem Willamette River offers one plausible explanation for the observed changes in specific gage. This activity has occurred over the full analysis period and at many points over the full length of the main-stem channel. But no conclusive statements about the impact of this activity can be given from the limited analysis made here. It should be noted that local removal of streambed sediment will result in adjustment of the sediment transport regime near that location which may be accompanied by bank scour as well as bed scour. These local effects of sand-and-gravel removal should be more readily apparent than general effects along the entire stream and bear further investigation.

As an item of interest with respect to aggregate removal from the main-stem Willamette River, a very rough calculation is possible of the <u>net</u> loss of sediment indicated by the specific gage curves. If one assumes that streambed lowering occurs at a rate of 1 foot per 10 years for a channel about 350 feet wide and 150 miles long, this corresponds to a loss of material from the channel at the rate of about 1 million cubic yards per year. There was no opportunity to compare this figure with average annual rate of aggregate removal from the main-stem Willamette River. But the comparison of such order-of-magnitude figures would give some idea of the significance of aggregate removal with respect to the observed changes of specific gage along the channel.

A different line of speculation also offers plausible explanations for the observed changes in specific gage. Taking first a greatly simplified situation, imagine that a large meander loop is abruptly cut off at the neck. The new, steeper local energy gradient will allow the stream to scour the channel upstream of and at the cut off and the excess sediment will deposit downstream of the cut off. Over a long period of time the river will achieve a new "quasi-equilibrium". Usually this is done through the formation of a new meander loop elsewhere near the cut off so that the river eventually dissipates energy at the same rate per lineal distance as before the cut off occurred. But if the channel is prevented from scouring its banks to dissipate some of its excess energy after the cut off occurs, the long-term tendency of the river will be to re-establish "regime" conditions either by cutting its channel farther upstream or by lengthening its channel with deposits at the mouth, both situations allowing a return to local stream gradients which balance the availability of sediment to be carried as bed-load with the ability of the flow to carry that sediment.

One may apply this argument to channel protection works such as the many bank revetments along the main-stem Willamette River. It may be conjectured that bank stabilization has occurred at river bends where the stream was seeking to dissipate excess energy by means of appreciable erosion and that the "freezing" of channel configuration at these locations has prevented this natural process. As a consequence it may be argued that the river has sought a different means of balancing the sediment transport system -- through channel lengthening. But since the basaltic intrusion at Willamette Falls prevents downstream lengthening of the channel in order to flatten local gradients, the river has been forced to cut its bed in an upstream direction instead. This could account for the observed trend in specific gage at the four study sites. But the argument must presently be considered as unsubstantiated by fact until further investigation can be conducted.

The same line of speculation may also be applied to give a different explanation for the observed specific gage curves. It is conceivable that the main-stem Willamette River is in a non-equilibrium state which produces changes that are more readily measured over geological time than in years. Because of the resistent nature of Willamette Falls, the main-stem may have been cutting its bed and entrenching its channel slowly over the centuries, with the results most evident in the lower quarter of the Willamette from near site 10 to the falls.

The many higher floodplain terraces suggest that this could be the case. Such a situation would not be likely to be noticed during a 20 to 30 year study period. But a marked change in watershed conditions, such as the conversion of about one-third of the basin (the valley floor) from forest to agricultural and urban land, could greatly magnify such a process through the increased rates and amounts of storm runoff to the river caused by such a watershed change. This would probably be evident on specific gage curves even in the absence of dams and aggregate removal from the rivers of the basin.

Lowering of specific gage along the main-stem Willamette River should have a similar effect in the lower reaches of all tributaries, because or of the altered energy gradients and backwater curves that a change in specific gage reflects. The upstream limit of such influence will depend upon the permanence and other characteristics of those channel features which provide section control and channel control over the stage-discharge relationships for each tributary. For example, a lowering of streambed in the main-stem Willamette River might steepen the energy gradients across riffles in a tributary (near its mouth) and cause them to scour thus lowering the section control over the upstream reaches. It might also cause greater bank scour in the tributary (near its mouth) and change the channel control over larger discharges. Such effects would diminish with distance upstream in the tributary. Sites 1, 2, and 5 are on tributaries at distances of 9.4, 7.1, and 9.6 miles, respectively, upstream of the main-stem Willamette River.

Sites 1, 2, and 5 are on tributaries at distances of 9.4, 7.1, and 9.6 miles, respectively, upstream of the main-stem Willamette River. Stage-discharge relations at site 1 are greatly influenced by bed and bank vegetation and it is improbable that lowering of specific gage in the main-stem Willamette has had any influence over the specific gage values at site 1. But sites 2 and 5 may be affected to a limited extent by changes in specific gage along the main-stem Willamette. There is insufficient information presently available to confirm this possibility, however.

From the above discussion it should be clear that several interpretations may be given to the trends shown by the specific gage curves. In fact the cummulative effects of several different causative factors may be responsible for the progressive lowering of specific gage. A definite identification of the reason(s) for this trend requires a much more detailed examination of available information than was possible during this study.

Little Sandy River Near Bull Run

The general trend for specific gage curves at this site during 1935 - 1965 has been for constant conditions at small and intermediate flows and some lowering of specific gage over time at larger flows (see Figure 16). Year-to-year fluctuations of stage occur at all stages. Little additional information was obtained about the site during the study period, so adequate interpretation of the specific gage curves is not possible.

SUMMARY AND CONCLUSIONS

This study was a brief examination to determine whether or not streambed degradation is a real problem in the Willamette Basin, including development of a methodology to make such a determination. Further, the study included an attempt to identify the potential causes of streambed degradation if this condition was found to exist.

Several noteworthy findings emerged from this study. However, the number of study sites analyzed was too small to adequately document and support some of the findings describing areal variability of conditions. With hindsight gained from the study, it would now be possible to select additional study sites in order to give better definition to this areal variability. Interpretation of the causes for water stage changes at specific discharges was found to be more complex than merely identifying that water stage stability was equivalent to streambed stability and that falling or raising water stage over time represented streambed degradation or aggradation, respectively.

Interpretative techniques were developed but the study drew to a close before they could be applied to all study sites. Therefore, the identification of causes for changing specific gages is to be considered as tentative rather than definitive. Application of the developed interpretative techniques would now provide better definition of these causes and greater support to any indications of streambed degradation.

With the foregoing restrictions in mind, several tentative findings have been made. These are:

1. Water stage lowering over time at specific discharges is primarily associated with the main-stem Willamette River and nearby portions of some tributaries, rather than with streams in other parts of the Willamette Basin.

2. The main-stem Willamette River is not in dynamical equilibrium (is not in-regime) in the hydraulic-hydrologic sense, due to progressively changing conditions which collectively influence the stage-discharge relationships at given sites.

3. It appears appropriate to describe the changes of specific gage for the main-stem Willamette River study sites as streambed degradation, although changes of channel configuration are also involved.

4. The indicated recent average rate of streambed degradation along the main-stem Willamette River, based on limited data, is approximately 1 foot per 10 years.

5. The McKenzie River at site 2 is undergoing streambed degradation which amounted to about 3 feet during the 20-year analysis period and involves approximately 3 feet more in the 6 years since then.

6. The observed changes of specific gage along the main-stem Willamette River and near the lower ends of tributaries cannot be directly attributable to upstream dams.

7. Sand-and-gravel removal from the Willamette River appears to be related to the observed changes of specific gage, although the analysis was not carried far enough to reach other than tentative conclusions. Further investigation is warranted.

8. The possibility exists that bank protection works along the Willamette River may have a role in channel lengthening and profile adjustments upstream of Willamette Falls which are reflected by streambed degradation. There is presently no factual basis for this hypothesis although reasonable arguments can be advanced.

9. Similar to item 8 above but on a geological time scale, the possibility exists that the Willamette River is a degrading stream which has not yet achieved an equilibrium profile. Investigation of a hydrogeological nature is warranted to pursue this possibility, as human-activities generally greatly accelerate such processes.

10. Degradation of the main-stem Willamette River will have a similar effect upon the lower reaches of most tributary streams. It is possible that this has happened on the lower Santiam and McKenzie Rivers near the study sites, but the analysis was not extensive enough to confirm this.

11. Because of the large economic values involved in channel protection, there is justification for a detailed investigation of the main-stem Willamette River and lower reaches of tributary streams which covers the full period of record for these and additional stations. A combination of factors appear to be involved in the observed changes of specific gage and the relative importance of these causes needs better identification.

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APPENDIX

Rating Curve Data Used
in Preparation of
Specific Gage Curves

Source:

U.S. Geological Survey
Water Supply Papers

and

Surface Water Records

Table A-1. Rating Curves for Study Site 1, Marys River near Philomath (14-1710), 1941-65.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages. (1)							
	1941 W.Y.		1942 W.Y.		10/1-12-31 1942	1/1/42-12/3/43	12/4/43-9/30/45	10/1-11/26 1945
	10/1-1/18	1/19-9/30	10/1-2/4	2/5-9/30				
21	-	-	-	-	-	-	-	-
20.7	-	-	-	-	-	-	-	-
20.5	-	-	-	-	-	-	-	-
20.4	-	-	-	-	-	-	-	-
20.3	-	-	-	-	-	7,330	-	-
20.2	-	-	-	-	-	-	-	-
20.1	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-
19.5	-	-	-	-	-	-	-	-
19	-	-	-	-	4,850	4,850	-	-
18.5	-	-	-	-	-	-	-	-
18	-	-	3,750	3,750	-	-	-	-
17.5	-	-	-	-	-	-	-	-
17	-	-	-	-	2,890	2,890	-	-
16.5	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	2,600	-
15.5	-	-	-	-	-	-	2,420	-
15	2,170	2,170	2,170	2,170	-	-	-	-
14	-	-	-	-	1,880	1,880	1,970	-
13	1,640	1,640	1,642	1,642	-	-	-	-
12	-	-	-	-	-	-	1,500	1,500
11	1,220	1,220	1,225	1,225	1,225	1,250	1,300	-
10	-	-	-	-	-	-	1,100	1,100
9.5	-	-	-	-	-	-	-	-
9	829	858	858	858	858	885		915
8	-	-	-	-	-	-	735	735
7.2	-	-	-	-	560	579	-	-
7	485	530	530	530	-	-	560	560
6	342	383	383	380	380	385	395	395
5.5	-	-	-	-	-	-	-	-
5	217	246	246	245	245	241	250	250
4.5	163	-	-	-	-	-	-	-
4.3	-	-	163	161	161	154	161	161
4.2	-	-	-	-	-	-	-	-
4.0	116	132	-	-	-	-	-	-
3.7	-	-	103	100	100	89	96	96
3.6	84	-	-	-	-	-	-	-
3.5	-	86	-	-	-	-	-	-
3.4	-	-	-	-	-	-	-	-
3.3	-	-	70	66	66	51	58	58
3.2	57	-	-	-	-	-	-	-
3.1	-	-	-	-	-	-	-	-
3.0	-	50	-	-	-	-	33	33
2.9	40	-	44	38	38	29	-	-
2.8	-	-	-	-	-	18	-	18
2.7	-	32	-	-	-	-	12	-
2.6	25	-	27	21	21	9	-	8
2.5	-	-	-	-	-	-	5	-
2.4	-	17	-	12	12	-	-	-
2.3	13	-	-	-	-	-	-	-
2.2	-	-	-	-	-	-	-	-
2.1	-	7	-	-	-	-	-	-
2.0	-	-	-	-	-	-	-	-
1.9	-	-	-	-	-	-	-	-
1.8	-	-	-	-	-	-	-	-
1.7	-	-	-	-	-	-	-	-
1.6	-	-	-	-	-	-	-	-
1.4	-	-	-	-	-	-	-	-

(1) W.Y. = Water Year

Table A-1. Continued.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages.						
	11/27/45-12/13/46	12/14/46-1/6/48	1/7-11/3 1948	11/4/48-1/3/51	1/4-11/11 1951	11/12/51-1/19/53	1/20-11/22 1953
21	-	-	-	-	-	-	-
20.7	-	-	-	-	-	-	-
20.5	-	7,820	-	7,010	7,010	-	-
20.4	-	-	7,570	-	-	-	-
20.3	-	-	-	-	-	-	-
20.2	5,400	-	-	-	-	-	-
20.1	-	-	-	-	-	6,010	6,010
20	-	6,670	6,670	5,800	5,800	5,800	5,800
19.5	-	-	-	4,940	4,940	-	-
19	-	4,870	4,870	4,380	4,380	4,380	4,380
18.5	-	4,200	4,290	-	-	-	-
18	3,680	3,710	-	3,670	3,670	3,670	3,670
17.5	-	3,370	3,500	-	-	-	-
17	-	-	-	3,200	3,200	-	-
16.5	-	2,860	-	-	-	-	-
16	-	-	2,750	-	-	-	-
15.5	-	-	-	-	-	-	-
15	2,300	2,300	-	2,500	2,500	2,500	-
14	-	-	-	-	2,260	-	-
13	-	-	1,850	1,930	1,930	-	-
12	1,540	1,540	-	-	-	-	-
11	-	-	-	-	-	-	1,430
10	-	-	1,230	-	1,180	1,180	-
9.5	1,040	1,040	-	-	-	-	-
5	-	-	-	970	-	-	-
8	755	755	-	-	-	-	-
7.2	-	-	-	-	-	-	-
7	570	570	650	560	526	576	620
6	395	395	-	-	-	-	-
5.5	-	-	-	305	-	-	-
5	243	243	280	-	210	264	285
4.5	-	-	-	156	-	-	-
4.3	154	154	-	-	-	-	-
4.2	-	-	146	-	-	-	-
4.0	-	-	-	89	102	156	163
3.7	87	87	72	53	-	-	-
3.6	-	-	-	-	-	-	-
3.5	-	-	-	32	60	-	-
3.4	-	-	39	23	-	-	-
3.3	49	49	-	15	-	-	-
3.2	-	-	22	9	-	-	-
3.1	33	33	-	-	-	-	-
3.0	-	-	9	-	28	70	71
2.9	19	19	-	-	-	-	-
2.8	-	-	-	-	-	-	-
2.7	8	8	-	-	16	-	-
2.6	-	-	-	-	-	-	-
2.5	-	-	-	-	12	35	40
2.4	-	-	-	-	-	-	-
2.3	-	-	-	-	-	-	-
2.2	-	-	-	-	8	-	-
2.1	-	-	-	-	-	14	-
2.0	-	-	-	-	-	-	13
1.9	-	-	-	-	-	7	-
1.8	-	-	-	-	-	5	-
1.7	-	-	-	-	-	-	-
1.6	-	-	-	-	-	-	-
1.4	-	-	-	-	-	-	-

Table A-1. Continued.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages.						
	11/23/53-9/30/55	10/1-12/20 1955	12/21/55-2/23/57	2/24-9/30 1957	10/1/57-1/30/58	1/31/58-1/8/59	1/9/59-2/8/60
21	-	-	9,250	-	-	9,250	9,250
20.7	-	-	-	-	-	-	-
20.5	-	-	-	-	-	-	-
20.4	-	-	-	-	-	-	-
20.3	-	-	-	-	-	-	-
20.2	-	-	-	-	-	-	-
20.1	-	-	-	-	-	-	-
20	-	-	6,050	-	6,050	-	-
19.5	4,940	-	-	-	-	-	-
19	-	4,380	4,500	-	-	4,500	-
18.5	-	-	-	-	-	-	-
18	3,670	-	3,800	-	3,800	-	3,850
17.5	-	-	-	-	-	-	-
17	-	3,200	-	3,320	-	-	-
16.5	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-
15.5	-	-	-	-	-	-	-
15	2,500	2,500	2,550	-	-	-	-
14	-	-	-	2,220	2,220	2,510	2,510
13	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-
10	1,150	1,150	1,230	1,230	1,230	1,330	1,330
9.5	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-
7.2	-	-	-	-	-	-	-
7	600	600	630	638	638	661	661
6	-	-	-	-	-	-	-
5.5	-	-	-	-	-	-	-
5	270	270	285	308	308	308	308
4.5	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-
4.2	-	-	-	-	-	-	-
4.0	148	148	149	170	170	177	170
3.7	-	-	-	-	-	-	-
3.6	-	-	-	-	-	-	-
3.5	-	-	97	-	-	-	-
3.4	-	-	-	-	-	-	-
3.3	-	-	-	-	-	-	-
3.2	-	-	-	-	-	-	-
3.1	-	-	-	-	-	-	-
3.0	62	62	60	74	74	85	74
2.9	-	-	-	-	-	-	-
2.8	-	-	-	-	-	-	-
2.7	-	-	-	-	-	-	-
2.6	-	-	-	-	-	-	-
2.5	34	34	32	41	41	51	41
2.4	-	-	-	-	-	-	-
2.3	-	-	-	-	-	-	-
2.2	-	-	-	-	-	-	-
2.1	18	-	-	-	-	-	-
2.0	-	-	13	16	16	23	16
1.9	-	-	-	-	-	-	-
1.8	-	-	-	-	-	-	10
1.7	-	-	7	-	-	12	-
1.6	-	-	-	6	6	-	6
1.4	-	-	-	-	-	6	-

Table A-1. Continued.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages.						
	2/9-9/30 1960	1961 W.Y.		1962 W.Y.		1963 W.Y.	
		10/1-11/24	11/25-9/30	10/1-12/20	12/21-9/30	10/1-3/30	3/31-9/30
21	-	-	9,250	-	-	-	-
20.7	-	-	-	-	-	-	-
20.5	-	-	-	-	-	-	-
20.4	-	-	-	-	-	-	-
20.3	-	-	-	-	-	-	-
20.2	-	-	-	-	-	-	-
20.1	-	-	-	-	-	-	-
20	6,000	-	-	-	-	-	-
19.5	-	-	-	-	-	5,000	5,000
19	-	-	-	-	4,500	-	-
18.5	-	-	-	-	-	-	-
18	3,820	-	3,820	-	-	-	-
17.5	-	-	-	-	-	-	-
17	-	-	-	-	-	3,320	3,320
16.5	-	-	-	-	-	-	-
16	-	-	-	2,950	-	-	-
15.5	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-
14	2,370	-	2,370	2,370	2,350	-	-
13	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-
10	1,390	1,390	1,390	1,390	1,300	1,300	1,300
9.5	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-
7.2	-	-	-	-	-	-	-
7	700	700	640	640	615	615	615
6	-	-	-	-	-	-	-
5.5	-	-	-	-	-	-	-
5	308	308	262	262	262	262	258
4.5	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-
4.2	-	-	-	-	-	-	-
4.0	170	170	136	136	142	142	142
3.7	-	-	-	-	-	-	-
3.6	-	-	-	-	-	-	-
3.5	-	-	-	-	-	-	-
3.4	-	-	-	-	-	-	-
3.3	-	-	-	-	-	-	-
3.2	-	-	-	-	-	-	-
3.1	-	-	-	-	-	-	-
3.0	74	74	54	54	53	53	53
2.9	-	-	-	-	-	-	-
2.8	-	-	-	-	-	-	-
2.7	-	-	-	-	-	-	-
2.6	-	-	-	-	-	-	-
2.5	41	41	28	28	22	22	22
2.4	-	-	-	-	-	-	-
2.3	-	-	-	-	-	-	-
2.2	-	-	-	17	-	-	-
2.1	-	-	-	-	8	-	-
2.0	-	-	11	-	-	-	-
1.9	14	14	-	-	-	-	-
1.8	-	-	-	-	-	-	-
1.7	-	-	-	-	-	-	-
1.6	-	-	-	-	-	-	-
1.4	-	-	-	-	-	-	-

Table A-1. Continued.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages.		
	10/1/63-1/19/64	1/20-12/21 1964	12/22/64-9/30/65
21	-	-	-
20.7	-	-	13,000
20.5	-	-	7,800
20.4	-	-	-
20.3	-	-	-
20.2	-	-	-
20.1	-	-	-
20	6,000	6,000	5,820
19.5	-	-	-
19	4,500	4,500	4,500
18.5	-	-	-
18	-	-	-
17.5	-	-	-
17	3,320	3,200	-
16.5	-	-	-
16	-	-	2,780
15.5	-	-	-
15	-	-	-
14	-	2,150	-
13	-	-	-
12	-	-	-
11	-	-	1,380
10	1,300	-	-
9.5	-	-	-
9	-	-	-
8	-	735	-
7.2	-	-	-
7	615	-	511
6	-	-	-
5.5	-	-	-
5	258	239	194
4.5	-	-	-
4.3	-	-	-
4.2	-	-	-
4.0	127	111	90
3.7	-	-	-
3.6	-	-	-
3.5	-	-	52
3.4	-	-	-
3.3	-	49	-
3.2	-	-	-
3.1	-	-	-
3.0	45	-	23
2.9	-	-	-
2.8	-	20	-
2.7	-	-	11
2.6	-	-	-
2.5	-	8	6
2.4	16	-	-
2.3	-	-	-
2.2	-	-	-
2.1	-	-	-
2.0	-	-	-
1.9	-	-	-
1.8	-	-	-
1.7	-	-	-
1.6	-	-	-
1.4	-	-	-

Table A-2. Rating Curves for Study Site 2, McKenzie River near Coburg (14-1655), 1945-65

Water stage above 1971 datum, feet (2)	Effective period for rating curve and discharges (cfs) at given stages.[1]							
	1945 W.Y.		1946 W.Y.		1947 W.Y.		1948 W.Y.	
	10/1-2/13	2/14-9/30	10/1-12/28	12/29-9/30	10/1-11/25	11/26-9/30	10/1-1/5	1/6-9/30
21	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-
19.6	-	-	-	66,500	-	-	-	57,000
19.5	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	48,000
18	-	-	-	-	-	-	-	-
17.8	-	-	-	-	-	51,400	-	-
17.5	-	-	-	44,900	-	-	-	-
17	-	-	-	-	-	-	-	-
16.6	-	-	-	-	-	39,600	-	38,200
16	-	34,700	-	34,700	-	-	-	-
15.4	-	-	-	-	-	-	-	-
15	-	-	-	-	-	30,400	-	-
14.5	-	27,500	-	27,500	-	-	-	-
13	-	22,000	-	21,000	-	21,800	-	-
12.8	-	-	-	-	-	-	21,000	-
12.5	18,200	-	-	-	-	-	-	-
12.4	-	-	-	-	-	-	-	-
12	-	-	-	-	17,100	-	-	20,800
11.9	-	-	16,700	16,700	-	-	-	-
11.5	-	15,300	-	-	-	-	-	-
11	12,800	-	13,700	13,600	13,600	14,500	14,500	-
10	-	10,800	10,800	10,500	10,500	-	-	13,200
9.5	8,510	-	-	-	-	-	-	-
9	-	8,210	8,210	7,760	7,760	8,450	8,450	-
8.5	-	-	-	-	-	-	-	-
8.4	5,740	-	-	-	-	-	-	-
8	-	5,750	5,750	5,430	5,430	-	-	6,860
7.6	3,960	-	-	-	-	4,900	4,900	-
7.5	-	-	-	-	-	-	-	-
7.3	-	-	-	-	-	-	-	-
7	2,720	3,620	3,620	3,390	3,390	-	-	4,520
6.8	-	-	-	-	-	-	-	-
6.6	1,940	-	-	-	-	2,900	2,900	-
6.5	-	2,700	2,700	2,490	2,490	-	-	-
6.2	1,260	-	-	-	-	-	-	-
6	-	1,920	1,920	1,670	-	-	-	2,690
5.9	-	-	-	-	1,520	1,700	1,700	-
5.6	-	1,440	-	-	-	-	-	-
5.5	-	-	1,330	-	-	-	-	-
5.4	-	-	-	-	-	-	-	1,770
5.2	-	-	-	-	-	-	-	-
5.1	-	-	-	-	-	-	-	-
5.0	-	-	-	-	-	-	-	-
4.9	-	-	-	-	-	-	-	-
4.8	-	-	-	-	-	-	-	-
4.7	-	-	-	-	-	-	-	-
4.6	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-	-
4.0	-	-	-	-	-	-	-	-
2.8	-	-	-	-	-	-	-	-

(1) W.Y. = Water Year

No data published for 1954, 1960 water years.

(2) Datum plane was lowered 4.00 ft. on 3/1/1965.

Table A-2. Continued

Water stage above 1971 datum, feet (2)	Effective period for rating curve and discharges (cfs) at given stages.							
	1949 W.Y.		1950 W.Y.		1951 W.Y.		1952 W.Y.	
	10/1-12/12	12/13-9/30	10/1-3/17	3/18-9/30	10/1-10/29	10/30-9/30	10/1-2/3	2/4-9/30
21	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-
19.6	-	-	-	-	-	-	-	-
19.5	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-
18	-	-	-	-	48,400	-	-	-
17.8	-	-	-	-	-	-	-	-
17.5	-	-	-	-	-	-	-	-
17	43,100	-	-	-	-	-	-	-
16.6	-	-	-	-	-	-	-	-
16	-	-	-	-	-	35,900	-	-
15.4	-	-	35,400	-	-	-	-	-
15	-	35,400	-	-	-	-	-	30,900
14.5	-	-	-	-	-	-	-	-
14	29,000	-	-	-	29,000	-	26,400	-
13	-	24,800	24,800	-	-	-	-	-
12.8	-	-	-	-	-	-	-	-
12.5	-	-	-	-	-	-	-	-
12.4	-	-	-	22,300	-	-	-	-
12.	20,800	-	-	-	-	18,400	-	-
11.9	-	-	-	-	-	-	-	-
11.5	-	-	-	-	18,500	-	-	-
11	-	16,800	16,800	16,400	-	-	14,800	-
10	13,200	-	-	12,400	-	-	-	11,900
9.5	-	11,100	11,100	-	10,500	-	-	-
9	-	-	-	8,870	-	-	-	-
8.5	-	-	-	-	-	7,450	7,450	-
8.4	-	-	-	-	-	-	-	-
8	6,860	6,600	6,600	6,090	-	-	-	6,850
7.6	-	-	-	-	-	-	-	-
7.5	-	-	-	-	4,920	-	-	-
7.3	-	-	-	-	-	-	-	-
7	4,520	4,340	4,340	3,900	-	-	-	-
6.8	-	-	-	-	-	-	-	-
6.6	-	-	-	-	-	-	-	-
6.5	-	-	-	-	-	3,470	3,470	-
6.2	-	-	-	2,540	-	-	-	-
6	2,690	2,510	2,510	-	2,250	-	-	3,570
5.9	-	-	-	2,110	-	-	-	-
5.6	2,070	1,870	-	-	-	-	-	-
5.5	-	-	1,710	-	-	-	2,200	-
5.4	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	-
5.1	-	-	-	-	-	1,780	-	-
5.0	-	-	-	-	-	-	-	-
4.9	-	-	-	-	-	-	-	-
4.8	-	-	-	-	-	-	-	1,840
4.7	-	-	-	-	-	-	-	-
4.6	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-	-
4.0	-	-	-	-	-	-	-	-
2.8	-	-	-	-	-	-	-	-

Table A-2. Continued

Water stage above 1971 datum, feet (2)	Effective period for rating curve and discharges (cfs) at given stages. 1953 W.Y. 10/1-1/18	1953 W.Y. 1/19-9/30	10/1-12/31 1954	1/1-11/19 1955	11/20/55-2/21/56	2/22-9/30 1956	1957 W.Y. 10/1-12/12	1957 W.Y. 12/12-9/30
21	64,400	-	-	-	-	-	-	-
20	-	-	-	-	71,500	-	-	-
19.6	-	-	-	-	-	-	-	-
19.5	-	-	-	-	-	-	-	-
19	-	64,000	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-
17.8	-	-	-	-	-	-	-	-
17.5	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-
16.6	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	43,000
15.4	-	-	-	-	-	-	-	-
15	-	-	-	-	37,000	-	37,000	-
14.5	-	-	-	-	-	-	-	-
14	26,400	31,300	-	-	-	-	-	-
13	-	-	27,700	27,700	-	-	-	25,600
12.8	-	-	-	-	-	-	-	-
12.5	-	-	-	-	-	-	-	-
12.4	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	21,200	-
11.9	-	-	-	-	-	-	-	-
11.5	-	-	-	-	-	-	-	-
11	-	-	-	-	16,400	-	-	-
10	11,900	12,600	13,500	13,200	-	13,800	13,800	12,700
9.5	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-
8.5	-	-	-	-	-	-	-	-
8.4	-	-	-	-	-	-	-	-
8	6,850	6,850	6,500	6,550	6,550	7,000	7,000	6,400
7.6	-	-	-	-	-	-	-	-
7.5	-	-	-	-	-	-	-	-
7.3	-	-	-	-	4,910	-	-	-
7	-	-	4,210	4,270	-	4,500	4,500	4,180
6.8	-	-	-	-	-	-	-	-
6.6	-	-	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-	-
6.2	-	-	-	-	-	-	-	-
6	-	-	2,640	2,610	-	2,700	2,700	2,650
5.9	-	-	-	-	-	-	-	-
5.6	-	-	2,140	2,090	-	2,160	2,160	-
5.5	-	-	-	-	-	-	-	-
5.4	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	1,540
5.1	-	-	-	-	-	-	-	-
5	-	1,850	-	-	-	-	-	-
4.9	-	-	-	-	-	-	-	-
4.8	1,710	-	-	-	-	-	-	-
4.7	-	-	-	-	-	-	-	-
4.6	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-	-
4.0	-	-	-	-	-	-	-	-
2.8	-	-	-	-	-	-	-	-

Table A-2. Continued

Water stage above 1971 datum, feet (2)	Effective period for rating curve and discharges (cfs) at given stages.								
	1958 W.Y.		1959 W.Y.		1961 W.Y.			1962 W.Y.	
	10/1-12/20	12/21-9/30	10/1-11/19	11/20-9/30	10/1-11/23	11/24-5/16	5/17-9/30	10/1-12/19	12/20-9/30
21	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-
19.6	-	-	-	-	-	-	-	-	-
19.5	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	68,000	-	-	-
18	-	-	-	-	-	-	-	-	-
17.8	-	-	-	-	-	-	-	-	-
17.5	-	-	-	-	-	-	-	-	-
17	49,500	49,500	-	-	-	-	-	-	-
16.6	-	-	-	-	-	-	-	-	-
15.4	-	-	-	-	-	-	-	-	-
15	-	-	-	37,000	-	-	-	-	-
14.5	-	-	-	-	-	-	-	-	-
14	31,000	31,000	-	-	-	-	-	-	37,000
13	-	-	-	-	-	28,300	-	29,000	-
12.8	-	-	-	-	-	-	-	-	-
12.5	-	-	-	-	-	-	-	-	-
12.4	-	-	-	-	-	-	-	-	-
12	21,100	-	19,800	-	19,800	-	-	-	-
11.9	-	-	-	-	-	-	-	-	-
11.5	-	-	-	-	-	-	-	-	-
11	-	15,400	-	15,400	-	-	-	-	-
10	12,700	-	11,500	-	11,500	14,500	-	15,500	16,800
9.5	-	-	-	-	-	-	-	-	-
9	-	8,500	-	8,200	-	-	-	-	-
8.5	-	-	-	-	-	-	-	-	-
8.4	-	-	-	-	-	-	-	-	-
8	6,400	-	6,000	5,580	5,300	7,500	8,500	8,500	9,300
7.6	-	-	-	-	-	-	-	-	-
7.5	-	-	-	-	-	-	-	-	-
7.3	-	-	-	-	-	-	-	-	-
7	4,180	4,060	-	3,520	3,100	-	-	-	-
6.8	-	-	-	-	-	-	-	-	-
6.6	-	-	-	-	-	3,900	-	-	-
6.5	-	-	-	-	-	-	-	-	-
6.2	-	-	-	-	-	-	-	-	-
6	2,650	-	2,510	2,120	1,600	-	3,400	3,400	3,800
5.9	-	-	-	-	-	-	-	-	-
5.6	-	-	-	1,660	-	-	-	-	-
5.5	-	-	-	-	-	-	-	-	-
5.4	1,790	1,670	1,670	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	-	-
5.1	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	1,620	1,620	1,950
4.9	-	-	-	-	-	-	-	-	-
4.8	-	-	-	-	-	-	-	-	1,650
4.7	-	-	-	-	-	-	-	-	-
4.6	-	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-	-	-
4.0	-	-	-	-	-	-	-	-	-
2.8	-	-	-	-	-	-	-	-	-

Table A-2. Continued

Water stage above 1971 datum, feet (2)	Effective period for rating curve and discharges (cfs) at given stages.						
	1963 W.Y.		1964 W.Y.		1965 W.Y.	1965 W.Y.	
	10/1-2/3	2/4-9/30	10/1-11/8	11/9-9/30	10/1-12/23	12/24-2/28	5/1-9/30
21	-	-	-	-	-	-	-
20	-	-	-	-	86,500	-	-
19.6	-	-	-	-	-	-	-
19.5	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-
17.8	-	-	-	-	-	-	-
17.5	-	-	-	-	-	-	-
17	-	-	-	-	-	77,700	-
16.6	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-
15.4	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-
14.5	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-
12.8	-	-	-	-	-	-	-
12.5	-	-	-	-	-	-	-
12	26,000	26,000	-	30,000	30,000	-	-
11.9	-	-	-	-	-	-	-
11.5	-	-	-	-	-	-	-
11	-	-	21,000	-	-	-	-
10	16,800	16,800	-	19,000	19,000	-	-
9.5	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-
8.5	-	-	-	-	-	-	-
8.4	-	-	-	-	-	-	-
8	9,300	9,300	9,300	10,000	-	17,800	
7.6	-	-	-	-	-	-	-
7.5	-	-	-	-	8,100	-	-
7.3	-	-	-	-	-	-	-
7	-	-	-	-	-	-	12,400
6.8	-	-	-	-	-	-	-
6.6	-	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-
6.2	-	-	-	-	-	-	-
6	3,800	3,900	3,900	4,040	4,040	8,000	8,000
5.9	-	-	-	-	-	-	-
5.6	-	-	-	-	-	-	-
5.5	-	-	-	-	-	-	-
5.4	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-
5.0	1,950	2,280	2,280	-	2,280	-	-
4.9	1,800	-	-	-	-	-	-
4.8	-	-	-	2,000	-	5,150	-
4.7	-	-	-	-	-	-	-
4.6	-	-	-	-	1,760	-	-
4.3	-	1,440	1,440	-	-	-	-
4.0	-	-	-	-	-	-	3,590
2.8	-	-	-	-	-	-	1,650

Table A-3. Rating Curves for Study Site 3, South Santiam River at Mehama (14-1875), 1935-65.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages.[1]							
	1935 W.Y.	1936 W.Y. 10/1-2/4	1936 W.Y. 2/5-9/30	1937 W.Y.	1938 W.Y.	1939 W.Y.	1940 W.Y.	1941 W.Y.
23	-	-	-	-	-	-	-	-
19.2	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-
17.1	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-
14	-	33,100	-	33,100	33,100	-	-	-
13	-	-	-	-	-	-	-	-
12	25,300	25,300	-	25,300	25,300	-	-	-
11	-	-	-	-	-	-	-	-
10.6	-	-	-	-	-	-	-	-
10.5	-	-	-	-	-	19,900	-	-
10	18,100	18,100	-	18,100	18,100	-	-	-
9.5	-	-	-	-	-	-	-	-
9.3	-	-	-	-	-	-	-	-
9	14,800	14,800	-	-	-	-	-	14,800
8.7	-	-	-	-	-	-	-	-
8.5	-	-	-	-	-	-	13,200	-
8	11,600	11,600	-	11,600	11,600	11,600	11,600	11,600
7.5	-	-	-	-	-	-	-	-
7	8,610	8,610	-	-	-	8,500	8,500	8,500
6.8	-	-	-	-	-	-	-	-
6	6,000	6,000	-	5,910	5,810	5,810	5,810	5,800
5.8	-	-	-	-	-	-	-	-
5.5	4,830	4,830	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	-
5	3,770	3,770	3,770	3,740	3,740	3,690	3,690	3,620
4.6	-	-	-	-	-	-	-	-
4.5	2,830	2,830	2,800	2,790	2,790	2,780	2,780	2,730
4.3	-	-	-	-	-	-	-	-
4	2,040	2,040	1,950	1,950	1,950	1,950	1,950	1,950
3.8	-	-	-	-	-	-	-	-
3.7	-	-	-	-	-	-	-	-
3.6	1,490	1,490	-	-	-	-	-	-
3.5	-	-	-	1,260	1,260	1,260	1,260	1,260
3.4	-	-	-	-	-	-	-	-
3.3	-	-	-	-	-	-	-	-
3.2	1,000	1,000	925	-	-	-	-	-
3	-	-	-	730	730	730	730	730
2.9	680	680	-	-	-	-	-	-
2.7	-	-	-	465	465	465	465	465
2.6	420	420	390	-	-	-	-	-
2.5	-	-	-	-	-	-	-	320
2.4	280	280	258	258	258	258	258	-
2.3	-	-	-	-	-	-	-	208
2.2	178	178	167	167	167	167	167	-
2.1	-	-	-	-	-	-	-	132
2	111	111	101	101	101	101	101	-
1.9	-	-	-	-	-	-	-	-
1.8	-	-	-	-	-	-	-	-

(1) W.Y. = Water Year

No data published for 1952 water year.

Table A-3. Continued

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages.							
	1942 W.Y.		1943 W.Y.		1944 W.Y.		1945 W.Y.	1946 W.Y.
	10/1-11/15	11/16-9/30	10/1-12/31	1/1-9/30	10/1-11/4	11/5-9/30		
23	-	-	-	-	-	-	-	-
19.2	-	-	-	-	-	-	-	56,600
19	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-
17.1	-	-	-	-	-	-	-	-
17	-	-	-	46,800	-	-	-	46,800
16	-	-	-	-	-	-	-	-
15	-	-	37,200	-	-	-	-	38,100
14	-	-	-	33,800	-	-	-	-
13	-	-	-	-	-	-	29,600	29,600
12	25,300	25,300	25,300	25,500	-	-	-	-
11	-	-	-	-	-	-	21,600	21,600
10.6	20,200	-	-	-	-	-	-	-
10.5	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-
9.5	-	16,400	16,450	16,100	-	-	-	-
9.3	-	-	-	-	-	-	15,400	15,400
9	14,800	-	-	-	-	-	-	-
8.7	-	-	-	-	13,300	13,300	-	-
8.5	-	-	-	-	-	-	-	-
8	11,600	-	-	-	-	-	11,000	11,000
7.5	-	10,000	10,100	9,400	9,400	9,400	-	-
7	8,500	-	-	-	-	-	-	-
6.8	-	-	-	-	-	-	7,390	7,390
6	5,800	5,800	5,800	5,390	5,390	5,390	-	-
5.8	-	-	-	-	-	-	4,940	4,940
5.5	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	-
5	3,620	3,510	3,510	3,350	3,350	3,350	3,350	3,350
4.6	-	-	-	-	-	-	-	-
4.5	2,730	-	-	-	-	-	-	-
4.3	-	2,300	2,300	2,220	2,220	2,220	2,220	2,220
4	1,950	-	-	-	-	-	-	-
3.8	-	-	-	-	-	-	1,510	1,510
3.7	-	1,450	1,450	1,380	1,380	1,380	-	-
3.6	-	-	-	-	-	-	-	-
3.5	1,260	-	-	-	-	-	-	-
3.4	-	-	-	-	-	-	1,040	1,045
3.3	-	990	990	945	945	945	-	-
3.2	-	-	-	-	-	-	-	-
3	730	-	-	675	675	675	675	675
2.9	-	625	625	-	-	-	-	-
2.7	465	-	-	450	450	450	450	450
2.6	-	390	390	-	-	-	-	-
2.5	-	-	-	-	-	324	324	324
2.4	-	-	-	270	-	-	-	-
2.3	-	222	222	-	-	218	218	218
2.2	-	-	-	182	-	-	-	-
2.1	-	149	149	-	-	139	139	139
2	-	-	-	-	-	-	-	-
1.9	-	-	-	-	-	-	-	-
1.8	-	-	-	-	-	-	-	-

Table A-3. Continued

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages.							
	1947 W.Y.		1948	1949 W.Y.		1950	1951 W.Y.	
	10/1-12/13	12/14-9/30	W.Y.	10/1-12/12	12/13-9/30	W.Y.	10/1-2/10	2/11-9/30
23	-	-	-	-	-	-	-	-
19.2	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-
17.1	-	-	47,200	-	-	-	-	-
17	-	46,800	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-
15	38,100	38,100	38,100	-	-	-	-	-
14	-	-	-	33,800	-	33,800	33,800	-
13	29,600	29,600	29,600	-	-	-	-	-
12	-	-	-	-	-	-	-	-
11	21,600	21,700	21,700	21,700	-	21,700	21,700	-
10.6	-	-	-	-	-	-	-	-
10.5	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-
9.5	16,100	16,400	16,400	16,400	-	16,400	-	-
9.3	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	15,500
8.7	-	-	-	-	-	-	-	-
8.5	-	-	-	-	-	-	-	-
8	11,000	11,400	11,400	11,400	-	11,400	11,400	-
7.5	-	-	-	-	-	-	-	-
7	7,940	8,350	8,350	8,350	-	8,350	-	8,800
6.8	-	-	-	-	-	-	-	-
6	5,390	5,650	5,650	5,650	-	5,650	5,650	6,060
5.8	-	-	-	-	-	-	-	-
5.5	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	3,890	-	-
5	3,350	3,500	3,500	3,500	-	-	3,500	3,700
4.6	-	-	-	-	-	2,780	-	-
4.5	-	-	2,610	2,610	-	-	-	-
4.3	2,220	2,280	-	-	-	-	-	-
4	-	-	1,850	1,850	-	1,850	1,850	1,920
3.8	1,510	1,590	-	-	-	-	-	-
3.7	-	-	-	-	-	-	-	-
3.6	-	-	-	-	-	-	-	-
3.5	-	-	-	-	-	-	1,200	1,240
3.4	1,040	1,130	1,130	1,130	1,080	1,080	-	-
3.3	-	-	-	-	-	-	-	-
3.2	-	-	-	-	-	-	-	-
3	675	745	745	745	680	680	680	720
2.9	-	-	-	-	-	-	-	-
2.7	450	490	490	490	452	452	-	-
2.6	-	-	-	-	-	-	392	-
2.5	-	-	349	-	-	336	-	370
2.4	268	287	-	-	286	-	-	-
2.3	-	-	241	-	-	241	241	-
2.2	175	186	-	-	200	-	-	-
2.1	-	-	163	-	-	163	-	-
2	-	-	-	-	130	-	-	160
1.9	-	-	-	-	-	-	-	-
1.8	-	-	-	-	-	-	-	105

Table A-3. Continued

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (CFS) at given stages.						
	1953 W.Y.		1954 W.Y.	1955 W.Y.	1956 W.Y.	1957 W.Y.	
	10/1-1/17	1/18-9/30				10/1-12/11	12/12-9/30
23	-	-	-	-	-	-	-
19.2	-	-	-	-	-	-	-
19	-	55,700	-	-	-	-	-
18	-	-	-	-	52,500	-	-
17.1	-	-	-	-	-	-	-
17	-	-	-	-	-	47,500	-
16	-	-	42,400	-	-	-	-
15	-	38,100	-	-	-	-	-
14	-	-	-	-	33,800	33,800	-
13	30,000	-	-	29,700	-	-	29,700
12	-	-	-	-	-	-	-
11	-	21,700	21,700-	-	-	-	-
10.6	-	-	-	-	-	-	-
10.5	-	-	-	-	-	-	-
10	19,000	-	-	18,600	18,600	18,600	18,600
9.5	-	-	-	-	-	-	-
9.3	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-
8.7	-	-	-	-	-	-	-
8.5	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-
7.5	-	9,850	9,850	-	-	-	-
7	8,800	-	-	8,700	8,700	8,700	8,700
6.8	-	-	-	-	-	-	-
6	-	5,690	5,690	-	-	-	-
5.8	-	-	-	-	-	-	-
5.5	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-
5	3,700	3,550	3,550	3,490	3,490	3,490	3,400
4.6	-	-	-	-	-	-	-
4.5	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-
4	1,920	1,800	1,800	1,790	1,790	1,790	1,710
3.8	-	-	-	-	-	-	-
3.7	-	-	-	-	-	-	-
3.6	-	-	-	-	-	-	-
3.5	1,240	1,150	1,150	-	-	-	-
3.4	-	-	-	-	-	-	-
3.3	-	-	-	-	-	-	-
3.2	-	-	-	-	-	-	-
3	720	660	660	720	720	720	660
2.9	-	-	-	-	-	-	-
2.7	-	-	-	-	-	-	-
2.6	-	-	-	-	-	-	-
2.5	370	345	345	360	360	335	335
2.4	-	-	-	-	-	-	-
2.3	-	-	250	-	-	-	-
2.2	230	-	-	205	-	-	-
2.1	-	175	-	-	160	-	-
2	-	-	-	-	-	125	135
1.9	130	-	-	-	-	-	-
1.8	-	-	-	-	-	-	-

Table A-3. Continued

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages.							
	1958 W.Y.		1959 W.Y.		1960 W.Y.		1961 W.Y.	
	10/1-2/16	2/17-9/30	10/1-11/19	11/20-9/30	10/1-10/9	10/10-9/30	10/1-11/24	11/25-9/30
23	-	-	-	-	-	-	-	-
19.2	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	57,700
18	-	-	-	-	-	-	-	-
17.1	-	-	-	-	-	-	-	-
17	47,500	-	-	-	-	-	47,500	-
16	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	33,800	33,800
13	29,700	-	-	-	-	-	-	-
12	-	-	25,800	25,800	-	-	-	-
11	-	-	-	-	-	-	-	-
10.6	-	-	-	-	-	-	-	-
10.5	-	-	-	-	-	-	-	-
10	18,600	18,600	18,600	-	-	18,600	18,600	18,500
9.5	-	-	-	-	-	-	-	-
9.3	-	-	-	-	-	-	-	-
9	-	-	-	15,200	-	-	-	-
8.7	-	-	-	-	-	-	-	-
8.5	-	-	-	-	-	-	-	-
8	-	-	-	-	12,000	-	-	-
7.5	-	-	-	-	-	-	-	-
7	8,700	8,700	8,700	8,800	-	-	-	-
6.8	-	-	-	-	-	-	-	-
6	-	-	-	-	5,900	5,900	5,900	5,540
5.8	-	-	-	-	-	-	-	-
5.5	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	-
5	3,400	3,400	3,490	3,600	3,600	3,600	3,600	3,420
4.6	-	-	-	-	-	-	-	-
4.5	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-	-
4	1,710	1,790	1,790	1,870	1,870	1,930	1,930	1,790
3.8	-	-	-	-	-	-	-	-
3.7	-	-	-	-	-	-	-	-
3.5	-	-	-	-	-	1,250	1,250	1,140
3.4	-	-	-	-	1,110	-	-	-
3.3	-	-	-	-	-	-	-	-
3.2	-	-	-	-	-	-	-	-
3	660	720	720	710	-	750	750	645
2.9	-	-	-	-	630	-	-	-
2.7	-	-	-	-	-	-	-	-
2.6	-	-	-	-	-	-	-	-
2.5	335	360	360	345	-	350	350	300
2.4	-	-	-	-	-	-	-	-
2.3	240	-	-	-	-	-	-	-
2.2	-	-	-	-	-	-	-	-
2.1	-	160	160	157	-	157	157	128
2	-	-	-	-	-	-	-	-
1.9	-	-	-	-	-	-	-	-
1.8	-	-	-	-	-	-	-	-

Table A-3. Continued

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages.				
	1962 W.Y.		1963 W.Y.	10/1/63-12/21/64	12/22/64-9/30/65
	10/1-12/19	12/20-9/30			
23	-	-	-	-	83,700
19.2	-	-	-	-	-
19	-	-	-	-	-
18	-	-	-	-	-
17.1	-	-	-	-	-
17	-	-	-	-	-
16	-	-	-	-	-
15	-	-	-	-	38,100
14	-	-	-	-	-
13	-	29,700	-	29,700	-
12	-	-	-	-	-
11	22,100	-	22,100	-	-
10.6	-	-	-	-	-
10.5	-	-	-	-	-
10	-	18,500	18,500	18,500	18,500
9.5	-	-	-	-	-
9.3	-	-	-	-	-
9	-	-	-	-	-
8.7	-	-	-	-	-
8.5	-	-	-	-	-
8	-	-	-	-	-
7.5	-	-	-	-	-
7	8,300	-	-	8,400	8,600
6.8	-	-	-	-	-
6	-	5,760	-	-	-
5.8	-	-	-	-	-
5.5	-	-	-	-	-
5.2	-	-	-	-	-
5	3,420	3,630	3,630	3,750	3,900
4.6	-	-	-	-	-
4.5	-	-	-	-	-
4.3	-	-	-	-	-
4	1,790	1,960	1,960	2,040	2,150
3.8	-	-	-	-	-
3.7	-	-	-	-	-
3.6	-	-	-	-	-
3.5	1,140	1,300	1,300	1,350	-
3.4	-	-	-	-	-
3.3	-	-	-	-	-
3.2	-	-	-	-	-
3	645	760	760	790	860
2.9	-	-	-	-	-
2.7	-	-	-	-	-
2.6	-	-	-	-	-
2.5	300	360	360	363	405
2.4	-	-	-	-	-
2.3	-	-	-	-	-
2.2	164	-	186	176	213
2.1	-	139	-	-	-
2	-	-	-	-	-
1.9	-	-	-	-	100
1.8	-	-	-	-	-

Table A-4. Rating Curves for Study Site 4, North Santiam River at Mehama (14-1830), 1935-65.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages.[1]							
	1935, 1936 1937 W.Y.	1941 W.Y.	1942 W.Y.	1943 W.Y. 10/1-11/23	1943 W.Y. 11/24-9/30	1946 W.Y. 10/1-12/27	1946 W.Y. 12/28-9/30	1947, 1948 W.Y.
13.5	-	-	-	-	-	-	60,200	-
12	35,600	-	-	-	-	-	-	47,300
11.5	-	-	-	-	-	-	43,200	-
11	-	-	-	-	30,600	-	-	39,200
10.1	-	-	-	-	-	-	-	-
10	25,700	-	-	25,700	-	-	31,600	31,600
9.6	-	-	-	-	-	-	-	-
9	-	-	21,000	-	-	-	-	24,800
8.5	-	-	-	18,730	18,700	-	21,600	-
8.4	-	-	-	-	-	-	-	-
8.1	-	-	-	-	-	-	-	-
8	16,600	16,600	16,600	-	-	-	-	18,700
7.5	-	-	-	-	-	-	-	-
7.2	-	-	-	-	-	-	-	-
7	12,600	12,600	12,600	12,600	12,600	-	13,800	13,800
6.5	10,800	-	-	-	-	-	-	-
6	9,150	9,170	9,170	9,170	9,170	-	-	-
5.8	-	-	-	-	-	-	9,140	9,140
5.5	7,690	-	-	-	-	7,690	-	-
5.3	-	-	-	-	-	-	-	-
5	6,350	6,220	6,220	6,220	6,350	-	-	-
4.8	-	-	-	-	-	-	6,040	6,040
4.7	-	-	-	-	-	5,600	-	-
4.5	5,140	4,950	4,950	-	-	-	-	-
4.2	-	-	-	4,270	4,430	-	-	-
4	4,030	3,840	3,840	-	-	3,990	4,090	4,090
3.5	3,040	2,860	2,860	2,860	-	-	-	-
3.4	-	-	-	-	2,810	-	2,900	2,900
3.3	-	-	-	-	-	2,640	-	-
3.1	-	-	-	-	-	-	-	-
3	2,160	2,050	2,050	-	-	-	-	-
2.9	-	-	-	1,900	-	-	2,070	2,070
2.8	-	-	-	-	1,850	1,850	-	-
2.6	-	1,490	1,490	-	-	-	-	-
2.5	1,440	-	-	-	-	-	-	-
2.4	-	-	-	1,250	-	-	1,380	1,380
2.3	-	-	-	-	1,200	1,200	-	-
2.2	-	1,030	1,030	-	-	-	-	-
2.1	-	-	-	-	-	-	-	-
2	885	-	-	830	-	-	930	930
1.9	-	740	740	-	-	790	-	-
1.8	-	-	-	-	700	-	-	-
1.7	620	-	-	-	-	-	-	650
1.6	-	500	500	500	-	-	570	-
1.5	475	-	-	-	-	475	-	-

(1) W.Y. = Water Year

No data published for 1938, 1939, 1940, 1944, 1945 water years.

Table A-4. Continued

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages.						
	1949 W.Y.		1950 W.Y.		1951 W.Y.	1952 W.Y.	1953 W.Y.
	10/1-2/16	2/17-9/30	10/1-10/9	10/10-9/30			
13.5	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-
11.5	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-
10.1	-	-	-	-	32,400	-	-
10	-	-	-	31,600	-	-	-
9.6	-	28,800	-	-	-	-	-
9	-	-	-	24,800	24,800	-	-
8.5	-	21,600	-	-	-	-	-
8.4	21,000	-	-	-	-	-	-
8.1	-	-	-	-	-	18,800	-
8	18,700	-	-	18,700	-	-	21,000
7.5	-	16,100	-	-	-	-	-
7.2	-	-	-	-	-	-	-
7	13,800	-	-	13,700	13,700	13,200	13,200
6.5	-	11,700	-	-	-	-	-
6	-	-	-	9,680	-	-	-
5.8	9,140	-	-	-	-	-	-
5.5	-	8,150	-	-	-	-	-
5.3	-	-	-	-	-	-	-
5	-	-	-	6,430	6,430	6,200	6,200
4.8	6,040	-	-	-	-	-	-
4.7	-	-	-	-	-	-	-
4.5	-	5,170	-	5,040	-	-	-
4.2	-	-	-	-	-	-	-
4	4,090	3,980	-	3,870	3,870	3,800	3,800
3.5	-	2,950	2,950	2,910	-	-	-
3.4	2,900	-	-	-	-	-	-
3.3	-	-	-	-	-	-	-
3.1	-	-	-	-	-	-	-
3	-	2,120	2,120	2,120	2,120	2,070	2,070
2.9	2,070	-	-	-	-	-	-
2.8	-	-	-	-	-	-	-
2.6	-	-	-	-	-	-	-
2.5	-	-	-	1,460	-	-	-
2.4	1,380	1,290	1,290	-	-	-	-
2.3	-	-	-	-	-	-	-
2.2	-	-	-	-	-	-	-
2.1	-	-	-	-	-	-	-
2	930	860	860	920	920	920	900
1.9	-	-	-	-	-	-	-
1.8	-	-	-	740	-	-	-
1.7	-	600	600	-	650	650	-
1.6	-	-	-	-	-	-	570
1.5	-	-	-	-	-	-	-

Table A-4. Continued

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages.							
	1954 W.Y.		1955	1956	1957 W.Y.		1958 W.Y.	
	10/1-11/22	11/23-9/30	W.Y.	W.Y.	10/1-11/16	11/17-9/30	10/1-4/20	4/21-9/30
13.5	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-
11.5	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-
10.1	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-
9.6	-	-	-	-	-	-	-	-
9	24,000	-	-	22,300	-	-	-	-
8.5	-	-	-	-	-	-	-	-
8.4	-	-	-	-	-	-	-	-
8.1	-	-	-	-	-	-	-	-
8	-	17,100	17,100	-	-	17,000	17,000	17,000
7.5	-	-	-	-	-	-	-	-
7.2	-	-	-	-	-	-	-	-
7	13,200	-	-	12,800	-	-	-	-
6.5	-	-	-	-	-	8,620	8,620	8,620
6	-	9,220	9,220	-	-	-	-	-
5.8	-	-	-	-	-	-	-	-
5.5	-	-	-	-	7,030	-	-	-
5.3	-	-	-	-	-	5,700	5,700	5,700
5	6,200	-	-	6,190	-	-	-	-
4.8	-	-	-	-	-	-	-	-
4.7	-	-	-	-	-	-	-	-
4.5	-	-	-	-	-	-	-	-
4.2	-	-	-	-	3,820	3,500	3,500	3,500
4	3,800	3,830	3,830	3,830	-	-	-	-
3.5	-	-	-	-	-	-	-	-
3.4	-	-	-	-	-	-	-	-
3.3	-	-	-	-	-	-	-	-
3.1	-	-	-	-	-	-	-	-
3	2,070	2,010	2,010	2,010	-	1,930	1,930	1,930
2.9	-	-	-	-	-	-	-	-
2.8	-	-	-	-	1,760	-	-	-
2.6	-	-	-	-	-	-	-	-
2.5	1,430	-	-	-	-	-	-	-
2.4	-	-	-	-	-	-	1,230	-
2.3	-	-	-	1,220	-	-	-	-
2.2	-	-	-	-	-	-	-	-
2.1	-	-	1,020	-	-	-	-	880
2	-	930	-	-	-	-	-	-
1.9	-	840	-	-	-	765	-	-
1.8	-	-	-	-	-	-	-	-
1.7	-	-	-	-	-	-	-	-
1.6	-	-	-	-	-	-	-	-
1.5	-	-	-	-	-	-	-	-

Table A-4. Continued

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages.							
	1959 W.Y.		1960 W.Y.		1961 W.Y.		1962 W.Y.	
	10/1-1/27	1/28-9/30	10/1-3/11	3/12-9/30	10/1-11/24	11/25-9/30	10/1-11/22	11/23-9/30
13.5	-	-	-	-	-	-	-	-
12.	-	-	-	-	-	-	-	-
11.5	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-
10.1	-	-	-	-	-	-	-	-
10	-	-	-	-	28,500	-	-	-
9.6	-	-	-	-	-	-	-	-
9	-	-	-	-	22,300	22,300	-	-
8.5	-	-	-	-	-	-	-	-
8.4	-	-	-	-	-	-	-	-
8.1	-	-	-	-	-	-	-	-
8	17,000	-	-	17,000	-	-	-	-
7.5	-	-	-	-	-	-	-	-
7.2	-	-	-	-	-	-	-	-
7	-	12,400	12,400	12,400	12,400	12,400	12,400	12,400
6.5	-	-	-	-	-	-	-	-
6	8,620	-	-	-	-	-	-	-
5.8	-	-	-	-	-	-	-	-
5.5	-	-	-	-	-	-	-	-
5.3	-	-	-	-	-	-	-	-
5	5,700	5,700	5,700	5,400	5,400	5,700	5,700	5,740
4.8	-	-	-	-	-	-	-	-
4.7	-	-	-	-	-	-	-	-
4.5	-	-	-	-	-	-	-	-
4.2	-	-	-	-	-	-	-	-
4	3,500	3,480	3,480	3,260	3,260	3,530	3,530	3,500
3.5	-	-	-	-	-	-	-	-
3.4	-	-	-	-	-	-	-	-
3.3	-	-	-	-	-	-	-	-
3.1	-	-	-	-	1,830	-	-	-
3	-	1,860	1,860	1,700	-	1,940	1,940	1,900
2.9	-	-	-	-	-	-	-	-
2.8	1,650	-	-	-	-	-	-	-
2.6	-	-	-	-	-	-	-	-
2.5	-	-	1,250	1,140	-	-	-	-
2.4	-	-	-	-	-	-	1,220	1,190
2.3	-	-	-	-	-	1,120	-	-
2.2	-	940	-	-	-	-	-	-
2.1	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-
1.9	-	-	-	-	-	-	-	-
1.8	-	-	-	-	-	-	-	-
1.7	-	-	-	-	-	-	-	-
1.6	-	-	-	-	-	-	-	-
1.5	-	-	-	-	-	-	-	-

Table A-4. Continued

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages.			
	1963 W.Y.	1964 W.Y.	1965 W.Y. 10/1-12/21	1965 W.Y. 12/22-9/30
13.5	-	-	-	-
12	-	-	-	44,000
11.5	-	-	-	-
11	-	-	-	-
10.1	-	-	-	-
10	-	-	-	-
9.6	-	-	-	-
9	22,300	-	-	22,300
8.5	-	-	-	-
8.4	-	-	-	-
8.1	-	-	-	-
8	-	-	17,000	-
7.5	-	-	-	-
7.2	-	13,200	-	-
7	12,400	-	12,400	12,400
6.5	-	-	-	-
6	-	-	-	-
5.8	-	-	-	-
5.5	-	-	-	-
5.3	-	-	-	-
5	5,740	5,740	5,740	5,740
4.8	-	-	-	-
4.7	-	-	-	-
4.5	-	-	-	-
4.2	-	-	-	-
4	3,500	3,500	3,500	3,500
3.5	-	-	-	-
3.4	-	-	-	-
3.3	-	-	-	-
3.1	-	-	-	-
3	1,900	1,900	-	1,890
2.9	-	-	1,770	-
2.8	-	-	-	-
2.6	-	-	-	-
2.5	-	-	-	-
2.4	1,190	1,190	-	-
2.3	-	-	-	-
2.2	990	990	-	-
2.1	-	-	-	880
2	-	-	-	-
1.9	-	-	-	-
1.8	-	-	-	-
1.7	-	-	-	-
1.6	-	-	-	-
1.5	-	-	-	-

Table A-5. Rating Curves for Study Site 5, Santiam River at Jefferson (14-1890), 1941-65.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stage.[1]								
	1941 W.Y.	1943 W.Y.		1944 W.Y.		1947 W.Y.		1951 W.Y.	
		10/1-11/23	11/24-9/30	10/1-11/4	11/5-9/30	10/1-12/12	12/13-9/30	10/1-12/6	12/7-9/30
23	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-
20.8	-	-	-	-	-	-	109,000	-	-
20	-	-	87,400	87,400	-	-	94,100	-	-
19	-	-	-	-	-	-	80,400	80,400	-
18	-	-	-	-	-	-	-	-	-
17	-	-	61,500	61,500	-	-	61,400	-	-
16.2	-	-	-	-	-	55,000	-	-	-
16	-	-	-	-	-	-	-	-	-
15.5	-	-	-	-	-	-	-	-	49,600
15	-	46,000	-	-	-	45,800	-	45,800	-
14.5	-	-	42,200	-	-	-	-	-	-
14	-	-	-	-	-	-	38,700	-	-
13	33,300	-	-	-	-	32,300	-	-	-
12.8	-	-	-	-	31,100	-	-	-	-
12	-	27,400	26,600	-	-	-	26,600	27,100	27,100
11	22,500	-	-	-	-	21,600	-	-	-
10.8	-	-	-	-	20,700	-	-	-	-
10.5	-	20,100	-	-	-	-	-	-	-
10	18,000	-	17,200	17,200	-	-	17,200	-	-
9.5	-	-	-	-	-	15,200	-	-	-
9.3	-	-	-	-	14,400	-	-	-	-
9	14,100	14,000	-	-	-	-	-	14,200	14,800
8.5	-	-	11,800	11,800	-	12,000	11,800	-	-
8	10,800	-	-	-	-	-	-	-	-
7.8	-	-	-	-	9,760	-	-	-	-
7.5	-	9,270	-	-	-	9,320	-	-	-
7	8,110	-	7,800	7,800	-	-	7,730	-	-
6.4	-	-	-	-	6,540	-	-	-	-
6	5,810	5,800	-	-	-	5,890	-	5,770	6,260
5.8	-	-	5,400	5,400	-	-	5,040	-	-
5.2	-	-	-	-	4,350	-	-	-	-
5	3,950	3,930	-	-	-	4,020	3,570	-	-
4.7	-	-	3,550	3,550	-	-	-	-	-
4.5	3,100	-	-	-	-	-	-	-	-
4.3	-	-	-	-	2,970	-	-	-	-
4.2	-	2,610	-	-	-	-	2,470	-	-
4	2,320	-	-	2,580	-	2,580	-	2,230	2,420
3.8	-	-	2,340	-	-	-	-	-	-
3.6	1,750	1,810	-	-	-	-	-	-	-
3.5	-	-	-	-	1,990	-	-	-	-
3.4	-	-	-	-	-	-	1,570	-	-
3.3	-	-	-	1,780	-	-	-	-	-
3.2	1,200	-	-	-	-	-	-	-	-
3.1	-	1,180	-	-	-	-	-	-	-
3	-	-	1,470	-	-	1,450	-	-	-
2.9	-	-	-	-	1,350	-	-	-	1,230
2.8	740	-	-	-	-	-	980	990	-
2.7	-	770	-	1,170	-	-	-	-	-
2.5	490	-	-	-	-	965	-	-	-
2.4	-	540	920	-	885	-	660	-	-
2.3	-	-	-	-	-	-	-	-	-
2.2	320	-	-	785	-	740	-	-	-
2.1	-	365	-	-	-	-	-	-	-
2	-	-	-	-	615	-	-	-	530
1.9	-	-	620	-	-	-	-	-	-
1.8	-	-	-	570	-	505	-	-	-
1.7	-	-	-	-	-	-	-	-	-
1.6	-	-	-	-	410	-	-	-	-
1.4	-	-	-	-	-	-	-	-	-
1.3	-	-	-	-	290	-	-	-	-
1	-	-	-	-	-	-	-	-	-

(1) W.Y. = Water Year

No data published for 1942, 1945, 1946, 1948, 1949, 1950, 1952, 1954 water years.

Table A-5. Continued

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stage.								
	1953 W.Y.		1955	1956 W.Y.		1957 W.Y.		1958 W.Y.	
	10/1-1/19	1/10-9/30	W.Y.	10/1-10/10	10/11-9/30	10/1-12/12	12/13-9/30	10/1-4/21	4/22-9/30
23	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-
21	-	-	-	-	113,000	-	-	-	-
20.8	-	-	-	-	-	-	-	-	-
20	-	95,000	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	81,100	-
18	-	-	-	-	70,500	70,000	-	-	-
17	-	61,800	61,800	-	-	-	-	-	-
16.2	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	53,700	-
15.5	-	-	-	-	-	-	-	-	-
15	-	-	-	-	46,000	46,000	-	-	-
14.5	-	-	-	-	-	-	-	-	-
14	40,000	-	-	40,000	-	-	-	-	-
13	-	34,000	34,000	-	-	-	-	-	33,100
12.8	-	-	-	-	-	-	-	-	-
12	28,500	-	-	-	27,500	27,500	-	27,500	-
11	-	-	-	23,500	-	-	-	-	-
10.8	-	-	-	-	-	-	-	-	-
10.5	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	19,500
9.5	-	-	-	-	-	-	-	-	-
9.3	-	-	-	-	-	-	-	-	-
9	15,200	15,200	15,400	-	15,000	15,000	15,000	15,000	-
8.5	-	-	-	-	-	-	-	-	-
8	-	-	-	12,200	-	-	-	-	-
7.8	-	-	-	-	-	-	-	-	-
7.5	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-
6.4	-	-	-	-	-	-	-	-	-
6	6,270	6,270	6,770	6,770	6,840	6,840	6,700	6,700	7,200
5.8	-	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-
4.7	-	-	-	-	-	-	-	-	-
4.5	-	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-	-	-
4.2	-	-	-	-	-	-	-	-	-
4	2,650	2,650	2,800	2,800	2,980	2,980	3,000	3,000	3,300
3.8	-	-	-	-	-	-	-	-	-
3.6	-	-	-	-	-	-	-	-	-
3.5	-	-	-	-	-	-	-	-	-
3.4	-	-	-	-	-	-	-	-	-
3.3	-	-	-	-	-	-	-	-	-
3.2	-	-	-	-	-	-	-	-	-
3.1	-	-	-	-	-	1,710	-	-	-
3	1,400	1,350	1,450	1,450	1,590	-	-	-	-
2.9	-	-	-	-	-	-	-	-	-
2.8	-	-	-	-	-	-	1,480	1,480	-
2.7	-	-	-	-	-	-	-	-	-
2.5	-	-	-	-	-	-	-	-	1,350
2.4	-	-	-	-	970	-	-	-	-
2.3	-	-	720	-	-	-	-	-	-
2.2	-	-	-	-	-	-	-	-	-
2.1	-	530	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-
1.9	380	-	-	-	-	-	-	-	-
1.8	-	-	-	-	-	-	620	-	750
1.7	-	-	-	-	-	-	-	-	-
1.6	-	-	-	-	-	-	-	-	-
1.4	-	-	-	-	-	-	-	-	-
1.3	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-

Table A-5. Continued

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stage.							
	1959 W.Y.		1960 W.Y.		1961 W.Y.		1962 W.Y.	
	10/1-1/27	1/28-9/30	10/1-10/22	10/23-9/30	10/1-11/24	11/25-9/30	10/1-11/22	11/23-9/30
23	-	-	-	-	-	-	-	-
22	-	-	-	-	-	135,000	-	-
21	-	-	-	-	-	113,000	-	-
20.8	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-
18	-	-	-	-	70,500	70,500	-	-
17	61,800	-	-	-	-	-	-	-
16.2	-	-	-	-	-	-	-	-
16	-	53,700	-	-	-	-	-	53,700
15.5	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-
14.5	-	-	-	-	-	-	-	-
14	-	-	-	-	-	39,500	-	39,500
13	33,100	33,500	-	33,500	33,500	-	-	-
12.8	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	24,000	-
10.8	-	-	-	-	-	-	-	-
10.5	-	-	-	-	-	-	-	-
10	19,500	-	20,000	20,000	-	20,000	-	20,000
9.5	-	-	-	-	-	-	-	-
9.3	-	-	-	-	-	-	-	-
9	-	16,300	16,300	-	16,300	-	-	-
8.5	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-
7.8	-	-	-	-	-	-	-	-
7.5	-	-	-	-	-	-	-	-
7	-	-	-	9,940	-	9,800	9,800	10,000
6.4	-	-	-	-	-	-	-	-
6	7,200	7,510	7,510	-	7,320	-	-	-
5.8	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	-
4.7	-	-	-	5,190	-	5,050	5,050	5,270
4.5	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-	-
4.2	-	-	-	-	-	-	-	-
4	3,300	3,540	-	-	3,410	-	-	-
3.8	-	-	3,220	-	-	-	-	-
3.6	-	-	-	-	-	-	-	-
3.5	-	-	-	-	-	-	-	-
3.4	-	-	-	-	-	-	-	-
3.3	-	-	-	-	-	-	-	-
3.2	-	-	-	-	-	-	-	-
3.1	-	-	-	-	-	-	-	-
3	-	-	-	2,040	-	1,990	1,990	2,250
2.9	-	-	-	-	-	-	-	-
2.8	1,660	-	-	-	-	-	-	-
2.7	-	-	-	-	1,690	-	-	-
2.5	-	1,490	-	-	-	-	-	-
2.4	-	-	-	-	-	-	-	-
2.3	-	-	-	-	-	-	-	-
2.2	-	-	-	-	-	-	-	-
2.1	-	-	-	-	-	-	1,070	-
2	-	-	-	-	-	-	-	-
1.9	-	-	-	890	-	-	-	-
1.8	-	-	-	-	-	-	-	-
1.7	-	-	-	-	-	725	-	-
1.6	-	650	-	-	-	-	-	930
1.4	-	-	-	-	-	-	-	-
1.3	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-

Table A-5. Continued

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stage.					
	1963 W.Y.		1964 W.Y.		1965 W.Y.	
	10/1-11/20	11/21-9/30	10/1-11/8	11/9-9/30	10/1-1/28	1/29-9/30
23	-	-	-	-	161,000	-
22	-	-	-	-	-	-
21	-	-	-	-	-	113,000
20.8	-	-	-	-	-	-
20	-	-	-	-	95,000	95,000
19	-	-	-	-	-	-
18	-	-	-	-	-	-
17	-	-	-	-	-	-
16.2	-	-	-	-	-	-
16	-	53,700	53,700	-	53,700	53,700
15.5	-	-	-	-	-	-
15	-	-	-	-	-	-
14.5	-	-	-	-	-	-
14	39,500	39,500	39,500	39,500	-	-
13	-	-	-	-	-	-
12.8	-	-	-	-	-	-
12	-	-	-	29,000	29,000	29,000
11	-	-	-	-	-	-
10.8	-	-	-	-	-	-
10.5	-	-	-	-	-	-
10	20,000	20,000	20,000	-	-	-
9.5	-	-	-	-	-	-
9.3	-	-	-	-	-	-
9	-	-	-	-	-	-
8.5	-	-	-	-	-	-
8	-	-	-	13,500	13,500	12,800
7.8	-	-	-	-	-	-
7.5	-	-	-	-	-	-
7	10,000	10,000	10,000	-	-	-
6.4	-	-	-	-	-	-
6	-	-	-	-	-	7,300
5.8	-	-	-	-	-	-
5.2	-	-	-	-	-	-
5	5,270	5,480	5,480	5,760	5,760	-
4.7	-	-	-	-	-	-
4.5	-	-	-	-	-	-
4.3	-	-	-	-	-	-
4.2	-	-	-	-	-	-
4	-	-	-	-	-	3,560
3.8	-	-	-	-	-	-
3.6	-	-	-	-	-	-
3.5	-	-	-	-	-	-
3.4	-	-	-	-	-	-
3.3	-	-	-	-	-	-
3.2	-	-	-	-	-	-
3.1	-	-	-	-	-	-
3	2,250	2,400	2,400	2,510	2,510	-
2.9	-	-	-	-	-	-
2.8	-	-	-	-	-	-
2.7	-	-	-	-	-	-
2.5	1,710	-	-	-	-	-
2.4	-	-	-	-	-	-
2.3	-	-	-	-	-	-
2.2	-	-	-	-	-	-
2.1	-	-	-	-	-	-
2	-	-	-	1,390	1,390	1,350
1.9	-	-	-	-	-	-
1.8	-	1,190	1,190	-	-	-
1.7	-	-	-	-	-	-
1.6	-	-	-	-	-	-
1.4	-	880	-	-	-	-
1.3	-	-	-	800	-	-
1	-	-	-	-	-	640

Table A-6. Rating Curves for Study Site 6, Clackamas River above Three Lynx Creek (14-2095), 1935-65.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages. (1)							
	1935 W.Y.		1936	1937 W.Y.		1938 W.Y.		1939
	10/1-12/19	12/20-9/30	W.Y.	10/1-12/22	12/23-9/30	10/1-12/29	12/30-9/30	W.Y.
18	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-
12.6	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-
11	-	-	19,700	-	-	-	-	-
10	-	-	-	-	16,700	-	16,700	-
9.1	-	-	-	-	-	-	-	-
9	-	-	13,900	-	-	-	-	-
8.5	-	-	-	-	-	-	-	-
8	-	-	-	-	11,200	11,200	11,200	-
7.5	-	-	-	-	-	-	-	-
7	-	-	8,730	-	8,730	8,730	-	-
6.5	-	-	-	-	-	-	-	-
6	6,600	6,600	6,520	-	6,520	6,520	6,520	-
5.6	-	-	-	-	-	-	-	5,770
5.5	-	-	-	-	-	-	-	-
5	4,780	4,780	4,730	-	4,810	4,810	4,800	4,800
4.9	-	-	-	-	-	-	-	-
4.5	-	-	-	-	-	-	-	4,070
4.3	-	-	-	-	-	-	-	-
4	3,360	3,360	3,330	-	3,440	3,440	3,400	3,400
3.8	-	-	-	-	-	-	-	-
3.5	-	-	2,730	-	-	-	-	2,790
3.4	-	-	-	-	-	-	-	-
3	2,210	2,210	2,180	2,180	2,260	2,260	2,240	2,240
2.9	-	-	-	-	-	-	-	-
2.5	1,710	1,710	1,690	1,690	-	-	-	1,740
2.3	-	-	-	-	-	-	-	-
2.2	-	-	-	-	-	-	-	-
2	1,310	1,300	1,270	1,270	1,290	1,290	1,310	1,310
1.9	-	-	-	-	-	-	-	-
1.7	-	-	-	-	-	-	-	-
1.6	-	-	995	995	-	-	-	-
1.5	970	955	-	-	930	930	960	960
1.3	-	-	-	-	-	-	-	-
1.2	-	-	745	745	-	-	-	780
1.1	-	-	-	-	690	690	-	-
1	700	660	-	-	-	-	675	-
0.9	-	-	595	595	-	-	-	630
0.8	-	-	-	-	-	-	-	-
0.7	570	535	-	-	520	520	-	-
0.6	-	-	490	490	-	-	-	-

(1) W.Y. = Water Year

No data published for 1952, 1954, 1958 water years.

Table A-6. Continued.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages. (1)							
	1940 W.Y.	1941 W.Y.	1942 W.Y. 10/1-3/10	1942 W.Y. 3/11-9/30	1943 W.Y. 10/1-11/22	1943 W.Y. 11/23-9/30	1944-1945 W.Y.	1946 W.Y.
18	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-
12.6	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	22,500
11	-	-	-	-	-	19,360	-	19,400
10	-	-	-	-	-	-	-	16,300
9.1	-	-	-	-	-	-	-	-
9	-	-	13,900	-	-	13,460	-	13,500
8.5	12,540	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	10,800
7.5	9,950	-	9,950	-	-	9,510	-	-
7	-	-	-	-	-	-	-	8,340
6.5	7,580	-	-	-	-	-	-	-
6	6,520	6,520	6,520	-	-	6,260	6,260	6,260
5.6	-	-	-	-	-	-	-	-
5.5	5,580	5,580	-	-	-	-	-	-
5	4,750	4,750	-	-	-	4,560	4,560	4,560
4.9	-	-	4,600	-	-	-	-	-
4.5	4,020	4,020	-	-	-	-	-	-
4.3	-	-	-	-	3,720	-	-	-
4	3,360	3,360	-	-	-	3,240	3,240	3,220
3.8	-	-	3,120	3,090	-	-	-	-
3.5	2,760	2,760	-	-	-	-	-	-
3.4	-	-	-	-	2,610	-	-	-
3	2,220	2,220	-	-	-	2,180	2,180	2,110
2.9	-	-	2,120	2,060	-	-	-	-
2.5	1,730	1,720	-	-	1,670	-	-	-
2.3	-	-	-	-	-	-	-	-
2.2	-	-	1,440	1,400	-	1,440	1,440	1,400
2	1,3-0	1,280	-	-	-	-	-	-
1.9	-	-	-	-	1,160	-	-	-
1.7	-	-	-	1,020	-	-	-	-
1.6	-	-	990	-	-	970	970	960
1.5	950	920	-	-	-	-	-	-
1.3	-	-	-	-	800	-	-	-
1.2	-	-	-	750	-	-	725	725
1.1	720	700	-	-	-	680	-	-
1	-	-	655	-	-	-	-	-
0.9	-	-	-	-	-	-	-	-
0.8	585	570	-	580	580	-	580	550
0.7	-	-	-	-	-	-	-	-
0.6	-	-	-	-	-	-	-	-

Table A-6. Continued.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages. (1)								
	1947 W.Y.	1948 W.Y.	1949 W.Y.	1950 W.Y.	1951 W.Y.	1953 W.Y. 10/1-1/18	1953 W.Y. 1/19-9/30	1955 W.Y.	1956 W.Y.
18	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	28,100	28,100	-	26,100
12.6	-	24,700	-	-	-	-	-	-	-
12	22,500	-	-	-	-	-	-	-	-
11	19,400	19,600	-	-	-	-	-	-	-
10	16,300	-	-	-	-	-	-	-	-
9.1	-	-	13,900	-	-	-	-	-	-
9	13,500	13,600	-	13,600	14,100	14,100	14,100	-	13,400
8.5	-	-	-	-	-	-	-	-	-
8	10,800	-	-	-	-	-	-	-	-
7.5	-	-	-	-	-	-	-	-	-
7	8,340	8,560	8,560	8,560	8,740	8,740	8,740	8,740	-
6.5	-	-	-	-	-	-	-	-	-
6	6,260	6,440	6,440	6,440	-	-	-	-	6,500
5.6	-	-	-	-	-	-	-	-	-
5.5	-	-	-	-	-	-	-	-	-
5	4,560	4,730	4,730	4,730	4,730	4,730	4,730	4,730	-
4.9	-	-	-	-	-	-	-	-	-
4.5	-	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-	-	-
4	3,220	3,340	3,340	3,340	-	-	-	-	3,340
3.8	-	-	-	-	-	-	-	-	-
3.5	-	-	-	-	-	-	-	-	-
3.4	-	-	-	-	-	-	-	-	-
3	2,110	2,120	2,120	2,120	2,120	2,120	2,140	2,120	2,120
2.9	-	-	-	-	-	-	-	-	-
2.5	-	-	-	-	-	-	-	-	-
2.3	-	1,460	1,460	1,460	-	-	-	-	-
2.2	1,400	-	-	-	-	-	-	-	-
2	-	-	-	-	1,220	1,200	1,250	1,220	1,220
1.9	-	-	-	-	-	-	-	-	-
1.7	-	1,010	1,010	-	-	-	-	-	-
1.6	960	-	-	-	-	-	-	930	930
1.5	-	-	-	-	-	-	-	-	-
1.3	-	765	765	765	745	-	-	-	-
1.2	725	-	-	-	-	-	710	690	690
1.1	-	665	665	-	-	635	-	-	-
1	630	-	-	-	-	-	-	-	-
0.9	-	-	-	-	-	-	-	-	-
0.8	-	-	-	-	-	-	-	-	490
0.7	-	-	-	-	-	-	-	-	-
0.6	-	-	-	-	-	-	-	-	-

Table A-6. Continued.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages. (1)							
	1957 W.Y.	1959 W.Y.	1960 W.Y.	1961 W.Y. 10/1-11/24	1961 W.Y. 11/25-9/30	1962 W.Y.	1963 W.Y. 10/1-5/6	1963 W.Y. 5/7-9/30
18	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-
13	-	-	-	26,100	26,100	-	-	-
12.6	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-
11	-	-	-	16,400	16,400	-	16,400	-
10	16,400	-	-	-	-	-	-	-
9.1	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-
8.5	-	10,900	10,900	-	-	10,900	10,900	-
8	10,900	-	-	-	-	-	-	-
7.5	-	8,590	8,590	8,590	8,590	-	-	-
7	-	-	-	-	-	-	-	-
6.5	-	-	-	-	-	6,500	6,500	6,500
6	6,500	-	-	-	-	-	-	-
5.6	-	-	-	-	-	-	-	-
5.5	-	4,730	4,720	4,720	4,830	4,830	-	-
5	-	-	-	-	-	-	-	-
4.9	-	-	-	-	-	-	-	-
4.5	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	3,400	3,400
4	3,340	-	-	-	-	-	-	-
3.8	-	-	-	-	-	-	-	-
3.5	-	-	-	-	-	-	-	-
3.4	-	2,170	2,100	2,100	2,170	2,170	2,170	2,170
3	2,120	-	-	-	-	-	-	-
2.9	-	-	-	-	-	-	-	-
2.5	-	-	-	-	-	-	-	-
2.3	-	-	-	-	-	-	-	-
2.2	-	-	1,200	1,200	1,280	1,280	1,280	1,240
2	1,220	-	-	-	-	-	-	-
1.9	-	-	-	-	-	-	-	-
1.7	-	-	-	-	-	-	-	-
1.6	950	880	-	-	-	-	-	-
1.5	-	-	-	-	-	-	-	-
1.3	-	-	-	-	-	-	-	-
1.2	720	-	615	-	-	-	-	-
1.1	-	-	-	-	-	-	605	-
1	-	-	-	-	550	550	-	545
0.9	-	-	-	460	-	-	-	-
0.8	-	-	-	-	-	-	-	-
0.7	470	390	-	-	-	-	-	-
0.6	-							

Table A-6. Continued.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages. (1)		
	1964 W.Y.	1965 W.Y.	
		10/1-12/22	12/23-9/30
18	-	48,000	48,000
14	-	29,800	29,800
13	-	-	-
12.6	-	-	-
12	-	-	-
11	-	-	-
10	-	16,400	16,400
9.1	-	-	-
9	-	-	-
8.5	-	-	-
8	10,900	-	-
7.5	-	-	-
7	-	-	-
6.5	-	-	-
6	6,500	6,500	6,500
5.6	-	-	-
5.5	-	-	-
5	-	-	-
4.9	-	-	-
4.5	-	-	-
4.3	-	-	-
4	3,400	3,400	3,400
3.8	-	-	-
3.5	-	-	-
3.4	-	-	-
3	2,170	2,170	2,220
2.9	-	-	-
2.5	-	-	-
2.3	-	-	-
2.2	-	-	-
2	1,240	1,240	1,320
1.9	-	-	-
1.7	-	-	-
1.6	-	-	-
1.5	-	-	-
1.3	-	-	-
1.2	-	-	-
1.1	-	-	-
1	595	595	560
0.9	-	-	-
0.8	-	-	-
0.7	-	-	-
0.6	-	-	-

Table A-7. Rating Curves for Study Site 7, Willamette River at Harrisburg (14-1660), 1945-65.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages. (1)							
	1945 W.Y.	1946 W.Y.	1947 W.Y.		1948 W.Y.		1949 W.Y.	
			10/1-1126	11/27-9/30	10/1-10/16	10/17-9/30	10/1-12/13	12/14-9/30
18.9	-	169,600	-	-	-	-	-	-
18.3	-	-	-	-	-	147,000	-	-
18	-	-	-	-	-	-	-	-
17.5	-	124,000	-	-	-	124,000	-	-
17.2	-	-	116,000	116,000	-	-	-	-
17	-	-	-	-	-	-	-	-
16.4	-	-	-	-	-	-	97,900	-
16	-	-	89,900	89,900	-	89,900	89,900	-
15.5	-	80,900	-	-	-	-	-	-
15.2	75,900	-	-	-	-	-	-	-
15	-	-	-	-	-	73,800	73,800	73,800
14.5	65,600	65,600	65,600	65,600	-	-	-	-
14	-	-	-	-	-	63,000	63,000	63,000
13.5	-	-	54,500	54,500	-	-	-	-
13	-	-	-	-	-	-	-	-
12.5	45,600	45,580	-	-	-	-	-	-
12	-	-	41,900	41,900	-	47,000	47,000	47,300
11	-	-	-	-	-	-	-	-
10.5	32,400	32,420	-	-	-	-	-	-
10	-	-	29,800	29,800	-	33,500	33,500	34,800
9.1	-	-	-	-	25,200	-	-	-
9	-	-	-	-	-	-	-	-
8.5	22,300	22,330	-	-	-	-	-	-
8	-	-	20,000	20,000	20,000	22,400	22,400	23,500
7	-	-	-	-	-	17,600	17,600	-
6.8	14,800	14,850	-	-	-	-	-	-
6.5	-	-	13,700	13,600	13,600	-	-	-
6	-	-	-	-	-	13,600	13,600	14,300
5.5	-	-	-	10,300	10,300	-	-	-
5.3	10,000	10,000	-	-	-	-	-	-
5	-	-	9,200	-	-	10,200	10,200	-
4.5	-	-	-	7,920	7,920	-	-	8,650
4.1	6,980	6,980	-	-	-	-	-	-
4	-	-	-	-	-	7,400	7,400	-
3.5	-	-	5,680	-	-	-	-	5,700
3	4,700	4,700	-	5,030	5,030	5,130	5,130	-
2.9	-	-	-	-	-	-	-	-
2.7	-	-	-	-	-	-	-	-
2.6	-	-	-	-	-	-	-	3,750
2.5	-	-	3,830	-	-	-	-	-
2.2	-	-	-	-	-	-	-	-
2	3,050	3,050	-	3,410	3,410	3,430	3,430	2,700
1.9	-	-	-	-	-	-	3,280	-
1.8	-	-	-	-	-	-	-	-
1.7	-	-	-	-	-	-	-	-
1.6	-	-	2,500	-	-	2,890	-	-
1.5	-	-	-	-	-	-	-	-
1.4	-	-	-	-	-	-	-	-
1.3	-	-	-	-	-	-	-	-
1.2	2,010	2,010	-	2,430	2,430	-	-	-
1.1	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-
0.8	-	-	-	-	-	-	-	-
0.7	-	-	-	-	-	-	-	-
0.4	-	-	-	-	-	-	-	-
0.3	-	-	-	-	-	-	-	-

(1) W.Y. - Water Year

No data published for 1950, 1954, 1959, 1960 water years

Table A-7. Continued.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages. [1]							
	1951 W.Y.		1952 W.Y.		1953 W.Y.		1955 W.Y.	
	10/1-12/13	12/14-9/30	10/1-10/29	10/30-9/30	10/1-1/8	1/9-9/30	10/1-10/21	10/22-9/30
18.9	-	-	-	-	-	-	-	-
18.3	-	-	-	-	-	-	-	-
18	-	-	-	-	-	150,000	-	-
17.5	-	-	-	-	-	-	-	-
17.2	-	-	-	-	-	-	-	-
17	111,000	111,000	-	-	-	-	-	-
16.4	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-
15.5	-	-	-	-	-	-	-	-
15.2	-	-	-	-	-	-	-	-
15	73,800	73,800	-	-	-	96,000	-	-
14.5	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-
13.5	-	-	-	-	-	-	-	-
13	-	-	54,500	70,000	-	70,000	-	-
12.5	-	-	-	-	-	-	-	-
12	47,300	47,300	-	-	-	-	-	-
11	-	-	-	-	-	-	-	51,000
10.5	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-
9.1	-	-	-	-	-	-	-	-
9	29,000	29,000	29,000	-	-	34,700	-	-
8.5	-	-	-	-	-	-	-	-
8	-	-	-	28,000	-	-	-	-
7	-	-	-	-	22,000	-	-	24,800
6.8	-	-	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-	-
6	14,300	14,700	14,700	-	-	17,000	-	-
5.5	-	-	-	-	-	-	-	-
5.3	-	-	-	-	-	-	-	-
5	-	-	-	12,000	12,000	-	-	15,000
4.5	-	-	-	-	-	-	-	-
4.1	-	-	-	-	-	-	-	-
4	7,100	5,900	5,900	-	-	8,750	-	-
3.5	-	-	4,200	-	-	-	-	-
3	4,550	-	-	4,450	4,450	-	6,650	7,450
2.9	-	2,600	-	-	-	-	-	-
2.7	3,950	-	-	-	-	-	-	-
2.6	-	-	-	-	-	-	-	-
2.5	-	-	-	3,000	-	-	5,300	-
2.2	-	-	-	-	2,250	-	-	-
2	-	-	-	-	-	3,200	-	-
1.9	-	-	-	-	-	-	3,900	-
1.8	-	-	-	-	-	-	-	-
1.7	-	-	-	-	-	-	-	-
1.6	-	-	-	-	-	-	-	-
1.5	-	-	-	-	-	-	-	3,250
1.4	-	-	-	-	-	-	-	-
1.3	-	-	-	-	-	-	-	-
1.2	-	-	-	-	-	-	-	-
1.1	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-
0.8	-	-	-	-	-	-	-	-
0.7	-	-	-	-	-	-	-	-
0.4	-	-	-	-	-	-	-	-
0.3	-	-	-	-	-	-	-	-

Table A-7. Continued.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages. (1)							
	1956 W.Y.		1957 W.Y.			1958 W.Y.		
	10/1-12/22	12/23-9/30	10/1-10/30	10/31-2/26	2/27-9/30	10/1-12/28	12/29-4/23	4/24-9/30
18.9	-	-	-	-	-	-	-	-
18.3	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-
17.5	-	-	-	-	-	-	-	-
17.2	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-
16.4	-	-	-	-	-	-	-	-
16	110,000	110,000	-	--	-	-	-	-
15.5	-	-	-	-	-	-	-	-
15.2	-	-	-	-	-	-	-	-
15	-	-	-	-	-	98,000	-	-
14.5	-	-	-	-	-	-	-	-
14	82,000	-	-	82,000	-	-	87,000	-
13.5	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-
12.5	-	-	-	-	-	-	-	-
12	-	60,000	-	-	70,000	-	-	-
11	-	-	-	-	-	-	-	-
10.5	-	-	-	-	-	-	-	-
10	43,000	-	-	43,000	-	51,000	47,000	-
9.1	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-
8.5	-	-	-	-	-	-	-	-
8	-	30,300	30,000	-	35,100	-	-	32,000
7	24,800	-	-	25,500	-	-	26,000	-
6.8	-	-	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-	-
6	-	-	20,000	-	-	23,500	-	21,900
5.5	-	-	-	-	-	-	-	-
5.3	-	-	-	-	-	-	-	-
5	15,000	15,700	-	-	16,800	-	-	-
4.5	-	-	-	15,000	-	-	-	-
4.1	-	-	-	-	-	-	-	-
4	-	-	11,800	-	-	-	13,000	-
3.5	-	-	-	-	10,400	-	-	-
3	7,450	-	-	-	-	9,250	-	10,600
2.9	-	-	-	-	-	-	-	-
2.7	-	-	-	-	-	-	-	-
2.6	-	-	-	-	-	-	-	-
2.5	-	7,140	-	-	-	-	-	-
2.2	-	-	-	-	-	-	-	-
2	-	-	6,000	6,450	5,700	5,820	6,200	-
1.9	-	-	-	-	-	-	-	-
1.8	4,000	-	-	-	-	-	-	-
1.7	-	-	-	-	-	-	-	-
1.6	-	-	-	-	-	-	-	-
1.5	-	-	-	-	-	-	-	-
1.4	-	-	-	-	-	-	-	-
1.3	-	-	-	-	-	-	-	-
1.2	-	-	-	-	-	-	-	-
1.1	-	-	-	-	-	-	-	-
1	-	4,100	-	-	-	3,700	-	3,900
0.8	-	-	-	-	-	-	-	-
0.7	-	-	-	-	3,220	-	-	-
0.4	-	-	3,020	-	-	-	-	-
0.3	-	-	-	-	-	-	-	-

Table A-7. Continued.

Water stage above 1971 datum, feet	Effective period for rating curve and discharges (cfs) at given stages. (1)							
	1961 W.Y.		1962	1963 W.Y.		1964	1965 W.Y.	
	10/1-2/10	2/11-9/30	W.Y.	10/1-10/10	10/11-9/30	W.Y.	10/1-12/22	12/23-9/30
18.9	-	-	-	-	-	-	-	-
18.3	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-
17.5	-	-	-	-	-	-	-	-
17.2	-	-	-	-	-	-	-	-
17	-	114,000	-	-	-	-	-	121,000
16.4	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-
15.5	-	-	-	-	-	-	-	-
15.2	-	-	-	-	-	-	-	-
15	76,500	-	-	-	-	-	-	-
14.5	-	-	-	-	-	-	-	-
14	-	76,400	-	-	-	-	76,400	-
13.5	-	-	-	-	-	-	-	-
13	-	-	67,700	-	-	-	-	-
12.5	-	-	-	-	-	-	-	-
12	-	-	-	-	59,700	-	-	-
11	-	-	-	-	-	-	-	57,000
10.5	-	-	-	-	-	-	-	-
10	42,400	45,200	45,200	-	-	45,200	45,200	-
9.1	-	-	-	-	-	-	-	-
9	-	-	-	-	38,700	-	-	-
8.5	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	28,500
6.8	-	-	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-	-
6	22,400	21,800	21,800	-	21,800	-	-	-
5.5	-	-	-	-	-	-	-	-
5.3	-	-	-	-	-	-	-	-
5	-	-	-	17,100	-	-	-	-
4.5	-	-	-	-	-	-	-	-
4.1	-	-	-	-	-	-	-	-
4	-	-	-	-	-	14,900	14,900	-
3.5	-	-	-	-	-	-	-	-
3	10,600	8,910	8,910	8,910	9,360	-	-	9,800
2.9	-	-	-	-	-	-	-	-
2.7	-	-	-	-	-	-	-	-
2.6	-	-	-	-	-	-	-	-
2.5	-	-	-	-	-	-	-	-
2.2	-	-	-	-	-	-	-	-
2	-	-	-	-	-	7,400	7,400	6,600
1.9	-	-	-	-	-	-	-	-
1.8	-	-	-	-	-	-	-	-
1.7	-	-	-	4,790	-	-	-	-
1.6	-	-	-	-	-	-	-	-
1.5	-	-	-	-	-	-	-	-
1.4	-	4,010	-	-	-	-	-	-
1.3	-	-	3,760	-	-	-	-	-
1.2	-	-	-	-	-	-	-	-
1.1	-	-	-	-	3,800	-	-	-
1	3,900	-	-	-	-	-	-	4,300
0.8	-	-	-	-	-	-	4,650	-
0.7	-	-	-	-	-	-	-	3,700
0.4	-	-	-	-	-	-	-	-
0.3	-	-	-	-	-	3,650	-	-

Table A8. Rating Curves for Study Site 8, Willamette River at Albany (14-1740), 1935 - 65.

Water stage above 1971 datum feet(2)	Effective period for rating curve and discharges (cfs) at given stages. (1)							
	1935 W.Y.	1936,1937 W.Y.	1939 W.Y.	1940 W.Y. 10/1 - 2/17	1940 W.Y. 2/18-9/30	1943 W.Y.	1944 W.Y. 10/1 -6/5	1944 W.Y. 6/6 - 9/30
35	-	-	-	-	-	206,000	-	-
34	-	-	-	-	-	-	-	-
33	-	-	-	-	-	170,000	-	-
32	-	-	-	-	-	-	-	-
31	-	-	-	-	-	140,000	-	-
30.5	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-
29.5	-	-	-	-	-	-	-	-
29	-	122,000	-	-	-	117,000		
28	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-
26	-	-	-	-	-	91,000	-	-
25	-	88,500	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-
23	-	-	-	-	-	71,500	-	-
22	-	69,000	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-
20.2	-	-	58,900	63,200	61,200	-	-	-
20	-	-	-	-	-	55,900	-	-
19	52,600	52,600	-	52,600	51,200	-	-	-
18	-	-	-	-	-	-	-	-
17.6	-	-	-	-	-	-	44,600	-
17	43,300	43,300	43,300	41,800	41,900	-	-	-
16	-	-	-	-	-	-	37,500	-
15	34,800	34,800	34,800	34,800	-	-	-	-
14	-	-	-	-	-	29,600	29,600	-
13	26,900	26,900	26,950	26,950	25,160	-	-	-
12	23,100	23,100	-	23,200	-	22,400	22,400	-
11.5	-	-	-	-	-	-	-	-
11	19,400	19,400	19,600	19,600	18,040	-	-	-
10	15,800	15,800	16,140	16,140	14,820	15,600	15,600	-
9.5	14,100	14,100	14,460	-	-	-	-	-
9	12,400	12,400	12,820	12,820	11,820	-	12,500	-
8.6	11,100	11,100	11,540	-	-	-	-	-
8.5	-	-	-	-	-	-	-	-
8.4	-	-	-	-	-	10,600	-	-
8.2	9,900	9,900	10,280	10,280	-	-	-	-
8	-	-	-	-	9,020	-	9,420	-
7.8	8,700	8,700	9,040	-	-	-	-	-
7.6	-	-	-	8,440	-	-	-	-
7.4	7,530	7,530	7,840	-	-	-	-	-
7	6,410	6,410	6,680	6,680	6,400	6,710	6,710	6,800
6.7	5,590	5,590	5,840	-	-	-	-	-
6.5	-	-	-	-	5,160	-	-	-
6.4	4,800	4,800	5,040	5,040	-	-	-	-
6.1	4,040	4,040	4,280	-	-	-	-	-
6	-	-	-	-	3,980	4,600	4,600	4,810
5.8	3,320	3,320	3,560	3,560	-	-	-	-
5.6	2,860	2,860	3,100	-	-	-	-	-
5.5	-	-	-	-	2,860	-	-	-
5.4	2,420	2,420	2,660	2,660	-	-	-	-
5.2	2,000	2,000	2,240	-	-	-	-	-
5.1	-	-	-	-	-	3,090	-	-
5	-	-	-	-	1,820	2,950	-	3,140
4.9	-	-	-	-	-	-	-	-
4.6	-	-	-	-	-	-	-	-
4.5	-	-	-	-	-	2,290	-	-
4.4	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-	-
4.2	-	-	-	-	-	-	-	2,130
4.1	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-
3.9	-	-	-	-	-	-	-	-
3.8	-	-	-	-	-	-	-	-
3.7	-	-	-	-	-	-	-	-
3.6	-	-	-	-	-	-	-	-
3.5	-	-	-	-	-	-	-	-
3.4	-	-	-	-	-	-	-	-
3.3	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-

(1) W.Y. = Water Year

No data published for 1938, 1941, 1942, 1946, 1948 Water Years

(2) Datum plane was lowered 5.00 feet on 10/1/1962

Table A8. Continued.

Water Stage above 1971 datum feet (2)	Effective period for rating curve and discharges (cfs) at given stages (1)						
	1945 W.Y.		1947	1949 W.Y.		1950 W.Y.	
	10/1 - 2/15	2/16 - 9/30	W.Y.	10/1 - 7/16	7/17 - 9/30	10/1 - 1/24	1/25 - 9/30
35	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-
33	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-
30.5	-	-	134,000	-	-	-	-
30	-	-	-	-	-	-	-
29.5	-	-	-	122,000	-	-	-
29	-	-	-	-	-	-	-
28	-	-	108,000	-	-	-	-
27	-	-	-	-	-	99,000	-
26	-		-	-	-	-	-
25	-	-	84,100	84,100	-	-	-
24	-	-	-	-	-	78,200	84,400
23	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-
20.2	-	-	-	-	-	-	-
20	55,900	57,200	57,200	57,200	-	57,200	-
19	-	-	-	-	-	-	56,200
18	-	-	-	-	-	-	-
17.6	-	-	-	-	-	-	-
17	41,900	43,300	-	-	-	-	-
16	-	-	-	-	-	39,00	-
15	33,400	34,900	34,900	34,900	-	-	37,200
14	-	-	-	-	-	-	-
13	25,900	27,200	-	27,200	-	27,200	-
12	-	-	-	-	-	-	25,400
11.5	-	-	21,700	-	-	-	-
11	18,900	19,900	-	20,100	-	-	-
10	-	-	-	-	-	17,000	-
9.5	-	-	-	-	-	-	-
9	12,500	13,300	-	-	-	-	14,800
8.6	-	-	-	-	-	-	-
8.5	-	-	11,700	-	-	-	-
8.4	-	-	-	-	-	-	-
8.2	-	-	-	-	-	-	-
8	9,420	10,200	-	10,300	-	10,900	-
7.8	-	-	-	-	-	-	-
7.6	-	-	-	-	-	-	-
7.4	-	-	-	-	-	-	-
7	6,800	7,550	7,550	7,810	-	8,240	8,820
6.7	-	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-
6.4	-	-	-	-	-	-	-
6.1	-	-	-	-	-	-	-
6	4,810	5,210	-	5,680	-	5,960	6,370
5.8	-	-	4,800	-	-	-	-
5.6	-	-	-	-	-	-	-
5.5	-	-	-	4,760	5,020	-	-
5.4	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-
5.1	-	-	-	-	-	-	-
5	3,140	3,370	3,370	-	4,200	4,200	4,480
4.9	-	-	-	3,800	-	-	-
4.6	2,570	-	-	-	-	-	3,880
4.5	-	-	2,680	-	3,440	-	-
4.4	-	2,560	-	-	-	-	-
4.3	-	-	-	-	-	-	-
4.2	-	-	-	-	-	3,000	3,400
4.1	-	-	-	-	2,870	-	-
4	-	-	-	-	-	-	-
3.9	-	-	-	-	-	-	-
3.8	-	-	-	-	-	-	-
3.7	-	-	-	-	-	-	-
3.6	-	-	-	-	-	-	-
3.5	-	-	-	-	-	-	-
3.4	-	-	-	-	-	-	-
3.3	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-

Table A-8 Continued.

Water Stage above 1971 datum feet (2)	Effective period for rating curve and discharges (cfs) at given stages (1)								
	1951 W.Y.		1952	1953	1954 W.Y.		1955	1956 W.Y.	
	10/1 - 8/31	9/1 - 9/30	W.Y.	W.Y.	10/1 - 4/30	5/1 - 9/30	W.Y.	10/1 - 5/29	5/30 - 9/30
35	-	-	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-	-	-
33	-	-	-	173,000	-	-	-	-	-
32	-	-	-	-	-	-	-	158,000	
31	-	-	-	-	-	-	-	-	-
30.5	146,000	-	-	-	-	-	-	-	-
30	-	-	-	136,000	-	-	-	-	-
29.5	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-
27	-	-	-	-	108,000	-	-	-	-
26	-	-	-	-	-	-	-	100,000	-
25	9,1600	-	-	-	-	-	-	-	-
24	-	-	84,400	84,400	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-
20.2	-	-	-	-	-	-	-	-	-
20	-	-	-	-	61,400	-	64,100	-	-
19	56,200	-	-	-	-	-	-	59,100	-
18	-	-	51,200	51,200	-	-	-	-	-
17.6	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-
15	-	-	-	-	37,200	-	40,100	40,100	-
14	-	-	-	-	-	-	-	-	-
13	29,200	-	-	-	-	-	-	-	-
12	-	-	25,400	25,400	-	-	-	-	-
11.5	-	-	-	-	-	-	-	-	-
11	- -	-	-	-	21,700	-	23,600	23,600	-
10	-	-	-	-	-	-	-	-	-
9.5	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	17,800
8.6	- -	-	-	-	-	-	-	-	-
8.5	-	-	-	-	-	14,800	-	-	-
8.4	-	-	-	-	-	-	-	-	-
8.2	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
7.8	-	-	-	-	-	-	-	-	-
7.6	-	-	-	-	-	-	-	-	-
7.4	-	-	-	-	-	-	-	-	-
7	8,820	-	9,260	9,260	9,260	-	10,100	10,100	11,500
6.7	-	-	-	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-	-	-
6.4	-	--	-	-	-	-	-	-	-
6.1	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	7,600	-	-	-
5.8	-	-	-	-	-	-	-	-	-
5.6	-	-	-	-	-	-	-	-	-
5.5	-	-	-	-	-	-	-	-	-
5.4	-	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	-	-
5.1	-	-	-	-	-	-	-	-	-
5	4,480	-	5,210	5,210	5,210	-	5,400	-	5,750
4.9	-	-	-	-	-	-	-	5,200	-
4.6	-	-	-	-	-	-	-	-	-
4.5	-	4,400	-	-	-	4,400	4,400	-	4,600
4.4	-	-	-	-	-	-	-	-	-
4.3	-	-	-	-	4,090	-	-	-	-
4.2	-	-	3,950	3,950	-	-	-	-	-
4.1	3,300	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-
3.9	-	-	-	-	-	-	-	-	-
3.8	-	-	-	-	-	-	-	-	-
3.7	-	3,340	-	-	-	-	-	-	-
3.6	-	-	-	-	-	-	-	-	-
3.5	-	-	-	-	-	-	-	-	-
3.4	-	-	-	-	-	-	-	-	-
3.3	-	-	-	2,880	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-

Table A-8. Continued.

Water Stages above 1971 datum feet (2)	Effective period for rating curve and discharges (cfs) at given stages (1)						
	1957 W.Y.		1958 W.Y.		1959 W. Y.		1960 W.Y.
	10/1 - 4/15	4/16 - 9/30	10/1 - 12/22	12/23 - 9/30	10/1 - 1/28	1/29 - 9/30	
35	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-
33	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-
30.5	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-
29.5	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-
27	-	-	108,000	-	-	-	-
26	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-
24	-	-	-	86,600	-	-	-
23	80,600	-	-	-	80,200	80,200	-
22	-	-	-	-	-	-	-
21	-	-	-	-	-	-	67,000
20.2	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-
19	59,800	-	59,800	57,700	-	-	-
18	-	-	-	-	-	-	-
17.6	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-
15	41,200	-	-	-	39,300	41,000	38,900
14	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-
11.5	-	-	-	-	-	-	-
11	25,000	-	-	24,400	-	-	-
10	-	-	-	-	-	-	-
9.5	-	-	-	-	-	-	-
9	-	17,800	17,800	-	16,800	17,800	17,500
8.6	-	-	-	-	-	-	-
8.5	-	-	-	-	-	-	-
8.4	-	-	-	-	-	-	-
8.2	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-
7.8	-	-	-	-	-	-	-
7.6	-	-	-	-	-	-	-
7.4	-	-	-	-	-	-	-
7	11,500	11,400	-	-	-	-	-
6.7	-	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-
6.4	-	-	-	-	-	-	-
6.1	-	-	-	-	-	-	-
6.	-	-	-	-	-	-	-
5.8	-	-	-	-	-	-	-
5.6	-	-	-	-	-	-	-
5.5	-	-	-	-	-	-	-
5.4	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-
5.1	-	-	-	-	-	-	-
5	5,750	5,900	5,900	6,600	6,300	6,680	6,680
4.9	-	-	-	-	-	-	-
4.6	-	-	-	-	-	-	-
4.5	-	-	-	-	-	-	-
4.4	-	-	4,650	-	5,300	-	-
4.3	-	-	-	-	-	-	-
4.2	4,000	-	-	-	-	-	-
4.1	-	4,050	-	-	-	-	-
4	-	-	-	4,100	-	-	-
3.9	-	-	-	-	-	-	-
3.8	-	-	-	-	-	-	-
3.7	-	-	-	-	-	-	-
3.6	-	-	-	-	-	3,890	3,890
3.5	-	-	-	-	-	-	-
3.4	-	-	-	-	-	-	-
3.3	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-

Table A-8. Continued.

Water stage above 1971 Datum feet (2)	Effective period for rating curve and discharges (cfs) at given stages (1).								
	1961 W.Y.		1962 W.Y.		1963	1964 W.Y.		1965 W.Y.	
	10/1 - 2/11	2/12 - 9/30	10/1 - 3/28	3/29 - 9/30	W.Y.	10/1 - 1/6	1/7 - 9/30	10/1 - 12/24	12/25 - 9/30
35	-	-	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-	187,000	-
33	-	-	-	-	-	-	-	-	170,000
32	-	155,000	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-
30.5	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	130,000	130,000
29.5	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-
27	106,000	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	85,000	85,000	85,000
23	-	-	-	-	-	-	-	-	-
22	-	-	73,000	-	74,000	-	-	-	-
21	67,000	67,000	-	-	-	-	-	-	-
20.2	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-
19	-	-	-	57,000	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-
17.6	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-
15	38,900	38,900	39,800	39,800	-	40,000	-	-	-
14	-	-	-	-	36,000	-	-	-	-
13	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	30,000	30,000	30,000
11.5	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-
9.5	-	-	-	-	-	-	-	-	-
9	17,500	17,600	17,600	18,300	-	-	-	-	-
8.6	-	-	-	-	-	-	-	-	-
8.5	-	-	-	-	-	-	-	-	-
8.4	-	-	-	-	-	-	-	-	-
8.2	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
7.8	-	-	-	-	-	-	-	-	-
7.6	-	-	-	-	-	-	-	-	-
7.4	-	-	-	-	-	-	-	-	-
7	-	-	-	-	12,600	12,600	-	-	-
6.7	-	-	-	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-	-	-
6.4	-	-	-	-	-	-	-	-	-
6.1	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	10,300	10,300	10,700
5.8	-	-	-	-	-	-	-	-	-
5.6	-	-	-	-	-	-	-	-	-
5.5	-	-	-	-	-	-	-	-	-
5.4	-	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	-	-
5.1	-	-	-	-	-	-	-	-	-
5	6,680	7,550	7,550	7,440	-	-	-	-	-
4.9	-	-	-	-	-	-	-	-	-
4.6	-	-	-	-	-	6,720	-	-	-
4.5	-	-	-	-	-	-	-	-	-
4.4	-	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-	-	-
4.2	-	-	-	-	-	-	-	-	-
4.1	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-
3.9	-	-	-	-	-	-	5,350	-	-
3.8	4,250	-	-	-	-	-	-	5,150	-
3.7	-	-	-	-	-	-	-	-	-
3.6	-	-	-	-	-	-	-	-	-
3.5	-	4,500	-	-	-	-	-	-	-
3.4	-	-	-	4,180	-	-	-	-	-
3.3	-	-	-	-	4,040	-	-	-	-
3	-	-	-	-	-	-	-	-	4.050

Table A-9 Rating Curves for Study Site 9, Willamette River a Salem (14-1910), 1935-65.

Water stage above 1971 datum feet(2)	Effective period for rating curve and discharges (cfs) at given stages. (1)							
	1935 W.Y.		1936 W.Y.		1937 W.Y.		1938 W.Y.	1939 W.Y.
	10/1-12/22	12/23-9/30	10/1-1/13	1/14-9/30	10/-4/15	4/16-9/30		
39	-	-	-	-	-	-	-	-
38	-	-	-	-	-	-	-	-
37	-	-	-	-	-	-	-	-
35.5	-	-	-	-	-	-	-	-
35	-	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-	-
33	-	-	-	-	-	-	-	-
32	-	-	-	228,000	228,000	-	-	-
31	-	-	-	-	-	-	-	-
30.5	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-
28	-	162,000	-	162,000	162,000	-	162,000	-
27.1	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-
24	-	-	-	112,000	112,000	-	112,000	-
23	-	102,000	-	-	-		-	
22	-	-	-	-	-	-	-	930,000
21	-	-	-	-	-	-	-	-
20	-	76,700	-	76,700	76,700	-	76,700	76,700
19	-	-	-	-	-	-	-	-
18	-	62,500	-	62,500	62,500		62,500	62,500
17	-							
16	49,100	49,100	-	49,100	49,100	-	49,100	49,100
15	-	-	-	-	-	-	-	-
14	37,100	37,300	-	37,300	37,300	-	37,300	37,300
13	-	-	-	-	-	-	-	-
12	27,300	28,300	-	28,300	28,300	28,400	29,100	28,000
11.5	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-
10.2	-	-	-	-	-	-	-	-
10	19,300	19,900	19,900	19,900	19,900	20,300	19,840	19,500
9	-	16,200	-	-	-	-	-	-
8	12,400	12,800	12,800	12,900	12,900	13,200	12,640	12,300
7.5	-	-	-	-	-	-	-	-
7.4	-	-	-	-	-	-	-	-
7	-	9,510	9,510	9,680	9,680	10,000	9,590	9,500
6.8	-	-	-	-	-	-	-	-
6.5	7,790	-	8,010	-	8,200	-	-	-
6.4	-	-	-	-	-	-	-	-
6	-	6,630	6,630	6,850	6,850	7,180	6,990	6,990
5.5	5,110	5,450	5,450	5,700	5,700	5,940	5,850	5,850
5.4	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	-
5.1	-	-	-	-	-	-	-	-
5	-	4,450	4,450	4,710	4,710	4,860	4,840	4,840
4.9	-	-	-	-	-	-	-	-
4.8	-	-	-	-	-	-	-	-
4.7	-	-	-	-	-	-	-	-
4.6	-	-	-	-	-	-	-	-
4.5	3,230	3,650	3,650	3,890	3,890	3,990	3,940	3,940
4.4	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-	-
4.2	-	-	-	-	-	-	-	-
4	-	3,080	3,080	3,220	3,220	3,250	3,130	3,130
3.8	-	-	-	-	-	-	-	2,830
3.7	-	-	-	-	-	-	-	-
3.6	-	-	-	-	-	-	-	-
3.5	-	-	-	-	-	-	-	-

(1) W.Y. = Water Year

No data published for 1944, 1946, 1947 water years

(2) Datum plane was lowered 8.00 feet on 10/1/1962.

Table A-9. Continued.

Water stage above 1971 datum feet	Effective period for rating curve and discharges (cfs) at given stages.							
	1940	1941 W. Y.		1942 W.Y.		1943 W.Y.		1945
	W.Y.	10/1-12/29	12/30-9/30	10/1-12/20	12/21-9/30	10/1-1/1	1/2-9/30	W.Y.
39	-	-	-	-	-	297,000	-	-
38	-	-	-	-	-	-	-	-
37	-	-	-	-	-	-	-	-
35.5	-	-	-	-	-	-	-	-
35	-	-	-	-	-	235,000	-	-
34	-	-	-	-	-	-	-	-
33	-	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-	-
31						179,000	-	-
30.5	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-
27.1	-	-	-	-	-	-	-	-
27	-	-	-	-	131,000	131,000	-	-
26	-	-	-	-	-	-	-	-
25	-	-	-	123,000	-	-	-	-
24	112,000	-	-	-	-	-	-	-
23	-	-	-	-	92,400	92,400	-	99,500
22	93,000	-	-	-	-	-	-	-
21	-	-	-	84,500	-	-	-	-
20	76,700	-	76,700	-	69,800	69,800	70,000	77,900
19	-	-	-	-	-	-	-	
18	62,500	62,500	62,500	62,500	57,300	-	-	-
17	-	-	-	-	-	51,800	53,200	58,900
16	49,100	49,100	49,100	49,100	46,500	-	-	-
15	-	-	-	-	-	-	-	46,800
14	37,300	37,300	37,300	37,300	36,900	36,900	38,200	-
13	-	-	-	-	-	-	-	35,700
12	28,000	28,000	27,610	28,200	28,200	28,200	29,000	-
11.5	-	-	-	-	-	-	-	28,200
11	-	-	-	-	-	-	-	-
10.2	-	-	-	-	-	-	-	22,400
10	19,500	19,500	19,400	20,000	20,000	20,000	20,400	-
9	-	-	-	-	-	-	-	17,800
8	12,300	12,300	12,400	13,000	13,000	13,000	13,200	14,200
7.5	-	-	-	-	-	-	-	-
7.4	-	-	-	-	-	-	-	-
7	9,500	9,500	9,690	9,980	9,980	-	-	10,900
6.8	-	-	-	-	-	9,400	9,640	-
6.5	-	-	-	-	-	-	-	-
6.4	-	-	-	-	-	-	-	-
6	6,990	6,990	7,170	7,280	7,280	-	-	7,800
5:5	5,850	5,750	-	-	-	6,120	6,290	-
5.4	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	5,830
5.1	-	-	-	-	-	-	-	-
5	4,840	4,840	5,050	5,060	5,060	-	-	-
4.9	-	-	-	-	-	-	-	-
4.8	-	-	-	-	-	-	-	-
4.7	-	-	-	-	-	-	-	-
4.6	-	-	-	-	-	-	-	4,645
4.5	3,940	3,940	4,120	4,120	-	4,120	4,200	-
4.4	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-	-
4.2	-	-	-	-	-	-	-	-
4.	3,120	3,120	3,300	-	3,300	-	-	3,550
3.8	-	-	3,000	-	-	-	-	-
3.7	2,680	2,680	-	-	-	2,860	-	-
3.6	-	-	-	-	-	-	-	-
3.5	2,400	-	-	-	-	-	-	-

Table A-9. Continued.

Water stage above 1971 datum feet	Effective period for rating curve and discharges (cfs) at given stages.							
	1948	1949	1950 W.Y.		1951 W.Y.	1952 W. Y.		1953 W.Y.
			10/1-1/23	1/2-9/30		10/1-11/11	11/12-9/30	
39	-	-	-	-	-	-	-	-
38	-	-	-	-	-	-	-	-
37	-	-	-	-	-	-	-	-
35.5	242,000	-	-	-	-	-	-	-
35	-	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-	-
33	-	-	-	-	-	-	-	233,000
32	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-
30.5	-	175,000	-	-	-	-	-	-
29	158,000	158,000	-	158,000	158,000	-	-	-
28	-	-	146,000	-	-	-	-	-
27.1	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	151,000	-
26	-	-	-	126,000	-	-	-	140,000
25	-	-	-	-	-	-	-	-
24	108,000	108,000	108,000	-	-	-	-	-
23	-	-	-	99,500	99,500	-	-	-
22	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-
20	77,900	77,900	77,900	-	-	-	85,000	85,000
19	-	-	-	72,300	-	72,300	-	-
18	-	-	-	-	-	-	-	-
17	-	-	-	-	60,500	-	-	-
16	-	-	-	-	-	-	56,500	56,500
15	-	-	-	49,400	-	49,400	-	-
14	41,000	41,000	41,000	-	-	-	-	-
13	-	-	-	-	-	-	-	-
12	-	-	-	-	33,400	33,400	-	-
11.5	-	-	-	-	-	-	-	-
11	25,900	25,900	25,900	28,400	-	-	-	-
10.2	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-
9	17,800	17,800	17,800	19,300	-	-	20,500	20,500
8	-	-	-	-	-	-	-	-
7.5	-	12,500	12,500	-	-	-	-	-
7.4	-	-	-	12,900	-	-	-	-
7	-	-	-	-	-	-	-	-
6.8	-	-	-	-	10,800	10,800	-	-
6.5	-	-	-	-	-	-	-	-
6.4	9,000	-	-	-	-	-	-	-
6	-	7,800	7,800	8,400	-	-	9,000	9,000
5.5	-	-	-	-	-	-	-	-
5.4	6,270	-	-	-	-	-	-	-
5.2	-	5,830	5,830	6,300	-	-	-	-
5.1	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-
4.9	-	-	-	-	-	-	-	-
4.8	-	-	-	-	-	5,300	-	-
4.7	-	-	-	-	-	-	-	-
4.6	-	-	4,640	-	-	-	-	-
4.5	-	-	-	-	-	-	-	5,000
4.4	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	4,600	-
4.2	3,910	-	-	4,000	4,000	-	-	-
4	-	3,550	-	-	-	-	-	-
3.8	-	-	-	-	-	-	-	-
3.7	-	-	-	-	-	-	-	-
3.6	-	-	-	-	-	-	-	3,500
3.5	-	-	-	-	-	-	-	-

Table A-9. Continued.

Water stage above 1971 datum feet	Effective period for rating curve and discharges (cfs) at given stages							
	1954 W. Y.		1955	1956 W. Y.		1957	1958 W.Y.	
	10/1-12/10	12/11-9/30	W.Y.	10/1-12/22	12/23-9/30	W.Y.	10/1-12/22	12/23-9/30
39	-	-	-	-	-	-	-	-
38	-	-	-	-	-	-	-	-
37	-	-	-	-	-	-	-	-
35.5	-	-	-	-	-	-	-	-
35	-	-	-	-	248,000	-	-	-
34	-	-	-	-	-	-	-	-
33	-	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-	-
31	-	-	-	204,000	-	-	-	-
30.5	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-
27.1	-	152,000	-	-	-	-	-	-
27	151,000	-	-	-	-	-	151,000	-
26	-	-	-	140,000	-	-	-	141,300
25	-	-	-	-	130,000	130,000	-	-
24	-	-	-	-	-	-	-	-
23	-	-	110,000	-	-	-	110,000	-
22	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-
20	85,000	85,000	85,000	85,000	-	-	-	-
19	-	-	-	-	-	-	-	-
18	-	-	-	-	70,800	70,800	-	72,800
17	-	-	-	-	-	-	-	-
16	56,500	-	-	-	-	-	-	-
15	-	-	-	-	-	-	50,300	-
14	-	42,000	42,000	42,000	-	-	-	-
13	-	-	-	-	38,800	38,800	-	-
12	-	-	-	-	-	-	-	-
11.5	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-
10.2	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	24,800
9	-	-	-	-	-	-	-	-
8	20,500	15,500	15,500	15,500	-	-	15,800	-
7.5	-	-	-	-	-	-	-	-
7.4	-	-	-	-	13,400	13,400	-	-
7	-	-	-	-	-	-	-	12,500
6.8	-	-	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-	-
6.4	-	-	-	-	-	-	-	-
6	9,000	-	-	-	-	-	-	-
5.5	-	-	-	7,500	-	-	-	-
5.4	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	-
5.1	6,450	-	-	-	-	-	6,450	-
5	-	-	-	-	-	-	-	-
4.9	-	5,950	5,950	-	-	-	-	-
4.8	-	-	-	-	5,700	-	-	-
4.7	-	-	-	-	-	-	-	-
4.6	-	-	-	-	-	5,200	-	-
4.5	-	-	-	-	-	-	-	5,500
4.4	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-	-
4.2	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-
3.8	-	-	-	-	-	-	-	-
3.7	-	-	-	-	-	-	-	-
3.6	-	-	-	-	-	-	-	-
3.5	-	-	-	-	-	-	-	-

Table A-9. Continued.

Water stage above 1971 datum feet	Effective period for rating curve and discharges (cfs) at given stages									
	1959 W.Y.	1960 W.Y.	1961 W.Y.		1962 W.Y.		1963 W.Y.	1964 W.Y.	1965 W.Y.	
			10/1-11/25	11/26-9/30	10/1-12/21	12/22-9/30			10/1-12/21	12/26-9/30
39	-	-	-	-	-	-	-	-	-	-
38	-	-	-	-	-	-	-	-	-	312,000
37	-	-	-	-	-	-	-	-	295,000	-
35.5	-	-	-	-	-	-	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-
34	-	-	-	248,000	-	-	-	-	-	-
33	-	-	-	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-	-
30.5	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	164,000
27.1	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-
26	-	-	141,000	141,000	-	-	-	-	-	-
25	131,000	-	-	-	-	132,000	-	132,000	132,000	-
24	-	-	-	-	122,000	-	-	-	-	-
23	-	-	-	-	-	-	113,000	-	-	-
22	-	105,000	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-
18	72,800	72,800	72,800	72,800	72,800	72,000	72,000	72,000	72,000	70,000
17	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	34,000	33,600	33,600	30,500
11.5	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-
10.2	-	-	-	-	-	-	-	-	-	-
10	24,800	24,800	24,800	24,800	24,800	24,300	-	-	-	-
9	-	-	-	-	-	-	-	-	-	16,500
8	16,000	16,000	16,000	16,000	16,000	16,000	-	-	-	-
7.5	-	-	-	-	-	-	-	-	-	-
7.4	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	12,500	12,100	12,100	-
6.8	-	-	-	-	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-	-	-	-
6.4	-	-	-	-	-	-	-	-	-	-
6	9,350	9,350	9,350	8,900	8,900	9,400	-	-	-	6,650
5.5	-	-	-	-	-	-	-	-	-	-
5.4	-	-	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	-	-	-
5.1	-	-	-	-	-	-	-	-	-	-
5	-	-	6,600	-	-	-	-	-	6,300	4,200
4.9	-	-	-	-	-	-	-	6,060	-	-
4.8	-	-	-	-	-	-	-	-	-	-
4.7	-	-	-	5,540	5,540	-	-	-	-	-
4.6	-	-	-	-	-	-	-	-	-	-
4.5	-	-	-	-	-	5,500	-	-	-	-
4.4	5,300	5,300	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	5,060	-	-	-
4.2	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-
3.8	-	-	-	-	-	-	-	-	-	-
3.7	-	-	-	-	-	-	-	-	-	-
3.6	-	-	-	-	-	-	-	-	-	-
3.5	-	-	-	-	-	-	-	-		

Table A-10. Rating Curves for Study Site 10, Willamette River at Wilsonville (14-1980), 1949-56.

Water stage above 1971 datum, feet (2)	Effective period for rating curve and discharges (cfs) at given stages. (1)					
	1949 W.Y.	1951 W.Y.	1952 W.Y. 10/1/-122	1952 W.Y. 12/3-9/30	1954 W.Y.	1956 W.Y.
86	-	-	-	-	-	235,000
84.8	192,000	-	-	-	-	-
80	154,000	-	-	-	160,000	-
79	-	147,000	-	152,000	-	-
75	118,000	118,000	-	-	-	-
73	-	-	104,000	-	-	-
70	85,500	85,500	-	88,500	88,500	100,000
65	56,700	56,700	56,700	-	-	-
61	-	37,100	-	-	-	-
60	32,600	-	32,600	32,600	32,000	37,000
57	20,100	20,100	-	-	-	-
56	-	-	-	-	16,400	-
55	12,900	-	-	-	-	14,700
54	-	9,600	9,600	9,600	-	-
53.5	8,060	-	-	-	-	-
53	-	-	-	-	6,750	-
52.5	5,520	-	-	-	-	-
52.4	-	-	-	-	-	6,080
51.7	3,660	-	-	-	-	-

(1) W.Y. = Water Year

No data published for 1950, 1953, 1955, 1957, and all following water years.

(2) Prior to 10/1/54 gage was 5.6 miles upstream at same datum; from 10/1/1954 to 11/2/1970 gage was 1.1 miles upstream at same datum.

Table A-11. Rating Curves for Study Site 11, Little Sandy River near Bull Run (14-1415), 1935-65.

Water stage above 1965 datum, feet (2)	Effective period for rating curve and discharges (cfs) at given stages. (1)							
	1935 W.Y.	1936 W.Y.	1937,1938 W.Y.	1939 W.Y.	1940 W.Y. 10/1-2/5	1940 W.Y. 2/6-9/30	1941 W.Y.	1942 W.Y.
8	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-
6.7	-	-	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-	-
6.3	-	-	-	-	-	-	-	-
6	-	1,570	1,570	-	-	-	-	-
5.8	-	-	-	-	-	-	-	-
5.7	-	-	-	-	-	-	-	-
5.6	-	-	-	1,250	-	-	1,250	-
5.5	1,180	1,180	1,180	-	-	-	-	-
5.4	-	-	-	-	-	-	-	-
5.3	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	970	970	-
5.1	-	-	-	-	-	-	-	-
5	840	840	840	840	-	-	-	-
4.9	-	-	-	-	-	-	-	780
4.8	-	-	-	-	725	-	725	-
4.6	-	-	-	-	-	-	-	-
4.5	580	580	580	580	-	-	-	-
4.4	-	-	-	-	535	530	530	530
4.3	-	-	-	-	-	-	-	-
4.2	-	-	-	-	-	-	-	-
4.1	-	-	-	-	-	-	-	-
4	380	380	-	380	380	-	370	370
3.9	-	-	-	-	-	-	-	-
3.8	-	-	-	-	-	-	-	-
3.7	-	-	-	-	-	-	-	-
3.6	-	-	-	-	247	240	240	240
3.5	225	222	219	219	-	-	-	-
3.3	-	-	-	-	-	-	-	-
3.2	-	-	-	-	151	144	144	144
3.1	-	-	-	-	-	-	-	-
3	120	115	115	115	-	-	-	-
2.9	-	-	-	-	99	95	95	95
2.8	-	-	-	-	-	-	-	-
2.7	77	73	73	73	-	-	-	-
2.6	-	-	-	-	62	59	59	59
2.5	-	-	-	-	-	-	-	-
2.4	46	45	43	43	-	42	42	42
2.3	-	-	-	-	35	-	-	-
2.2	30	30	28	28	-	27	27	27
2.1	-	-	-	-	22	-	-	-
2	17	17	17	17	-	16	16	16
1.9	-	-	-	12	12	-	11	11
1.8	8	8	9	-	-	7	-	-
1.7	-	-	-	-	-	-	-	-

(1) W.Y. = Water Year
No data published for 1950 Water Year.

(2) 1965 datum used instead of 1970 datum because gage was 0.1 mile downstream of present site from 10/1/1931 to 11/3/1967 at a datum 8 feet lower. Use of 1971 datum would make all of the stages in this table become negative.

Table A-11. Continued.

Water stage above 1965 datum, feet (2)	Effective period for rating curve and discharges (cfs) at given stages. (1)						
	1943 W.Y.						
	10/1-11/22	11/23-9/30	10/1/43 - 2/13/45	2/14-9/30 1945	10/1/45 - 10/23/46	10/24/46 - 9/30/47	10/1-11/6 1947
8	-	-	-	-	-	-	-
7	-	2,110	-	-	2,480	-	-
6.7	-	-	-	-	-	2,350	-
6.5	-	-	-	-	2,010	-	-
6.3	-	-	-	-	-	-	-
6	-	1,310	-	-	1,570	-	-
5.8	-	-	-	-	-	1,540	-
5.7	-	-	-	-	-	-	-
5.6	-	-	-	-	1,250	-	-
5.5	-	-	-	-	-	-	-
5.4	-	910	-	-	-	-	-
5.3	-	-	-	1,040	-	-	-
5.2	-	-	-	-	970	-	-
5.1	-	-	-	-	-	1,040	-
5	-	-	-	-	-	-	-
4.9	-	-	645	-	-	-	-
4.8	-	600	-	725	725	-	855
4.6	625	-	-	-	-	-	-
4.5	-	-	-	-	-	675	-
4.4	-	-	-	-	-	-	615
4.3	-	410	410	485	485	-	-
4.2	445	-	-	-	-	-	-
4.1	-	-	-	-	-	465	-
4	-	-	-	-	-	-	425
3.9	-	285	285	335	335	-	-
3.8	300	-	-	-	-	-	-
3.7	-	-	-	-	-	315	-
3.6	-	-	-	-	-	-	280
3.5	213	188	188	215	215	-	-
3.3	-	-	-	-	-	200	200
3.2	144	131	131	153	153	-	-
3.1	-	-	-	-	-	-	-
3	-	-	-	-	-	135	135
2.9	95	91	91	99	85	-	-
2.8	-	-	-	-	-	-	-
2.7	-	-	-	-	-	85	85
2.6	59	60	60	63	63	-	-
2.5	-	-	-	-	-	60	60
2.4	42	43	43	46	-	-	-
2.3	-	-	-	-	39	39	39
2.2	27	30	30	32	-	-	-
2.1	-	-	-	-	26	24	24
2	16	19	19	21	-	-	18
1.9	11	14	14	-	16	13	-
1.8	-	-	10	12	-	-	-
1.7	-	-	-	-	-	-	-

Table A-11. Continued.

Water stage above 1965 datum, feet (2)	Effective period for rating curve and discharges (cfs) at given stages. (1)					
	11/7/47 - 2/17/49	2/18 - 9/30 1949	10/1/50 - 6/29/52	6/30 - 9/30 1952	10/1/52 - 1/18/53	1/19 - 11/22 1953
8	-	-	-	-	-	-
7	-	-	-	-	-	-
6.7	-	-	-	-	-	-
6.5	-	-	-	-	-	-
6.3	-	-	-	-	2,200	-
6	1,700	-	-	-	-	-
5.8	-	-	-	-	-	-
5.7	-	-	-	-	-	-
5.6	-	-	-	-	-	-
5.5	-	-	1,220	-	-	-
5.4	-	-	-	-	-	-
5.3	-	-	-	-	-	-
5.2	1,100	1,100	-	-	-	-
5.1	-	-	-	-	-	-
5	-	-	890	-	1,070	1,030
4.9	-	-	-	-	-	-
4.8	-	-	-	-	-	-
4.6	-	-	-	-	-	-
4.5	675	675	605	740	-	-
4.4	-	-	-	-	-	-
4.3	-	-	-	-	-	-
4.2	-	-	-	-	-	-
4.1	480	-	-	-	-	-
4	-	440	388	470	470	445
3.9	-	-	-	-	-	-
3.8	-	-	-	-	-	-
3.7	335	-	-	-	-	-
3.6	-	-	-	-	-	-
3.5	-	270	230	275	275	265
3.3	218	-	-	-	-	-
3.2	-	-	161	-	-	-
3.1	-	159	-	-	-	-
3	150	-	-	140	140	132
2.9	-	-	103	-	-	-
2.8	-	102	-	-	-	-
2.7	95	-	-	-	-	-
2.6	-	-	62	69	69	66
2.5	-	62	-	-	-	-
2.4	56	-	42	-	-	-
2.3	-	42	-	36	36	36
2.2	35	-	28	-	-	-
2.1	27	27	-	22	-	23
2	20	-	19	-	16	-
1.9	15	18	-	12	-	14
1.8	-	-	13	-	8	-
1.7	-	-	-	-	-	-

Table A-11. Continued.

Water stage above 1965 datum, feet (2)	Effective period for rating curve and discharges (cfs) at given stages. (1)					
	11/23/53 - 11/18/54	11/19/54 - 10/9/55	10/10/55 - 12/11/56	12/12/56 - 12/19/57	12/20/57 - 12/10/58	12/11/58 - 10/22/59
8	-	-	-	-	-	-
7	-	-	-	-	-	-
6.7	-	-	-	-	-	-
6.5	-	-	3,039	-	-	-
6.3	-	-	-	-	-	-
5	-	1,870	-	-	2,450	-
5.8	-	-	-	-	-	-
5.7	-	-	-	-	-	-
5.6	-	-	-	-	-	-
5.5	1,400	-	1,860	-	-	-
5.4	-	-	-	-	-	-
5.3	-	-	-	1,620	-	-
5.2	-	-	-	-	-	-
5.1	-	-	-	-	-	1,370
5	1,000	1,000	-	-	1,300	-
4.9	-	-	-	-	-	-
4.8	-	-	-	-	-	-
4.6	-	-	-	-	-	-
4.5	675	675	920	840	840	780
4.4	-	-	-	-	-	-
4.3	-	-	-	-	-	-
4.2	-	-	-	-	-	-
4.1	-	-	-	-	-	-
4	440	440	-	-	-	-
3.9	-	-	485	460	440	440
3.8	-	-	-	-	-	-
3.7	-	-	-	-	-	-
3.6	-	-	-	-	-	-
3.5	252	-	-	-	-	-
3.3	-	205	238	230	217	217
3.2	-	-	-	-	-	-
3.1	-	-	-	-	-	-
3	126	-	-	-	-	-
2.9	-	120	-	-	-	-
2.8	-	-	117	120	-	-
2.7	-	-	-	-	99	96
2.6	62	-	-	-	-	-
2.5	-	56	-	-	-	-
2.4	-	-	58	-	-	-
2.3	33	-	-	50	50	46
2.2	-	29	-	-	-	-
2.1	20	-	34	-	-	-
2	-	-	-	24	27	24
1.9	-	14	-	-	-	-
1.8	-	-	20	14	-	14
1.7	-	-	-	-	13	-

Table A-11. Continued.

Water stage above 1965 datum, feet (2)	Effective period for rating curve and discharges (cfs) at given stages. (1)							
	10/23/59 - 11/24/60	11/25/60 - 9/30/61	1962 W.Y.		1963 W.Y.	1964 W.Y.	1965 W.Y.	
			10/1-10/10	10/11-9/30			10/1-12/21	1/22-9/30
8	-	-	-	-	-	-	-	3,530
7	-	-	-	-	-	-	-	-
6.7	-	-	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-	-
6.3	-	-	-	-	-	-	-	-
6	-	2,230	-	1,890	0	-	-	1,500
5.8	-	-	-	-	-	-	-	-
5.7	-	-	-	-	1,630	-	-	-
5.6	-	-	-	-	-	-	-	-
5.5	-	-	-	-	-	1,450	-	-
5.4	-	-	-	-	-	-	-	-
5.3	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	-
5.1	-	-	-	-	-	-	-	-
5	1,260	1,130	-	1,030	-	-	1,050	840
4.9	-	-	-	-	-	-	-	-
4.8	-	-	-	-	-	-	-	-
4.6	-	-	-	-	-	-	-	-
4.5	-	-	-	-	710	710	710	-
4.4	-	-	-	-	-	-	-	-
4.3	-	-	-	-	-	-	-	-
4.2	-	-	-	-	-	-	-	-
4.1	-	-	-	-	-	-	-	-
4	490	465	-	420	440	440	440	400
3.9	-	-	-	-	-	-	-	-
3.8	-	-	-	-	-	-	-	-
3.7	-	-	-	-	-	-	-	-
3.6	-	-	-	-	-	-	-	-
3.5	295	270	270	-	260	260	260	240
3.3	-	-	-	-	-	-	-	-
3.2	-	-	-	-	-	-	-	-
3.1	-	-	-	-	-	-	-	-
3	156	143	143	136	139	139	139	122
2.9	-	-	-	-	-	-	-	-
2.8	-	-	-	-	-	-	-	-
2.7	-	-	-	-	-	-	-	-
2.6	-	-	-	-	-	-	-	-
2.5	69	67	67	67	64	64	64	48
2.4	-	-	-	-	-	-	-	-
2.3	-	-	-	-	-	-	-	-
2.2	38	-	-	-	36	36	36	22
2.1	-	30	30	-	-	-	-	-
2	-	-	-	26	-	-	-	12
1.9	18	-	18	-	18	18	-	-
1.8	-	13	-	16	-	-	-	-
1.7	-	-	-	-	-	-	-	-