U.S. Department of the Interior
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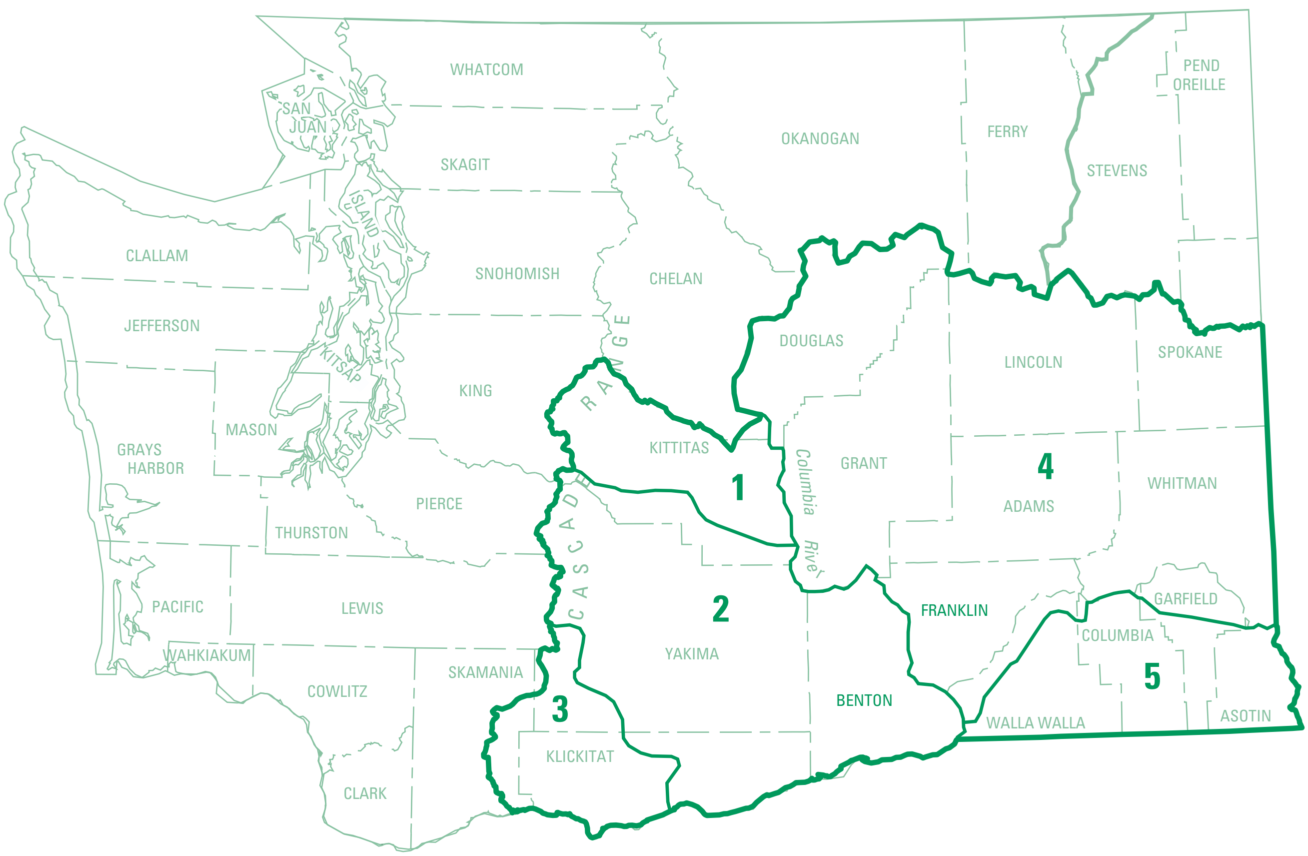
Determination of Upstream Boundary Points on Southeastern Washington Streams and Rivers Under the Requirements of the Shoreline Management Act of 1971

Water-Resources Investigations Report 03-4042



Prepared in cooperation with the
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By Johnna L. Higgins

U.S. GEOLOGICAL SURVEY

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WASHINGTON STATE DEPARTMENT OF ECOLOGY

Tacoma, Washington

U.S. DEPARTMENT OF THE INTERIOR

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CONTENTS

PLATE

[Plate is in pocket]

FIGURE

TABLES

CONVERSION FACTORS

Multiply	By	To obtain
inch (in)	2.54	centimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer
cubic foot per second (ft^3/s)	0.02832	cubic meter per second

Determination of Upstream Boundary Points on Southeastern Washington Streams and Rivers Under the Requirements of the Shoreline Management Act of 1971

By Johnna L. Higgins

ABSTRACT

Regulation of the shorelines of the State of Washington, as mandated by the Shoreline Management Act of 1971, requires knowledge of the locations on streams and river reaches where specific regulatory criteria are satisfied. The U.S. Geological Survey conducted a study in 1971 to determine the upstream boundary points of these reaches for many of the State's streams and rivers. Updated upstream boundary points were determined in the current study for all the streams and rivers in southeastern Washington that fall under the jurisdiction of the Shoreline Management Act of 1971. Upstream boundary point locations where the mean annual discharge equals 20 ft^3/s (cubic feet per second) were determined for 149 streams. In addition, upstream boundary point locations where the mean annual discharge equals 200 ft^3/s or the drainage area equals 300 square miles were determined for 22 rivers.

Boundary point locations were determined by application of multiple-linear-regression equations that relate mean annual discharge to drainage area and mean annual precipitation. Southeastern Washington was divided into five hydrologically distinct regions, and a separate regression equation was developed for each region. The regression equations are based on data for gaging stations with at least 10 years of record. The number of stations in the regression analysis for each of the five regions ranged from 5 to 33. The coefficient of determination, R^2, of the regression equations ranged from 0.953 to 0.997. The equation for the Upper Yakima region had the lowest standard error, ranging from -7 to +9 percent for a regression estimate of 20 ft^3/s. The equation for the Columbia Basin to Palouse region had the highest standard error, ranging from -36 to +55 percent for a regression estimate of 20 ft^3/s. The approximate error in the location of an upstream boundary point can be calculated using the variables mean annual precipitation of the basin upstream from a boundary point and average basin width in the vicinity of the boundary point. The calculation gives only a rough estimate of the error of the boundary point location, because of the uncertainty in estimating average basin width.

INTRODUCTION

The Washington State legislature, in 1971, identified the shorelines of the State as being "among the most valuable and fragile of its natural resources" and expressed great concern regarding their utilization, protection, restoration, and preservation. Therefore, the legislature enacted the Shoreline Management Act of 1971 (hereafter referred to either as the Shoreline Management Act or the Act) and designated the Washington State Department of Ecology (Ecology) as the agency responsible for regulating the State's shorelines (State of Washington, 1971). The reaches of streams and rivers that fall under the Act's jurisdiction must be defined in order for Ecology to properly administer the provisions of the Shoreline Management Act.

The Act designates separate regulatory criteria for streams and rivers. For southeastern Washington, the study area of this report (fig. 1), the Act defines "shorelines" as *stream* reaches where the mean annual flow exceeds 20 ft^3/s (cubic feet per second) and "shorelines of statewide significance" as *river* reaches where the mean annual flow is greater than 200 ft^3/s or the drainage area is greater than 300 mi^2 (square miles), whichever results in a longer river reach. The location of the upstream boundary point for a stream or river is defined as the most upstream point where one of these criteria is met.

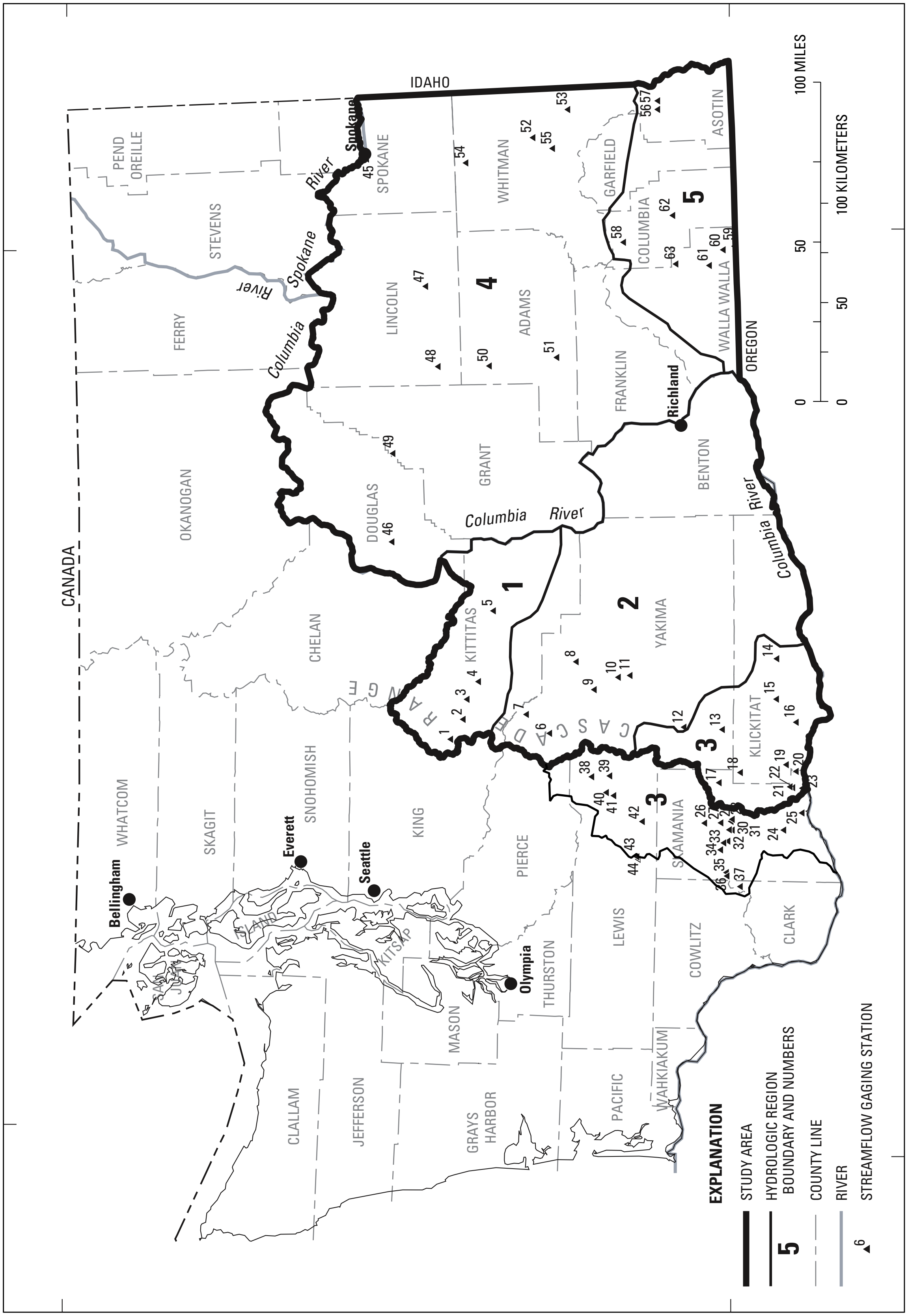

Figure 1. Location of study area, hydrologic regions, and streamflow-gaging stations used to determine upstream boundary points for streams and rivers in southeastern Washington.

Previous Investigations

The U.S. Geological Survey (USGS), in cooperation with Ecology, conducted a study in 1971 to determine the upstream boundary points on many streams throughout the State for which Ecology had regulatory responsibility (David H. Appel, U.S. Geological Survey, written commun., 1971). However, in 1990, Ecology decided that the upstream boundary points determined in the 1971 study needed to be updated for the following reasons.

1. The 1971 study did not include all streams that met the regulatory criteria.
2. The 1971 study did not determine upstream boundary points for shorelines of statewide significance.
3. In the 1971 study, if the regulatory discharge occurred upstream of certain political or jurisdictional boundaries, such as those for national forests, Indian reservations, and national parks, the Shoreline Management Act upstream boundary point was placed at the political or jurisdictional boundary.
4. The 1971 study determined upstream boundary points for the regulatory discharge of 20 ft^3/s plus the standard error of the determining regression equations, rather than for just the regulatory discharge itself as in the current study.
5. Three additional decades of streamflow data collected since 1971 provide improved estimates of long-term average flow conditions.

The USGS, in cooperation with Ecology, began updating upstream boundary points in 1990. At the request of Ecology, the State was divided into the same 13 hydrologic regions that were used in the 1971 study. From 1990 through 1998, the USGS determined updated upstream boundary points for all northeastern and western Washington streams and rivers for which Ecology has regulatory responsibility (Kresch, 1998a, b).

Purpose and Scope

This report presents the results of the study to determine the upstream boundary points for the streams and rivers in southeastern Washington. The study area includes the five hydrologic regions located in southeastern Washington (fig. 1).

Region 1. Upper Yakima

Region 2. Lower Yakima

Region 3. Mount Adams

Region 4. Columbia Basin to Palouse

Region 5. Blue Mountains

The report describes the analytical methods used to develop regression equations that relate stream discharge to precipitation and basin area, and to determine the locations of upstream boundary points through the use of these equations. A series of tables provides streamflow gaging-station records used in the development of the regression equations, regression equations and descriptive statistics, and the coordinates of the upstream boundary point locations, and both the boundary point locations and the boundaries of the drainage basins upstream from them are shown on a plate.

The regional boundaries for this study are, at the request of Ecology, the same ones used in the 1971 study. For region 3 (Mount Adams), only boundary points for streams located east of the Cascade Range crest and for the Muddy Fork of the Cispus River are included in this report. Upstream boundary points located west of the Cascade Range crest in region 3 were updated by the USGS during the western Washington study, with the exception of the Muddy Fork (Kresch, 1998b, p. 2). The Muddy Fork is the only "shoreline" stream in Yakima County that flows west from the Cascade Range, and the decision was made to include it in the southeastern study along with all other "shoreline" streams in Yakima County.

Acknowledgments

The author would like to express appreciation and gratitude to the hard working people who assisted in the determination of the upstream boundary points: Colleen Seto, Kim Mueller, and Anni Watkins, USGS.

APPROACH

Most of the streams and rivers of interest in the study area do not have streamflow records (ungaged). Thus, a direct-measurement approach for determining upstream boundary points was not feasible because (1) the use of stream-gaging records to determine mean annual discharges would require continuous operation of a number of new streamflow gages on each stream over a period of years, (2) the locations at which to measure the streams would not be known beforehand, and (3) the cost of operating the large number of gages required would be economically impractical.

The most practical way to determine streamflow at ungaged sites is by transfer of information developed for gaged sites. A widely accepted approach uses multiple-linear-regression equations that relate streamflow to physical and climatic characteristics. The 1971 USGS study concluded that only drainage area and mean annual precipitation were needed in order to determine mean annual discharge at ungaged sites (David H. Appel, U.S. Geological Survey, written commun., 1971). The form of the regression equation developed for that study, and subsequently used for this study is:

$$Q = aA^bP^c \qquad (1)$$

Q is mean annual discharge, in cubic feet per second,

A is basin drainage area, in square miles,

P is mean annual precipitation, averaged over the basin, in inches, and

a,b,c are constants.

The basin area (A) and precipitation (P) values are those for the drainage basin upstream of the point on the stream or river at which mean annual discharge (Q) is desired.

In the 1971 study, other independent variables (percentage of forest, mean drainage-basin altitude, and January minimum temperature) were considered, but did not significantly improve the accuracy of the equation in determining the boundary points. Also, including additional independent variables to equation 1 would make applying the equation more difficult because the required values for many additional variables are not readily available and would have to be determined for drainage basins upstream of the boundary points. The use of only drainage area and mean annual precipitation as independent variables in equation 1 is partially compensated for by dividing the study area into five hydrologically distinct regions. This results in the calculation of unique values for the constants a, b, and c in equation 1 for each region.

Basin areas needed for points in this study were determined using ARC/INFO™, a geographic information system (GIS) software package. Drainage-basin boundaries were delineated manually on 7.5-minute topographic quadrangle maps and digitized into GIS coverages. Use of GIS for automatic delineation of drainage-basin boundaries was assessed during the western Washington study. In areas of low relief, basins determined by the GIS procedure differed by as much as 50 percent from those delineated manually (Kresch 1998b, p.6). Since much of southeastern Washington is of low relief, the manual procedure was selected for delineation of basin boundaries.

Mean annual precipitation for each basin area was determined from an GIS coverage of mean annual precipitation for Washington that was created and used to determine boundary points on northeastern and western Washington streams and rivers (Kresch, 1998a,b). The coverage was generated by digitizing all the lines of equal mean annual precipitation on a U.S. Weather Bureau precipitation map of Washington (U.S. Weather Bureau, 1965) and then converting the digitized data into a grid coverage of point values. The precipitation map was developed using data for the period 1930 to 1957. The mean annual precipitation over a basin was calculated in GIS by averaging all the grid values that lie within the basin. Where part of a drainage basin extended into Oregon or Idaho, mean annual precipitation data from the Natural Resources Conservation Services and Oregon Climate Services (2002a,b) were used.

DEVELOPMENT OF REGIONAL REGRESSION EQUATIONS

Records from 63 streamflow-gaging stations with at least 10 years of unregulated daily streamflow record were used to develop regression equations for determining mean annual discharge for streams and rivers in the five southeastern Washington hydrologic regions. The number of gaging stations used for each region ranged from 5 to 33. Values of mean annual discharge, mean annual precipitation, and basin drainage area for the gaging-station records are given in table 2 (at back of report), as well as summary statistics for each basin characteristic.

This study assumed there was no significant regulation or diversion at or upstream from the upstream boundary point. At the request of Ecology, this study used the same boundary locations for the Mount Adams region as were used in the 1971 study. In this study the Mount Adams region (region 3) shows the results for the eastern half of the Mount Adams region. In the 1996 USGS study (Kresch, 1998b) the Mount Adams region, called region 7 in that report, shows the results for the western half of the Mount Adams region. Both studies used the same gaging stations for developing the regression equation.

Values of the constants *a*, *b*, and *c* in equation 1 were determined for each region using logarithms of the values of mean annual discharge, basin drainage area, and mean annual precipitation for the gaging-station records in table 2. The regression equations for each region and their descriptive statistics are given in table 1. As an example, the coefficient of determination, R^2, of the regression equation for region 1, the Upper Yakima region, is 0.997, which indicates that about 99.7 percent of the variation in the base-10 logarithm of mean annual discharge, *Q*, is explained by the regression equation. The standard error of estimate of the equation is ±0.034 log units. The standard error of the Upper Yakima equation, expressed in terms of discharge, ranges from -1.4 ft^3/s (-7.0 percent) to +1.8 ft^3/s (9.0 percent) for a mean annual discharge of 20 ft^3/s and from -14 to +18 ft^3/s for a mean annual discharge of 200 ft^3/s.

The equation for the Upper Yakima region had the lowest standard error, which, for a regression estimate of 20 ft^3/s, ranged from -7 to +9 percent. The equation for region 4, the Columbia Basin to Palouse region, had the highest standard error, and for a regression estimate of 20 ft^3/s the accuracy ranged from -36 to +55 percent (table 1). The coefficient of determination, R^2, of the regression equations ranged from 0.953 to 0.997, and the standard errors of the equations ranged from 0.034 to 0.188. The corresponding potential errors in the accuracy of 20 ft^3/s discharges determined from these equations ranged from less than 1.8 ft^3/s for region 1 to as much as 10.9 ft^3/s for region 4.

Table 1. Regression equations used for calculation of mean annual discharge for streams and rivers located in southeastern Washington

[**R^2**, coefficient of determination; **SEE**, standard error of estimate; ft^3/s, cubic feet per second]

Region number and name (See fig. 1)		Regression equation	R^2	SEE (log units)	Number of stations	Range of accuracy of discharge of 20 ft^3/s: Cubic feet per second	Range of accuracy of discharge of 20 ft^3/s: Percent
1	Upper Yakima	$Q = 0.00828A^{0.975}P^{1.48}$	0.997	0.034	5	-1.4 to +1.8	-7.0 to 9.0
2	Lower Yakima	$Q = 0.00000203A^{1.24}P^{3.07}$	0.978	0.096	6	-4.2 to +5.1	-21 to 26
3	Mount Adams	$Q = 0.00759A^{0.995}P^{1.43}$	0.985	0.072	33	-3.0 to +3.4	-15 to 17
4	Columbia Basin to Palouse	$Q = 0.00000184A^{1.18}P^{3.70}$	0.963	0.188	11	-7.1 to +10.9	-36 to 55
5	Blue Mountains	$Q = 0.0000318A^{1.14}P^{2.75}$	0.953	0.089	8	-3.8 to+4.5	-19 to 22

The approximate error in a boundary point location can be obtained from equation 1 and the estimated errors in discharge. All that is required is to replace the variable Q with Q_{error}, the standard error of estimate of regression equation 1, in cubic feet per second, and the variable A with $W*L_{error}$, where W is average basin width, in miles, in the vicinity of the boundary point and L_{error} is the error in the boundary point location. When solved for L_{error}, the result is equation 2. This equation provides only a rough estimate of the actual error because it is difficult to estimate the average basin width precisely and because it assumes that the stream course is perpendicular to the basin width, which may not be true.

$$L_{error} = \frac{\left(\frac{Q_{error}}{aP^c}\right)^{1/b}}{W} \qquad (2)$$

Using the Upper Yakima region as an example, the approximate error in location of the upstream boundary points for shorelines was determined for a drainage basin with a mean annual precipitation (P) of 80 inches and an average basin width (W) of 2 miles in the vicinity of a boundary point. The regression equation constants are a=0.00828, b=0.975, and c=1.48 (table 1). The estimated possible error in the location of the boundary point would range from 0.16 mile upstream, corresponding to an error in discharge of -1.4 ft^3/s, to 0.12 mile downstream, corresponding to an error in discharge of +1.8 ft^3/s. The error in location of the upstream boundary points of shorelines of statewide significance would be calculated using errors in discharge of -14 ft^3/s and +18 ft^3/s.

Equation 2 is applicable only to those locations where inflow in the vicinity of the boundary point increases approximately linearly along the stream reach. Actual possible errors for boundary points that are located at the confluence of two or more streams normally will be less than those calculated by equation 2.

DETERMINATION OF UPSTREAM BOUNDARY POINT LOCATIONS

The following steps were used to determine the location of each upstream boundary point.

1. A trial point was selected as an initial estimate of the location of the boundary point on the stream or river.

2. The drainage-basin boundary upstream of the trial point was manually delineated on a 7.5-minute topographic quadrangle map.

3. The basin boundary was digitized into an GIS coverage.

4. GIS programs were used to determine the basin area contributing streamflow to the trial point and the mean annual precipitation over the basin.

5. The basin area and mean annual precipitation were entered into the regional regression equation to determine the mean annual discharge at the trial point.

6. Steps 1-5 were repeated at upstream or downstream trial points until the calculated discharge was within 1 percent of either 20 ft^3/s (±0.2 ft^3/s) for boundary points of shorelines or 200 ft^3/s (±2 ft^3/s) for boundary points of shorelines of statewide significance.

7. The point on a river at which the mean annual discharge was determined to be 200 ft^3/s was designated as the upstream boundary of the shoreline of statewide significance for the river unless the corresponding drainage area at that point was greater than 300 mi^2. In the latter case, steps 1-4 were repeated at upstream trial points until the location of the point having a drainage area of 300 mi^2 was determined. That point was designated as the upstream boundary point for the shoreline of statewide significance.

There are two conditions for which the discharge at an upstream boundary point may not be equal to a regulatory discharge. The first is if an upstream boundary point occurs at the confluence of two or more streams, and the second is if an upstream boundary point occurs at either the inlet or outlet of a lake.

If the discharge of each of two or more confluent streams is less than the regulatory discharge but their combined discharge at the confluence is equal to or greater than the regulatory discharge, then the upstream boundary point would be placed at the confluence. For example, if two confluent streams each have discharges of 19 ft^3/s, then the upstream boundary point would be placed at the confluence and the discharge at that point would be greater than the regulatory discharge.

If the discharge from a lake's outlet exceeds the regulatory discharge and the discharge of the lake's largest inflow is less than the regulatory discharge, then the location of the boundary point depends on the nature of the inflow to the lake. If the inflow originates from two or more separate streams and each stream has a discharge of less than the regulatory discharge, then the upstream boundary point would be placed at the lake outlet and the discharge there would exceed the regulatory discharge. However, if the inflow to the lake is primarily from a single stream with a discharge of less than the regulatory discharge, then the upstream boundary would be placed at the lake inlet and the discharge at that point would be less than the regulatory discharge. For example, the upstream boundary point for a lake fed by three inflow streams that have discharges of 5, 11, and 18 ft^3/s would be placed at the outlet of the lake and the stream discharge at that point would be more than the regulatory discharge. However, if a lake is fed primarily by only a single stream with a discharge of 17 ft^3/s, and the computed discharge at the lake's outlet is greater than 20 ft^3/s, then the upstream boundary point would be placed at the mouth of the inflow stream.

Boundary point locations determined on streams or rivers for which gaging-station records were available were adjusted, if necessary, on the basis of comparisons with those records. For example, if the upstream boundary determined by the appropriate regression equation for a 20 ft^3/s point was found to lie either downstream from a gaging station with a mean annual discharge of more than 20 ft^3/s or upstream from a gaging station with a discharge of less than 20 ft^3/s, then the boundary point location would need to be adjusted. The adjusted location was found by calculating an adjusted discharge and then determining the upstream boundary corresponding to that discharge. The adjusted discharge was obtained by multiplying the regulatory discharge of either 20 ft^3/s or 200 ft^3/s by the ratio of the discharge calculated by the appropriate regression equation for the gaging-station basin divided by the published mean annual discharge for the basin.

The only boundary point locations that were adjusted in this manner were for sites 120, 129, and 137. The adjusted discharge used to determine the locations of these sites (4.7 ft^3/s) was determined on the basis of the ratio of the regression discharge (26 ft^3/s) to the published discharge (110 ft^3/s) at streamflow-gaging station 12508500 located downstream on Satus Creek.

A total of 149 streams was identified in southeastern Washington that meet the 20 ft^3/s regulatory criterion. The locations of the upstream boundary points on these streams and the drainage boundaries of the basins upstream from all except one are shown on plate 1. No drainage-basin boundary is shown for Rock Ford Creek in Grant County (site No. 20) because the upstream boundary point is located at Rocky Ford Springs, the source of the creek. The mean annual discharge of the springs is believed to be significantly greater than 20 ft^3/s because the mean annual discharge for streamflow-gaging station 12470500, located 1.4 miles downstream from the springs, is 73.7 ft^3/s. Latitude-longitude and Universal Transverse Mercator grid coordinates for the 149 boundary points are given in table 3 (at back of report). Upstream boundary points were not determined for any of the streams in Benton and Adams Counties because none of the streams in those counties have mean annual discharges that exceed 20 ft^3/s.

A total of 22 upstream boundary points were determined for rivers having shorelines of statewide significance in southeastern Washington. The locations of the upstream boundary points and the drainage boundaries of the basins upstream from them are shown on plate 1. Coordinates for these upstream boundary point locations are given in table 4 (at back of report).

SUMMARY

The Washington State Department of Ecology (Ecology) is responsible for regulation of the shorelines of the State, as mandated by the Shoreline Management Act of 1971. Implementation of the portion of the Act that deals with stream and river shorelines requires a knowledge of the locations of upstream boundary points where specific regulatory criteria are satisfied.

The U.S. Geological Survey (USGS), in cooperation with Ecology, conducted a study in 1971 to determine the upstream boundary points for many of the stream reaches in the State. Ecology decided to update the 1971 study, beginning in 1990, because in the 1971 study the determination of boundary points for streams located within certain political boundaries and for rivers of statewide significance were omitted, the regulatory discharge plus the standard error of the regression was used to determine boundary point locations, and the three additional decades of streamflow data collected since 1971 provide improved estimates of long-term average flow conditions. From 1990-98 the USGS, in cooperation with Ecology, updated boundary points for streams and rivers in northeastern and western Washington, and in this report updated boundary points were determined for the streams and rivers in southeastern Washington.

Upstream boundary point locations where the mean annual discharge is 20 cubic feet per second were determined for 149 streams in southeastern Washington. In addition, upstream boundary point locations where the mean annual discharge is 200 cubic feet per second or the drainage area is 300 square miles were determined for 22 rivers in southeastern Washington. Boundary point locations were determined by application of multiple-linear-regression equations that relate mean annual discharge to basin drainage area and mean annual precipitation averaged over the basin.

Drainage-basin boundaries were manually delineated on 7.5-minute topographic quadrangle maps and digitized into geographic information system (GIS) coverages. A GIS coverage of mean annual precipitation, created by digitizing lines of mean annual precipitation from a 1965 U.S. Weather Bureau map, was used to determine the mean annual precipitation within each digitized drainage basin. Mean annual precipitation data from the Natural Resources Conservation Services and Oregon Climate Services were used for the portions of drainage basins that extended into Oregon or Idaho.

Southeastern Washington was divided into five hydrologically distinct regions and a separate regression equation was developed for each region. The regression equations are based on data from gaging stations with at least 10 years of record. The number of stations used in the regression analysis for each of the five regions ranged from 5 to 33. The coefficient of determination, R^2, of the regression equations ranged from 0.953 to 0.997. The Upper Yakima region had the equation with the lowest standard error, and for a regression estimate of 20 ft^3/s, the error ranged from -7 to +9 percent. The Columbia Basin to Palouse region had the equation with the highest standard error, and for a regression estimate of 20 ft^3/s, the error ranged from -36 to +55 percent.

The approximate error in the location of an upstream boundary point can be calculated from the mean annual precipitation and the average basin width in the vicinity of the boundary point. The approximate error gives only a rough estimate of the actual error in a boundary point location, because it is difficult to estimate the average basin width precisely, and because it assumes that inflow in the vicinity of the boundary point increases approximately linearly along the stream reach.

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Table 2. Streamflow gaging-station records used in the development of the regression equations for five hydrologic regions in southeastern Washington

[**Abbreviations**: ft^3/s, cubic feet per second; in/yr, inches per year; mi^2, square miles]

Map No. (See fig. 1)	Streamflow-gaging station number and name		Mean annual dis-charge (ft^3/s)	Mean annual precipi-tation (in/yr)	Drainage area (mi^2)	Period of record
		Region 1 - Upper Yakima				
1	12474500	Yakima River near Martin	338	97.46	54.7	1903–78
2	12476000	Kachess River near Easton	294	73.22	63.6	1903–78
3	12479000	Cle Elum River near Roslyn	934	81.18	203	1903–78
4	12479500	Yakima River at Cle Elum	2,044	73.60	495	1906–78, 1988–90
5	12483800	Naneum Creek near Ellensburg	57.1	24.42	69.5	1957–71, 1972–78
		Maximum	2,044	97.46	495	
		Minimum	57.1	24.42	54.7	
		Mean	733.4	69.98	177.2	
		Median	338	73.60	69.5	
		Region 2 - Lower Yakima				
6	12488000	Bumping River near Nile	296	81.93	70.7	1910–78
7	12488500	American River near Nile	236	72.65	78.9	1940–99
8	12489500	Naches River at Oak Flat near Nile	1,221	56.66	641	1904–17
9	12492500	Tieton River at Headworks of Tieton near Naches	570	55.82	239	1907–78
10	12500500	North Fork Ahtanum Creek near Tampico	69.9	53.15	68.9	1910–15,1931–78
11	12501000	South Fork Ahtanum Creek at Conrad Ranch near Tampico	20	52.33	24.8	1915–78
		Maximum	1,221	81.93	641	
		Minimum	20	52.33	24.8	
		Mean	402.2	62.09	187	
		Median	266	56.24	74.8	
		Region 3 - Mount Adams				
12	14107000	Klickitat River above West Fork near Glenwood	330	57.30	152	1944–77
13	14110000	Klickitat River near Glenwood	841	55.95	358	1909–71
14	14112000	Little Klickitat River near Goldendale	60.1	31.62	83.4	1910–12, 1946–51, 1957–70
15	14112500	Little Klickitat River near Wahkiacus	174	26.27	281	1944–81
16	14113000	Klickitat River near Pitt	1,617	39.63	1,300	1909–12, 1928–90
17	14121300	White Salmon River below Cascade Creek near Trout Lake	152	104.87	32.4	1957–78
18	14121500	Trout Lake Creek near Trout Lake	264	79.02	69	1909–11, 1959–69
19	14123000	White Salmon River at Husum	980	71.05	294	1909–19, 1929–41, 1957–62
20	14123500	White Salmon River near Underwood	1,114	65.95	384	1915–30, 1935–90
21	14124500	Little White Salmon River at Willard	450	74.36	113	1903–06, 1944–61
22	14125000	Little White Salmon above Lapham Creek	526	74.16	116	1949–63
23	14125500	Little White Salmon River near Cook	547	72.28	134	1956–77
24	14127000	Wind River above Trout Creek near Carson	579	103.42	109	1944–69

Table 2. Streamflow gaging-station records used in the development of the regression equations for five hydrologic regions in southeastern Washington—*Continued*

Map No. (See fig. 1)	Streamflow-gaging station number and name		Mean annual dis-charge (ft^3/s)	Mean annual precipi-tation (in/yr)	Drainage area (mi^2)	Period of record
		Region 3 - Mount Adams—*Continued*				
25	14128500	Wind River near Carson	1,199	98.85	224	1934–77
26	14213200	Lewis River near Trout Lake	697	106.21	127	1958–72
27	14213500	Big Creek below Skookum Meadow near Trout Lake	59.9	97.13	13.3	1927–31, 1955–70
28	14214000	Rush Creek above Meadow Creek near Trout Lake	23.4	85.09	5.89	1955–65
29	14214500	Meadow Creek below Lone Butte Meadow near Trout Lake	94.4	92.00	11.7	1927–31, 1955–65
30	14215000	Rush Creek above Falls near Cougar	170	90.08	26.1	1927–31, 1955–74
31	14215500	Curly Creek near Cougar	61.0	94.38	11.7	1955–70
32	14216000	Lewis River above Muddy River near Cougar	1,273	104.22	225	1927–34, 1954–70
33	14216500	Muddy River below Clear Creek near Cougar	859	119.06	132	1927–34, 1954–73, 1983–90
34	14216800	Pine Creek near Cougar	192	130.67	22.4	1957–70
35	14217500	Swift Creek near Cougar	201	132.69	27.4	1924–33, 1954–56
36	14218000	Lewis River near Cougar	2,888	113.84	484	1924–58
37	14219500	Lewis River near Amboy	4,030	112.77	668	1910–31
38	14224500	Clear Fork Cowlitz River near Packwood	237	97.38	54.9	1907–17, 1930–42, 1950
39	14225500	Lake Creek near Packwoood (Lewis)	101	105.52	19.1	1911–24, 1930–42, 1949–54, 1959–80
40	14226500	Cowlitz River at Packwood	1,598	94.70	282	1911–19, 1931–90
41	14230000	Johnson Creek near Packwood	201	102.54	49.7	1907–14, 1918–24, 1946–51
42	14232500	Cispus River near Randle	1,327	83.98	322	1911–12, 1931–90
43	14233400	Cowlitz River near Randle	4,868	86.38	1,030	1968–90
44	14233500	Cowlitz River near Kosmos	4,999	86.31	1,030	1947–68
		Maximum	4,999	132.69	1,300	
		Minimum	23.4	26.27	5.89	
		Mean	991	87.57	248	
		Median	526	92.00	127	

Table 2. Streamflow gaging-station records used in the development of the regression equations for five hydrologic regions in southeastern Washington—*Continued*

Map No. (See fig. 1)	Streamflow-gaging station number and name		Mean annual dis-charge (ft^3/s)	Mean annual precipi-tation (in/yr)	Drainage area (mi^2)	Period of record
		Region 4 - Columbia Basin to Palouse				
45	12424000	Hangman Creek at Spokane	238	21.00	689	1949–77, 1979–99
46	12463000	Douglas Creek near Alstown	4.18	10.00	99.9	1949–55, 1963–68
47	12464800	Coal Creek at Mohloer	4.31	14.00	64.7	1963–74
48	12465000	Crab Creek at Irby	67.8	13.39	1,042	1943–99
49	12468500	Park Creek below Park Lake near Coulee City	10.4	10.00	317	1945–68
50	12471270	Farrier Coulee near Schrag	0.81	10.25	42	1963–74
51	12512500	Providence Coulee at Cunningham	0.26	10.00	27.8	1952–77
52	13346100	Palouse River at Colfax	306	20.00	497	1963–79
53	13348500	Missouri Flat Creek at Pullman	8.47	20.00	27.1	1960–79
54	13349400	Pine Creek at Pine City	60.6	19.51	302	1961–75
55	13350500	Union Flat Creek near Colfax	37.1	17.37	189	1953–71
		Maximum	306	20.00	1,042	
		Minimum	0.26	10.00	27.1	
		Mean	67.1	14.96	300	
		Median	10.4	14.00	189	
		Region 5 - Blue Mountains				
56	13334500	Asotin Creek near Asotin	68.4	26.59	156	1928–59
57	13334700	Asotin Creek below Kearney Gulch near Asotin	72.5	25.71	170	1959–82, 1989–96
58	13344500	Tucannon River near Starbuck	173	23.14	431	1915–14, 1929–31, 1959–90, 1995–99
59	14013000	Mill Creek near Walla Walla	96.3	43.04	59.6	1913–17, 1939–76, 1979–99
60	14013500	Blue Creek near Walla Walla	15.6	36.49	17	1939–71
61	14016000	Dry Creek near Walla Walla	21.9	25.96	48.4	1949–67
62	14016500	East Fork Touchet River near Dayton	120	30.00	120	1941–51, 1956–68
63	14017000	Touchet River at Bolles	226	25.67	361	1924–29, 1952–89
		Maximum	226	43.04	431	
		Minimum	15.6	23.14	17	
		Mean	99.2	29.58	170	
		Median	84.4	26.28	138	

Table 3. Upstream boundary points of shorelines, as defined in the Shoreline Management Act of 1971, that are located where the mean annual discharge is equal to 20 cubic feet per second on streams in southeastern Washington

[**Mean annual precipitation:** for basins above upstream boundary points; **Boundary point location:** given in both latitude-longitude coordinates and Universal Transverse Mercator (UTM) grid coordinates; points west of 120 degrees longitude are given in UTM zone 10 coordinates and points east of 120 degrees longitude are given in UTM zone 11 coordinates. –, no data]

Region No.	Map site No. (See plate 1)	Stream	Mean annual precipitation (inches)	Quadrangle (7.5 minute)	Boundary point location			
					Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	UTM Easting (meters)	UTM Northing (meters)
		Asotin County						
5	1	Alpowa Creek	19	Stenber Creek	46 24 12	117 15 01	480,748	5,138,710
5	2	George Creek	22	Rockpile Creek	46 16 47	117 09 00	488,428	5,124,945
		Chelan County						
1	3	Colockum Creek	19	Malaga	47 17 30	120 09 33	714,788	5,241,297
		Columbia County						
5	4	Butte Creek	40	Oregon Butte	46 03 48	117 43 19	444,140	5,101,139
5	5	Mill Creek	45	Deadman Peak	46 01 45	117 58 17	424,803	5,097,545
5	6	Panjab Creek	39	Panjab Creek	46 10 35	117 43 04	444,586	5,113,706
5	7	Third Creek	40	Oregon Butte	46 05 18	117 37 37	451,525	5,103,870
5	8	Touchet River, North Fork	38	Eckler Mountain	46 09 41	117 48 36	437,462	5,112,106
5	9	Touchet River, South Fork	41	Deadman Peak	46 07 14	117 58 22	424,822	5,107,712
5	10	Wenaha River, North Fork	44	Godman Spring	46 00 32	117 51 54	433,029	5,095,195
5	11	Wolf Fork	32	Robinette Mountain	46 14 16	117 53 41	431,006	5,120,639
		Douglas County						
4	12	Moses Coulee	10	Palisades	47 26 57	119 53 15	282,321	5,258,906
		Franklin County						
4	13	Esquatzel Coulee	10	Mesa East	46 35 58	118 56 38	351,099	5,162,277
		Garfield County						
5	14	Asotin Creek, North Fork	35	Pinkham Butte	46 11 46	117 25 55	466,651	5,115,724
4	15	Deadman Creek at confluence of Meadow Creek	15	Dodge	46 37 02	117 47 29	439,385	5,162,723
5	16	First Creek	37	Diamond Peak	46 02 30	117 33 22	456,953	5,098,613
5	17	Pataha Creek	23	Pomeroy	46 28 24	117 32 48	458,030	5,146,594
5	18	Tucannon River	40	Stentz Spring	46 10 25	117 34 23	455,750	5,113,285
		Grant County						
4	19	Lind Coulee	10	Bassett Junction	47 02 29	119 05 35	340,990	5,211,686
4	20	Rocky Ford Creek	–	Grant Orchards	47 19 22	119 26 17	315,163	5,243,698
		Kittitas County						
2	21	Bear Creek, West Fork	71	Mount Clifty	47 04 47	121 14 30	633,464	5,215,329
1	22	Big Creek	83	Easton	47 09 07	121 14 35	633,182	5,223,357
1	23	Box Canyon Creek	91	Chikamin Peak	47 24 55	121 17 53	628,373	5,252,502
1	24	Box Canyon Creek, West Fork	85	Chikamin Peak	47 23 59	121 17 22	629,063	5,250,793

Table 3. Upstream boundary points of shorelines, as defined in the Shoreline Management Act of 1971, that are located where the mean annual discharge is equal to 20 cubic feet per second on streams in southeastern Washington—*Continued*

Region No.	Map site No. (See plate 1)	Stream	Mean annual precipitation (inches)	Quadrangle (7.5 minute)	Boundary point location			
					Latitude	Longitude	UTM Easting	UTM Northing
					(degrees, minutes, seconds)		(meters)	
				Kittitas County—*Continued*				
1	25	Cabin Creek	90	Blowout Mountain	47 13 53	121 19 27	626,853	5,232,042
1	26	Cherry Creek	17	Kittitas	46 57 11	120 27 31	693,364	5,202,876
1	27	Chief Creek	123	Mount Daniel	47 31 03	121 13 30	633,637	5,264,008
1	28	Cle Elum River	140	Mount Daniel	47 34 47	121 08 01	640,346	5,271,080
1	29	Coal Creek	108	Snoqualmie Pass	47 24 20	121 24 09	620,534	5,251,260
1	30	Cold Creek	115	Lost Lake	47 21 42	121 25 50	618,498	5,246,331
1	31	Coleman Creek	19	Colockum Pass South West	47 01 08	120 26 44	694,120	5,210,237
1	32	Delate Creek	110	Chikamin Peak	47 27 50	121 16 26	630,084	5,257,958
1	33	Fortune Creek	77	Mount Stuart	47 28 40	120 59 59	650,697	5,259,979
1	34	French Cabin Creek	67	Kachess Lake	47 20 56	121 09 30	639,079	5,245,385
1	35	Gale Creek	80	Stampede Pass	47 21 52	121 17 23	629,131	5,246,873
1	36	Goat Creek	82	Davis Peak	47 28 55	121 06 25	642,603	5,260,249
1	37	Gold Creek	114	Chikamin Peak	47 27 15	121 20 03	625,562	5,256,771
1	38	Lemah Creek	117	Chikamin Peak	47 28 36	121 15 28	631,264	5,259,396
1	39	Little Creek	67	Ronald	47 09 23	121 07 27	642,183	5,224,030
2	40	Little Naches River, N. Fork	100	Raven Roost	47 07 25	121 21 25	624,620	5,220,017
1	41	Log Creek	94	Blowout Mountain	47 10 43	121 17 06	629,950	5,226,234
1	42	Lost Lake, Outlet	104	Lost Lake	47 20 00	121 23 34	621,426	5,243,269
2	43	Manastash Creek, S. Fork	69	Frost Mountain	47 02 13	120 57 09	655,539	5,211,115
1	44	Meadow Creek	110	Lost Lake	47 18 24	121 24 26	620,385	5,240,275
1	45	Mineral Creek	95	Chikamin Peak	47 25 58	121 16 34	629,982	5,254,504
1	46	Naneum Creek	25	Naneum Canyon	47 14 59	120 28 37	690,919	5,235,801
1	47	Park Creek	13	Kittitas	46 58 12	120 23 14	698,740	5,204,938
2	48	Quartz Creek	66	Quartz Mountain	47 01 27	121 07 13	642,832	5,209,357
1	49	Scatter Creek	90	The Cradle	47 30 41	121 02 58	646,852	5,263,647
1	50	Shovel Creek	140	Mount Daniel	47 32 52	121 12 58	634,219	5,267,365
1	51	Sliver Creek	60	Kachess Lake	47 15 04	121 10 42	637,834	5,234,483
1	52	Spade Creek	125	Mount Daniel	47 31 35	121 11 06	636,611	5,265,053
1	53	Spinola Creek	118	Mount Daniel	47 32 18	121 08 11	640,250	5,266,470
1	54	Stafford Creek	45	Red Top Mountain	47 21 56	120 48 05	665,994	5,247,922
1	55	Swauk Creek	28	Liberty	47 19 10	120 41 21	674,620	5,243,058
1	56	Taneum Creek, North Fork	70	Quartz Mountain	47 06 32	121 06 12	643,890	5,218,802
1	57	Taneum Creek, South Fork	67	Quartz Mountain	47 05 38	121 02 17	648,888	5,217,257
1	58	Teanaway River, Middle Fork	61	Mount Stuart	47 22 59	120 58 10	653,261	5,249,517
1	59	Teanaway River, West Fork	50	Cle Elum Lake	47 20 12	121 02 20	648,156	5,244,231
1	60	Thorp Creek	69	Kachess Lake	47 22 06	121 08 35	640,186	5,247,559
1	61	Trail Creek	95	The Cradle	47 30 01	121 06 59	641,853	5,262,263
1	62	Unnamed tributary to Lemah Creek	124	Chikamin Peak	47 29 46	121 15 42	630,915	5,261,567
1	63	Unnamed tributary to Teanaway River, North Fork	69	Mount Stuart	47 25 23	120 56 20	655,452	5,254,019

Table 3. Upstream boundary points of shorelines, as defined in the Shoreline Management Act of 1971, that are located where the mean annual discharge is equal to 20 cubic feet per second on streams in southeastern Washington—*Continued*

Region No.	Map site No. (See plate 1)	Stream	Mean annual precipitation (inches)	Quadrangle (7.5 minute)	Boundary point location: Latitude (degrees, minutes, seconds)	Boundary point location: Longitude (degrees, minutes, seconds)	UTM Easting (meters)	UTM Northing (meters)
		Kittitas and Yakima Counties						
2	64	Little Naches River, Middle Fork	94	Raven Roost	47 05 04	121 18 04	628,952	5,215,759
		Klickitat County						
3	65	Bowman Creek	31	Grayback Mountain	45 55 26	121 00 34	654,333	5,087,297
3	66	Buck Creek	61	Northwestern Lake	45 49 45	121 33 08	612,447	5,075,876
3	67	Cave Creek	58	Guler Mountain	45 57 47	121 34 26	610,494	5,090,735
3	68	Dead Canyon Creek	35	Dead Canyon	45 56 42	121 09 07	643,238	5,089,377
3	69	Gilmer Creek	48	Husum	45 51 33	121 29 47	616,710	5,079,290
3	70	Holmes Creek	45	Quigley Butte	45 57 13	121 23 22	624,803	5,089,944
3	71	Little Klickitat River, E. Prong	26	Satus Pass	45 54 44	120 42 17	677,997	5,086,654
3	72	Little White Salmon River	59	Guler Mountain	45 53 00	121 36 30	607,966	5,081,829
3	73	Major Creek, West Fork	48	Husum	45 46 07	121 23 53	624,550	5,069,386
3	74	Mill Creek	31	White Pine Buttes	45 55 08	120 54 47	661,816	5,086,931
3	75	Rattlesnake Creek	39	Camas Prairie	45 53 20	121 19 45	629,631	5,082,869
3	76	Simmons Creek	35	Klickitat	45 50 34	121 12 54	638,599	5,077,940
3	77	Summit Creek	34	Hagarty Butte	46 02 41	120 57 56	657,390	5,100,816
3	78	Swale Creek	15	Wishram	45 44 30	120 55 12	661,809	5,067,235
		Lincoln County						
4	79	Crab Creek	15	Sprague Lake NE	47 25 42	118 04 42	418,663	5,253,142
4	80	Negro Creek	17	Sprague	47 17 45	117 56 57	428,232	5,238,283
		Skamania County						
3	81	Buck Creek	90	Trout Lake	46 04 41	121 33 55	610,937	5,103,523
3	82	Cascade Creek	122	Mount Adams West	46 09 59	121 34 07	610,489	5,113,316
3	83	Cultus Creek	83	Sleeping Beauty	46 03 47	121 43 37	598,464	5,101,631
3	84	Dry Creek	82	Little Hucklebery Mountain	45 57 58	121 44 28	597,536	5,090,857
3	85	Dry Creek	66	Little Hucklebery Mountain	45 58 15	121 38 08	605,710	5,091,504
3	86	Goose Lake, Outlet	85	Gifford Peak	45 56 21	121 45 24	596,367	5,087,823
3	87	Hole in the Ground Creek	87	Trout Lake	46 04 39	121 31 23	614,193	5,103,527
3	88	Little Goose Creek	77	Sleeping Beauty	46 03 30	121 40 11	602,892	5,101,198
3	89	Lost Creek	75	Little Hucklebery Mountain	45 58 10	121 43 13	599,147	5,091,254
3	90	Lusk Creek	68	Willard	45 52 16	121 38 35	605,308	5,080,427
3	91	Meadow Creek	88	Sleeping Beauty	46 05 00	121 43 04	599,135	5,103,896
3	92	Mosquito Creek	95	Sleeping Beauty	46 06 22	121 43 18	598,789	5,106,435
3	93	Salt Creek	118	Mount Adams West	46 09 05	121 33 15	611,644	5,111,690
3	94	Trout Lake Creek	93	Steamboat Mountain	46 07 41	121 41 04	601,615	5,108,898
3	95	Unnamed tributary to Cascade Creek	124	Mount Adams West	46 09 34	121 33 54	610,800	5,112,547
3	96	White Salmon River	102	Mount Adams West	46 09 41	121 37 27	606,207	5,112,687

Table 3. Upstream boundary points of shorelines, as defined in the Shoreline Management Act of 1971, that are located where the mean annual discharge is equal to 20 cubic feet per second on streams in southeastern Washington—*Continued*

Region No.	Map site No. (See plate 1)	Stream	Mean annual precipitation (inches)	Quadrangle (7.5 minute)	Boundary point location: Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	UTM Easting (meters)	UTM Northing (meters)
				Spokane County				
4	97	Coulee Creek	16	Nine Mile Falls	47 45 08	117 32 54	458,896	5,288,700
4	98	Rock Creek	19	North East Fairfield	47 26 23	117 06 07	492,311	5,253,823
				Walla Walla County				
5	99	Dry Creek	27	Buroker	46 07 12	118 13 07	405,837	5,107,911
5	100	Wetstone Hollow	20	Prescott	46 18 50	118 17 06	401,056	5,129,533
				Whitman County				
4	101	Cottonwood Creek	18	Ewan	47 06 57	117 39 01	450,660	5,218,045
4	102	Fourmile Creek	25	Albion	46 50 07	117 09 54	487,404	5,186,670
4	103	Palouse River, South Fork	–	Pullman	46 42 56	117 09 49	487,492	5,173,356
4	104	Pine Creek	21	Oakesdale	47 08 45	117 11 07	485,947	5,221,194
				Yakima County				
2	105	Ahtanum Creek, North Fork	57	Foundation Ridge	46 30 51	121 03 30	648,948	5,152,814
2	106	Ahtanum Creek, South Fork	53	Pine Mountain	46 30 31	120 55 06	659,695	5,152,457
2	107	American Lake	90	Cougar Lake	46 51 30	121 26 37	618,633	5,190,406
3	108	Big Muddy Creek	105	Mount Adams East	46 11 11	121 24 36	622,698	5,115,779
3	109	Bird Creek	92	King Mountain	46 06 36	121 25 45	621,385	5,107,254
3	110	Brush Creek	29	McKays Butte	46 07 59	120 59 40	654,907	5,110,585
2	111	Bumping River	100	Cougar Lake	46 46 06	121 24 55	620,984	5,180,428
3	112	Butte Meadows	68	Fairview Ridge	46 27 41	121 12 34	637,477	5,146,659
2	113	Clear Creek, South Fork	84	Spiral Butte	46 39 06	121 20 22	627,065	5,167,581
3	114	Clearwater Creek	63	Glaciate Butte	46 18 36	121 23 58	623,226	5,129,514
2	115	Conrad Creek	93	Pinegrass Ridge	46 30 01	121 20 53	626,744	5,150,754
2	116	Cougar Creek	91	Cougar Lake	46 49 42	121 22 35	623,822	5,187,168
3	117	Crawford Creek	65	Windy Point	46 16 38	121 21 07	626,975	5,125,964
2	118	Crow Creek	88	Goose Prairie	46 59 41	121 22 26	623,626	5,205,649
2	119	Deep Creek	92	Bumping Lake	46 45 27	121 20 54	626,125	5,179,338
3	120	Diamond Fork	68	Fairview Ridge	46 27 54	121 11 55	638,310	5,147,086
2	121	Dry Creek	66	Glenwood	46 04 26	121 19 41	629,273	5,103,417
3	122	Dry Creek[1]	19	Logy Creek North East	46 13 46	120 37 17	683,417	5,122,089
3	123	Gotchen Creek	86	King Mountain	46 04 59	121 29 09	617,053	5,104,199
3	124	Hellroaring Creek	103	Mount Adams East	46 09 35	121 24 56	622,323	5,112,812
3	125	Huckleberry Creek	68	Jennies Butte	46 25 21	121 20 00	628,068	5,142,141
2	126	Indian Creek	79	Spiral Butte	46 41 04	121 18 03	629,917	5,171,315
3	127	Klickitat River	95	Walupt Lake	46 27 15	121 23 29	623,529	5,145,562
3	128	Little Muddy Creek	93	Glaciate Butte	46 16 00	121 23 06	624,442	5,124,742
2	129	Little Naches River, South Fork	94	Raven Roost	47 02 57	121 20 35	625,842	5,211,768
2	130	Logy Creek[1]	26	Logy Creek Falls	46 08 09	120 38 19	682,386	5,111,639
3	131	McCreedy Creek	50	Windy Point	46 19 54	121 15 10	634,465	5,132,174
3	132	Morrison Creek	114	Mount Adams West	46 07 40	121 31 02	614,549	5,109,109

Table 3. Upstream boundary points of shorelines, as defined in the Shoreline Management Act of 1971, that are located where the mean annual discharge is equal to 20 cubic feet per second on streams in southeastern Washington—*Continued*

Region No.	Map site No. (See plate 1)	Stream	Mean annual precipitation (inches)	Quadrangle (7.5 minute)	Boundary point location: Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	UTM Easting (meters)	UTM Northing (meters)
		Yakima County—*Continued*						
3	133	Muddy Fork[2]	101	Glaciate Butte	46 16 26	121 28 32	617,445	5,125,412
3	134	Piscoe Creek	53	Castile Falls	46 21 39	121 09 10	642,104	5,135,596
2	135	Rainier Fork	87	Norse Peak	46 53 29	121 27 15	617,751	5,194,051
2	136	Rattlesnake Creek	73	Rimrock Lake	46 43 52	121 14 04	634,894	5,176,601
3	137	Rusk Creek	98	Mount Adams East	46 11 33	121 23 48	623,705	5,116,492
2	138	Satus Creek[1]	24	Kusshi Creek	46 02 13	120 35 06	686,867	5,100,779
2	139	Simcoe Creek	46	Medicine Valley	46 26 46	120 51 34	664,398	5,145,646
3	140	Surveyors Creek	36	Signal Peak	46 12 27	121 12 45	637,890	5,118,445
3	141	Swamp Creek	70	Jungle Butte	46 12 58	121 20 20	628,111	5,119,203
3	142	Tepee Creek	31	Poland Butte	46 08 55	121 03 24	650,061	5,112,184
2	143	Tieton River, North Fork	106	Old Snowy Mountain	46 31 42	121 24 39	621,873	5,153,782
2	144	Toppenish Creek	35	Willy Dick Canyon	46 15 07	120 57 09	657,807	5,123,894
3	145	Trappers Creek	72	Windy Point	46 17 17	121 22 11	625,578	5,127,152
3	146	Trout Creek	36	Signal Peak	46 07 59	121 11 26	639,767	5,110,232
2	147	Union Creek	82	Norse Peak	46 56 57	121 22 45	623,326	5,200,570
3	148	Unnamed tributary of Fish Lake Stream	55	Glaciate Butte	46 21 57	121 27 29	618,609	5,135,641
3	149	Unnamed tributary of Gotchen Creek	71	King Mountain	46 03 47	121 27 31	619,206	5,101,996
3	150	White Creek	34	Poland Butte	46 07 37	121 04 30	648,715	5,109,741

[1]Upstream boundary point location was determined using an adjusted discharge of 4.7 ft^3/s instead of 20 ft^3/s on the basis of the ratio of the regression discharge (26 ft^3/s) to the published discharge (110 ft^3/s) at streamflow-gaging station 12508500 located downstream on Satus Creek.

[2]Although Muddy Fork is located west of the Cascade Range crest, it was included wth this study so that it could be presented with the other "shoreline" streams in Yakima County, all of which are located east of the crest (Kresch, 1998b, p. 2).

Table 4. Upstream boundary points of shorelines of statewide significance, as defined in the Shoreline Management Act of 1971, that are located where discharge is 200 cubic feet per second or where drainage area is 300 square miles on rivers in southeastern Washington

[**Mean annual precipitation:** for basins above upstream boundary points; **Boundary point location**: given in both latitude-longitude coordinates and Universal Transverse Mercator (UTM) grid coordinates; points west of 120 degrees longitude are given in UTM zone 10 coordinates and points east of 120 degrees longitude are given in UTM zone 11 coordinates]

Region No.	Map site No. (See plate 1)	River	Mean annual precipitation (inches)	Quadrangle (7.5 minute)	Boundary point location			
					Latitude	Longitude	UTM	
							Easting	Northing
					(degrees, minutes, seconds)		(meters)	
				Asotin County				
5	A	Asotin Creek[1]	23	Asotin	46 19 37	117 06 12	492,032	5,130,186
				Columbia County				
5	B	Tucannon River[1]	23	Delaney	46 30 31	117 59 41	423,675	5,150,830
				Columbia and Walla Walla Counties				
5	C	Touchet River[1]	26	Waitsburg	46 16 20	118 09 12	411,109	5,124,743
				Kittitas County				
1	D	Cle Elum River	114	The Cradle	47 30 07	121 03 24	646,342	5,262,581
1	E	Cooper River	98	Polallie Ridge	47 25 16	121 09 30	638,906	5,253,395
1	F	Kachess Lake, Outlet	73	Kachess Lake	47 15 42	121 12 07	636,023	5,235,590
1	G	Keechelus Lake, Outlet	97	Stampede Pass	47 19 19	121 20 15	625,621	5,242,094
1	H	Teanaway River	44	Teanaway Butte	47 15 05	120 52 36	660,650	5,235,084
1	I	Waptus River	114	Polallie Ridge	47 29 36	121 09 12	639,075	5,261,447
				Kittitas and Yakima Counties				
2	J	Little Naches River	83	Mount Clifty	47 03 57	121 13 27	634,846	5,213,810
				Lincoln County				
4	K	Crab Creek[1]	15	Sprague Lake	47 21 10	118 07 31	415,010	5,244,767
				Skamania County				
3	L	Lava Creek	80	Willard	45 48 17	121 41 27	601,709	5,072,983
3	M	Trout Lake Creek	84	Sleeping Beauty	46 04 01	121 38 05	605,582	5,102,198
3	N	White Salmon River	100	Trout Lake	46 03 37	121 32 57	612,202	5,101,573
				Spokane County				
4	O	Hangman Creek[1]	23	Spangle East	47 29 34	117 19 35	475,416	5,259,760
				Whitman County				
4	P	Pine Creek[1]	20	Pine City	47 11 46	117 32 08	459,425	5,226,892

Table 4. Upstream boundary points of shorelines of statewide significance, as defined in the Shoreline Management Act of 1971, that are located where discharge is 200 cubic feet per second or where drainage area is 300 square miles on rivers in southeastern Washington—*Continued*

Region No.	Map site No. (See plate 1)	River	Mean annual precipitation (inches)	Quadrangle (7.5 minute)	Boundary point location			
					Latitude	Longitude	UTM	
							Easting	Northing
					(degrees, minutes, seconds)		(meters)	
Yakima County								
2	Q	American River	84	Goose Prairie	46 56 05	121 20 27	626,288	5,199,038
2	R	Bumping Lake, Outlet	82	Bumping Lake	46 52 23	121 17 48	629,799	5,192,257
3	S	Klickitat River	65	Castile Falls	46 22 27	121 11 35	638,961	5,137,005
3	T	Klickitat River, West Fork	56	Windy Point	46 16 30	121 18 40	630,124	5,125,774
2	U	Satus Creek	18	Toppenish South West	46 15 12	120 23 46	700,695	5,125,308
2	V	Tieton River	74	Spiral Butte	46 37 47	121 16 04	632,588	5,165,268

[1]Upstream boundary point locations where the drainage equals 300 square miles.

USGS

Higgins

Determination of Upstream Boundary Points on Southeastern Washington Streams and Rivers Under the Requirements of the Shoreline Management Act of 1971

WRIR 03-4042