Waterpower Resources and Reconnaissance Geology of Sites in the Alsea River Basin Oregon

By L. L. YOUNG, D. W. NEAL, *and* D. L. GASKILL

WATERPOWER RESOURCES OF THE UNITED STATES

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An estimate of the potential power of the river and a discussion of the possibilities for developing it

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CONTENTS

ILLUSTRATIONS

[Plates are in pocket]

TABLES

WATERPOWER RESOURCES OF THE UNITED STATES

WATERPOWER RESOURCES AND RECONNAISSANCE GEOLOGY OF SITES IN THE ALSEA RIVER BASIN, OREGON

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ABSTRACT

The Alsea River basin is a sparsely settled section in the central part of the Oregon Coast Range. The only major roadway through the basin is State Highway 34. The primary economic activity is, and probably will continue to be, the production of lumber and associated products although scenic and recreational activities are quite important.

The drainage area of the Alsea River basin is 473 square miles, and the annual runoff averages about 66 inches. Runoff follows precipitation closely in time and both are concentrated in the late fall and winter months. No storage reservoirs have been developed in the basin, but several good sites are present. The technically feasible power of the basin, estimated from an illustrative plan of development containing six sites, based on gross head, average discharge, and 100 percent efficiency, is 61,000 kilowatts. One site, the Scott Mountain, accounts for 34,000 kw and a second site, Tidewater, 11,000 kw.

A preliminary geologic examination of the Scott Mountain and Tidewater sites indicates that a number of problems must be investigated further before the location and height of the dams can be definitely selected.

There are many possibilities for the development of pumped storage in connection with the two sites selected for illustrating potential power. Sites with high head and small high reservoirs or sites with low head and large storage reservoirs might be developed.

There are two possible sites for diverting Alsea River water to the Willamette River basin, one in the headwaters area of the North Fork Alsea River, and the other in the headwaters area of the South Fork Alsea River.

INTRODUCTION

PURPOSE AND SCOPE

This report presents an evaluation of the waterpower potential of the Alsea River basin. The principal features for consideration include topography, geology, precipitation, streamflow, temperature, and evaporation. The power estimates are based on an assumed plan of development considered adaptable to this basin. Actual development may not follow the plan outlined, but the plan serves as a means of estimating the potential power.

PREVIOUS INVESTIGATIONS

A report, "Tidewater Reservoir Site, Alsea River, Oregon," was prepared by R. O. Helland in 1945 and is in the Geological Survey open file. A supplement was added in 1952.

A report, "Waterpower of the Coast Streams of Oregon," by R. O. Helland was released on open file in 1953. This report gives general information plus a short discussion of nine coast streams including the Alsea River.

POWER VALUE OF OREGON COAST STREAMS

The concentration of runoff during late fall and winter makes the coast streams of Oregon potentially valuable for furnishing firming power because most hydropower in the Northwest is produced on the Columbia River and its tributaries which have their low flows during this period. The Columbia reaches a peak in June when approximately 20 percent of the annual runoff occurs. From September through February, average monthly runoff of the Columbia River ranges from 4 to 5 percent of the annual average and is barely more than 25 percent for the 6-month period. The coast streams could be developed to concentrate power production in this critical period, and could thus increase the prime power of the Northwest power system.

GEOGRAPHY

LOCATION AND DESCRIPTION

The Alsea River basin is in Lincoln, Benton, and Lane counties on the central Oregon coast. The river is formed by its North and South Forks, which join at an altitude of 285 feet in sec. 1, T. 14 S., R. 8 W., near the settlement of Alsea. From this point the river flows west some 40 miles to its mouth at Alsea Bay near the town of Waldport. The major tributaries entering the Alsea River downstream from the junction of its forks are Fall Creek, Five Rivers, and Drift Creek. Major features of the Alsea River basin are shown in figure 1 on which isohyets have also been shown.

The Alsea River drains an area of 473 square miles. The drainage areas of its principal tributaries are as follows:

	Square miles
North Fork	63
South Fork	50
Fall Creek	30
Five Rivers	120
Drift Creek	70

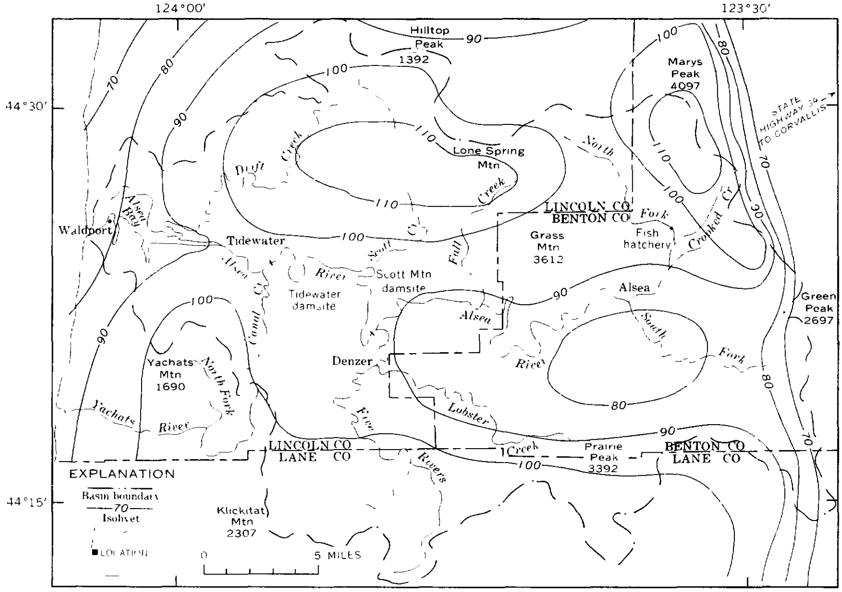

FIGURE 1.—Alsea River basin, Oregon.

The mouth of Fall Creek is in sec. 1, T. 14 S., R. 9 W.; Five Rivers joins the river in sec. 7, T. 14 S., R. 9 W., and Drift Creek in sec. 27, T. 13 S., R. 11 W. The basin is principally mountainous and rough, but valley bottoms are larger and smoother than those of many coast streams.

The North Fork heads on the slopes of Marys Peak, which at 4,097 feet in altitude is the highest point in the basin. Other altitudes in the North Fork basin range from 2,000 to 3,000 feet. Peak Creek, the principal tributary of the South Fork, drains the western slopes of Green Peak, which rises to nearly 2,700 feet in altitude. Other hilltops in the South Fork basin range from 1,800 to 2,000 feet in altitude. Yachats Mountain, within 3½ miles of the coast, on the south boundary of the basin is 1,700 feet in altitude. Highest altitude near the coast north of the river is about a thousand feet above sea level. In general, however, the drainage basin is higher north of the river than south of it. Tidewater extends about 14 miles up the Alsea River. The fall in the river between the junction of the North and South Forks and the upper limit of tidewater averages about 8 feet per mile. The adjacent drainage basins are Marys River on the northeast, Yaquina River on the north and northwest, Yachats River on the southwest, and Siuslaw River on the south and southeast.

MAPS AND AERIAL PHOTOGRAPHS

The Alsea River basin is covered by U.S. Geological Survey topographic quadrangles at a scale of 1:62,500 and a contour interval of 50 feet. They are the Toledo, Marys Peak, Monroe, Alsea, Tidewater, Waldport, Mapleton, Blachly, and Elmira quadrangles which were mapped in 1956 and 1957.

A map sheet by the Geological Survey dated 1957 and entitled "Miscellaneous Damsites, Coast Streams, Oregon," includes the Scott Mountain and the Tidewater damsites on the Alsea River. These were mapped on a scale of 1:4,800; a contour interval of 10 feet on land and 1 foot on the water surface was used.

The Salem sheet (1963) of the U.S. Army Map Service, 1:250,000 scale and a 200-foot contour interval, covers the basin. This map is printed and distributed by the Geological Survey. The Siuslaw National Forest map, which shows the Alsea River basin, is available from the U.S. Forest Service.

Aerial photographs of this region are available. Information concerning areas covered may be obtained from the Map Information Office, U.S. Geological Survey, Washington, D.C., or from the Forest Service in Portland, Oreg.

LAND USE

The primary land use in the Alsea River basin is timber production. The basin is covered by forest growth and heavy vegetation, and little clearing has been done because the steep terrain is not adaptable to agriculture. The valley is wider in the vicinity of Alsea, and much of the farming activity within the basin is in this area. The most common use of the open land is for grazing of cattle and sheep. The river valley is narrow below the mouth of Fall Creek, and there are only a few scattered farms. Some farms are located up tributary streams such as Five Rivers and Fall Creek.

Scenic and recreational activities are important to the region, and a considerable part of the economy depends on hunters and fishermen and on people vacationing on the beaches. Many permanent homes, vacation cabins, and tourist facilities are located along the river. Most of these are between the settlement of Tidewater and the mouth. Some salmon spawn in the basin, and the river has been partly cleared of obstructions to facilitate fish migration.

TOWNS AND ROADS

The ocean-front town of Waldport is the largest within the basin and is at the mouth of the Alsea River. The settlement of Tidewater is about 1 mile by road and 3 miles by river downstream from the upper limit of tidewater. Alsea, the second largest town, is in a valley at and downstream from the confluence of the North and South Forks. Other small villages include Bayview on Alsea Bay and Fisher on Five Rivers. Scattered farms, churches, homes, and businesses are located throughout the basin. State fish hatcheries are in operation on North Fork Alsea River and Fall Creek. The population of Waldport was 689 in 1950, 667 in 1960, and 715 on July 1, 1961. The other towns were too small to be listed but the Waldport and Alsea census divisions had 3,413 and 857 persons respectively in 1960. These figures approximately represent the population of the Alsea River basin.

State Highway 34 is the major roadway through the basin; it connects the Willamette valley cities such as Corvallis and Albany with the ocean beaches. This surfaced highway follows the Alsea River, North Fork Alsea River, and Crooked Creek to the Coast Range summit and then northeast where it joins U.S. Route 20 near Philomath. Highway 34 is a narrow, rather crooked two-lane road, but it is being improved. The Oregon Coast Highway (U.S. Route 101) crosses the Alsea River at Waldport on the Alsea Bay Bridge, the largest and most impressive structure within the basin. These routes are important to the region because they bring an annual surge of tourists and provide access to other coastal areas.

Short parts of the Lobster Valley Road south of Alsea and the Bayview Road on Alsea Bay are surfaced. The remainder of the roads in the basin are unpaved access, farm-to-market, and logging roads.

CLIMATE

The climate of this region is summarized briefly as wet and mild. Extremes of temperature are uncommon, temperature seldom exceeding 90°F in summer, and there are few extended freezing periods in winter. The average temperature at Tidewater is 52.7°F, and the temperature range is 8°F–105°F. Weather Bureau records beginning in 1948 show the number of days that certain temperatures prevail. At the Tidewater station this interval averaged 225 days for the 32°F temperature, 284 days for the 28°F temperature, and 338 days for the 24°F temperature. Since 1955 a similar column is listed in Weather Bureau records for temperatures of 20°F and 16°F, but none have been recorded for both spring and fall of the same year.

WATER SUPPLY

Measurements of discharge in the Alsea River basin began in 1939 at a station near Tidewater. In 1957 and 1958, six new stations were added to the basin's network as follows: North Fork Alsea River at Alsea, South Fork Alsea River near Alsea, Fall Creek near Alsea, Five Rivers near Fisher, Drift Creek near Salado, and Needle Branch near Salado. The last named station has a drainage area of only 0.32 square mile and will not be used in this report.

In order to extend these short records to cover the 1940–60 period during which the river was gaged near Tidewater, precipitation and runoff data for stations in and near the Alsea River basin were analyzed as shown in table 1 so that short-term records could be compared with those for longer periods. The stations outside the basin chosen for this purpose are Newport, Corvallis, and Summit. The Newport station is near the coast. The Corvallis station is north of the city of Corvallis and northeast of the basin, and it is operated by Oregon State University. The Summit station is at a pass on the Coast Range north of the Alsea River basin.

According to the results obtained, the period of record of discharge of Alsea River near Tidewater (1940–60) approximately represents average conditions and therefore makes possible the assumption that average runoff over that 21-year period equals the long-term average. Runoff at the Tidewater gaging station averaged 62.9 inches during that period. Measured runoff in the basin subparts ranged from a low of 42.6 inches on the South Fork to a high of 76 inches (partially estimated) on Fall Creek. Long-term averages as indicated by the precipitation stations included in table 1 and the runoff records of the Alsea River near Tidewater range from a low of 41 inches on the South Fork to 74 inches for Fall Creek. Precipitation records at the Alsea fish hatchery date to 1955. Measured precipitation there averaged 97.3 inches for the 1955–60 period and 91 inches is the indicated projected average. At Tidewater an average of 96.8 inches of precipitation annually between 1944 and 1960 is reduced to 88 inches for the projected average.

The gages at the Alsea fish hatchery and at Tidewater measure precipitation at only two points and by themselves do not accurately represent the amount of precipitation that produces the runoff throughout the drainage areas. In order to estimate the

TABLE 1.—*Precipitation and runoff data for stations in or near the Alsea River basin, and estimated long-term runoff in basin subparts*

	Long-term average		Projected average		1940–60		1944–60		1955–60		1958–60	
	Actual		Indicated									
	Inches	Index	Inches	Index	Inches	Index	Inches	Index	Inches	Index	Inches	Index
Precipitation data												
Precipitation stations:												
Newport [1]	66.1	100	(2)	(2)	66.5	100.5	68.3	103.3	73.7	111.5	74.0	111.9
Corvallis [3]	37.3	100	(2)	(2)	38.5	103.2	39.1	104.8	41.0	109.8	39.4	105.6
Summit	66.1	100	(2)	(2)					67.4	101.9	67.9	102.6
Tidewater			88	100			96.8	110.0	93.4	106.1	91.8	[4] 103.8
Alsea fish hatchery			91	100					97.3	106.5	95	[4] 103.8
Runoff data												
Gaging stations:												
Alsea River near Tidewater	62.9	100	63	100	62.9	100	63.3	100.5	67.3	106.9	66.1	105.1
North Fork			56	100							58.0	[4] 103.8
South Fork			41	100							42.6	[4] 103.8
Fall Creek			74	100							[5] 76	[6] 102.6
Five Rivers			65	100							[5] 70	[7] 108.5
Drift Creek			71	100							[5] 73	[6] 102.6

[1] Records date to 1892.
[2] Same as figures under long-term average.
[3] Records date to 1890.
[4] Assumed to vary with average of Summit rainfall and Alsea River streamflow.
[5] Estimated.
[6] Assumed to vary with Summit rainfall.
[7] Assumed to vary with Newport rainfall and Alsea River Streamflow.

runoff from the basin subparts, precipitation and runoff measurements for stations in and near the basin were compared as shown in table 1. The runoff in inches shown in table 2 for the basin subparts are estimates made by using the relations established in table 1.

TABLE 2.—*Estimated average runoff for the Alsea River basin, by subparts*

Subbasin	Area (sq mi)	Runoff (in.)
North Fork	63	56
South Fork	50	41
Fall Creek	30	74
Five Rivers	120	65
Alsea River near Tidewater	334	63
Drift Creek	70	71
Remainder of basin	69	75
Alsea River basin	473	66

The short-term records for the gaging stations given in table 1 are summarized and the projected long-term averages, in cubic feet per second, are shown in table 3.

Rainfall and runoff are concentrated in the late fall and winter. The gages near Tidewater recorded 73 and 80 percent, respectively, of the annual precipitation and runoff during the November–March period. From April through October the complementary percentages of average annual precipitation and runoff are 27 and 20.

The concentration of runoff during fall and winter enhances the value of the coast streams for supplying power during a period of high demand. On the Alsea River about 80 percent of the annual runoff occurs between November 1 and March 31. Figure 2 illustrates the concentration of flow in the Alsea River during the 5-

TABLE 3.—*Summary of streamflow data, Alsea River basin, Oregon, and estimated long-term average discharges*

Stream	Gaging station	Period of record [1]	Drainage area (sq mi)	Discharge, in cubic feet per second			Projected long-term average (cfs)
				Average	Maximum	Minimum	
North Fork Alsea	At Alsea	10/57–9/61	63	286	8,820	13	260
South Fork Alsea	Near Alsea	10/57–9/61	49.5	167	4,340	7.2	150
Fall Creek	do	8/58–9/61	29.4	173	2,970	5.9	160
Five Rivers	Near Fisher	8/58–9/61	114	566	15,700	17	545
Alsea River	Near Tidewater	10/39–9/61	334	1,560	32,200	56	[2] 1,547
Drift Creek	Near Fisher	9/58–9/61	20.6	127	2,300	3.8	110

[1] 1961 included to improve usefulness of short records.
[2] 1940–60, actual.

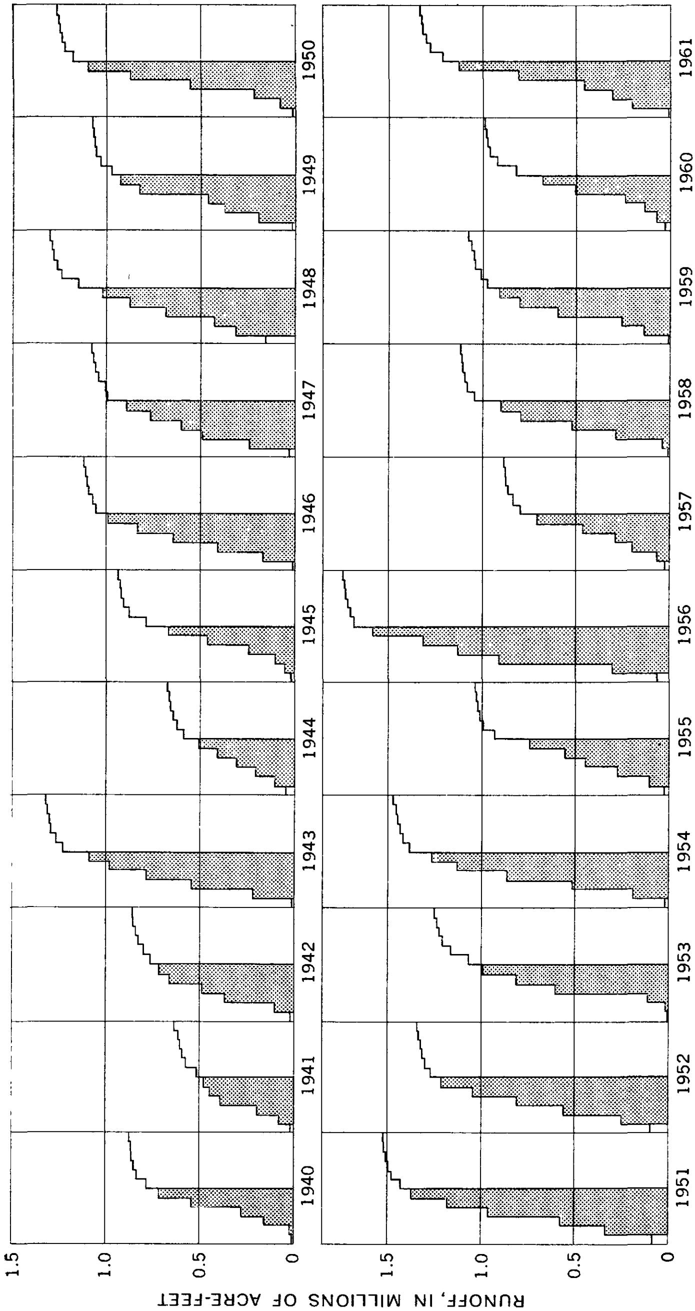

FIGURE 2.—Runoff in acre-feet accumulated monthly for water years 1940–61 for gage near Tidewater.

month period November through March (the shaded part of the yearly accumulation) for water years 1940–61. The water year begins October 1 and ends September 30. At first glance there might be a question as to whether the month of November or the month of April should be included in the 5-month high-yield period. However, the November yields are enough larger than those of April to be quickly verified by visual inspection. Actually, the November yield was greater than April during 17 of the 22 years shown. More detailed studies will probably show that the 5-month period should be started sometime during November and extended appropriately into April to obtain the maximum benefit. Wet and dry seasons as well as wet and dry years and the sequence of such wet and dry years are also illustrated in figure 2.

WATER RIGHTS

Records in the office of the state engineer in Salem, Oreg., show that 12.44 cfs (cubic feet per second) have been allotted from the Alsea River and its tributaries. Irrigation allotments were 83 percent of this total, and domestic use and fish culture were 9 percent and 8 percent respectively. About two-thirds of the allotment was from the main stem and one-third from tributary streams. It does not seem likely that water allotments will endanger the supply of water for power. The lowest flow recorded at the gaging station near Tidewater was 56 cfs.

STORAGE SITES

No storage reservoirs have been devloped in the basin. There are several potential storage sites, however, and many benefits would accrue from any measures taken to augment low summer flows and reduce excessive flows during the months of high precipitation. Available topographic maps are not suitable as to scale and contour interval for obtaining accurate reservoir capacities. However, approximate areas and capacities for several sites were obtained from 15-minute quadrangle maps, and this information follows the related discussion (p. D11–D15).

NORTH FORK

Small storage reservoirs could be built on the North Fork and its tributaries, and the capacity of one of these, the County Line site, is shown in the following tabulation. This site will be valuable if water is diverted to Marys River from North Fork. According to the Alsea topographic quadrangle, scale 1:62,500, the dam would be about a thousand feet long at the 1,000-foot altitude. The drainage area is 25.3 square miles.

Area and capacity of County Line reservoir site, North Fork Alsea River

[Damsite in sec. 13, T. 13 S., R. 8 W.]

Altitude (feet)	Area (acres)	Capacity (acre-feet)
810	0	0
850	30	600
900	100	3,850
950	180	10,900
1,000	340	24,000

SOUTH FORK

The South Fork has some storage sites that appear to be reasonably good topographically. One of these, Peak Creek, is far enough upstream that it, also, might be used in a plan to divert water to the Willamette River basin side of the Coast Range. The area and capacity of this site are as follows:

Area and capacity of Peak Creek reservoir site, South Fork Alsea River

[Damsite in sec. 23, T. 14 S., R. 7 W.]

Altitude (feet)	Area (acres)	Capacity (acre-feet)
675	0	0
700	30	375
750	50	2,375
800	130	7,000
850	590	25,000
900	1,390	74,000

The 1:62,500-scale Alsea topographic quadrangle map indicates that the Peak Creek dam would be about 1,800 feet long at the 900-foot altitude. The drainage area is 30 square miles.

Reservoirs on the North and South Forks would probably be more valuable to farming, fish culture, and recreation than to power because of the small drainage areas affected. They would almost surely be built if water is diverted from these streams to the Willamette River basin tributaries on the east side of the Oregon Coast Range.

FALL CREEK

Fall Creek passes through valleys in which it appears possible to build small reservoirs that would have value for sustaining flows in aid of fish culture. None have been studied.

FIVE RIVERS

There are sites in the lower basin that probably could support rather high dams. In downstream order, they are on Five Rivers, the main stem, and Drift Creek. The Five Rivers damsite might be placed in sec. 18, T. 14 S., R. 9 W. The Tidewater topographic quadrangle, scale 1:62,500, indicates that the dam would be about 1,400 feet long at an altitude of 400 feet. The drainage area is 120 square miles. The area and capacity of this reservoir site are as follows:

Area and capacity of Five Rivers reservoir site, Five Rivers

[Damsite in sec. 18, T. 14 S., R. 9 W.]

Altitude (feet)	Area (acres)	Capacity (acre-feet)
80	0	0
100	40	400
150	470	13,150
200	1,560	63,900
250	3,030	178,700
300	5,320	387,000
350	7,280	702,000
400	9,520	1,122,000

Five Rivers and its tributaries flow in deeply cut valleys, and there are many alternative reservoir sites. The reservoir that would be created by the Scott Mountain dam on the main stem would also inundate the valley bottoms in Five Rivers and its tributaries.

MAIN-STEM SITES

Immediately downstream from Five Rivers, the Alsea makes a long mule-shoe bend around Stoney Mountain, a southward extension of Scott Mountain, and topography is favorable for a rather high dam. The Scott Mountain damsite in sec. 18, T. 14 S., R. 9 W., discussed in the section on potential power, was surveyed in 1957. The area and capacity of the reservoir site are shown in figure 3 and in the following tabulation.

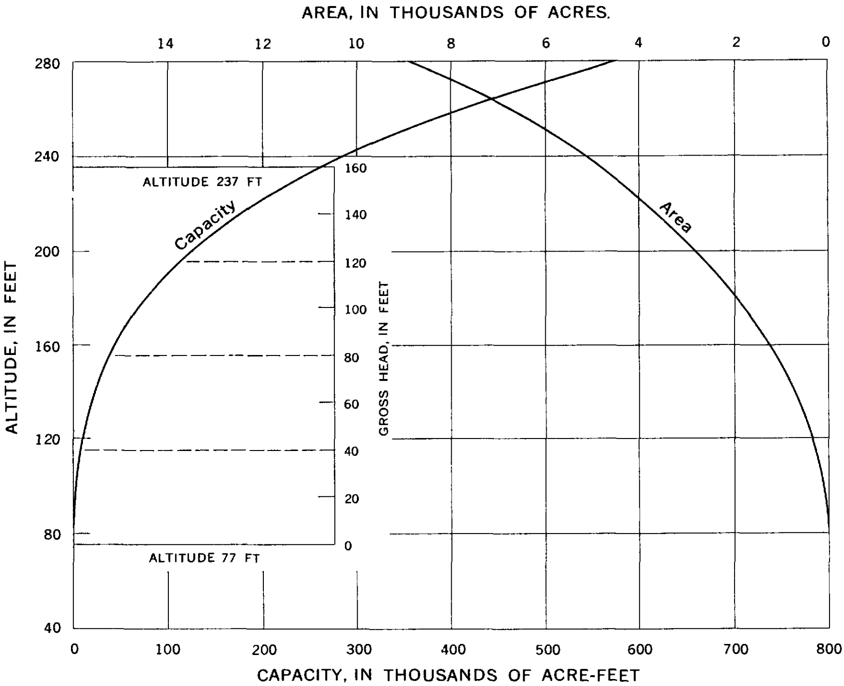

FIGURE 3.—Area and capacity of Scott Mountain reservoir site.

Area and capacity of Scott Mountain reservoir site, Alsea River

[Damsite in sec. 18, T. 14 S., R. 9 W.]

Altitude (feet)	Area (acres)	Capacity (acre-feet)
77	0	0
100	115	1,320
150	950	28,000
200	2,840	123,000
250	5,800	339,000
300	11,700	776,000

The damsite map, scale 1:4,800, indicates that a dam at the Scott Mountain site would be about a thousand feet long at an altitude of 237 feet (the height chosen in the illustrative plan discussed in the section on potential power). The drainage area is 321 square miles.

The capacity of the Scott Mountain reservoir site is 339,000 acre-feet at an altitude of 250 feet. The capacity of the Tidewater reservoir site at this same altitude is 724,000 acre-feet. The

Tidewater damsite is 13 miles downstream from the Scott Mountain damsite. The Tidewater damsite is a little below the tidewater limit, but there are other locations within a few miles upstream that appear to be about as good. The area and capacity of the Tidewater reservoir site follow and are also shown in figure 4.

Area and capacity of Tidewater reservoir site, Alsea River

[Damsite in sec. 32, T. 13 S., R. 10 W.]

Altitude (feet)	Area (acres)	Capacity (acre-feet)
7	0	0
50	695	15,000
100	1,590	72,000
150	3,000	187,000
200	5,000	387,000
250	8,500	724,000

The Tidewater damsite map shows that a dam would have a crest length of about 550 feet at an altitude of 77 feet. If continued to an altitude of 250 feet, the dam would be about 1,050 feet long. The drainage area is 357 square miles.

A dam at the Scott Mountain site built to back water to an

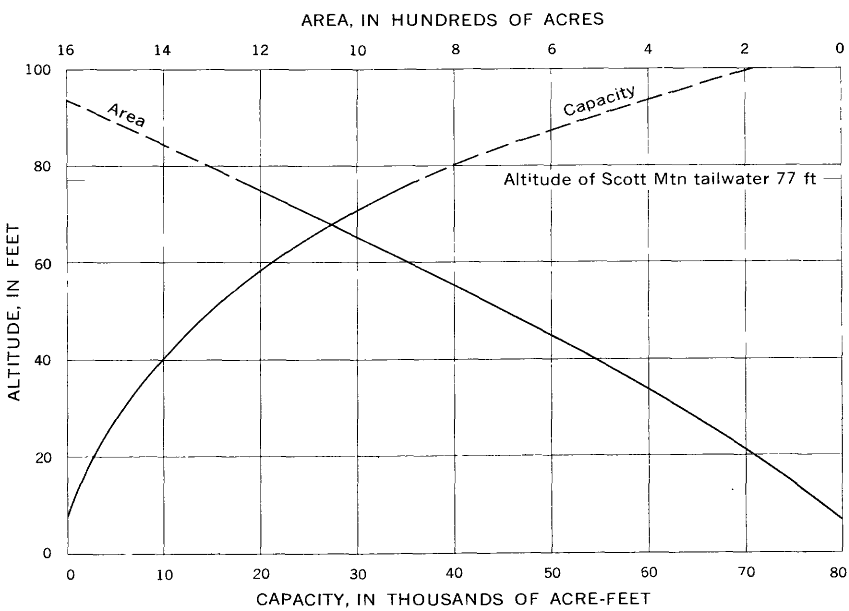

FIGURE 4.—Area and capacity of Tidewater reservoir site.

altitude of 300 feet or one at the Tidewater site built to an altitude of 250 feet would provide approximately equal storage capacity. At an altitude of 300 feet the town of Alsea would be almost completely covered by the Scott Mountain reservoir as would a large part of the tillable land in the valley. For this reason the Tidewater damsite might be preferable if a large reservoir is to be built.

The illustrative development plan presented in this paper on pages D24–D40 assumes a smaller reservoir with the dam at the Scott Mountain damsite. The water surface there is 77 feet above sea level and backwater would be at an altitude of 237 feet. This altitude limits the Tidewater reservoir site to a maximum capacity of 36,000 acre-feet.

DRIFT CREEK

There are two reservoir sites on Drift Creek: Slickrock, which has a damsite about 1 mile downstream from Slickrock Creek, and Trout Creek, which has a damsite about 1 mile downstream from Trout Creek. The drainage areas are 42 and 62 square miles, respectively, at the above damsites. The Tidewater topographic quadrangle map, scale 1:62,500, shows that a dam built to an altitude of 500 feet at the Slickrock site would be about 800 feet long, and that a dam built to an altitude of 250 feet at the Trout Creek site would be about 1,050 feet long. The areas and capacities of the two reservoir sites are shown in the following tabulations:

Slickrock reservoir site, damsite in sec. 3, T. 13 S., R. 10 W.

Altitude (feet)	Area (acres)	Capacity (acre-feet)
260	0	0
300	40	840
350	120	4,840
400	290	15,000
450	510	35,000
500	970	72,000

Trout Creek reservoir site, damsite in sec. 12, T. 13 S., R. 11 W.

25	0	0
50	40	500
100	190	6,250
150	420	21,500
200	690	49,300
250	1,000	92,000

GENERAL GEOLOGY OF THE ALSEA RIVER BASIN

By D. L. GASKILL

Rocks exposed in the Alsea drainage basin include marine and brackish-water sediments interbedded with basaltic lavas. These rocks are cut locally by basic and syenitic intrusives and include most of the sedimentary and igneous rocks of Cenozoic age known to occur in the central coast range of western Oregon.

The geology of the area has been mapped at a scale of 1:62,500. Most of the lower Alsea drainage basin is shown on a map by Baldwin (1955). The maps include brief geologic texts and references to earlier geologic work.

The predominant rocks are strata of the Tyee Formation of middle Eocene age (Baldwin, 1959; Wells and Peck, 1961; Snavely and Wagner, (1963). The name Burpee Formation, first given these rocks by Schenck (1927) and used by Vokes, Norbisrath, and Snavely (1949), has been abandoned by the Geological Survey in favor of the name Tyee Formation. The Siletz River Volcanic Series of Eocene age is exposed locally in the headwaters area (Baldwin, 1955).

Four of the storage sites discussed on pages D11–D15 are in the strata of the Tyee Formation, and two, the County Line dam and reservoir site on the North Fork and the Peak Creek dam site on the South Fork, are in the Siletz River Volcanic Series. Only the Scott Mountain and the Tidewater sites have been mapped with 10-foot contours and studied geologically for the purpose of this report. Accordingly, the following discussion concerns only rocks of the Tyee Formation.

The Tyee Formation in the lower Alsea drainage basin is 6,000–7,000 feet thick and has a regional dip of 15°–20° W., according to Vokes, Norbisrath, and Snavely (1949). They describe it as a * * * monotonous sequence of rhythmically bedded sandstones with mudstone partings * * *. Each bed is composed of medium- to coarse-grained, highly micaceous, arkosic sandstone that gradually grades upward into siltstones and mudstones in its upper part. Successive beds always begin with coarse sandy material which rests abruptly upon the upper mudstone zone of the underlying bed * * *. The sandstone * * * is firmly compacted, uniform, * * * somewhat calcareous * * * and is composed mainly of angular grains of quartz, feldspar, and tuffaceous fragments, with abundant wrinkled flakes of muscovite and biotite. The upper part of each bed is a dark, firm, sometimes sandy, mudstone. Fragmental plant material is almost universally present in these upper zones, and is commonly * * * present in the sands.

The Tyee Formation has been folded into broad gentle flexures. High-angle normal faults that have minor displacement may be observed in highway cuts along the Alsea River valley. Most of these faults trend eastward. Abrupt deviations in attitude of the strata suggest that many other faults occur in this region (Vokes, Norbisrath, and Snavely, 1949).

RECONNAISSANCE GEOLOGY OF THE SCOTT MOUNTAIN DAMSITE

The Alsea River occupies a 100- to 150-foot wide bedrock channel at the base of the west abutment of the proposed damsite at Scott Mountain (pl. 1, section *A–A'*). A silty to sandy flood-plain deposit 400–500 feet wide separates the river from the east abutment. The river gradient here is about 9 feet per mile. Abutment slopes are forested and generally covered with 10 feet or more of soil and slope wash overlying weathered fractured bedrock.

A large quarry adjoining the damsite area on the northeast exposes more than 200 feet of massive firmly compacted greenish-gray micaceous silty sandstone containing thin beds, partings, and lenses of shaly claystone, mudstone, and siltstone (fig. 5). The sandstone beds range from less than 1 foot to 12 feet thick and average about 4 feet in thickness. Intervening shaly beds average about 4 inches in thickness but range from thin clay-mud-siltstone partings to beds several feet thick. (See pl. 1, columnar section.) Samples of noncalcareous silty sandstone examined under the microscope are composed of angular to subangular very

FIGURE 5.—Quarry in Tyee Formation adjoining Scott Mountain damsite at junction of Five Rivers and the Alsea River.

fine to medium grains in a matrix of loosely cemented silt-sized particles. The quarry strata is characterized by weak bedding contacts exhibiting mud cracks, ripple marks, and channeled surfaces. Most of the sandstone is rather loosely bonded, but some exposures are well cemented with calcium carbonate.

Sedimentary beds in the general damsite area dip gently southeast. The river channel at the damsite is cut into massive sandstone which is more than 5 feet thick and which exhibits a rectilinear pattern of more than three well-developed, commonly continuous subvertical and vertical joint sets trending parallel, diagonally, and at right angles to the river. The most persistent joints strike north parallel to the river and are spaced ½–4 feet apart; however, north of section *A–A′* (pl. 1) and opposite the quarry, the most conspicuous joints strike N. 73° W. across the river and are generally 9–30 feet apart. Several small east-trending faults were observed north and south of the damsite area. A basaltic dike, 3–4 feet wide, intrudes one such fault at the north end of the quarry (pl. 1).

A ridge extending southwest from Scott Mountain (pl. 1, index map) forms the west abutment at the damsite and the west side of the reservoir area for a distance of about 1 mile. The ridge forms a narrow peninsula between the reservoir area and the Alsea River valley downstream.

Bedrock on this ridge dips at a low angle south and southeast roughly parallel or obliquely downstream toward the damsite area and seems to be widely fractured and bisected locally by small faults. At an altitude of 80 feet above the river, this ridge is only 1,400–1,700 feet wide for a distance of about 1 mile along which reservoir water would have nearly direct access to bedding. At the 300-foot contour, 230 feet above the river, the ridge is barely 1,000 feet wide. The narrow width of the Scott Mountain ridge indicates a deep zone of weathering, which, combined with bedrock fracturing and the almost horizontal strike of bedding planes across the ridge, suggests the possibility of reservoir leakage through this barrier. Similar conditions might be anticipated on the east abutment ridge in sec. 18 between Five Rivers and the Alsea River where bedding attitudes suggest a gentle synclinal flexure or possible faulting between the two river valleys.

Additional exploration is necessary, particularly in regard to the permeability of the Scott Mountain ridge. Permeable zones may be present or develop as a result of reservoir pressure along fractures, weak bedding contacts, or poorly bonded permeable sandstone beds. This ridge might prove too large an area for an economic grouting program.

Among the less favorable structural aspects of the damsite are the moderate dip of beds downstream and the persistent downstream-trending vertical joints in foundation and abutment rock. Leakage should be anticipated here through permeable zones that are subject to piping and scour unless properly grouted.

In view of the nearly horizontal position of the strata and the presence of massive sandstone beds, the damsite abutments are probably of sufficient strength and stability to support a wide-base earthfill or rockfill structure.

No faults were observed in foundation rock at or near section *A–A′* (pl. 1). The attitude of the sedimentary rocks at the damsite and in the immediate upstream reservoir area indicates little danger of slides during or after construction. Excavation requirements at this site would probably be moderate.

No examination was made of the general reservoir area. Unstable slopes are probably present in the reservoir area, as indicated by the steep mountain slopes and abrupt changes in attitudes of strata as shown in the published topographic and geologic maps.

The possibility of leakage through the Scott Mountain ridge seems to be the critical factor for a dam here. Consideration might be given to an alternate site where there would not be danger of reservoir leakage.

RECONNAISSANCE GEOLOGY OF THE TIDEWATER DAMSITE

The Tidewater site is about 5 miles downstream from the upper reach of tidewater and is subject to small daily tidal fluctuations. The Alsea River occupies most of the narrow valley at the proposed damsite (pl. 1, section *B–B′*), between steep abutments sloping 30°–40° and reaching altitudes of 800 feet above the river. Bedrock is exposed only in highway and logging roadcuts. Abutments are forested and covered with a thick soil mantle, local slope wash, slump, and some landslide debris. Valley fill consists of silty flood- and tidal-plain deposits.

Bedrock exposures in the area display sharply defined beds of sandstone, 1.5–9 feet thick, separated by shale layers 3 inches to 2 feet thick. The sedimentary beds dip 12°–19° downstream in abutment outcrops, but attitudes are probably affected by some slumping of exposures. Bedding attitudes near river level, both upstream and immediately downstream from the damsite area, indicate the dip of bedding is about 12° toward the southwest.

A system of closely spaced joints is exposed about a thousand feet southwest of the damsite area along the south bank of the river. The more prominent joints strike northwest and have 70°–75° dips. Other joints strike north and northeast and have dips of 55°–65° east and south. Bedding planes are offset as much as a foot along some of these fractures. Only a few north-south oriented joints were observed in highway cuts at the damsite.

A diabasic dike about 10 feet wide intrudes a fault on the north abutment. The dike strikes about N. 80° W. and dips about 40° N. If this fault orientation is correct, the dike should cut the south abutment west of section *B–B′* as shown on plate 1.

Normal faults trending about N. 80° W. are exposed along the highway between the damsite area and the community of Tidewater about a mile upstream. Other faults with similar orientation were observed near the mouth of Canal Creek. (See pl. 1, index map).

The depth of unconsolidated valley fill at section *B–B′* is not known, but it is probably less than 30 feet thick.

Stripping requirements are tied to thickness of the valley fill and obscure bedrock structures that might include weak bedding planes, shaly interbeds, poorly bonded sandstone, and other factors influencing permeability and bedrock stability. The abutment strata include thick massive beds of sandstone representative of the Tyee Formation. The sandstone beds apparently constitute the bulk of the sedimentary section at the damsite and should prove adequate support for a dam. The strike of the sedimentary strata, parallel to section *B–B′*, (pl. 1) is favorable to abutment stability, but the downstream dip of beds, though moderate, is not favorable to watertightness or hydrostatic reservoir pressure. At least one fault, intruded by a thick dike, cuts the north abutment and might bisect the line of section *B–B′*. This dike might prove a useful structural feature for selective-foundation or abutment treatment.

Construction would be in easily quarried rock. Tunnels will probably require strong support, and bedrock in spillway and stilling basins would require some protection from water erosion. Ground-water levels are assumed to be generally above possible reservoir levels. Stability of steep slopes above the damsite area should be investigated.

CONSTRUCTION MATERIALS

Intrusive rock has been crushed for road metal from a large gabbroic dike in the SE¼ sec. 36, T. 13 S., R. 10 W., 4 miles downstream from the Scott Mountain site. The quarried sandstone adjacent to the Scott Mountain site was apparently utilized for highway fill and embankment construction. Large quantities of earthfill material, gravel, and sand, are probably available from alluvial deposits in and near the damsite areas. Other intrusive bodies in the vicinity might be utilized as a source of aggregate and riprap.

POTENTIAL POWER

The highest altitude of perennial water in the Alsea River basin is about 2,300 feet above sea level. The median contour between this altitude and sea level is 1,150 feet. Average discharge is 4.63 cfs per sq mi at the gaging station near Tidewater. This rate of discharge applied to the 473 square-mile area of the basin equals 2,190 cfs and indicates a theoretical potential power of 214,000 kilowatts at 100 percent efficiency and average discharge. This theoretical power of the basin is not a measure of the power that could be developed. Inspection of the basin on the ground and by topographic maps indicates that it might be technically feasible to develop six sites that would have a total capacity of 61,000 kw at gross head, average discharge (mean flow) and 100 percent efficiency as shown in table 4.

This 214,000 kw is potential power that will never be economic. It might be of interest to note that the estimated technical power potential is 29 percent of the theoretical. This ratio appears to be reasonable. In Sweden, 43 percent of the gross theoretical is estimated to be technically feasible (Berglund and Larsson, 1959). In Italy, 20 percent and in Greece 12 percent of gross theoretical are considered exploitable at the present time (United Nations, 1961).

TABLE 4.—*Estimated potential power at technically feasible sites in Alsea River basin, Oregon*

[Gross head and 100 percent efficiency]

Site	Stream	Head (feet)	Kilowatts at percentages of time indicated		Kilowatts at mean flow
			95	50	
County Line	North Fork	300	130	1,280	2,660
Peak Creek	South Fork	300	130	1,020	2,300
Scott Mountain	Alsea	270	1,950	15,000	33,900
Tidewater	do	80	650	4,960	11,100
Slickrock	Drift Creek	225	290	2,010	4,200
Trout Creek	do	250	430	3,290	6,900
Total			3,580	27,560	61,060

The development scheme presented hereafter will, it is estimated, be economically feasible within the foreseeable future. It could produce 137,300,000 kilowatthours annually (equivalent to 16,000 kw continuous), about 10 percent of the above gross theoretical estimate of 214,000 kw reduced by an efficiency factor of 0.75.

There are no waterpower developments within the Alsea River basin.

UNDEVELOPED POWERSITES

COUNTY LINE

The North Fork drains 63 square miles in the northeast part of the Alsea River basin. Gaging-station records for 3 water years (1958–60) show a mean flow of 269 cfs and a corresponding mean unit flow of 4.27 cfs per sq mi. The long-term average discharge according to table 1 is 56 inches per year, equal to about 4.12 cfs per sq mi and about 260 cfs for the area above the gage. The County Line site would develop about 300 feet of head by diversion and conduit. Drainage area at this site is 25.3 square miles, which yields an estimated mean flow of about 105 cfs. Even with complete regulation, which would not be available, the power potential of this stream is small. It does not seem likely that streams of this size will be utilized for power in the foreseeable future. Although a certain potential does exist, the North Fork is not included in the plan of development in this report.

PEAK CREEK

The South Fork drains 49.5 square miles along the western edge of the Coast Range. Gaging-station records for water years 1958–60 show a mean flow of 155 cfs and a corresponding mean unit flow of 3.14 cfs per sq mi. Reduced to a long-term basis according to table 1 these amounts become 3.0 cfs per sq mi and 149 cfs for the area above the gage. The Peak Creek site would drain about 30 square miles and develop 300 feet of head by diversion and conduit. Estimated mean flow at the site is 90 cfs. The potential power of the South Fork is not considered in the plan of development.

FALL CREEK SITES

Fall Creek drains 30 square miles in the north-central part of the Alsea River basin. During water years 1959 and 1960 the gaging station recorded a mean flow of 168 cfs and a corresponding mean unit flow of 5.59 cfs per sq mi. Reduced to a long-term basis according to table 1 these amounts become 5.46 cfs per sq mi and 164 cfs for the area above the station. The Scott Mountain reservoir site on the main stem would back water about 3 miles up Fall Creek. A suitable powersite above this pool level would probably control less than 25 square miles. Small power developments could probably be undertaken on this stream but none are considered in the plan of development or in the power estimate of this report.

FIVE RIVERS

The next important tributary downstream is Five Rivers, and it has a drainage basin of about 120 square miles. The gaging station operated at Denzer Bridge during water years 1959 and 1960 recorded a mean flow of 509 cfs corresponding to a mean unit flow of 4.46 cfs per sq mi for a 114-square-mile drainage area. Extending this short record to the 1958–60 water years and making a further extension by the ratios developed in table 1, the long-term unit discharge becomes 4.79 cfs per sq mi. Average discharge for the entire 120 square miles in the basin would be 575 cfs.

Any significant development site on Five Rivers could also be utilized by constructing the dam downstream on the Alsea River. This explains the reason for the omission of a site on Five Rivers in the tabulation showing technically feasible waterpower sites. The Five Rivers subbasin contains a topographically good dam and reservoir site. A 200-foot dam near the mouth of the river would create a reservoir of 275,000 acre-feet. This reservoir would provide regulating storage plus a conservation pool of 100,000 acre-feet in excess of the 175,000 acre-feet required to regulate the stream to a minimum of 400 cfs. Average head during regulation would be 180 feet with that arrangement.

As previously mentioned, the Five Rivers storage capacity might be utilized by constructing the dam on the Alsea River down stream from Five Rivers. Should it be found undesirable to construct the dam on the Alsea River, a pumped-storage plan might be used for developing peaking energy with Alsea River water. The principal reason for such a development would be to avoid construction of a dam on the Alsea where it would interfere with passage of fish and would flood agricultural lands and a long length of very important highway. The Five Rivers reservoir would have a long and interesting shoreline and would be a valuable recreational asset. It would also provide easy access to timberlands and would be a deterrent to the spread of forest fires. This site is discussed further in the section on pumped storage (p. D40).

SCOTT MOUNTAIN AND TIDEWATER SITES

The Scott Mountain site near the mouth of Five Rivers and the Tidewater site near the upper end of tidewater influence have been considered in previous waterpower investigations. Helland (1945) discussed both of these in his report. Records at the gaging station between these two sites show a mean flow of 1,547 cfs and a corresponding mean unit flow of 4.63 cfs per sq mi. These sites are the only ones considered to approach economic feasibility. They are discussed in detail in the section, "Plan of development," on this page.

SLICKROCK AND TROUT CREEK SITES

Drift Creek drains 70 square miles in the northwest part of the Alsea River basin and enters the main river near its mouth. A gaging station was operated during water years 1959, 1960, and 1961 at an upstream location. The drainage area for this station is 20.6 square miles. This station recorded a mean flow of 118 cfs, and a corresponding mean unit flow of 5.73 cfs per sq mi. Extended to 1958–60 water years and from there to a long-term basis as in table 1, the unit discharge is 5.23 cfs. This is an average of 108 cfs for the gaging station and 366 cfs for the entire basin. Two sites on Drift Creek were studied. The Slickrock site a short distance below the mouth of Slickrock Creek drains 42 square miles. The Trout Creek site draining 62 square miles is in the SE¼ sec. 12, T. 13 S., R. 11 W. An annual average of about 220 cfs is indicated for the Slickrock site and about 325 cfs for the Trout Creek site. Reservoirs are possible at both sites.

PLAN OF DEVELOPMENT

Storage is essential for development of power on the Alsea River owing to considerable fluctuations in the flow. The Scott Mountain site would provide this storage, and would be the key power development in the basin. A development at the Scott Mountain site would limit the maximum water surface of the Tidewater reservoir site to an altitude of 77 feet and its capacity to 36,000 acre-feet. A reservoir of this size would be primarily valuable for reregulating Scott Mountain releases and for pondage. The Scott Mountain and Tidewater reservoir and powersites probably approach economic feasibility. None of the other sites discussed seem worthy of consideration for construction at this time.

SCOTT MOUNTAIN

Drainage area at the gaging station is 334 square miles, and 96 percent of this, or 321 square miles, is drained at the Scott Mountain site. The natural runoff at the site was estimated from gaging-station records on a ratio of drainage areas. Table 5 gives this estimated natural runoff at the Scott Mountain site in monthly acre-foot values. It shows that runoff during the period of November through March averaged more than 100,000 acre-feet each month and that January had the highest runoff at 217,100 acre-feet. The volume of runoff falls off sharply beginning in April to a low of 7,100 acre-feet in August.

Complete regulation of this stream would require a much greater storage volume than for operations confined to the 5 high-yield months. These 5 high-yield months correspond to the low-flow months at the Columbia River power stations. Power produced from November through March is valuable for peaking in the Northwest power pool, and the Alsea River requires less storage for regulation during this period. Therefore, the plan of development presented here will confine most power production to this period. A conservation release of 100 cfs or 6,000 acre-feet per month would be allowed to remain in the stream to maintain fish life, boating, and esthetic qualities. This release is slightly lower than the August average of 7,100 acre feet. However, extreme low flows would be eliminated because 18 months during the 21-year period 1940–60 had less than 6,000 acre-feet of runoff. During the 7-month period from April through October, power could be produced with the 100 cfs conservation release. A considerable quantity of secondary power could also be produced during full-reservoir periods.

The method used here to determine storage required does not assume full regulation but seeks to find optimum use of the water supply. The recurrence interval of deficient flow estimates the frequency of water-supply deficiencies for varying amounts of storage less than that required for full regulation. This gives a quantitative index by which quick comparisons can be made of the effect reduced storage would have on water release schedules.

By examination of table 5 the following minimum water-release schedules were prepared:

Schedule A: 110,000 acre-feet per month November–March and 6,000 acre-feet per month April–October, or 592,000 acre-feet per year.

TABLE 5.—*Estimated natural runoff, in thousands of acre-feet, at the Scott Mountain damsite*

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Year
1940	9.4	6.6	131.7	118.4	251.2	165.7	65.9	53.8	14.5	7.8	4.8	5.2	834.9
1941	11.9	58.7	116.5	181.0	55.2	35.6	39.7	54.3	17.7	9.1	6.8	25.8	612.2
1942	16.2	80.2	252.0	118.2	163.2	60.1	36.3	41.9	26.8	14.7	8.2	5.5	823.3
1943	6.6	204.3	310.5	229.3	193.8	104.8	132.1	36.3	24.6	11.5	8.5	5.6	1,267.8
1944	43.5	55.3	100.0	97.2	94.1	91.9	86.1	35.1	21.7	10.1	6.4	5.4	646.8
1945	6.0	40.1	47.4	141.3	203.0	201.1	114.3	90.6	28.2	11.6	7.0	8.9	899.5
1946	6.0	158.3	225.0	228.9	179.9	151.9	56.8	24.3	16.4	12.1	6.5	7.5	1,073.6
1947	29.2	198.6	244.1	104.9	155.2	120.3	85.3	23.8	38.0	14.5	9.8	8.1	1,031.8
1948	148.8	149.9	107.1	249.1	182.6	138.8	127.8	86.4	27.7	13.7	8.7	7.9	1,248.4
1949	13.9	75.0	269.5	81.5	351.1	98.5	42.3	64.7	16.7	9.6	6.4	5.8	1,035.0
1950	9.0	67.0	132.4	326.5	296.8	220.9	79.6	42.0	17.2	9.4	6.2	5.5	1,212.5
1951	83.7	236.1	234.6	361.0	210.0	185.3	56.8	48.9	18.2	10.0	5.4	4.8	1,454.9
1952	94.4	142.4	291.3	241.5	228.7	159.8	59.3	27.9	16.3	10.8	6.5	4.9	1,283.7
1953	4.5	8.6	95.2	464.7	206.7	170.9	73.5	91.1	41.3	15.9	11.1	7.7	1,191.5
1954	22.9	158.8	312.2	333.7	250.0	121.6	121.6	27.2	18.4	11.3	8.1	9.1	1,404.7
1955	21.3	82.9	158.8	159.4	106.6	184.8	181.2	53.1	18.2	13.0	6.4	8.0	993.6
1956	59.1	224.4	399.2	397.3	178.5	258.2	84.9	26.0	11.2	8.2	5.3	5.4	1,660.7
1957	23.1	37.2	130.1	87.8	163.4	234.6	88.6	41.2	20.9	11.3	8.0	5.4	851.5
1958	11.3	30.5	235.9	219.8	260.8	104.7	129.8	40.8	18.4	8.9	4.9	5.4	1,071.2
1959	8.1	132.4	110.0	322.3	189.7	104.8	70.6	42.0	21.6	11.1	6.1	20.0	1,038.8
1960	30.7	39.0	67.1	95.4	253.1	170.2	136.6	98.9	35.0	13.4	8.1	5.9	953.4
Average	31.4	104.1	189.1	217.1	199.2	146.9	89.0	50.0	22.5	11.3	7.1	8.0	1,075.7

Schedule B: 150,000 acre-feet per month November–March and 6,000 acre-feet per month April–October, or 792,000 acre-feet per year.

Schedule C: 160,000 acre-feet per month November–March and 6,000 acre-feet per month April–October, or 842,000 acre-feet per year.

Table 6 was prepared for the above schedules listing active storage required for periods of deficient natural streamflow.

The monthly entry in table 6 represents the difference between scheduled release and actual runoff as shown in table 5 since the deficient period began. This value represents the storage that would have been required at the beginning of the deficient period to maintain the specified release schedule. Entries were placed in table 6 as long as total runoff for the period was less than specified release schedules even though runoff for certain months during the period exceeds the release schedule. Months for which no entries appear indicate lack of a deficient period and monthly runoff exceeding that specified by the release schedule. The maximum active storage required for each water year and its ranking number are given in the last two columns for use in the statistical comparison of storage required and recurrence interval of deficient flow. A dead storage of 30,000 acre-feet was assumed at all times to maintain 70 feet of head. The sum of dead and maximum active storage required for each year was placed on a data sheet in ranked decreasing order. The recurrence interval of deficiencies for each ranked entry was computed by the formula: $R.I. = n+1/m$, where n=years of record and m=rank.

Figure 6 shows a graph of recurrence interval and storage required for the three release schedules considered. The storage required and corresponding dam height for any recurrence interval desired may be determined from this graph. With a 3-year recurrence interval, schedules A, B, and C would require dams that would raise the water surface 118 feet, 152 feet, and 159 feet, respectively. The 4-year recurrence interval would require corresponding dams to raise the water 126 feet, 160 feet, and 167 feet. A 10-year recurrence interval would require dams of sufficient height to raise the water 136 feet, 177 feet, and 187 feet. Schedule B at a 4-year recurrence interval has been selected to illustrate potential power for this report. This schedule will require 235,000 acre-feet of usable storage from the 265,000 acre-foot reservoir provided by a dam to raise the water surface 160 feet. A dam of this height would have a crest length of about a thousand feet. The full reservoir would rise to an altitude of

TABLE 6.—*Active storage, in thousands of acre-feet, required at the Scott Mountain site for periods of deficient natural streamflow*

[Rank is from the greatest to least requirement]

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Maximum in year	Rank
Schedule A														
1940		103.5	81.8	73.4							1.2	2.0	103.5	6
1941		51.3	44.8		54.8	129.2	95.5	47.2	35.6	32.5	31.7	11.9	129.2	2
1942	1.7	31.5				49.9	19.6					.5	49.9	9
1943						5.2						.4	5.2	13
1944		54.7	64.7	77.5	93.4	111.5	31.4	2.4				.6	111.5	5
1945	.6	70.5	133.2	101.9	8.9								133.2	1
1946													0.0	20
1947				5.1									5.1	15
1948			2.9										2.9	16
1949		35.0		2[illegible].5		11.5						.2	35.0	11
1950		43.0	20.6									.5	43.0	10
1951											.6	1.9	1.9	17
1952												1.1	1.1	19
1953	2.6	104.0	118.8										118.8	4
1954													0.0	21
1955		27.1			3.4								27.1	12
1956											.7	1.3	1.3	18
1957		72.8	52.7	74.9	21.5							.6	74.9	8
1958		79.5				5.3					1.1	1.7	79.5	7
1959						5.2							5.2	14
1960		71.0	113.9	128.5								.1	128.5	3
Release schedule	6.0	110.0	110.0	110.0	110.0	110.0	6.0	6.0	6.0	6.0	6.0	6.0		

TABLE 6.—*Active storage, in thousands of acre-feet, required at the Scott Mountain site for periods of deficient natural streamflow*—Continued

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Maximum in year	Rank
Schedule B														
1940		143.5	161.8	193.4	92.2	76.5	16.5				1.2	2.0	193.4	8
1941		91.3	124.8	93.8	188.7	303.1	269.4	221.1	209.4	206.3	205.5	185.7	303.1	3
1942	175.6	245.4	143.4	175.2	162.0	251.8	221.5	185.7	164.9	156.1	154.0	154.4	251.8	4
1943	153.8	99.5				45.2						.4	153.8	9
1944		94.7	144.7	197.5	253.4	311.5	231.4	202.4	186.7	182.6	182.2	182.7	311.5	2
1945	182.7	292.7	395.3	404.0	351.0	299.9	191.6	107.0	84.8	79.2	78.2	75.3	404.0	1
1946	75.3	67.0											75.3	13
1947				45.1	39.9	69.6							69.6	15
1948		.1	43.0			11.2							43.0	17
1949		75.0		68.5		51.5	15.2					.2	75.0	14
1950		83.0	100.6									.5	100.6	11
1951											.6	1.9	1.9	20
1952		7.6										1.1	7.6	19
1953	2.6	144.0	198.8										198.8	6
1954						28.4							28.4	18
1955		67.1	58.3	48.9	92.3	57.5							92.3	12
1956											.7	1.3	1.3	21
1957		112.8	132.7	194.9	181.5	96.9	14.3					.6	194.9	7
1958		119.5	33.6			45.3					1.1	1.7	119.5	10
1959		17.6	57.6			45.2							57.6	16
1960		111.0	193.9	248.5	145.4	125.2						.1	248.5	5
Release schedule	6.0	150.0	150.0	150.0	150.0	150.0	6.0	6.0	6.0	6.0	6.0	6.0		

TABLE 6.—*Active storage, in thousands of acre-feet, required at the Scott Mountain site for periods of deficient natural streamflow*—Continued

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar	Apr.	May	June	July	Aug.	Sept.	Maximum in year	Rank
Schedule C														
1940		153.5	181.8	223.4	132.2	126.5	66.5	18.8	10.2	8.5	9.6	10.5	223.4	8
1941	4.6	106.0	149.5	128.5	233.3	357.7	324.0	275.7	264.0	260.9	260.1	240.3	357.7	3
1942	230.2	310.0	218.0	259.8	256.6	356.5	326.2	290.3	269.5	260.7	258.6	259.0	356.5	4
1943	258.4	214.1	63.6			55.2						.4	258.4	6
1944		104.7	164.7	227.5	293.4	361.5	281.4	252.4	236.7	232.6	232.2	232.7	361.5	2
1945	232.7	352.7	465.3	484.0	441.0	399.9	291.6	207.0	184.8	179.2	178.2	175.3	484.0	1
1946	175.3	176.9	112.0	43.1	23.2	31.3							177.0	10
1947				55.1	59.9	99.6	20.3	2.5					99.6	14
1948		10.1	63.0			21.2							63.0	17
1949		85.0		78.5		61.5	25.2					.2	85.0	15
1950		93.0	120.6									.5	120.6	13
1951											.6	1.9	1.9	20
1952		17.6				.2						1.1	17.6	19
1953	2.6	154.0	218.8										218.8	9
1954		1.2				38.4							38.4	18
1955		77.1	78.3	78.9	132.3	107.5							132.3	11
1956											.7	1.3	1.3	21
1957		122.8	152.7	224.9	221.5	146.9	64.3	29.1	14.2	8.9	6.9	7.6	224.9	7
1958	2.3	131.8	55.9			55.3					1.1	1.7	131.8	12
1959		27.6	77.6			55.2							77.6	16
1960		121.0	213.9	278.5	185.4	175.2	44.6					.1	278.5	5
Release schedule	6.0	160.0	160.0	160.0	160.0	160.0	6.0	6.0	6.0	6.0	6.0	6.0		

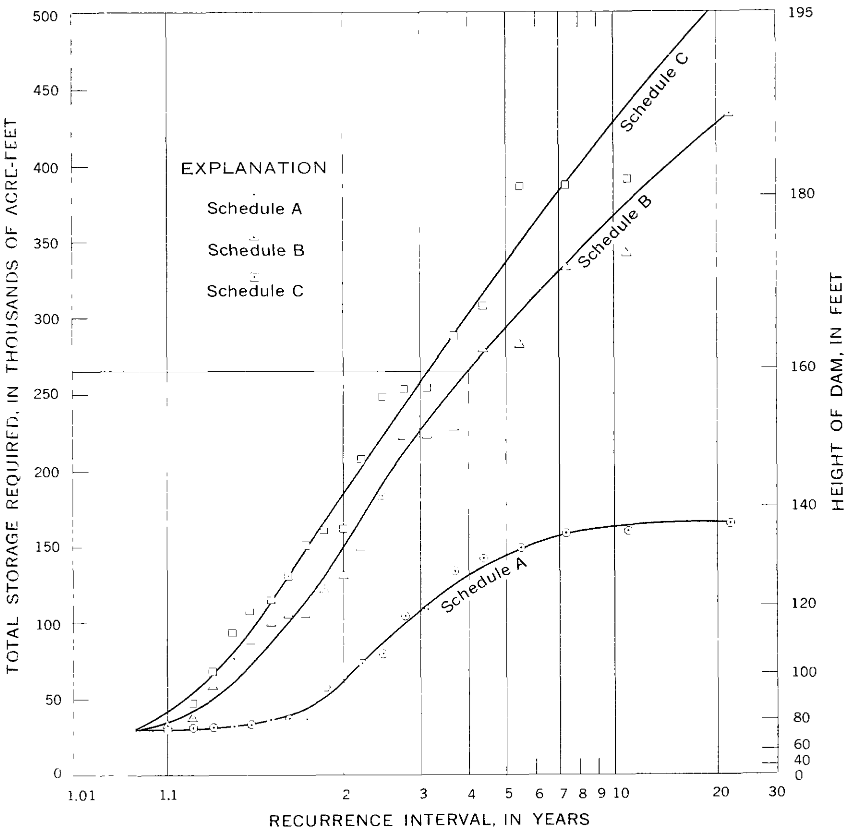

FIGURE 6.—Recurrence interval of flow deficiency for selected release schedules, Scott Mountain site.

237 feet and inundate approximately 10 miles of State Highway 34. The present water surface at the damsite has an altitude of about 77 feet. Table 7 shows the reservoir contents in acre-feet that would have resulted if schedule B had been used with a 160-foot dam (altitudes 77–237 ft) during water years 1940–60. The reservoir is full at 265,000 acre-feet and is not allowed to drop below 30,000 acre-feet.

Evaporation losses shown in table 7 were computed from evaporation records at Corvallis. A 3,000-acre reservoir was assumed. These losses total 31.55 inches per year. For the November–March period, average reservoir volume from table 7 was 194,000 acre-feet. The area-capacity curve in figure 3 shows a corresponding reservoir height of 144 feet for this volume of water. This head has been used in computing the potential power at the Scott Mountain site.

TABLE 7.—*Reservoir volumes, in thousands of acre-feet, for development of schedule B at the Scott Mountain site*

[Active storage is 235,000 acre-ft (265,000 − 30,000)]

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1940	[1] 2.9	[1] 3.4	[1] 129.1	33.5	134.7	150.4	209.6	256.3	263.5	263.6	260.9	259.0
1941	264.4	173.1	139.6	170.6	75.7	[2] 30.0	62.9	110.1	120.5	121.9	121.2	140.0
1942	149.7	79.8	181.8	150.0	163.2	73.4	102.9	137.7	157.2	164.2	164.9	163.4
1943	163.5	217.8	Full	Full	Full	219.8	Full	Full	Full	Full	Full	263.6
1944	Full	170.3	120.3	67.5	[2] 30.0	[2] 30.0	109.3	137.3	151.7	154.1	153.0	151.4
1945	150.9	41.0	[2] 30.0	[2] 30.0	83.0	134.1	241.6	Full	Full	Full	264.5	Full
1946	264.5	Full	Full	Full	Full	Full	Full	do	do	do	263.9	264.4
1947	Full	do	do	219.9	225.1	195.4	do	do	do	do	Full	Full
1948	do	264.9	222.0	Full	Full	253.8	do	do	do	do	do	Do.
1949	do	190.0	Full	196.5	do	213.5	249.0	do	do	do	263.8	262.7
1950	do	182.0	164.4	Full	do	Full	Full	do	do	do	263.7	262.2
1951	do	Full	Full	do	do	do	do	do	do	do	262.9	260.6
1952	do	257.4	do	do	do	do	do	do	do	do	263.9	261.8
1953	259.9	118.5	63.7	do	do	do	do	do	do	do	Full	Full
1954	Full	Full	Full	do	do	236.6	do	do	do	do	do	Do.
1955	do	197.9	206.7	216.1	172.7	207.5	do	do	do	do	263.9	264.9
1956	do	Full	Full	Full	Full	Full	do	do	do	do	262.8	261.2
1957	do	152.2	132.3	70.1	83.5	168.1	250.0	do	do	do	Full	263.4
1958	do	145.5	231.4	Full	Full	219.7	Full	do	do	do	262.4	260.8
1959	262.4	244.8	204.8	do	do	219.8	do	do	do	do	263.6	Full
1960	Full	154.0	71.1	230.0	133.1	153.3	do	do	do	do	Full	264.0
Evaporation loss	.5						.8	1.1	1.3	1.7	1.5	1.0

[1] Reservoir buildup period in October, November, and December of 1940 water year.
[2] Occurrence of flow deficiency. Reservoir never drawn below 30,000 acre-feet.

Table 8 gives releases that would have occurred from the Scott Mountain reservoir site if schedule B had been followed during periods when the reservoir was not full. This table is used for estimating runoff available at the Tidewater site downstream. It shows that deficiencies occurred during 6 months of 4 separate years. The deficiency during 3 of the 6 months amounted to less than 20,000 acre-feet. The first 3 months of the period of record are reserved for reservoir buildup and deficiencies to meet the release schedule during this period are not considered above.

TIDEWATER

Drainage area at the Tidewater damsite is 357 square miles. The runoff at the site, after regulation at the Scott Mountain site, was estimated to be the sum of releases at the Scott Mountain site (table 8) and the flow increment entering the stream between the two sites. This runoff is shown in table 9. Drainage areas at the Scott Mountain and Tidewater sites are 96 percent and 106 percent respectively of the area drained at the gaging station. The flow increment entering between the two sites, therefore, is estimated to be 10 percent of the runoff at the gaging station.

The altitude of the water surface at the Tidewater damsite is 7 feet, and at the Scott Mountain damsite it is 77 feet. These altitudes fix the lower and upper limits of the Tidewater reservoir. Because the height of the dam is fixed, recurrence-interval and storage-required curves would serve no purpose. Power development will be confined primarily to the November–March period, because runoff is highly concentrated during this time by the Scott Mountain reservoir releases. Table 9 shows that average monthly runoff during this period ranges from 164,700 acre-feet in November to 232,800 acre-feet in January. A conservation release of 100 cfs or 6,000 acre-feet per month would be assured during the April through October period. Figure 4 shows the full reservoir volume to be 36,000 acre-feet. A dead storage of 5,000 acre-feet would be kept to maintain a minimum head of 21 feet.

Table 10 shows the reservoir volumes that would have resulted if each of the three schedules had been used during the period of record. Evaporation losses shown in table 10 were computed from evaporation records at Corvallis on the basis of a 1,000-acre reservoir. These losses total 31.55 inches per year.

By examination of table 10 the following three water-release schedules were prepared:

TABLE 8.—*Release from Scott Mountain site, in thousands of acre-feet, if schedule B had been used*

[Aim: 150,000 acre-ft November-March; 6,000 acre-feet April-October]

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1940	[1] 6.0	[1] 6.0	[1] 70.0	150.0	150.0	150.0	6.0	6.0	6.0	6.0	6.0	6.0
1941	6.0	150.0	150.0	150.0	150.0	[2] 45.7	6.0	6.0	6.0	6.0	6.0	6.0
1942	6.0	150.0	150.0	150.0	150.0	150.0	6.0	6.0	6.0	6.0	6.0	6.0
1943	6.0	150.0	263.3	229.3	193.8	150.0	230.1	35.2	23.3	9.8	6.9	6.0
1944	35.7	150.0	150.0	150.0	[2] 131.6	[2] 91.9	6.0	6.0	6.0	6.0	6.0	6.0
1915	6.0	150.0	[2] 58.3	[2] 141.3	150.0	150.0	6.0	60.2	26.9	9.9	6.0	7.4
1946	6.0	157.8	225.0	228.9	179.9	151.9	56.0	23.2	15.2	10.4	6.0	6.0
1947	28.1	198.6	224.1	150.0	150.0	150.0	15.0	22.7	36.8	12.7	8.2	7.1
1948	148.3	150.0	150.0	206.1	182.6	150.0	115.8	85.3	26.5	11.9	7.1	6.9
1949	13.4	150.0	194.5	150.0	282.6	150.0	6.0	47.7	15.5	7.8	6.0	6.0
1950	6.2	150.0	150.0	225.9	296.8	220.9	78.8	40.9	16.0	7.7	6.0	6.0
1951	80.4	236.1	234.6	361.0	210.0	185.3	56.0	47.9	18.0	8.3	6.0	6.0
1952	89.5	150.0	283.7	241.5	228.7	159.8	58.5	26.8	15.0	9.1	6.0	6.0
1953	6.0	150.0	150.0	263.4	206.7	170.9	72.7	90.3	40.1	14.1	9.6	6.7
1954	22.4	158.8	312.2	333.7	259.9	150.0	92.4	26.1	17.2	9.6	6.6	8.1
1955	20.8	150.0	150.0	150.0	150.0	150.0	122.9	52.0	17.0	11.2	6.0	6.0
1956	58.5	224.4	399.2	297.3	178.5	258.2	84.2	24.9	12.9	6.4	6.0	6.0
1957	18.8	150.0	150.0	150.0	150.0	150.0	6.0	25.0	19.7	9.6	6.4	6.0
1958	9.2	150.0	150.0	186.2	260.8	150.0	83.7	39.8	17.2	7.1	6.0	6.0
1959	6.0	150.0	150.0	262.1	189.7	150.0	24.6	40.9	20.4	9.4	6.0	17.6
1960	30.2	150.0	150.0	[2] 136.5	150.0	150.0	24.1	97.9	33.7	11.6	6.6	6.0

[1] Reservoir buildup period, October, November, and December of 1940 water year.
[2] Occurrence of flow deficiency.

TABLE 9.—*Estimated runoff, in thousands of acre-feet, at the Tidewater site after regulation at the Scott Mountain site*

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Year
1940	7.0	6.7	83.7	162.3	176.2	167.3	12.9	11.6	7.5	6.8	6.5	6.5	655.0
1941	7.2	156.1	162.1	168.9	155.7	49.4	10.1	11.7	7.8	7.0	6.7	8.7	751.5
1942	7.7	158.4	176.3	162.3	167.0	156.3	9.8	10.4	8.8	7.5	6.9	6.6	877.9
1943	6.7	171.3	295.7	253.2	214.0	160.9	243.9	39.0	25.8	11.0	7.8	6.6	1,435.9
1944	40.2	155.8	160.4	160.1	141.4	101.4	15.0	9.7	8.3	7.1	6.7	6.6	812.5
1945	6.6	154.2	63.2	156.0	171.1	170.9	17.9	69.6	29.9	11.1	6.7	8.3	865.6
1946	6.6	174.3	248.4	252.7	198.7	167.7	62.0	25.8	16.9	11.6	6.7	6.8	1,178.1
1947	31.2	219.3	269.5	160.9	166.2	162.5	23.9	25.2	40.7	14.2	9.3	8.0	1,130.8
1948	163.8	165.6	161.2	232.0	201.6	164.5	129.2	94.3	29.4	13.3	8.1	7.7	1,370.7
1949	14.9	157.8	222.5	158.5	319.2	160.3	10.4	54.4	17.2	8.8	6.7	6.6	1,137.3
1950	7.1	157.0	163.8	259.9	327.7	243.9	87.1	45.2	17.8	8.6	6.6	6.6	1,331.4
1951	89.2	260.7	259.0	398.6	231.9	204.6	61.9	53.0	19.9	9.4	6.6	6.5	1,601.1
1952	99.4	164.8	314.1	266.7	252.5	176.4	64.7	29.7	16.7	10.2	6.7	6.5	1,408.3
1953	6.5	150.9	159.9	311.8	228.2	188.7	80.4	99.8	44.4	15.8	10.8	7.5	1,304.6
1954	24.7	175.4	344.7	368.4	287.0	162.7	105.1	28.9	19.1	10.8	7.4	9.0	1,543.2
1955	23.0	158.6	166.5	166.6	161.1	169.3	141.8	57.5	18.9	12.6	6.7	6.8	1,089.3
1956	64.7	247.8	440.8	438.7	197.1	285.1	93.0	27.6	14.4	7.3	6.6	6.6	1,829.5
1957	21.2	153.9	163.6	159.1	167.0	174.4	15.2	29.3	21.9	10.8	7.3	6.6	930.1
1958	10.3	153.2	174.6	209.1	288.0	160.9	97.3	44.0	19.1	8.1	6.5	6.6	1,177.6
1959	6.9	163.8	161.5	295.7	209.5	160.9	32.0	45.3	42.9	10.5	6.6	19.7	1,155.3
1960	33.4	154.1	157.0	146.4	176.4	167.7	38.3	103.1	37.4	13.0	7.4	6.6	1,040.8
Average	32.3	164.7	207.1	232.8	211.3	169.3	64.4	43.6	22.1	10.3	7.2	7.7	1,172.7

TABLE 10.—*Thousands of acre-feet of water in Tidewater reservoir, using the releases from Scott Mountain reservoir shown in table 8*

[Asterisk indicates that the reservoir was full, 36,000 acre-ft, 31,000 acre-ft usable]

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Schedule D												
1940	[1] 0.8	[1] 1.5	[1] 5.0	12.3	33.5	*	*	*	*	*	*	*
1941	*	*	*	*	*	(2)	8.9	14.2	15.6	16.0	16.2	18.5
1942	20.1	23.5	*	*	*	*	*	*	*	*	*	*
1943	*	*	*	*	*	*	*	*	*	*	*	*
1944	*	*	*	*	22.4	(3)	13.7	17.0	18.9	19.3	19.5	19.7
1945	20.2	19.4	(4)	6.0	22.1	*	*	*	*	*	*	*
1946	*	*	*	*	*	*	*	*	*	*	*	*
1947	*	*	*	*	*	*	*	*	*	*	*	*
1948	*	*	*	*	*	*	*	*	*	*	*	*
1949	*	*	*	*	*	*	*	*	*	*	*	*
1950	*	*	*	*	*	*	*	*	*	*	*	*
1951	*	*	*	*	*	*	*	*	*	*	*	*
1952	*	*	*	*	*	*	*	*	*	*	*	*
1953	*	31.9	*	*	*	*	*	*	*	*	*	*
1954	*	*	*	*	*	*	*	*	*	*	*	*
1955	*	*	*	*	*	*	*	*	*	*	*	*
1956	*	*	*	*	*	*	*	*	*	*	*	*
1957	*	34.9	*	*	*	*	*	*	*	*	*	*
1958	*	34.2	*	*	*	*	*	*	*	*	*	*
1959	*	*	*	*	*	*	*	*	*	*	*	*
1960	*	35.1	*	27.4	*	*	*	*	*	*	*	*
Evaporation loss	.17						.25	.36	.42	.58	.51	.33

See footnotes at end of table.

TABLE 10.—*Thousands of acre-feet of water in Tidewater reservoir, using the releases from Scott Mountain reservoir shown in table 8*—Continued

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Schedule E												
1940	[1]0.8	[1]1.5	[1]5.0	7.3	23.5	30.8	*	*	*	*	19.0	*
1941	*	32.1	34.2	*	31.7	(5)	8.9	14.2	15.6	16.0	16.2	18.5
1942	20.1	18.5	34.8	*	*	32.3	35.8	*	*	*	*	*
1943	*	*	*	*	*	*	*	*	*	*	*	*
1944	*	31.8	32.2	32.3	13.7	(6)	13.7	17.0	18.9	19.3	19.5	19.7
1945	20.2	14.4	(7)	(8)	16.1	27.0	*	*	*	*	*	*
1946	*	*	*	*	*	*	*	*	*	*	*	*
1947	*	*	*	*	*	*	*	*	*	*	*	*
1948	*	*	*	*	*	*	*	*	*	*	*	*
1949	*	33.8	*	34.5	*	*	*	*	*	*	*	*
1950	*	33.0	*	*	*	*	*	*	*	*	*	*
1951	*	*	*	*	*	*	*	*	*	*	*	*
1952	*	*	*	*	*	*	*	*	*	*	*	*
1953	*	26.9	26.8	*	*	*	*	*	*	*	*	*
1954	*	*	*	*	*	*	*	*	*	*	*	*
1955	*	34.6	*	*	*	*	*	*	*	*	*	*
1956	*	*	*	*	*	*	*	*	*	*	*	*
1957	*	29.9	33.5	32.6	*	*	*	*	*	*	*	*
1958	*	29.2	*	*	*	*	*	*	*	*	*	*
1959	*	*	*	*	*	*	*	*	*	*	*	*
1960	*	30.1	27.1	13.5	29.9	*	*	*	*	*	*	*
Evaporation loss	.17						.25	.36	.42	.58	.51	.33

See footnotes at end of table.

TABLE 10.—*Thousands of acre-feet of water in Tidewater reservoir, using the releases from Scott Mountain reservoir shown in table 8*—Continued

Water year	Oct.	Nov.	Dec.	Jan.	Feb	Mar.	Apr.	May	June	July	Aug.	Sept.
Schedule F												
1940	[1]0.8	[1]1.5	[1]5.0	(9)	16.2	18.5	25.1	30.4	31.5	31.7	31.7	31.9
1941	33.0	24.1	21.2	25.1	15.8	(10)	8.9	14.2	15.6	16.0	16.2	18.5
1942	20.1	13.5	24.8	22.1	24.1	15.4	18.9	22.9	25.3	26.2	26.5	26.8
1943	27.2	*	*	*	*	31.9	*	*	*	*	*	*
1944	*	26.8	22.2	17.3	(11)	(12)	13.7	17.0	18.9	19.3	19.5	19.7
1945	20.2	9.4	(13)	(14)	11.1	17.0	28.7	*	*	*	*	*
1946	*	*	*	*	*	*	*	*	*	*	*	*
1947	*	*	*	31.9	33.1	30.6	*	*	*	*	*	*
1948	*	*	32.2	*	*	35.5	*	*	*	*	*	*
1949	*	28.8	*	29.5	*	31.3	35.5	*	*	*	*	*
1950	*	28.0	26.8	*	*	*	*	*	*	*	*	*
1951	*	*	*	*	*	*	*	*	*	*	*	*
1952	*	35.8	*	*	*	*	*	*	*	*	*	*
1953	*	21.9	16.8	*	*	*	*	*	*	*	*	*
1954	*	*	*	*	*	33.7	*	*	*	*	*	*
1955	*	29.6	31.1	32.7	28.8	33.1	*	*	*	*	*	*
1956	*	*	*	*	*	*	*	*	*	*	*	*
1957	*	24.9	23.5	17.6	19.6	29.0	*	*	*	*	*	*
1958	*	24.2	33.8	*	*	31.9	*	*	*	*	*	*
1959	*	34.8	31.3	*	*	31.9	*	*	*	*	*	*
1960	*	25.1	17.1	(15)	16.4	19.1	*	*	*	*	*	*
Evaporation loss	.17	-----	-----	-----	-----	-----	.25	.36	.42	.58	.51	.33

[1] Reservoir buildup period, October–December of 1940 water year.
[2-15] Active storage exhausted. Deficiency in acre-feet:

2. 74.6.	7. 87.4.	12. 63.6.
3. 36.2.	8. 4.0.	13. 97.4.
4. 77.4.	9. 2.7.	14. 9.0.
5. 83.9.	10. 104.8.	15. 6.5.
6. 49.9.	11. 11.3.	

Schedule D: 155,000 acre-feet per month November–March and 6,000 acre-feet per month April–October, or 817,000 acre-feet per year.

Schedule E: 160,000 acre-feet per month November–March and 6,000 acre-feet per month April–October, or 842,000 acre-feet per year.

Schedule F: 165,000 acre-feet per month November–March and 6,000 acre-feet per month April–October, or 867,000 acre-feet per year.

If schedule D had been used, the reservoir would have been full 87 percent of the time, and three deficiencies would have occurred. The reservoir would have been full 79 percent of the time, and four deficiencies would have occurred if schedule E had been used. By using, schedule F the reservoir would have been full 63 percent of the time. Seven deficiencies would have occurred, but only three of them would have exceeded 7 percent of the scheduled release. Schedule F has been selected, because it is about the maximum release for which deficiencies in meeting the schedule can be tolerated. For the November–March period, average reservoir volume from table 10 (schedule F) was 27,930 acre-feet. Figure 4 shows the corresponding reservoir height to be 61 feet for this volume of water. This head has been used in computing the potential power at the Tidewater site.

The Tidewater reservoir would inundate the town of Tidewater and some homes along the river. The hillside above the present roadway between the Tidewater site and Hellion Canyon is more gradual than most places along the river. Road relocation would be over relatively favorable terrain and would not involve an extra hill because the present road climbs to an altitude of 250 feet to pass through a saddle east of Tidewater.

ESTIMATE OF POWER AND ENERGY

Power is computed by the formula $P=0.068QH$ when $P=$ power in kilowatts at 80 percent efficiency, $Q=$flow in cfs, and H $=$ head in feet. A summary of power and energy is given in table 11. The major part of the energy could be used in the Northwest power pool during critical periods in winter months. During the November–March period, 24,500 kw could be generated continuously at the Scott Mountain site and 11,400 kw at the Tidewater site for a total of 35,900 kw. The annual energy figure listed is the product of power and total hours in a year; this is a theoretical value based on complete use of water listed in the water-release schedule. In actual operation all the water listed in the schedule might not be used owing to demand fluctuations. However, a great

TABLE 11.—*Estimated potential power and energy, Alsea River, Oregon*

Powersite	*Q* Flow (cfs)	*H* Head (ft)	*P* Power (kw)	*E* Annual energy (kwh)
Scott Mountain:				
November to March	2,503	144	24,510	88,820,000
April to October	99	144	969	4,977,000
Total				93,797,000
Tidewater:				
November to March	2,754	61	11,420	41,386,000
April to October	99	61	411	2,111,000
Total				43,497,000
Total, power and energy			35,930	137,294,000

deal of secondary energy could be produced during certain periods, and actual energy output could exceed that shown in table 11. Energy potential from table 11 for the November–March period is 88,820,000 kwhr at the Scott Mountain site and 41,386,000 kwhr at the Tidewater site for a total of 130,206,000 kwhr.

PUMPED-STORAGE POSSIBILITIES

Pumped-storage powersites are plentiful in the Alsea River basin. One of these, the Five Rivers dam and reservoir site, has already been mentioned. To utilize this site for pumped-storage would require construction of a low dam downstream on the Alsea, probably at or below Tidewater, to raise the water to the tailrace of the Five Rivers powerplant site, which would be 80–90 feet above sea level. Water would be pumped from this reservoir into the upper reservoir on Five Rivers during off-peak hours, and energy would be supplied from the network or some of it could be generated at a powerplant installed at the Tidewater dam. The amount of power made available would depend upon the size of the installations and the length of the periods of use.

A pumped-storage development might also be achieved in connection with the Tidewater reservoir. Pumping capacity and head could be combined as desired to achieve a large or small development. A large development is described.

A hilltop in the SE¼ sec. 20, T. 13 S., R. 10 W., rises to an altitude of 1,750 feet above sea level within about 1½ miles of the Tidewater damsite. At an altitude of 1,600 feet the hilltop has an area of approximately 37 acres. By removing the top above this altitude and using it for embankment material, a reservoir of about 1,750 acre-foot capacity could be constructed. The embankment would be about 70 feet high, and have a 10-foot top and slopes of

2.5:1 in the reservoir and 2:1 outside of it. Average head would be about 1,560 feet, the difference between the reservoir at one-half capacity (estimated at altitude 1,637 ft) and the maximum pool of the lower reservoir (altitude 77 ft). The pumped water could also be passed through the turbines of the plant (see p. D33) below the Tidewater dam.

The potential capacity of the site would depend upon the schedule of operations. If, for example, the upper reservoir were filled and emptied twice a day, the filling being accomplished in 6- to 12-hour periods and the emptying in 3-hour periods, 7,060 cfs would be available for producing power. Acting through a head of 1,560 feet, this water would generate 749,000 kw at an operating efficiency of 80 percent. This would make 4,494,000 kwhr of energy available daily for use during hours of high demand. Pumping requirements would be in the neighborhood of 6 million kwhr daily of off-peak energy. This energy requirement is several times greater than the potential production capability of the Alsea River plants, and interconnecting high-voltage transmission lines would be a prerequisite.

A potential storage site on Canal Creek, which enters the Alsea in sec. 32, T. 13 S., 10 W., about half a mile downstream from the Tidewater damsite might be used for pumped storage. Drainage area of the creek is only 13 square miles, and for that reason the creek has little value for power production by itself. However, it could be used as a storage basin for a pumped-storage development in which as much as 400 feet of head could be achieved if a topographically suitable damsite in sec. 5, T. 14 S., R. 10 W., is geologically sound. According to the Tidewater quadrangle (scale 1:62,500, contour interval 50 ft), the reservoir would have the following areas and capacities:

Area and capacity of Canal Creek reservoir site

[Damsite in sec. 5, T. 14 S., R. 10 W.]

Altitude (feet)	Area (acres)	Capacity (acre-feet)
40	0	0
50	30	150
100	80	2,900
150	170	9,000
200	300	21,000
250	510	41,000
300	750	73,000
350	1,020	117,000
400	1,390	177,000

Water could be pumped into the Canal Creek reservoir from the Tidewater reservoir. A very large installation having a tailrace altitude of 10 feet could be made near tidewater for producing peaking kilowatts, or the relatively large volume of water could be held as standby storage for carrying a smaller plant for a considerable time. The reservoir would hold enough water for a discharge of 3,000 cfs for 30 days. When the reservoir was drawn to one-half capacity, head would be about 310 feet. It could produce nearly 63,000 kw at 80 percent efficiency.

DIVERSION TO THE WILLAMETTE RIVER BASIN

Alsea River water could be diverted to the Willamette River basin by way of tributaries to Marys River. Most of the water available for diversion falls as precipitation during the fall and winter months when there is ample water in the Willamette tributary streams in the area, and suitable storage sites to hold the water for use during July, August, and September would be necessary. The diverted water would probably be used principally for municipal supplies as the Corvallis-Philomath area population increases, but it would also be capable of providing supplemental irrigation water to lands on the benches on either side of Muddy Creek and the Marys River south of Philomath. Diversion routes from North and South Forks Alsea River are shown on plate 2.

An extensive study of the need for diversion of water from the Alsea River to the Willamette River basin is not within the scope of this paper. However, the amount of water available for diversion and the general physical barriers to such diversion are properly briefly described. Before a diversion is undertaken, a study should be made of the possibility for pumping the necessary water from the Willamette River and its tributaries and for providing the water in the Willamette when needed by constructing reservoirs inside the basin upstream from Corvallis.

NORTH FORK

The drainage basin of the North Fork Alsea River upstream from the County Line site could be connected with Marys River by way of Crooked and Wells Creeks in a canal which would be about 7 miles long and which would include some tunneling. In lieu of the canal and tunnel combination, a tunnel 3.7 miles long beginning at an altitude of about 850 feet would connect the County Line reservoir site and a point near a balancing reservoir site on Crooked Creek in the Alsea River basin. A second tunnel about

0.8 mile long at an altitude of 800 feet would connect the balancing reservoir with Wells Creek, a tributary of Greasy Creek in the Marys River basin. A conduit about 1½ miles long could carry the water from the tunnel outlet to a point on Greasy Creek where it can be dropped 290 feet (altitude of 790 ft to an altitude of 500 ft) if development of power in connection with the diversion is deemed advantageous.

It is estimated that 62,000 acre-feet could be diverted after allowing an average discharge of 10 cfs to pass downstream and after deducting 10 cfs for losses by evaporation and seepage in the County Line reservoir. The County Line reservoir site has a capacity of only 24,000 acre-feet for a 200-foot dam, and an additional storage site will be needed in order to assure delivery of water during dry periods. The most favorable site for this purpose is on the east side of the Oregon Coast Range on Greasy Creek, a Marys River tributary. A dam in sec. 16, T. 12 S., R. 6 W., that would raise the water surface from an altitude of about 310 feet to the 500-foot contour as shown on the Corvallis and Monroe 15-minute quadragles would create a reservoir of 144,000 acre-feet. The reservoir would be entirely downstream from the Wells Creek powersite previously mentioned, and the water could be retained in the reservoir until needed for municipal purposes or for irrigation. The area and capacity of this site are shown in the following tabulation:

Area and capacity of Greasy Creek reservoir site

[Damsite in sec. 16, T. 12 S., R. 6 W.]

Altitude (feet)	Area (acres)	Capacity (acre-feet)
310	0	0
350	180	3,600
400	590	22,850
450	1,160	67,000
500	1,950	144,000

SOUTH FORK

The drainage basin of the South Fork upstream from the Peak Creek site in secs. 23 and 26, T. 14 S., R. 7 W., could be connected with Marys River by way of Oliver and Muddy Creeks through a tunnel 2.2 miles long at an altitude of 800 feet. A tunnel 2.5 miles long at the same altitude would surface on Rainbow Creek, which is tributary to Oliver Creek in the Muddy Creek basin. This conduit could be extended about three-fourths of a mile in a canal to a 385-foot drop site should it be found desirable to develop waterpower in connection with the diversion. The average yield of the South Fork and Peak Creek at the Peak Creek site is estimated to be about 65,000 acre-feet per year. About 50,000 acre-feet would be available for diversion after providing 10 cfs average discharge downstream at the Peak Creek damsite and allowing an additional 10 cfs for evaporation and leakage in that reservoir. The Peak Creek reservoir site having a dam that would raise the water 225 feet to an altitude of 900 feet would have a capacity of about 74,000 acre-feet. The area-capacity tabulation shows that 67,000 acre-feet of this water would be stored above an atlitude of 800 feet. This storage would make the diversion schedule very flexible without any storage required on the east side of the Coast Range.

The valley bottoms on Muddy Creek and its tributaries are wide, and the streams have gentle gradients downstream from the powersite suggested on Rainbow Creek. Damsites are lacking, however, and it would be necessary to construct long dikes to retain the water until the dry season. A reservoir having a maximum altitude of 400 feet might be created on Muddy Creek in the valley around the settlement of Alpine. A dam 110 feet high would be 0.9 mile long at a site in the SW¼ sec. 19, T. 14 S., R. 5 W., and the SE¼ sec. 24, T. 14 S., R. 6 W. Auxiliary dams about 50 feet high would be required in saddles on each side of the main embankment. The area and capacity of this site as measured from the Monroe 1:62,500-scale quadrangle map, which has a 50-foot contour interval, are shown in the following tabulation.

Area and capacity of Alpine reservoir site, Muddy Creek

[Damsite in sec. 19, T. 14 S., R. 5 W., and sec. 24, T. 14 S., R. 6 W.]

Altitude (feet)	Area (acres)	Capacity (acre-feet)
290	0	0
300	730	3,650
325	1,460	31,000
350	2,450	79,900
375	3,070	148,900
400	4,320	241,000

If this site is to be used, it would probably be limited to a dam height that would create a reservoir having a maximum pool of not more than 350 feet in altitude unless it is to serve also as a storage site for excess runoff from Oliver and Reese Creeks and the Long Tom River. Water from these streams would have to be pumped into the reservoir, but that might become economically feasible and desirable. In any event the site is so large in comparison with the South Fork Alsea water available that complete regulation would be easily achieved by its use. The reservoir could be useful for flood control on Muddy Creek and Marys River.

A Corps of Engineers channel rectification project has been authorized on Muddy Creek and Marys River to benefit 16,275 acres of land.

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