LOWER COLUMBIA RIVER FISHERIES DEVELOPMENT PROGRAM

COWLITZ AREA

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COWLITZ RIVER AREA

BASIN DESCRIPTION

The Cowlitz River drains 2,490 square miles of the western slopes of the Cascade Range in Washington from Mount Rainier south to Mount Adams and Mount St Helens. Formed by the confluence of the Clear Fork and the Ohanapecosh River, the main Cowlitz flows generally southwest for about 133 miles to join the Columbia River at Longview, Washington, (Columbia River mile 68). The watershed was originally heavily timbered, but large areas of the bottom lands, which are well suited for agriculture, have been cleared and are now cultivated. A considerable portion of the higher levels has also been logged. The headwater areas are mountainous and heavily timbered. The upper tributaries flow through deep, narrow canyons with steep gradients. A short distance below the junction of Muddy Fork and Ohanapecosh River the valley floor opens out to a width of about one-half mile. At Randle, river mile 103, the valley floor has a width of one mile or more. At river mile 66 the stream enters Youngs Canyon. In the 14-mile reach from the head of Youngs Canyon to the foot of Mayfield Canyon, at river mile 52, the river flows in a box canyon. Below Mayfield Canyon, the stream flows southward, and the valley widens and maintains a width of about 3 miles from that point to the mouth of the river. The

stream gradient is moderate throughout most of its length from the confluence of Muddy Fork and Ohanapecosh River, at elevation 1,100 feet to the mouth, at practically sea level. From the confluence of the Muddy Fork and Ohanapecosh rivers, the Cowlitz flows for 41 miles with an average fall of 7 feet per mile to the mouth of Cispus River; then for 32 miles with an average slope of 16 feet per mile to the mouth of Tilton River; then 38 miles with an average slope of 7 feet per mile to the mouth of Toutle River, and then 20 miles with an average slope of 2 feet per mile to the confluence with Columbia River. Just below the mouth of the Cispus River at river mile 90, the Cowlitz flows through a deep, rocky canyon Several low falls in this section are passable with difficulty for migrating salmon. There are no other major obstructions in the main stream. Extensive spawning areas exist in the main Cowlitz River, particularly from Mayfield Canyon (river mile 52) upstream to above Randle (river mile 103).

Stream Flow Characteristics.

Primarily, Cowlitz River run-off results from rainfall. During the late spring, however, snow-melt from the headwaters area contributes appreciably to the stream flow. The annual discharge pattern is characterized by high flows between November and June and low flows from July through October. Recorded flows of Cowlitz River at Castle Rock, Washington, 14 miles upstream from the mouth, (drainage area of 2,240 square miles) indicate a maximum discharge for a 20-year period of record of 139,000 second-feet on December 23, 1933,

and a minimum of 998 second-feet on November 7 and 8, 1935. The only important tributary downstream from Castle Rock is Coweman River with a drainage area of 133 square miles.

Table 1. Recorded flows for Cowlitz River at Castle Rock, Washington, water years 1928-47.

Water Year	Minimum Daily Sec.ft.	Date	Maximum Daily Sec.ft.	Date	Mean Sec.ft.
1928	1,620	9/27-30	71,300	10/25	10,100
1929	1,390	9/29,30	21,100	5/25	6,480
1930	1,230	10/23	29,500	2/8,20	5,980
1931	1,280	10/1,2,3	63,200	4/1	6,300
1932	1,270	10/19,20	49,200	2/27	9,710
1933	1,430	9/9	52,200	11/14	11,500
1934	1,290	9/30,31	134,000	12/23	12,680
1935	1,260	10/19	58,100	10/6,7	10,140
1936	1,050	11/7	39,800	1/12	8,075
1937	1,110	12/1	47,200	4/15	7,726
1938	1,520	10/14	60,500	12/30	9,851
1939	1,540	10/9	39,800	2/15	7,728
1940	1,480	9/22	40,500	12/17	7,199
1941	1,390	10/8,9	22,100	11/29,30	4,881
1942	1,560	9/20	55,400	12/20	7,268
1943	1,320	10/22	58,300	11/24	9,468
1944	1,550	9/12	33,700	12/4	5,318
1945	1,600	10/29	44,200	2/8	7,418
1946	1,600	9/29	51,700	12/29	10,160
1947	1,340	10/18	82,400	12/13	9,615

Description of Tributaries.

The principal tributaries below the junction of Muddy Fork and Ohanapecosh River are Coweman, Toutle, Tilton, and Cispus rivers, and, in addition, there are numerous important smaller salmon streams including Salmon Creek and Olequa Creek.

During 1950 the Washington Department of Fisheries conducted a clearing project in the Cowlitz basin as part of the Lower River Program. Most of the tributaries were cleared of debris to permit passage of migrating salmon, and the balance will be cleared in 1951.

Coweman River (I-17-A), 33 miles long, enters the Cowlitz River one mile above the mouth on the left bank. The lower 4 miles of river, flowing through diked lowlands, is usually turbid, and since the bottom consists of mud and sand there is little available spawning area. The stream flows for the next 11 miles through a rather narrow valley that is canyon-like at intervals. The most extensive spawning areas are in the 8-mile section below the confluence of Mulholland Creek. The valley is narrow, the gradient steeper, and the spawning areas decrease in size and value in the upper sections. A low falls 5 miles upstream and another at 12 miles are reported to hinder fish movement. Twenty miles upstream, and 3 miles above the confluence of Mulholland Creek, there is a 9-foot falls that is a low-water barrier to salmon. Upstream 24 miles, two abandoned splash dams one of which was 38 feet high were total barriers to salmon. In 1949 they were opened to permit free passage of fish. Three tributaries to the Coweman River, Goble Creek (I-17-A-1), Mulholland Creek (I-17-A-2), and Baird Creek (I-17-A-3) have limited amounts of spawning area that are available since the obstructing log jams and dams have been removed.

Ostrander Creek (I-17-B) enters the Cowlitz River 7 miles

above the mouth and is 10 miles long. The lower mile is bordered by small farms and the remainder by second-growth timber. The gradient is moderate in the lower reaches and provides suitable spawning area for about 1.5 miles above the mouth where it enters a canyon. The gradient becomes steep at this point, and a series of cascades and boulder rapids limit fish migration, and spawning area becomes extremely limited to the source of the stream. These barriers have rendered all but the lower 2.3 miles of stream inaccessible. The South Fork of Ostrander Creek (I-17-B-(1)) has suitable spawning area available for a quarter mile to an 8-foot falls which is impassable. The next 3 miles of the stream provide good to excellent spawning and rearing area.

Arkansas Creek (I-17-C) enters the Cowlitz River 15 miles above the mouth near Castle Rock, Washington. Main Arkansas Creek is only 2 miles long below the confluence of North Fork and South Fork. The stream flows through a wide, farmed valley and is entirely slough-like with no available spawning area, however, there are numerous deep pools with good protective cover. There are no barriers or diversions in this lower section. North Fork Arkansas Creek, or Dobson Creek, (I-17-C-(1)) is about 10 miles long, of which the lower 2 miles flows through a flat lowland and has a mud and sand bottom of little value to salmon. The gradient increases in the next 2.5 miles and the stream has good distribution of spawning gravel. South Fork Arkansas Creek or Scantigrease Creek (I-17-C-(2)) has a total length of about 9 miles. The stream

is slow moving in the lower 2 miles as far as an impassable 18-foot falls but provides some good spawning and rearing areas. Above the falls the central section has excellent spawning gravel and a moderate gradient. Monahan Creek (I-17-C-(2)a) enters South Fork 2 miles above the mouth. A series of three cascades forms an obstruction 2.5 miles above the mouth, but additional desirable spawning areas exist above this obstruction.

Toutle River (I-17-D) enters the Cowlitz River about 17 miles above the mouth and is 52 miles long from its origin at Spirit Lake. The river is 135 feet wide and 4 to 5 feet deep at its mouth, and about 25 feet wide below Spirit Lake outlet. The gradient averages 20 feet per mile for the lower 15 miles, and gradually increases upstream to an average of 151 feet per mile in the upper 8 miles. The watershed is hilly and mountainous and has been logged except in the upper portions. Practically no farming is carried on in the valley. The only obstacke to the movement of fish is a small dam at Spirit Lake outlet which is at most only a partial barrier at low water. There are considerable areas of suitable gravel for spawning throughout most of the stream.

A constant water supply is assured by melting snow on Mount St. Helens. Flows of record for 23 years indicate a maximum discharge of 35,600 second-feet on March 2, 1910, near Silver Lake, about 12 miles above the mouth. The minimum discharge was 240 second-feet on November 21, 1929. Of the numerous tributaries that enter the Toutle River, the South Fork (I-17-D-(2)), and Green River

(I-17-D-(4)) are the largest and most important. Each of these streams is over 25 miles long, has moderate gradient becoming steeper in the upper sections, has numerous resting pools, and is free from major obstructions in the lower sections. Big Falls, 20.5 miles from the mouth of Green River, is a total barrier. A hatchery is now under construction on lower Green River as part of the Lower River Program. There are also numerous smaller tributaries to the Toutle River that have important spawning gravel available. Flow records for a 7-year period on the South Fork indicate a maximum flow of 8,710 second-feet on December 11, 1946, and a minimum flow of 63 second-feet on September 4, 1947. Flows of the Green River for the water-year 1946-47 indicate a maximum flow of 12,000 second-feet on December 11, 1946, and a minimum flow of 52 second-feet on September 4, 1947.

Olequa Creek (I-17-E) enters Cowlitz River 22 miles above the mouth and is 20 miles long. The hilly watershed has been logged, and the valley floor is farmed. There are two towns along the stream course, Winlock, and Vader. The gradient is low to moderate, and there are many deep, large pools with dense marginal vegetation. A low falls about 5 miles upstream is difficult for fish to pass at some water stages. A 22-foot lumber mill dam at Winlock was formerly an impassable barrier until 1948 when the State Fisheries Department in cooperation with the owners constructed a new fishway. There is considerable spawning area in Olequa Creek above the lower 5 miles and above the dam, as well as in some of the tributaries.

LaCamas Creek (I-17-F) enters the Cowlitz River 27 miles above the mouth and is 22 miles long. Much of the watershed has been logged off, and the stream is subject to some erosion. The stream gradient is generally slight and provides suitable spawning areas throughout the major portion of its length.

Salmon Creek (I-17-G) is 35 miles long and enters the Cowlitz River 37 miles from the mouth. Much of the stream has been exposed by logging operations and erosion has been severe. This has resulted in much of the bottom in the lower section being covered with silt. The upper sections have a steeper gradient and contain much suitable spawning gravel. Most of the tributaries are too small to be of value.

Tilton River (I-17-K) enters the Cowlitz River 64 miles from the mouth and is 26 miles long. The stream valley is narrow in the lower 6 miles, with a deep canyon occurring 3 to 6 miles upstream. Above the canyon the valley is quite wide and dotted with farms. Three difficult log jams, the upper one being over one-half mile long, blocked the stream to fish passage 12 and 16 miles above the mouth until recently removed. A power dam, 10 feet high, 15.5 miles above the mouth, recently was blasted out by the Washington State Department of Fisheries, thus making available the upper portions of the river. There are excellent spawning areas all along the river above the lower canyon. Stream flows of a 6-year period indicate a maximum discharge of 14,500 second-feet on December 13, 1946. The minimum of 66 second-feet was recorded on

September 11-12, 1944.

Several of the larger tributaries to the Tilton River have spawning areas available, however, most of the small tributary streams are precipitous and have little spawning area of value.

Cispus River (I-17-U) enters the Cowlitz River 90 miles above the mouth, and is one of the largest tributaries, being about 50 miles long. Gail Falls, 30 feet in height, forms an impassable barrier 33.5 miles from the mouth. There are no obstructions in the lower river except a bedrock chute and boulder cascades in the half mile immediately below the falls. The lower 6 miles of the river are bordered by benches and hills that have been denuded by logging operations. Proceeding upstream through a canyon-like section, the stream valley widens slightly so that there is a narrow valley floor between 8 and 18 miles above the mouth. The upper 13 miles to the falls are also in a canyon. Most of the upper section of the watershed has been burned over. The stream gradient is variable, increasing from 20 feet per mile near the mouth to 150 feet per mile near the falls. Large, deep, well-protected resting pools average eight per mile. Some glacial silt is brought into the stream from Mount Adams during the summer months, but the current is usually sufficient to prevent silting on the spawning riffles. There is considerable area suitable for spawning between 11 and 15 miles above the mouth with areas of lesser importance occurring above and below.

Stream flows recorded for a 19-year period at a point 14 miles above the mouth indicate a maximum discharge of 20,000 second-feet on December 22, 1933, and a minimum of 183 second-feet on December 30, 1936.

Many of the tributaries to the Cispus River are steep and subject to rapid run-off because of lack of adequate forest cover. The North Fork of Cispus River (I-17-U-(13)) has adequate forest cover and has excellent spawning areas for 6 miles of the stream to an impassable 18-foot falls.

Several tributaries between Cispus River (river mile 90) and Ohanapecosh River (river mile 133) have suitable spawning gravels available, particularly in the lower sections; many are blocked by impassable falls a short distance from their mouths.

Under the Lower River Program a salmon hatchery is proposed for construction on Hall Creek (I-17-MM) at river mile 120, with part of the water supply to be derived from Johnson Creek (I-17-LL). Flow records for Hall Creek indicate a maximum discharge of 604 second-feet on December 13, 1946, and a minimum discharge of 3.7 second-feet October 17-18, 1946. Maximum discharge of Johnson Creek was 2,990 second-feet December 11, 1946; minimum discharge 15 second-feet October 17-19, 1946.

The Washington State Department of Fisheries has installed hatchery racks near the mouths of both Clear Fork of the Cowlitz (I-17-TT) and Ohanapecosh River (I-17-UU) to obtain eggs of spring chinook salmon for artificial propagation. Natural falls and

steep gradient prevent access to the upper reaches of these streams above the racks.

ECONOMIC DEVELOPMENT

The entire Cowlitz River watershed was originally heavily timbered, but a considerable portion has been logged, and large areas of the bottom lands which are well suited for agriculture have been cleared and are now under cultivation. The headwater area is mountainous and still heavily timbered, although removal of forest cover on some of the watersheds has resulted in exposing the land to considerable erosion. The Cowlitz system has had several bad floods resulting in damage to lowland areas near its mouth. It has been found necessary to construct levees and install bank revetment to help control the excessive run-off.

There is very little present demand for irrigation water in the Cowlitz basin. The total irrigated area in 1939 was reported at 219 acres. As shown in a table in the appendix there is now a total of 3,925 acres under irrigation. Dairying and the production of hay and grains are important locally.

The hydroelectric power potentiality of the Cowlitz River has not, and, in the interest of a long-range fisheries program, should not be developed. Power developments as of 1947 consisted of five small privately-owned plants located on tributary streams. These plants are no longer in operation.

Potential irrigation developments in the Cowlitz basin

include projects involving the irrigation of substantial acreage, and expansion of hydroelectric power generation. There are 15 potential power sites on the main stream. The Columbia River Review Report of the U. S. Corps of Engineers describes nine of these sites. At two of these sites water rights have been applied for and the projects are being considered for immediate development by the city of Tacoma. These are the Mossyrock and Mayfield projects. The former site is located on Cowlitz River at mile 65 and contemplates a dam about 325 feet high, capable of about 300,000 kilowatts at ultimate installation. The latter site (Mayfield) is located at mile 52. At this location a dam about 185 feet high could be constructed, with ultimate installation of 160,000 kilowatts.

In addition to the Mossyrock and Mayfield plans, additional possible projects are as follows: Cowlitz Falls, located on Cowlitz River approximately one mile below the mouth of Cispus River. There are two possibilities for dams at this site. A single concrete dam of 330 feet high, or two dams, one concrete and the other earth-fill averaging 225 feet in height, would provide approximately the same storage, 5,000,000 acre-feet.

In the Walupt Lake project an earth dam 75 feet high at the outlet of Walupt Lake at the head of Cispus River would provide 40,000 acre-feet of storage capacity. Prime capability at the site would be only about 3,500 kilowatts.

The Muddy Fork project includes a dam site located on Cispus River just below the mouth of Muddy Fork About 35,700

kilowatts of prime capability could be developed at this site.

The Greenhorn project proposes a dam on Cispus River about 2 miles below the mouth of Greenhorn Creek. A dam at this site would raise the water surface 310 feet to create a reservoir of 420,000 acre-feet capacity. About 20,800 kilowatts of prime capability could be developed.

The Tilton dam site is located on Tilton River about 6 miles upstream from the confluence with Cowlitz River. At this site water surface could be raised 153 feet to provide total storage capacity of 55,000 acre-feet. According to the U. S. Bureau of Reclamation, development of the Tilton site for storage of 55,000 acre-feet could be used for irrigation of the Jackson Prairie area.

The Kid Valley site includes a possible dam located on Toutle River below the confluence of Green and North Fork Toutle rivers. This project would raise the water surface 420 feet and provide 625,000 acre-feet of usable storage capacity. In addition to the concrete dam, an earth dike about 800 feet long and 50 feet high would be required. Preliminary studies indicate 41,600 kilowatts of nominal prime capability could be developed at the site.

The Castle Rock project includes three dams and two diversion conduits by use of which the flows of Cowlitz River, Salmon Creek, and Toutle River could be combined at the head of one power drop. The three dams would be located at the Toledo, Salmon Creek, and Castle Rock sites. Toledo dam site is on Cowlitz River about 3

miles above Toledo. A possible future dam at this location would raise the water surface 120 feet to the tailwater level of the proposed Mayfield power plant. The Salmon Creek site is located on Salmon Creek, about 5.5 miles upstream from Cowlitz River. A possible dam at this site would raise the water surface 50 feet. A tunnel would carry combined flows of Cowlitz River and Salmon Creek to the Castle Rock dam on Toutle River.

Castle Rock dam site is located on Toutle River about 4 miles above the mouth. A possible dam at this site would be 50 feet high. About 116,000 kilowatts of nominal prime capability would be developed. About 4,510,000 acre-feet would be diverted from Cowlitz River, 92,000 acre-feet would be diverted from Salmon Creek, and the remaining 1,470,000 acre-feet would come from the Toutle.

An ultimate Cowlitz River hydroelectric system consisting of all potential and possible future projects would have a nominal prime capability of about 700,000 kilowatts. The U. S. Corps of Engineers has no immediate plans for development of the Cowlitz River because of the need of the area for salmon spawning grounds. The policy of giving priority to the fishery resource in this area should be extended since the State of Washington has set aside the lower Columbia area as a fish sanctuary to be maintained free of high dams.

Navigation on the Cowlitz is provided by a channel 2.5 feet deep and 50 feet wide to Castle Rock (mile 17); and beyond by a channel of 2.5-foot depth and not less than 40 feet wide to

Toledo (mile 34). The deep-water port developed at Longview on the Columbia River at the mouth of the Cowlitz River provides an outlet to the sea. Navigation is of very limited value on the Cowlitz River.

HISTORY OF FISHERY OPERATIONS

Historical data of the fishery operations on the Cowlitz is largely confined to the records of two salmon hatcheries and to spawning ground counts of salmon during the past 6 years.

The Tilton hatchery operated during the period of 1915 to 1921, during which time silver salmon and steelhead eggs were taken (Table 2). No rearing was done at the Tilton station, which was located near the old power dam site several miles downstream from the town of Morton.

The Cowlitz salmon hatchery was abandoned for rearing purposes in 1949 but has continued to serve as an egg-taking station for spring chinook (Table 2). The site still will be retained for spawn-taking operations when the new Cowlitz hatchery is placed in operation.

When it was operated as a rearing station the old hatchery had a total of four dirt ponds approximately 22 feet x 50 feet and one larger pond roughly 28 feet x 62 feet. Water was supplied, as it is now to the few remaining troughs, from an intake on the Clear Fork. Because of rigorous winters and long periods of cold water temperatures, however, production was limited and the growth of

salmon was slow.

Data on hatchery stocking of salmon in the area are available only for recent years, indicating that the greatest effort has been placed on spring chinook and silver salmon (Table 3).

Table 2. Cowlitz River egg take, 1915 to 1950.

Cowlitz River				Tilton River		
Calendar Year	Spring Chinook	Silver	Steelhead	Calendar Year	Silver	Steelhead
1915[1]	--	--	--	1915[1]	40,300	--
1915	--	--	--	1915	362,000	--
1916[2]	--	--	--	1916[2]	337,500	--
1917	--	--	--	1917	2,064,000	24,000
1918	--	--	--	1918	1,323,000	1,239,000
1919	--	--	--	1919	1,112,600	1,651,600
1920	--	--	--	1920	1,772,000	1,619,000
1921	--	--	--	1921	1,038,000	790,500
1922	--	--	--	1922	--	627,000
1923	--	--	--	1923	--	--
1924	--	--	--	1924	--	--
1925	--	--	--	1925	--	--
1926	2,635,000	--	--	1926	--	--
1927	2,083,000	--	--	1927	--	--
1928	2,035,500	--	--	1928	--	--
1929	2,062,000	--	--	1929	--	--
1930	5,023,400	--	--	1930	--	--
1931	2,657,800	--	--	1931	--	--
1932	882,800	--	--	1932	--	--
1933	392,100	--	--	1933	--	--
1934	6,099,907	--	--	1934	--	--
1935	1,066,900	--	--	1935	--	--
1936	2,013,100	--	--	1936	--	--
1937	1,030,300	--	--	1937	--	--
1938	878,216	--	--	1938	--	--
1939	1,397,025	--	--	1939	--	--
1940	1,218,750	--	--	1940	--	--

(Table 2 cont.)

Cowlitz River				Tilton River		
Calendar Year	Spring Chinook	Silver	Steel-head	Calendar Year	Silver	Steelhead
1941	1,327,762	104,188	--	1941	--	--
1942	1,393,231	24,320	--	1942	--	--
1943	603,698	60,495	3,555	1943	--	--
1944	1,062,200	68,354	--	1944	--	--
1945	543,542	68,240	--	1945	--	--
1946	122,082	--	--	1946	--	--
1947	469,544	42,420	--	1947	--	--
1948	372,856	--	--	1948	--	--
1949	371,050	--	--	1949	--	--
1950	190,464	--	--	1950	--	--

1/ Eight-month period.
2/ Four-month period.

Table 3. Cowlitz River plantings of salmon and steelhead, 1942 to 1950.

Calendar Year	Fall Chinook		Spring Chinook			Silver			Steelhead
	Fry	Fingerling	Fry	Fingerling	Yearling	Fry	Fingerling	Yearling	Fingerling
1942	--	--	215,074	585,180	77,755	--	11,087	26,794	3,172
1943	--	--	43,326	523,614	21,048	20,333	--	20,134	--
1944	--	100,000	--	182,308	43,494	--	--	79,494	--
1945	--	150,000	--	470,512	--	--	4,440	20,160	--
1946	--	70,000	--	271,898	31,853	--	35,583	101,741	--
1947	349,260	218,506	--	34,891	29,406	--	--	95,418	--
1948	--	30,000	--	161,508	13,005	--	68,899	22,675	--
1949	--	--	--	454,243	57,124	--	209,152	--	--
1950	--	200,000	--	170,985	--	--	--	--	--

Counts of salmon on the spawning grounds have been carried out recently by a two-man crew during the fall months. Although this method of survey is by no means accurate, much valuable data have been secured with reference to the magnitude of adult escapement, the preference and limits of spawning areas, the time of arrival and length of time that the several species of salmon spend in certain river sections and tributary streams, etc. By these check surveys at approximately the same time each year it has been hoped that the relative abundance of escapement can be ascertained, thus affording a more accurate basis for regulation of the fishery.

PRESENT STATUS OF FISHERY

General comments on type, extent, and production of fishery.

A discussion of the present fish status in the Cowlitz River necessitates considering the area by smaller parts. A convenient means by which to do this is to consider the main Cowlitz, each of the major tributaries, and the minor tributaries grouped together as separate producing areas. Consequently, the river has been divided into six areas, namely, (1) the main Cowlitz, (2) the minor tributaries, (3) Coweman River, (4) Toutle River, (5) Tilton River, and (6) Cispus River.

Salmon utilizing the waters of the Cowlitz River for spawning and rearing purposes are spring and fall chinook, early and late runs of silvers and a few chums.

Spring chinook salmon migrate to and spawn predominantly

in the uppermost available areas of the main Cowlitz and the Cispus rivers. They are found in small numbers in the headwaters of the Tilton and Toutle rivers and are known to occasionally enter the smaller tributaries of their headwaters.

An estimated escapement of 10,400 spring chinook annually enter the Cowlitz River to spawn. These are distributed generally in the following manner: 400 to the upper Toutle River, 200 to the upper Tilton River, 8,100 to the Cispus River, and 1,700 to the upper main Cowlitz River. These fish migrate through the Columbia River to the mouth of the Cowlitz between mid-February and mid-May. They are exploited by a February and May commercial fishery in the Columbia River as well as by the troll fishery offshore from California to Alaska. Protection is given this stock of fish in the Columbia during the commercially closed period throughout March and April. A fairly intensive sport fishery operates on this stock throughout the Cowlitz, but primarily near the mouth of the river.

Spring salmon require cool water in which to rest through the summer months until spawning time, which occurs primarily between mid-August and mid-September in the Cowlitz and its tributaries. Hence, they seek cold mountain streams of spring or glacier-fed waters, which are reasonably protected by forest cover. Consequently, no spring chinook spawn in the lower Cowlitz or in its lower tributaries because water temperatures in these areas become too high during the summer and early fall.

Spring chinook in the main Cowlitz spawn entirely above

the town of Packwood, Washington. The upstream limit of migration is the series of waterfalls located about 3 to 5 miles below Ohanapecosh Hot Springs. In the Cispus the spring chinook spawn almost entirely above Iron Creek, a tributary entering the Cispus 8 miles above the mouth. They are not found above the mouth of East Canyon Creek, 28 miles above the confluence of the Cispus and the Cowlitz. Little spawning area is present above this point and a series of extreme cascades terminating at the 35-foot Gail Falls form a complete barrier to further salmon migration within the next 5 miles upstream. Little is known of the spawning grounds present for this species in the Tilton and Toutle rivers.

The spawning escapement of 10,400 fish produces 53,000 pounds of fish to the river fishery valued at $30,200. The troll catch is estimated at 67,100 pounds valued at $38,300. Thus, the total commercial catch is 120,100 pounds valued at $68,500 annually. The sport fishery takes an additional 3,400 pounds, at $6,000, making a combined production of 123,500 pounds worth $74,500 a year.

Fall chinook salmon migrate to and spawn within all the major tributaries of the Cowlitz River, several of the smaller tributaries, as well as the main river. Spawning occurs throughout the available area open to anadromous fishes from the first favorable gravel riffle area in the lower river to the headwaters.

An estimated escapement of 31,000 fall chinook annually enter the Cowlitz River to spawn. These are distributed generally in the following manner: 10,900 in the main Cowlitz and its minor

tributaries, 6,500 in the Toutle and tributaries, 500 in the Tilton River, 8,100 in the Cispus and tributaries, and 5,000 in the Coweman River. The bulk of the Cowlitz River fall chinook pass through the lower Columbia between mid-August and mid-September. The river closed season between August 26 and September 10, consequently, offers considerable protection to these fish. There is, however, an intensive sport fishery in both the Columbia and Cowlitz rivers which takes a consierable number.

Fall chinook spawn normally on lowering water temperatures prevalent following the first rainfall in the autumn about October 1. They spawn primarily in the larger rivers and streams and only incidentally are found in the small tributaries. Common water temperatures prevailing during fall chinook spawning time range from 40° to 50° F. In the main Cowlitz, fall chinook can be found during spawning time from approximately 6 miles above the mouth of the river to the accessible headwaters. The bulk of these do, however, spawn in the lower sections of the stream. The spawning range in the Cispus River is, so far as is known, about the same as that for the spring chinook. In the Tilton, fall chinook are primarily found on the favorable gravel beds below the town of Morton, Washington. The Toutle River fall chinook migrate upstream as far as Coldwater Creek, which is 6 miles below the source of the river, Spirit Lake. An estimated 80 percent of the total spawners, however, utilize the lower 5 miles of the Toutle River. In the Coweman all chinook migrate beyond the 4 or 5 miles of slow

moving water at the mouth. Intensive spawning occurs in the next 8 miles of stream, and occasional pairs of these fish migrate as far as a 9-foot falls located 20 miles upstream.

Based upon the best available data, the spawning escapement of 31,000 fish produces 930,000 pounds of fish to the Columbia River fishery, valued at $353,400 annually. The troll catch amounts to 390,600 pounds, worth $148,400 annually, and the sport catch, 86,400 pounds worth $151,200. The combined contribution to the fisheries is 1,407,000 worth an annual value of $653,000.

Both early and late run silver salmon spawn throughout the accessible small tributaries of the Cowlitz River basin. An estimated escapement of 32,500 silvers annually enter the Cowlitz River to spawn. Approximately 16,000 of these are estimated to be of an early run, and the remainder are considered late run. It is generally considered that most of the early silvers migrate to upper tributaries while the bulk of the late silvers spawn in the lower streams. Only in the Coweman River, which, at present, has only two favorable silver tributaries, is there a scarcity of these fish. All silvers are subjected to the offshore troll fishery, which operates from California to Alaska. The early run of silvers is generally believed to migrate through the lower Columbia between mid-August and late September. A sizeable portion of these, consequently, are protected by the August 26 to September 10 closed commercial fishing period. Late silvers pass through the lower Columbia from October 1 until well into December and are therefore

exploited considerably more by the river fishery, which until December 1 observes only week-end closed fishing periods. Silvers are extensively fished by sportsmen in both the Columbia and the Cowlitz and its tributaries.

Early silvers spawn from late October until late November and the later races will be found to spawn from late November until well into March if water conditions are favorable. Both require small streams, fine gravel, and considerable timber and brush cover for the ideal spawning area. Common water temperatures prevailing during silver salmon spawning time range from 35° to 45° F. Silvers spawn in Gable Creek and Mulholland Creek, both of which are tributaries to the Coweman River, as well as in the main Coweman near the mouth of Mulholland Creek. Considerable numbers spawn at the source of the Toutle River just below Spirit Lake and in three small tributaries of the lake. At least 20 small tributaries of the Toutle River provide additional spawning grounds for large numbers of this species. The main Tilton and its numerous tributaries annually receive hundreds of migrant adult silvers. The same is true of all available tributaries to the Cispus River below East Canyon Creek. Migration beyond this stream is not known and is virtually non-existant because of difficult and impossible passage to all anadromous fishes in the main Cispus River above. Thirty-four tributaries of the main Cowlitz are known to have spawning silvers each year, and doubtless many more unknown small tributaries also contribute to the stocks of silver salmon. In virtually the case of every

silver tributary, the upper extremity of the spawning grounds is determined by a natural barrier, i.e. falls, log jams, natural dams, etc. The total lengths of the various streams varies from a few hundred feet to 10 or 12 miles in the lower Cowlitz. Tributaries entering the mountainous regions of the upper Cowlitz nearly all have waterfalls which are total barriers to fish passage a short distance above the stream's mouth.

Based upon the best available data, the spawning escapement of 16,000 early silvers produce 89,600 pounds of fish to the Columbia River fishery annually, and the 16,500 late silvers produce 396,000 pounds valued at $184,500. In the troll fishery 367,200 pounds are provided from these two stocks, worth $139,500. The sport take amounts to approximately 17,000 pounds valued at $29,800, giving a combined total contribution to all fisheries of 869,800 pounds worth annually $353,800.

Chum salmon are little known in the Cowlitz River watershed. They are reported to utilize to a small degree the lower sections and the lower tributaries of the Cowlitz. None are known to be blocked by any of the natural barriers in the entire subbasin, and it is highly unlikely that any chums migrate beyond Mayfield on the main Cowlitz River.

A total minimal estimated escapement of 1,000 chums annually enter the Cowlitz River to spawn. Chums are not caught by the offshore fishery and are consequently taken only in the Columbia River by commercial fishermen. The bulk of the chums are believed

to pass through the lower Columbia River fishery during the months of October and November. They are protected only by a week-end closed fishing period. No sport fishery operates on this species.

Chums reach the peak of spawning time during early November. They normally spawn in rather slow-moving, shallow water, which passes over medium-sized gravel. Common water temperatures during chum salmon spawning time range from 40° to 45° F. The limits of the spawning range for chums in the Cowlitz River and its tributaries are not known, however, it is probably that spawning occurs on the first available gravel present in the following tributaries: Coweman River, Ostrander Creek, Arkansas Creek, Toutle River, Salmon Creek, Olequa Creek, and LaCamas Creek. Extensive upstream migration in any tributary is not likely.

The spawning escapement of 1,000 fish is estimated to produce annually 33,000 pounds of fish to the Columbia River fishery valued at $10,600.

Steelhead.--The steelhead production from the Cowlitz River to the commercial fishery amounts to approximately 122,400 pounds worth $181,000, making a combined yield of 225,900 pounds valued at $236,200 annually.

Hatcheries.--At the present time there are no hatcheries in operation in the Cowlitz River area. The old Cowlitz River hatchery was closed in December of 1949 and is now used only for spring chinook egg-collection and eyeing during the late summer months. Eyed eggs are now transported to the Green River hatchery

for hatching and rearing and the reared fish are then planted in the upper Cowlitz River. No eggs of other species of salmon are taken at this station.

In the calendar year 1950 the following reared fish were planted in this sub-basin:

Alder Creek - 50,000 fall chinook fingerling.

South Fork Toutle River - 100,000 fall chinook fingerling.

Tilton River - 50,000 fall chinook fingerling.

Cowlitz River - 170,985 spring chinook fingerling.

No silvers were planted in 1950, but in previous years from 25,000 to 100,000 reared silvers were planted in the Cowlitz River system.

Other fish facilities and improvements.

Present upstream fish passage facilities on the Cowlitz watershed are confined to a single ladder located on Olequa Creek at the England Lumber Company dam within the town of Winlock. This ladder, 176 feet in length, was completed in the spring of 1948 by the lumber company under supervision of the Fisheries Department. The ladder has been very effective in passing the runs of silver salmon, steelhead and trout over this 22-foot-high dam.

The screening of water intake structures is a mandatory requisite in the issuance of all water diversion permits issued within the realm of fish-inhabited waters of the State. Diversions, though numerous in the Cowlitz area, are confined to relatively small amounts for purposes of irrigation, small power plants,

domestic use, gravel washing operations, etc. There are no diversions large enough to require rotary screens, therefore, present screening problems on the Cowlitz are at a minimum.

PROPOSED FISHERY PROGRAM

Lower River Program.

Stream Improvement.--The proposed fishway and stream improvement work under the Columbia River Fisheries Development Program is outlined in Table 4. The correction of remaining obstructions will be accomplished on a priority basis determined by the need and benefit. All initial stream clearance work has been accomplished with funds allocated for the fiscal year 1950.

Table 4. Stream Improvement Program of Cowlitz River.

Stream	Remaining Obstructions	Miles Added	Miles To be Added	Cost	Increased Number of Spawners 1/ Ch.	Sil.	Chum	Sth.	Remarks
Cowlitz River	7-ft. falls	None	None	10,000	1000	1000	--	100	Cowlitz Falls-2/
Coweman River	4'4'9'3' falls	14	22	30,000	200	1000	--	200	3/
Goble Creek	None	1.5	None	--	20	50	--	20	3/
Mulholland Cr.	9-ft. falls	6	6	10,000	--	200	--	50	3/
Baird Creek	None	6	None	--	--	300	--	30	3/
Ostrander Creek	8-ft. falls	1	3	6,000	--	250	--	30	3/
Ecklert Creek	None	1	None	--	--	50	--	--	3/
Arkansas Creek	None	None	None	--	--	--	--	--	
Dobson Creek	None	2	None	--	--	50	--	20	3/
Monahan Creek	6',8',8'falls	.5	4	30,000	--	350	--	50	3/
Scantigrease Cr.	18-ft. falls	1.5	7	35,000	--	400	--	100	3/
Toutle River	None	None	None	--	--	--	--	--	
Outlet Creek	None	.5	None	--	--	50	--	--	3/
S. Fk. Toutle R.	None	None	None	--	--	--	--	--	
Studebaker Cr.	None	2	None	--	--	200	--	30	3/
Johnson Creek	None	5	None	--	50	200	--	20	3/
Thirteen Creek	Cascades	None	None	--	--	--	--	--	4/
Eighteen Creek	10-ft. falls	None	None	--	--	--	--	--	4/
Twenty Creek	6-ft. falls	None	None	--	--	--	--	--	4/
Big Wolf Cr.	Cascades	None	None	--	--	--	--	--	4/
Whitten Creek	30-ft. falls	None	None	--	--	--	--	--	5/
Bear Creek	10-ft. falls	None	None	--	--	--	--	--	4/
Harrington Cr.	Cascades	None	None	--	--	--	--	--	4/
Trouble Creek	Cascades	None	None	--	--	--	--	--	4/
Middle Fk. Toutle	RR culvert	3	None	--	--	100	--	20	RR culvert partial block. 3/
Green River	6',13',60'falls	None	12	35,000	100	1000	--	100	60'falls not feasible to correct. 3/

(Table 4 cont.)

Stream	Remaining Obstructions	Miles Added	Miles To be Added	Cost	Increased Number of Spawners[1/] Ch.	Sil.	Chum	Sth.	Remarks
Devils Creek	6-ft. falls	None	3	6,000	--	100	--	20	2/
Cascade Creek	Cascades	None	None	--	--	--	--	--	5/
Elk Creek	7-ft. falls	None	1	6,000	--	50	--	20	2/
Miners Creek	Falls; cascades	None	6	10,000	100	300	--	20	Str.Cl.incomplete
Alder Creek	None	4	None	--	--	100	--	20	3/
Hoffstadt Creek	8' 6' falls	2	3	15,000	--	300	--	50	3/
Bear Creek	None	3	None	--	--	100	--	20	3/
Deer Creek	10',12',14'falls	1.5	None	--	--	100	--	30	3/
Jackson Creek	None	2	None	--	--	100	--	30	3/
Elk Creek	None	0.5	None	--	--	30	--	10	3/
Maratta Creek	None	1	None	--	--	75	--	25	3/
Castle Creek	20',10' falls	1	4	30,000	100	200	--	50	Str.Cl. to be completed by logging co.
Coldwater Creek	Cascades	5	2	5,000	100	200	--	30	3/
S.Fk. Coldwater	6-ft. falls	1	3.5	6,000	--	100	--	25	3/
Studebaker Creek	20'boulder cascade		None	2,000	--	100	--	30	3/
Olequa Creek	3-ft. falls	None	None	500	--	--	--	--	2/
N.Fk.Olequa Cr.	12-ft. falls	None	1.5	8,000	--	75	--	20	3/
E.Fk.Olequa Cr.	None	None	None	--	--	--	--	--	
W.Fk.Olequa Cr.	None	None	None	--	--	--	--	--	
Stillwater Cr.	4-ft. cascade	10	None	500	--	100	--	20	2/
Brim Creek	None	1	None	--	--	50	--	10	3/
Campbell Cr.	None	1	None	--	--	50	--	10	3/
Decker Cr.	None	0.5	None	--	--	30	--	10	3/
Ferrier Creek	None	2	None	--	--	50	--	20	3/
LaCamas Creek	None	8	None	--	--	200	--	30	3/
Salmon Creek	None	0.5	None	--	--	50	--	--	3/
Cedar Creek	30-ft. falls	0.5	4	30,000	--	500	--	50	3/
Mill Creek	20',15',20'falls	0.5	12	40,000	--	400	--	100	3/
Winston Creek	40',12',20'falls	None	None	--	--	--	--	--	5/

(Table 4 cont.)

Stream	Remaining Obstructions	Miles Added	Miles To be Added	Cost	Increased Number of Spawners[1/] Ch.	Sil.	Chum	Sth.	Remarks
Klickitat Creek	4 20-ft. falls	None	None	--	--	--	--	--	5/
Tilton River	20-ft. falls	None	4	20,000	--	300	--	50	3/
Cinnabar Creek	18', 20' falls	None	None	--	--	--	--	--	5/
Bear Canyon Cr.	Series of falls	None	None	--	--	--	--	--	5/
N.Fk.Tilton Riv.	Series of falls	None	None	--	--	--	--	--	5/
Wallanding Cr.	12'falls;cascades	None	None	--	--	--	--	--	5/
Otter Creek	Falls; cascades	None	None	--	--	--	--	--	5/
Rockies Creek	Falls; cascades	None	None	--	--	--	--	--	5/
Jesse Creek	Falls; cascades	None	None	--	--	--	--	--	5/
Winnie Creek	Falls; cascades	None	None	--	--	--	--	--	5/
Davis Creek	None	None	None	--	--	--	--	--	
Minnie Creek	10'concrete dam	None	1	--	--	100	--	--	Private dam
Mines Creek	10' falls & dam	None	None	--	--	--	--	--	5/
E.Fk.Tilton Riv.	None	7	None	--	50	100	--	30	3/
Nineteen Creek	12',20',15' falls	0.5	None	--	--	50	--	--	3/
W.Fk.Tilton Riv.	None	5	None	--	100	300	--	50	3/
Sulphur Creek	12',180' falls	None	None	--	--	--	--	--	5/
Shelton Creek	Falls; cascades	None	None	--	--	--	--	--	5/
Landers Creek	Series of falls	1	None	--	--	50	--	--	3/, 5/
Steffens Creek	Beaver dams	None	None	--	--	--	--	--	2/
Uden Creek	Beaver dams	None	None	--	--	--	--	--	2/
Frost Creek	Beaver dams	None	None	--	--	--	--	--	2/
Rainey Creek	None	3	None	--	--	150	--	50	3/
Goat Creek	35' falls	None	None	--	--	--	--	--	5/
Cispus River	30'falls;cascades	None	None	--	--	--	--	--	4/
Quartz Creek	Cascades; falls	2.5	None	--	--	100	--	10	3/, 5/
Iron Creek	30-ft. falls	2.5	None	--	--	200	--	10	3/, 5/
Greenhorn Creek	60-ft. falls	1.5	None	--	--	100	--	20	3/, 5/
Niggerhead Cr.	5',25'& series of falls	3	35,000	50	100	--	30	3/	
N.Fk.Cispus Riv.	25-ft. falls	None	5	40,000	100	300	--	50	4/
Juniper Creek	Falls	None	None	--	--	--	--	--	5/
E. Canyon Cr.	Falls	None	None	--	--	--	--	--	5/

(Table 4 cont.)

Stream	Remaining Obstructions	Miles Added	Miles To be Added	Cost	Increased Number of Spawners[1/] Ch.	Sil.	Chum	Sth.	Remarks
Squaw Creek	Falls	None	None	--	--	--	--	--	5/
Adams Creek	Falls	None	None	--	--	--	--	--	5/
Orr Creek	Falls	None	None	--	--	--	--	--	5/
Siler Creek	12',20' falls	1	2	30,000	--	150	--	20	3/
Miller Creek	Series of falls	None	None	--	--	--	--	--	5/
Silver Creek	Series of falls	None	2	40,000	--	100	--	50	3/
E.Fk.Silver Cr.	15-ft. falls	None	2	25,000	--	100	--	30	3/
Davis Creek	Series of falls	None	None	--	--	--	--	--	5/
Cunningham Creek	Beaver dams	None	None	--	--	--	--	--	2/
Owens Creek	Beaver dams	None	None	--	--	--	--	--	2/
Kilborn Creek	Series of falls	None	None	--	--	--	--	--	5/
Garrett Creek	Series of falls	None	None	--	--	--	--	--	5/
Burton Creek	Series of falls	None	None	--	--	--	--	--	5/
Willame Creek	2 20'falls;cascades		None	--	--	--	--	--	5/
Smith Creek	2 20'falls;cascades	1	None	--	--	50	--	--	3/, 5/
Johnson Creek	Series of falls	3	None	--	--	100	--	20	3/, 5/
Glacier Creek	Boulder cascades	None	None	--	--	--	--	--	5/
Hall Creek	None	2	None	--	--	200	--	20	3/
Hager Creek	Falls; power dam	0.5	None	--	--	20	--	--	5/
Skate Creek	Series of falls	None	5	35,000	--	300	--	70	3/
Johnson Creek	12'falls;cascades	None	None	--	--	--	--	--	5/
Butter Creek	Series of falls	None	None	--	--	--	--	--	5/
Lake Creek	Series of falls	None	None	--	--	--	--	--	5/
Coal Creek	Series of falls	None	None	--	--	--	--	--	5/
Purcell Creek	Series of falls	None	None	--	--	--	--	--	5/
Clear Fk.Cowlitz	Series of falls	None	None	--	--	--	--	--	5/

(Table 4 cont.)

Stream	Remaining Obstructions	Miles Added	Miles To be Added	Cost	Increased Number of Spawners 1/ Ch.	Sil.	Chum	Sth.	Remarks
Courtwright Creek	Series of falls	None	None	--	--	--	--	--	5/
Ohanapecosh River	Series of falls	None	None	--	--	--	--	--	5/
Stream clearance				36,000	___	___	___	___	
				~~556,000~~ $71,000	1970	11430		1930	

1/ Ch. - Chinook; Sil. - Silvers; Sth. - Steelhead
2/ Partial block
3/ Stream clearance completed
4/ Further survey required before work can be recommended
5/ Not economically feasible to correct

Table 5. Proposed Rainy Creek Hatchery production.

Species	No. Ponds Start	Final	Initial Population	Releases 1-3 Mos.	Releases Yearling	Total Releases
Fall Ch.	7	0	1,400,000	1,250,000	--	1,250,000
Silver	4	11	450,000	60,000	330,000	390,000
Steelhead	1	1	50,000	--	30,000	30,000
	12	12	1,900,000	1,310,000	360,000	1,670,000

Table 6. Proposed Toutle Hatchery production.

Species	No. Ponds Start	Final	Initial Population	Releases 1-3 Mos.	Releases Yearling	Total Releases
Sp. Chinook	1	1	150,000	90,000	35,000	125,000
Fall Ch.	12	1	2,400,000	1,750,000	35,000	1,785,000
Silver	10	20	1,500,000	800,000	650,000	1,450,000
Steelhead	1	2	90,000	--	60,000	60,000
	24	24	4,140,000	2,640,000	780,000	3,420,000

At the Toutle hatchery site it is planned to construct a dam with a fishway, and a trapping device on the Green River. Adult fish holding ponds will also be constructed.

Undoubtedly sufficient eggs can be collected from indigenous stocks of fall chinook, silver salmon, and steelhead for artificial propagation, releasing adequate amounts above the dam for natural propagation. It may be possible to collect sufficient spring chinook eggs for the proposed Toutle hatchery program at the Green River traps. The rearing schedule for this station will follow the same pattern as practiced at other State salmon hatcheries to get

the maximum production of all species consistent with controlling factors such as water temperatures and correct time of release of migrating stock.

The over-all plans for the development of this hatchery have been approved by the U. S. Fish and Wildlife Service

The Cowlitz hatchery cost of development is estimated at $515,000. Of this amount $220,000 is now authorized to be spent.

Construction work will begin in the spring of 1951, and it is anticipated that a partial operating unit will be completed by the spring of 1952, with the station going into full production in the fall of 1953.

Table 7 gives the approximate fish production after the station is fully developed.

Table 7. Proposed Cowlitz River Hatchery production.

Species	No. Ponds Start	Final	Initial Pop.	Releases 1-3 Mos.	Releases 4-9 Mos.	Yearling	Total Releases
Sp. Chinook	2	2	400,000	175,000	50,000	70,000	295,000
Fall Ch.	11	1	2,200,000	1,545,000	30,000	35,000	1,610,000
Silver	12	21	1,800,000	600,000	400,000	735,000	1,735,000
Steelhead	1	2	90,000	--	--	60,000	60,000
	26	26	4,490,000	2,320,000	480,000	900,000	3,700,000

Rearing and planting plans for the Cowlitz station will follow, in general, those of the Toutle hatchery. Because of lower summer temperatures, however, it will be possible to carry larger

pond populations over for fall and the following spring releases.

Spring chinook eggs for the station will be collected at the present egg-collection station at Ohanapecosh. The eyed eggs will then be transferred to the new station for hatching and rearing. A few fall chinook and silver salmon now enter Hall Creek. It is planned to trap both these species, together with steelhead, in this stream adjacent to the hatchery site. For the first few years of operation, however, it will be necessary to secure eggs of fall chinook, in particular, at another hatchery, probably the Toutle station, or until runs to the trapping stream are sufficient for egg-taking purposes.

All fish planted from this hatchery will be planted in the upper Cowlitz River and its tributaries.

Investigations directly pertinent to Lower River Program.--By carrying out two proposed investigations on the Cowlitz sub-basin area, considerable valuable data concerning the stocks of fish involved will be obtained. A permanent upstream-downstream weir is proposed for the Coweman River, a tributary to the lower Cowlitz River. One temporary counting weir is proposed for each of the following small streams: West Fork Tilton River, East Fork Tilton River, Rainy Creek, Kiona Creek, Johnson Creek, and North Fork Cispus River. These latter weirs would be installed and maintained only throughout the migrating and spawning periods of the species of salmon involved. The structures would be located at the mouths of the six proposed streams below all salmon spawning

grounds and would provide the following valuable information

1. They would provide complete tag and mark recoveries in the streams to be racked. They would, therefore, accurately show the return to a stream of hatchery marked and planted young fish, and, by means of tag recoveries, the contribution of this stream to the Columbia River fishery. Also by correlation with the time and speed of migration of the various species of salmon, the effect of the commercial fishery, sport fishery, and closed seasons on a given stock of fish would be found.

2. Accurate counts of spawning escapement would be provided, which could be used to compare with estimated escapement counts made by stream surveyors and a ratio between the two counts established which could be used with some degree of accuracy in other like streams.

3. They would offer an opportunity to trap fish for artificial propagation. Young resulting from this propagation and reared to the desired size in some nearby hatchery could then be sensibly planted in streams of comparable character to that from which the original eggs came.

4. They would provide an estimate of the number and species of predator, trash, and other fishes which are native to the stream. This information would be of considerable importance in measuring the success of fresh-water existence for young salmon.

5. By means of fyke nets used to catch downstream migrants resulting from a known number of spawners, a calculated total number

of young can be estimated, which, together with the number of spawners, would provide a measure of the success of natural spawning.

6. They would provide a means of determining the time of migration of adults with respect to weather and all water conditions (viz., low flow, high flow, turbidity, temperature, etc.).

Continued environmental and apawning ground studies should be undertaken to keep existing data current and to provide a means of determining whether or not stream improvements carried out in the Cowlitz River tributaries are increasing the fish population in the various streams. These studies would also provide a means of determining the physical conditions in the stream to which fish will be subjected in the future years.

Summary.--The proposed development of the Cowlitz River basin under the Lower River Program is estimated to cost $2,141,000 for initial phases and $199,000 annually for operation and maintenance (Table 8).

Table 8. Summary of improvements recommended for Cowlitz River Area.

Stream	Type of Correction or Improvement	Estimated Cost
All area streams	Removal of log jams, etc.	$ 36,000*
Main Cowlitz Riv.	Correction of falls	10,000
Coweman River	Correction of falls	30,000
Mulholland Creek	Correction of falls	10,000
Ostrander Creek	Correction of falls	6,000
Monahan Creek	Correction of falls	30,000
Scantigrease Creek	Correction of falls	30,000
Green River	Correction of falls	35,000
Devils Creek	Correction of falls	6,000
Elk Creek	Correction of falls	6,000
Miners Creek	Correction of falls;cascades	10,000
Hoffstadt Creek	Correction of falls	15,000

(Table 8 cont.)

Stream	Type of Correction or Improvement	Estimated Cost	
Castle Creek	Correction of falls	$ 30,000	
Coldwater Creek	Correction of cascades	5,000	
Coldwater Cr.,S.Fk.	Correction of falls	6,000	
Studebaker Creek	Correction of cascades	2,000	
Olequa Creek	Correction of falls	500	
Olequa Cr., N.Fk.	Correction of falls	8,000	
Stillwater Creek	Correction of cascades	500	
Cedar Creek	Correction of falls	30,000	
Mill Creek	Correction of falls	40,000	
Tilton River	Correction of falls	20,000	
Niggerhead Creek	Correction of falls	35,000	
Cispus Riv., N.Fk.	Correction of falls	40,000	
Siler Creek	Correction of falls	30,000	
Silver Creek	Correction of falls	40,000	
Silver Creek, E.Fk.	Correction of falls	25,000	
Skate Creek	Correction of falls	35,000	
Total - Stream Improvements			571,000
Cowlitz River Hatchery	Construction	515,000**	
Toutle River Hatchery	Construction	620,000**	
Rainy Creek Hatchery	Construction	400,000	
Total - Hatcheries			1,535,000
Upstream Traps, 7 locations	Construction	50,000	50,000
Total Improvements			$ 2,156,000
Annual Costs			
Hatcheries		174,000	
Fishways		8,000	
Stream Maintenance		5,000	
Appraisal of project results		22,000	
Total - Annual Costs			$ 209,000

* Completed in 1950.
** Current development

State Program.

The State program regarding problems pertinent to salmon management will be continued as at present. These problems involve:

A. Field investigation and writing of approvals or permits for:

   (1) Water diversion applications

   (2) Gravel removal operations in streams

   (3) Culvert construction

   (4) Channel changes or revetment work

   (5) Logging operations along or across streams

B. Assistance in the preparation of plans and the supervision of construction and operation of fish-passage facilities over any obstructions created by individuals, companies, or governmental agencies.

C. Cooperation with the State Pollution Commission in investigation and correction of stream pollution problems where fish life is involved.

D. Gathering, compilation and application of biological data for management purposes. In summation the State will continue to manage in so far as possible the various factors as they affect the fish life produced by these streams to gain the maximum public benefit in perpetuity.

E. The continuation of technical advice and cooperation in private projects, educational projects, etc., where salmon conservation or utilization is involved.

CONTEMPLATED RESULTS OF FISHERY PROGRAM

As a result of the recommended improvements of the Cowlitz River and tributaries, it is estimated that the production in the fishery will be increased 2,262,100 pounds a year, worth $781,700, giving a total expected yield of 4,347,400 pounds and $2,109,800 (Table 9).

Table 9. Summary of present and proposed production of Cowlitz area.

Species	Present Yield Pounds	Present Yield Dollars	Increased Yield: Stream Improvement Pounds	Increased Yield: Hatcheries Pounds	Increased Yield: Total Dollars	Total Expected Yield Pounds	Total Expected Yield Dollars
Spring chinock	123,500	74,500	--	31,500	19,000	155,000	93,500
Fall chinook	1,407,000	653,000	83,900	483,700	262,400	1,974,600	915,400
Silvers	869,800	353,800	455,300	545,100	407,600	1,870,200	761,400
Chum	33,000	10,600	--	--	--	33,000	10,600
Steelhead	225,900	236,200	34,700	54,000	92,700	314,600	328,900
Totals	2,659,200	1,328,100	573,900	1,688,200	781,700	4,347,400	2,109,800
				2,262,100			

Total annual benefit		$ 781,700
Total annual cost		
Initial cost prorated at 4%	85,600	
Proposed O & M	199,000	284,600

Cost-benefit ratio = 1:2.7

A P P E N D I X

TEMPERATURE AND STREAM FLOW DATA

COWLITZ RIVER AREA

Stream	Tributary of	Water Temp. Max.	Min.	Location	Period Covered	Water Flow Max.	Min.	Location	Period Covered
Cowlitz R.	Columbia R.	68	33	At Castle Rock	1/[illegible]/49	139,000	998	Same	1926-49
Coweman R.	Cowlitz R.	76	32	Nr. mouth Mulholland Cr.	1/49-8/50	140	35	Same	1/49-8/49
Goble Cr.	Coweman R.	70	?	At highway bridge	1949	?	5	Same	1949
Mulholland Cr.	Coweman R.	77	?	At mouth	7/49-8/49	?	12	Same	8/1/49
Ostrander Cr.	Cowlitz R.	64	?	NW¼, Sec. 12, T.8N., R.2W. 1mi. above mouth at Kelso	8/1/49	13	1.7	Same	1949
North Fork	Ostrander Cr.	66	?	Same NW¼ at RR cross.	8/1/49	?	1.09	Same	8/31/49
Arkansas Cr.	Cowlitz R.	68	39	W½ Sec. 17 T9N R2W near Castle Rock	5/49-4/50	25	1.66	Same	5/49-4/50
North Fork	Arkansas Cr.	72	?	1mi.W. Castle Rock	7/49-9/49	?	3.66	Same	7/49-9/49
Scantigrease	Arkansas Cr.	67	33	At road crossing	1/49-6/50	15	1.33	Same	1/49-6/50
Monahan Cr.	Scantigrease	62	33	At county road bridge	1949-1950	30	2.91	Same	1949-1950
Toutle R.	Cowlitz R.	67	32	Near Silver Lake	1944-1949	31,000	255	Same	1920-1949
Outlet Cr.	Toutle R.	61	?	NW¼ Sec 30 T10N R1E at road crossing nr. Silver Lake	8/30/48	227	.05	Same	2/43-9/49
South Fork	Toutle R.	70	36	At Toutle, Wash.	1944-1949	6,900	64	At bridge	1940-1949
Green River	Toutle R.	67	32	Above mouth at Toutle	1946-1949	12,000	52	Same	1946-1949
North Fork	Toutle R.	56	?	.5 mi. above mouth of Green River	7/49-9/49	961	24	Same	1906-1907
Hoffstadt Cr.	Toutle R.	?	33	At bridge	1/49	14	?	Same	1949
Olequa Cr.	Cowlitz R.	68	?	NW¼ Sec 33 T12N R2W 6.5 mi. above mouth at Winlock, Wash.	4/49-9/49	282	1	Same	3/49-9/49
Stillwater Cr.	Olequa Cr.	73	?	.5 mi. above mouth	7/49-9/49	34.5	2.47	Same	1942-1949
Brim Cr.	Stillwater	70	?	Sec 24 T11N R3W, 2.5 mi. NW of Vader, Wash.	7/49-9/49	?	1.35	Same	7/49-9/49
Salmon Cr.	Cowlitz R.	68	?	NW¼ Sec 28 T11N R1W 3 mi. above mouth	7/49-9/49	18+	1.01	Same	1944-1949

Stream	Tributary of	Water Temp. Max.	Min.	Location	Period Covered	Water Flow Max.	Min.	Location	Period Covered
Cedar Cr.	Salmon Cr.	61	?	NE¼ Sec 20 T11N R1E 100' below road crossing	7/49-9/49	?	.45	Same	7/49-9/49
Mill Cr.	Cowlitz R.	66	?	Nr. Salkum at hwy. cross.	1949	-	-	Same	1949
Winston Cr.	Cowlitz R.	64	?	At Mayfield Bridge	1949-1950	?	16	Same	7/20/49
Tilton R.	Cowlitz R.	62	33	In and nr. Morton	1948-1949	?	65	Same	7/20/49
North Fork	Tilton R.	55	?	At Ladd Log Co. bridge	7/49-9/49	?	10	Same	7/20/49
East Fork	Tilton R.	59	?	At highway bridge	7/49-8/49	?	20	Same	7/20/49
West Fork	Tilton R.	57	?	At Ladd Log Co. bridge Road 302	7/49-8/49	?	25	Same	7/20/49
Landers Cr.	Cowlitz R.	59	32	Near mouth	1950	?	8	Same	9/13/50
Staffen Cr.	Cowlitz R.	58	?	At Cosmos Bridge	7/49-9/49	?	5	Same	9/17/49
Rainy Cr.	Cowlitz R.	63	35	At Ottis Shack	1949-1950	?	8	At bridge	9/17/48
Cispus R.	Cowlitz R.	57	36	At bridge crossing & near mouth	1/49-11/50	-	-	-	-
Iron Creek	Cispus R.	55	?	Near mouth	9/45	?	25	Same	9/45
Tower Rock Sp.	Cispus R.	59	?	At hwy. crossing	1949-1950	?	5.7	At mouth	9/12/45
Siler Cr.	Cowlitz R.	60	?	--	7/11/49	?	7	-	7/20/49
Kiona Cr.	Cowlitz R.	55	?	Lower Cowlitz Falls Road crossing	2/49-11/50	?	1.53	Same	9/14/50
Silver Cr.	Cowlitz R.	59	33	At forest camp	1942-1950	120	35+	Same	9/43-1/49
Johnson Cr.	Cowlitz R.	60	36	Highway bridge	1943-1947	?	30.3	Sec.32 T13N R9E nr.mouth	9/13/45
Hall Cr.	Cowlitz R.	55	34	T13N R9E nr. mouth and old log bridge	1943-1950	604	3.7	Nr. Packwood	1947-1949

COWLITZ RIVER WATERSHED

Stream	Acres of Land Irrigated	Number Applications	Other Applications
Main Cowlitz River	593.95	10	11
Arkansas Cr. and tributaries	127	4	2
Bill's Creek	1	1	
Blue Creek	40	1	
Burton Creek			1
Butter Creek			1
Cispus R. and tributaries	2	1	5
Coweman R. and tributaries	85.50	4	5
Crescent R.			1
Davis Creek	100	1	1
Hager Creek			1
Jewell's Spring			1
Johnson Creek			1
Kiona Cr. and tributaries	6	2	3
Klickitat Creek	15	1	2
LaCamas Cr. and tributaries	16	3	5
Lake Cr. and tributaries			4
Lucenda Springs			1
McCoy Creek			1
Mayfield Reservoir			1
Mill Cr. #1 and tributaries	188	5	1
Miller Creek			1
Mossy Rock Reservoir			1
Oden Cr. (Uden Cr.)			1
Ohanapecosh Cr. and tributaries			5
Olequa Cr. and tributaries	578.46	29	10
Osborne Cr. and tributaries	15	1	
Packwood Lake			1
Schooley Creek			1
Peters Creek			2
Powder Creek			1
Purcell Creek	1	1	1
Rainey Cr. and tributaries	82	3	8
Ripple Creek			1
Salmon Cr. and tributaries	100	3	8
Siler Creek	48	1	3
Silver Creek #1	105	4	
Silver Creek #2	42	3	1
Silver Lake	1	1	
Sink Creek	5	1	
Smith Creek			1
Snyder Creek			2
Spears Creek			1

Stream	Acres of Land Irrigated	Number Applications	Other Applications
Spring Creek			1
Steel Canyon Creek	250	1	1
Sulpher Creek			1
Summit Creek			1
Tilton R. and tributaries	159	9	7
Toutle R. and tributaries	4	3	12
Misc. unnamed streams	337.77	16	19
Winston Creek			3
Total	3,925	112	145

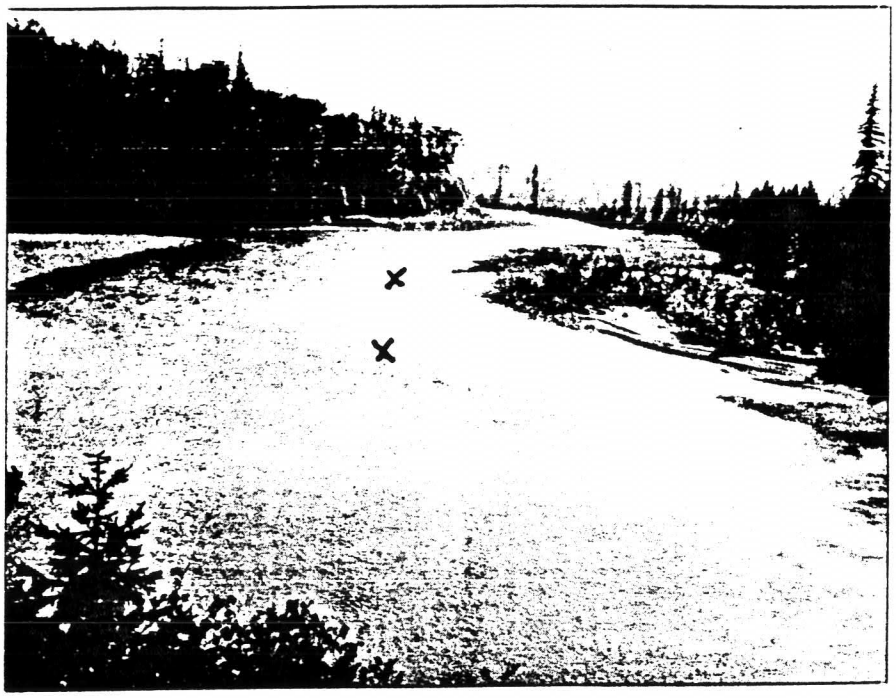


Fig. 1. Main Cowlitz River at mouth of Steffens Creek showing good spawning areas.

Fig. 2. Log and debris jam removal on West Fork Tilton River. Jam was total block to upstream migrant salmon.

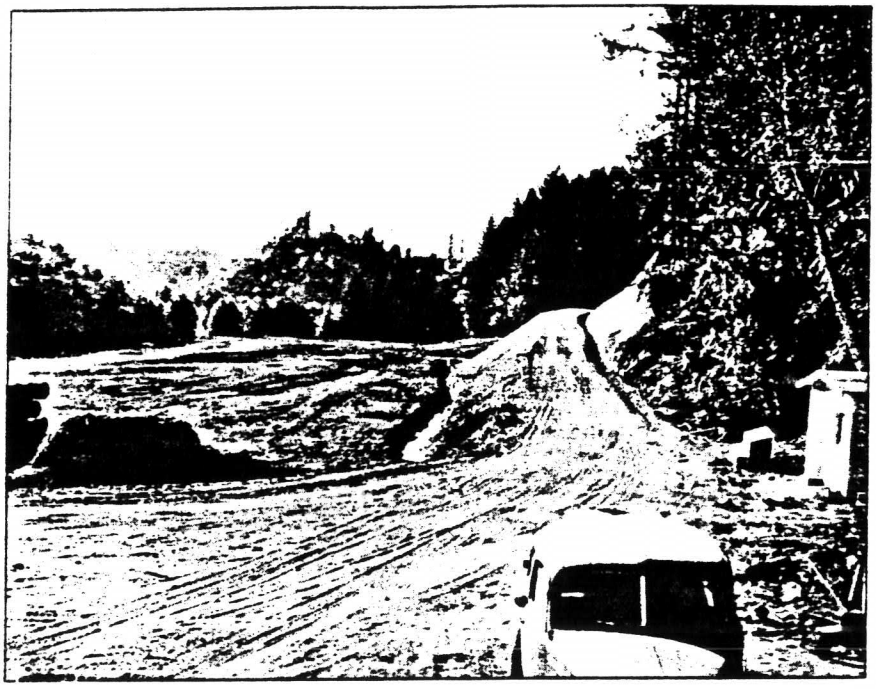


Fig. 3. Toutle River Salmon Hatchery site showing entrance road and building area, September 1950.

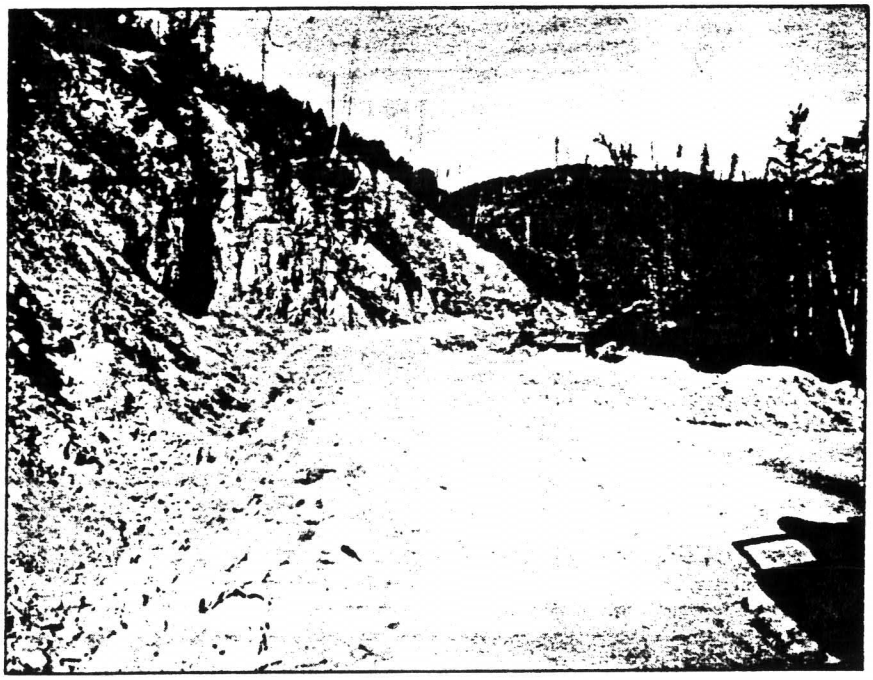


Fig. 4. Road constructed to Toutle Hatchery water supply intake. Green River on right. Pipeline buried between bank and road. Length of pipeline and road approximately one mile. September 1950.

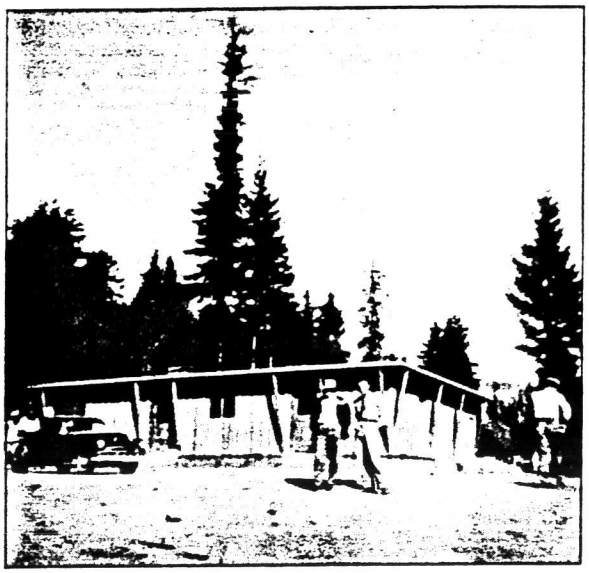


Fig. 5. Residence at Toutle Hatchery site.

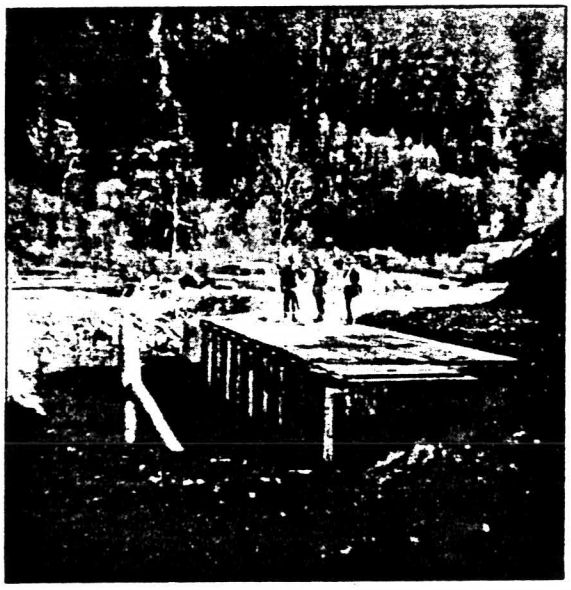
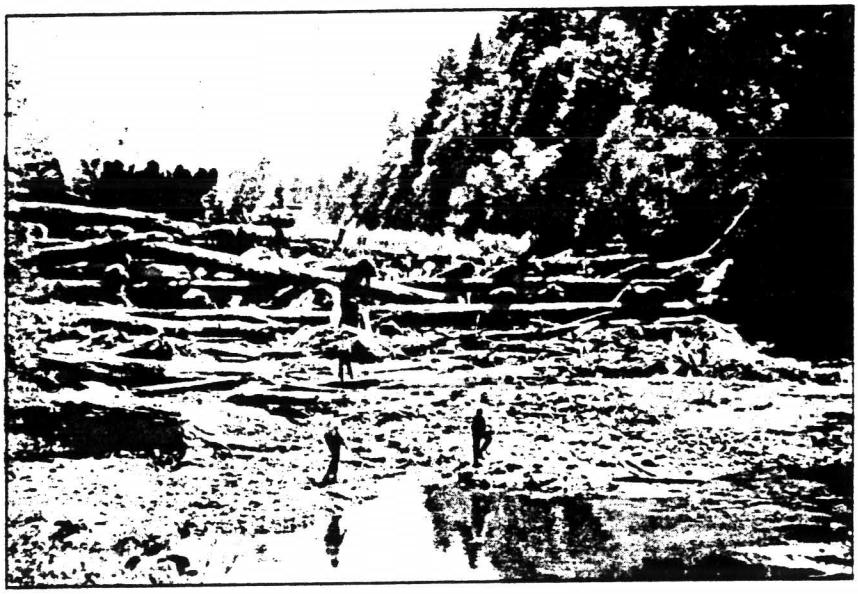


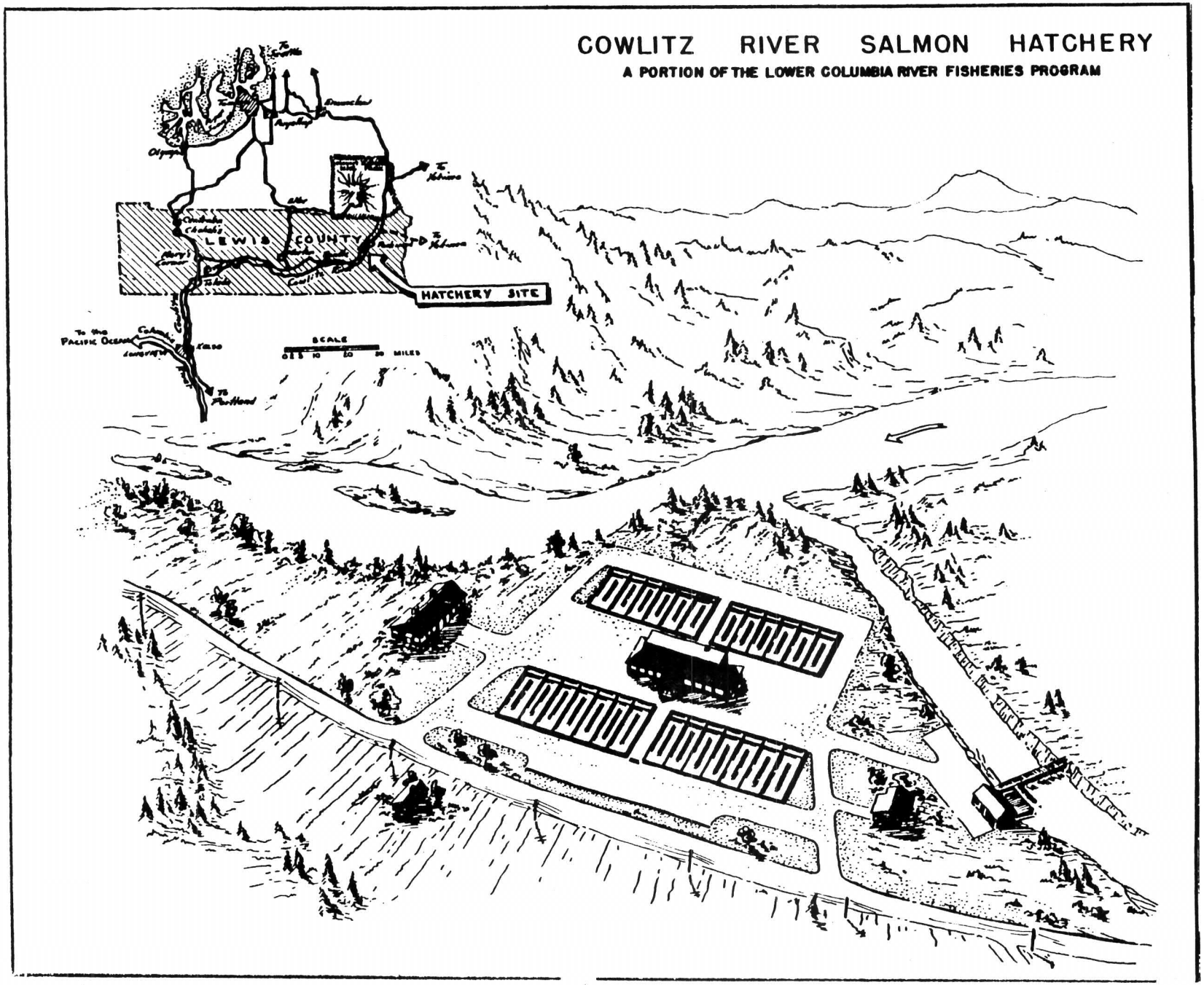
Fig. 6. Toutle Hatchery water supply intake on Green River.



Log splash dam on Coweman River,
removed in stream clearance program

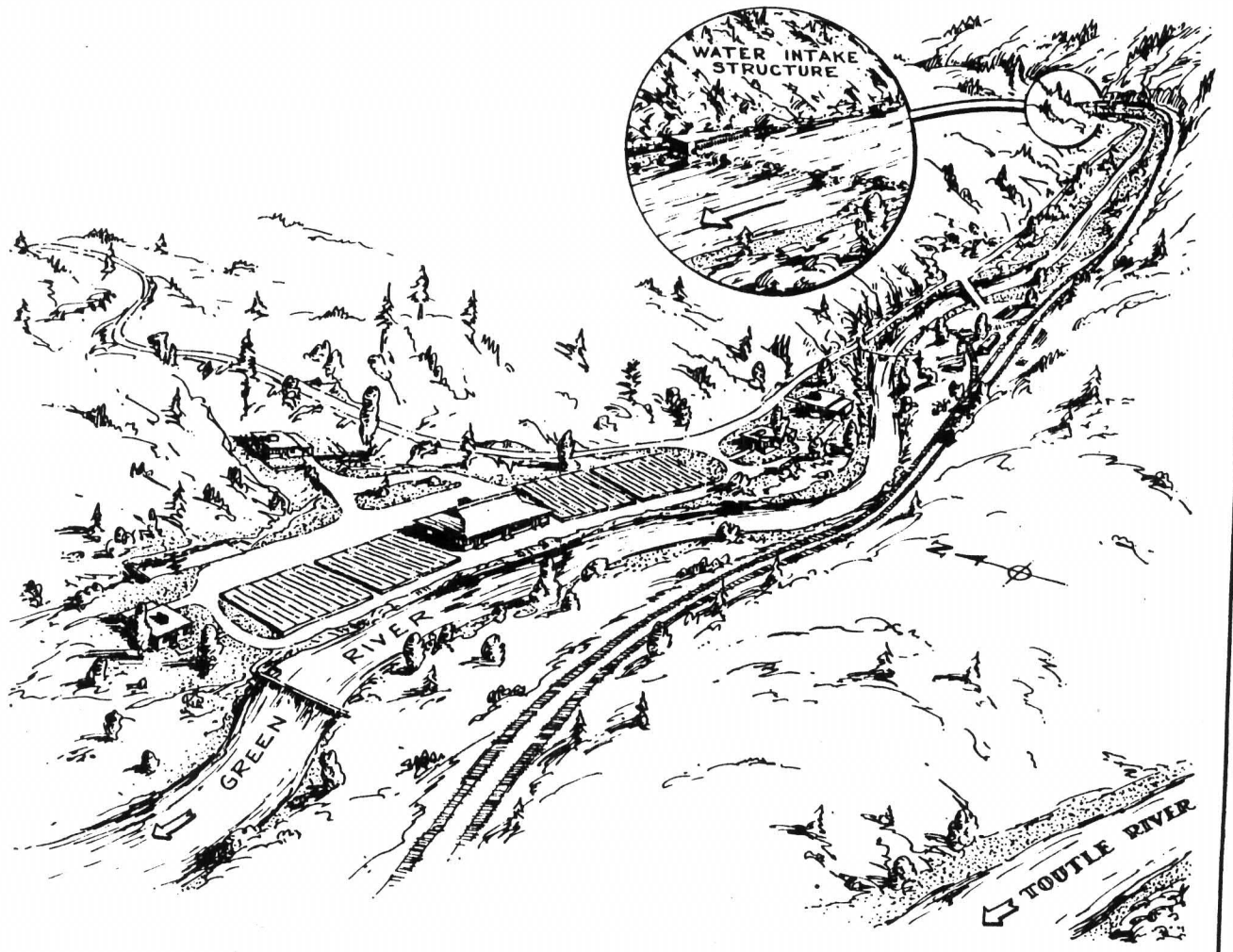
COWLITZ RIVER SALMON HATCHERY

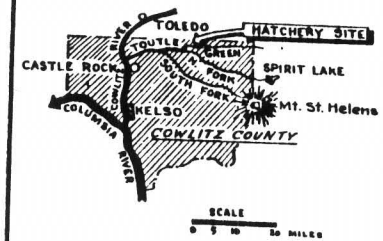
A PORTION OF THE LOWER COLUMBIA RIVER FISHERIES PROGRAM



TOUTLE RIVER SALMON HATCHERY

A PORTION OF THE LOWER COLUMBIA RIVER FISHERIES PROGRAM





APPROXIMATE ELEVATION 800'- ABOVE SEA LEVEL

24 PONDS

DATE	REVISION

STATE OF WASHINGTON
DEPARTMENT OF FISHERIES

TOUTLE HATCHERY
BIRDSEYE VIEW &
LOCATION SKETCH

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SCALE _____ DATE _____