State of Washington
CLARENCE D. MARTIN, Governor

Ninth Biennial Report

of the

Department of Conservation and Development

October 1, 1936 — September 30, 1938

JOHN BROOKE FINK
DIRECTOR

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1939

STATE OF WASHINGTON

CLARENCE D. MARTIN, GOVERNOR

DEPARTMENT OF CONSERVATION AND DEVELOPMENT

JOHN BROOKE FINK, *Director*

Division of FORESTRY
T. S. Goodyear, *Supervisor*

Administration of forest protection laws, slash disposal, logging operations, railroads and highways, CCC camps on State and private lands, Reforestation Act

Forest patrol assessments on privately owned lands

Selection, acquisition and management of lands for State Forest Board

Reforestation and timber development investigation

Construction and maintenance of fire protection roads, trails, telephone systems, lookout and ranger stations

Division of GEOLOGY
H. E. Culver, *Supervisor*

Economic studies:
Inventory of mineral resources

Special investigations: Coal, oil and gas, clay, magnesite, talc and saline deposits, municipal and domestic water supplies (Co-op.), gold, silver, lead, zinc, copper, and mercury, chromium, molybdenum, tungsten, and manganese

Basic geology:
Stratigraphy structures, paleontology bibliography

Topographic mapping (Co-op.)

Division of RECLAMATION
John Brooke Fink, *Director*

Administration of State Reclamation Revolving Fund

Refinancing, reorganization and rehabilitation of irrigation, diking and drainage districts, and supervision of reclamation works financed by State

Land settlement

Special investigations re state development by reclamation

Advice and assistance to reclamation districts

COLUMBIA BASIN PROJECT
John Brooke Fink, *Director*

State agency in matters relating to Grand Coulee dam and Columbia Basin project, including establishment of irrigation districts covering all lands to be irrigated

Settlement of project upon completion

Miscellaneous activities properly belonging to State

Division of HYDRAULICS
Chas. J. Bartholet *Supervisor*

Supervision of surface water resources:

Determination and administration of existing rights

Granting of new rights for all purposes

Examination of plans for proposed hydraulic works and inspection of existing structures to insure safety

Hydrographic surveys, stream measurements, river utilization surveys, ground water surveys

Administration of Flood Zoning Act

Division of MINES & MINING
Thos. B. Hill, *Supervisor*

Compilation of mineral resources

Inventory of mineral claims and mining properties

Mineral exhibit

Special mineral investigations

Special studies on uses and markets for minerals

Inspection of mineral areas and properties

Investigations and reports on need for mine-to-market roads

Maintenance of mining library

Distribution of bulletins and material on mineral resources of Washington

FLOOD CONTROL
Lars Langloe, *Flood Control Engineer*

Administration of flood control acts, including organization and supervision of flood control districts

Cooperation with local organizations and Federal agencies in presenting flood control projects for adoption under the Federal flood control acts

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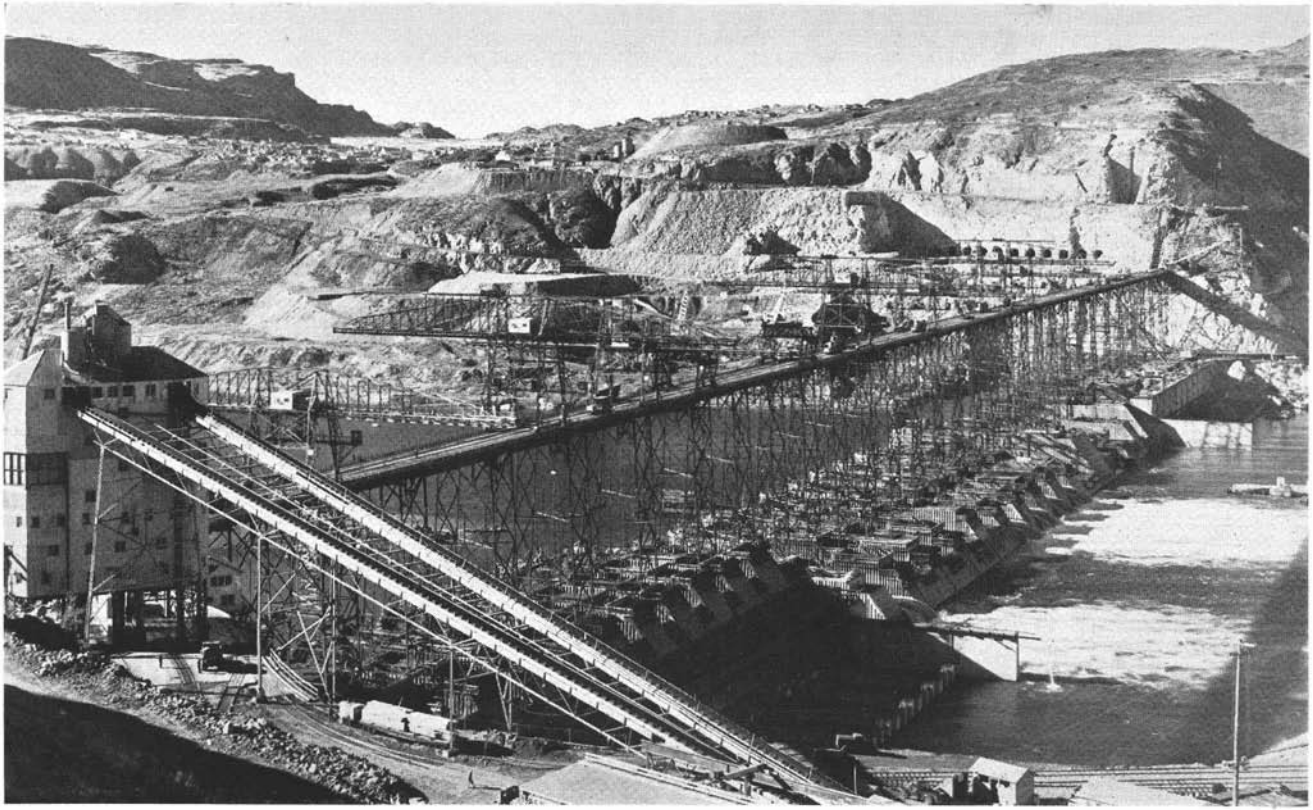


GRAND COULEE DAM

Downstream face of dam from east abutment, fall of 1938, showing closeup of mixing plant and conveyor belts at extreme left. Across river can be seen 12 tunnel openings, 18 feet in diameter, through which water will be lifted 267 feet to balancing reservoir, which will be located beyond the hill shown, and from which water will be carried by canals to irrigate the 1,200,000 acres of the Columbia Basin project. (Picture courtesy U. S., Bureau of Reclamation, Coulee Dam.)

LETTER OF TRANSMITTAL

DEPARTMENT OF CONSERVATION AND DEVELOPMENT

November 30, 1938.

To His Excellency, Clarence D. Martin,
Governor of the State of Washington.

Sir:

I have the honor to submit herewith, pursuant to law, the Ninth Biennial Report of the Department of Conservation and Development, covering the period from October 1, 1936, to September 30, 1938.

Respectfully,

J. B. FINK,
Director.

DEPARTMENT OF CONSERVATION AND DEVELOPMENT

JOHN BROOKE FINK, Director

INTRODUCTION

The State of Washington is unsurpassed by any other section of the country in the variety and extent of its natural resources and advantages. These resources include large areas of fertile land, great forests of timber, valuable mineral deposits, almost unlimited water for irrigation, power, domestic, and industrial uses, and commercial and game fish and game in abundance. The state has climatic advantages over other regions, and our scenic beauty is unequalled anywhere on this continent. It was to conserve these natural resources by preventing exploitation and waste on the one hand and, on the other, to develop them through proper and economic use that the Department of Conservation and Development was created. Natural resources are the foundation of all commercial and industrial activity—of the sustenance of life itself—and therefore their conservation and economic use are of the utmost importance.

The Department of Conservation and Development has the administration of the laws relating to the reclamation and use of land, the highest and most beneficial use of water, both surface and underground, the protection and development of State and private forest lands, the control of floods, and the development of our mineral resources. For the administration of this broad field, the Department is organized into the following seven divisions:

Forestry
Geology
Reclamation
Columbia Basin
Hydraulics
Mines and Mining
Flood Control

In the administration of the laws relating to the natural resources of the state, including scenic and recreational features, the general welfare of the people must constantly be kept in mind. True conservation means prevention of exploitation and waste, but does not necessarily mean lack of use. Development means economic use, which does not permit waste. In applying the policy of conservation and development to one resource its effect upon other resources must be taken into consideration, and the greatest benefit will follow the establishment and maintenance of a balanced program of both conservation and development.

More thought is being given today to the conservation and proper use of our natural resources than ever before. These resources represent our capital and, like capital in any business, must be utilized, but within proper limits and under adequate supervision in order to provide maximum benefits for the present and the future. The folly of exploitation and indifference has been demonstrated in recent years so forcefully that the issue can no longer be evaded. More frequently recurring disastrous floods, "dust bowls" that include whole states, millions of tons of fertile soil carried away by wind and water, steadily decreasing yields on over-cropped, unfertilized agricultural lands, declining fisheries, denuded forest lands, dried out swamps and natural reservoirs, vanishing wild life, cannot be attributed to anything but a thoughtless, wasteful people. In some states the resources have been so nearly exhausted that the problem is no longer one of conservation, but one of rehabilitation. Fortunately, Washington has not yet reached that

condition. We still have more than three million acres of undeveloped lands and thirteen million acres of splendid forests, our water resources are practically undiminished, our fish life has not been exterminated, our minerals have hardly been touched, and game is still abundant.

It is the aim of the Department of Conservation and Development to so administer the laws relating to our natural resources that the greatest benefit will accrue to present and future generations.

DIVISION ACTIVITIES

The important activities of the Department of Conservation and Development for the period from October 1, 1936, to September 30, 1938, are set forth in detail in the reports of the several divisions, except in connection with the Grand Coulee Dam and Columbia Basin project, which are reported under the heading, "Columbia Basin Project."

Our Division of Forestry is working most effectively in the protection of State and private timber and in the acquisition of forest lands and development of new forests. This division, with a small central office personnel and a maximum field crew of approximately six hundred during the fire season, has effected very material reductions in fire losses during recent years. Due credit must be given the Washington Forest Fire Association and the young men of the Civilian Conservation Corps for their cooperation and valuable assistance in this phase of our work.

The Division of Geology has continued its studies as a fact finding bureau. It is engaged in working out the basic geology of the State, in platting the formation and structures which indicate, in a general way, the mineralized areas, in making studies of certain deposits in both the metallic and nonmetallic fields, and in cooperating with the U. S. Geological Survey in the topographic mapping of the State.

The Division of Reclamation, under the direct supervision of the Director, with the cooperation of the Supervisor of Hydraulics and his staff, has assisted the various reclamation districts, in so far as possible, in the settlement of their financial and administrative problems, and has frequently been called upon to act in an advisory capacity. Because a great many of our reclamation districts were refinanced and placed upon a sound financial basis by the State between 1933 and 1936, there has been less demand from the various districts for such assistance during the past two years. It is, however, of serious concern that appropriations for various departmental activities other than this work continue to be made from the Reclamation Revolving Fund.

Activities relating to the Columbia Basin project have lately developed into a new field, namely, of organizing the Columbia Basin area into an irrigation district or districts in order to comply with the Federal Anti-speculation Act. The Department, as the agency of the State in Coulee Dam and Columbia Basin activities and as the logical representative of the landowners and the State as a whole, has consistently advocated the speedy organization of the project in an orderly manner and in compliance with State and Federal laws. In cooperation with the United States Bureau of Reclamation, this Department has prepared legislation which is deemed both necessary and desirable for consideration by the 1939 Legislature, and we have advised that district organization be deferred until such legislation is enacted.

We will then join with the Federal Bureau of Reclamation in assisting the landowners of the area to organize as speedily as possible.

The Division of Hydraulics handles widely varied problems relating to our public waters, including establishment of water rights under the Water Code, settlement of differences between water users, collection of stream flow data, examination of plans for dams and inspection of existing hydraulic structures, collection of annual power license fees, and administration of the Flood Zoning Act. This division does effective work with a very small personnel, augmented during the dry season by county water masters, stream and ditch patrolmen. During the biennium not one appeal was made to the courts from a decision or ruling of this office in matters relating to water right controversies.

The Division of Mines and Mining, a comparatively new departmental activity, has been compiling statistics and information relating to mining, milling and metallurgy in the State. It is collecting a library relating to mines and mining, and has a display of Washington minerals. This division cooperates with prospectors, miners, and others engaged in exploration and development of the State's mineral resources.

The work of the Division of Flood Control has been handled almost entirely by one engineer in the employ of the Division of Hydraulics. During this biennium, because of lack of funds, this work has consisted chiefly of advice, assistance and cooperation rendered to the various Federal and local interests in flood control matters. If adequately financed, this division could render a much more valuable service in this important field.

EXTENSION OF ACTIVITIES

During the past biennium the Director has been a member of a committee appointed by the Governor to study stream pollution, and the Department has assisted in financing the investigations and studies in this connection. It has been recommended that this work be continued as a function of the Department of Conservation and Development. These studies are necessary for the protection of both domestic and industrial water users, and of our game and fish life and, therefore, an appropriation is requested for their continuation.

During the past five years soil surveys have been made of various counties in the State under the sponsorship of the State Planning Council and the State College, cooperating, with funds allotted by the Department of Social Security. It has been recommended that these surveys be continued by the same personnel, under the direction of the Department of Conservation and Development, and an appropriation is accordingly sought for that purpose.

EXTRA-DEPARTMENTAL ACTIVITIES

In addition to his duties as administrator of the Department and in immediate charge of reclamation and Columbia Basin activities, the Director is a member of the State Forest Board, the State Planning Council, and the Pacific Northwest Drainage Basin Committee, as well as the State Pollution Commission, mentioned above.

RECOMMENDATIONS

The demands upon the various divisions of the Department far exceed our ability to serve. Some increases in personnel of each division are therefore recommended, as set forth in the departmental budget submitted to the Governor.

The recommendations for legislation relating to the activities of the various divisions are outlined in the division reports. Serious thought and consideration has been given to each such suggestion. They have the approval of the Director, and we respectfully urge that they be given serious consideration.

ACKNOWLEDGMENTS

We have enjoyed our associations with and the cooperation of various Federal, State, and private agencies. Of these, we list the following:

The Works Progress Administration, through the assistance of which our Division of Mines and Mining has been enabled to do effective work on a scale which would otherwise have been impossible. Also, extensive reclamation and flood control work has been done in the State with the assistance of W. P. A. funds.

The Corps of Army Engineers has done most effective work on flood control in the State, and has consistently invited the suggestions of this Department and cooperated in every way.

The U. S. Bureau of Mines has been of material assistance to our relatively new Division of Mines and Mining.

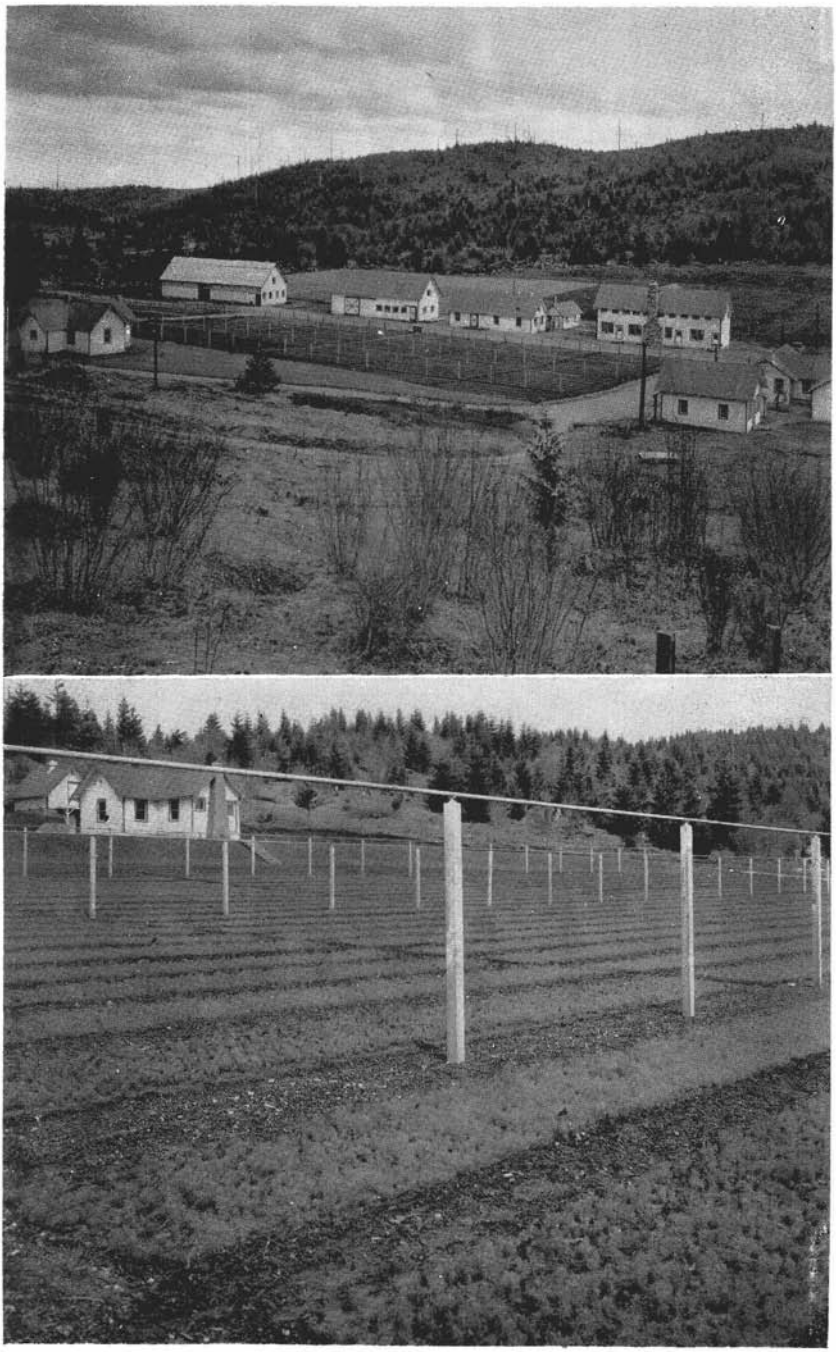
The several branches of the United States Geological Survey, both under cooperative Federal-State agreements in work relating to our divisions of Hydraulics, Geology, and Mines and Mining, and independent of such agreements, have cooperated with the Department at all times.

The U. S. Bureau of Reclamation and this Department have worked in close cooperation in matters relating to the Columbia Basin project, as well as in matters of a more routine nature in which they are associated. We sincerely appreciate the friendly attitude and spirit of cooperation evidenced in our associations with officials of this Bureau.

The Civilian Conservation Corps, Emergency Conservation Work, U. S. Forest Service, Washington Forest Fire Association, and various other groups are of invaluable assistance to our Division of Forestry in the protection and development of the forests in the State.

The cooperation of other Federal, State and private agencies, and many public spirited individuals, is also appreciated. We trust our associations with them will continue to be as successful as they have been during this past biennium.

The Director wants especially to commend the interest, loyalty and cooperation of the Department supervisors and the individual members of the staff. It is only through such a spirit of loyalty and effort that the Department has been able to successfully accomplish its extensive and widely varied activities with a restricted personnel.



Above: State Forestry Nursery Buildings.
Below: Douglas Fir Seedlings and Overhead Irrigation System.

DIVISION OF FORESTRY

T. S. GOODYEAR
Supervisor of Forestry

1937—ANNUAL REPORT

During 1937 there were 1,058 fires reported that burned over 20,111 acres, with a subsequent loss and damage of $58,216.00. The average area burned per fire was 19 acres, compared with 34.7 for 1936. Of 12,000,000 acres protected by state and private agencies, only 16/100 of one per cent burned during the current fire season. This is considered by foresters, adequate forest fire protection.

Favorable weather and increased caution by the traveling public were largely responsible for such a decided reduction in number of man-caused fires. There was a fifty per cent decrease of incendiary fires and a creditable drop in all other causes, except lightning and logging operations. The former started 199 fires or double the number set during 1936, and operators were responsible for a slight increase of fires. The comparatively small acreage burned and nominal loss and damage for 1937 are the lowest recorded since organized forest fire protection was established in the State of Washington.

Men from the Civilian Conservation Corps camps carried on most of the fire fighting and, as usual, their work was performed in a most creditable manner. During the peak of season many side camps were established throughout the more hazardous fire areas. Trained fire crews, fully equipped for emergency calls, were effective in suppressing fires before they spread over much ground. New lookouts, telephone lines, trails and roads constructed in formerly inaccessible areas were also contributing factors toward lowering the annual damage and loss resulting from fires. The logging operators also deserve credit for standardizing their fire equipment and for employment of more watchmen and special patrolmen within the operations. A large percentage of the operators voluntarily shut down their camps when weather conditions became hazardous and the fire risk excessive.

The 1937 fire season was advanced by legislative action to April 15 and extended to October 15. An unusually heavy growth of ferns and brush, kept green by frequent rains, delayed the usual crop of land clearing fires until the latter part of April. Between April 30 and May 6, dry weather prevailed, during which it was necessary to control numerous small fires started from road and land clearing operations. From May 28 to June 6 there was another dry period, with northerly winds, above normal temperature and low humidity. At this time a number of slash fires, particularly in southwestern Washington, got beyond control and caused the operators considerable worry and expense. July 16 to July 27 was the most hazardous period during the entire season. The weather was abnormally warm, with changeable winds and low humidity. Fires were numerous in the northern counties —several of them in abandoned logging operations. On July 19 there was a dry lightning storm which set a number of fires throughout the mountainous areas of western Washington. An accidental fire on July 20 started from the operations of a pulp company in the fog belt of western Clallam county, where usually fires are uncommon and it is difficult to burn slashings. This particular fire burned over approximately 2,500 acres and effectively disposed of several years accumulated slashings. On July 21 a fire in Skagit county, that had been under control for several days, broke over the fire lines and destroyed a considerable quantity of second growth trees. From July 22 to 25 an alarming number of berry pickers fires were set at rather inaccessible places and on July 27 a lightning storm started an additional 28 fires in Clark,

Cowlitz and Skamania counties, which were widely scattered and difficult to reach with control crews. However, this somewhat critical situation was relieved by four days of cloudy weather which gave the wardens and rangers an opportunity to put all existing fires under control.

On August 6 and 7 there were scattered showers throughout western Washington and a general rain on August 8. The last critical fire period of the season was from August 15 to 21. During this time one operator's fire broke away and caused considerable loss of equipment and damage to logs before it was controlled. A general rain on August 22 practically terminated the 1937 fire season. There were no serious fires during balance of season.

The following table of climatological statistics, compiled by the United States Weather Bureau, indicates atmospheric conditions during the fire season of 1937.

Month	Average Precipitation For the State	Below Normal	Above Normal	Western Washington			Eastern Washington		
				Clear	Partly Cloudy	Cloudy	Clear	Partly Cloudy	Cloudy
April	5.13	.....	2.65	2	9	19	7	12	11
May	1.24	0.76	.....	12	9	10	18	8	5
June	4.38	.....	2.79	10	6	14	12	7	11
July	0.38	0.28	.....	18	8	5	24	6	1
August	1.31	.....	0.50	12	9	10	21	6	4
September	1.27	0.55	.....	13	7	10	19	6	5
October	2.79	0.47	.....	10	8	13	14	8	9

Cooperation

For the measure of success attained in forest fire protection during 1937 acknowledgment for effective cooperation is herewith extended to the United States Forest Service, the director, officers, technical personnel and enrollees of Civilian Conservation Corps, United States Weather Bureau, Pacific Northwest Forest Experiment Station, Washington Forest Fire Association, the logging and lumber industry, West Coast Lumbermen's Association, Western Pine Association, and the members of 1937 Legislature that provided funds and necessary legislation for forest fire protection; also, for the loyalty and faithful performance of duties by the field and office staffs of this division.

The membership represented by West Coast Lumbermen's and Western Pine Associations has voluntarily continued to comply with the Rules of Forest Practice in logging operations and has maintained able foresters to carry on the necessary field work. During 1937 the logging and lumbering industry expended approximately $601,000.00 for installation of standard fire fighting equipment, snag falling, slash disposal and general hazard reduction, in a concerted effort to leave cutover lands in better productive condition for crop renewal.

Civilian Conservation Corps

The following table is a combined progress report of work performed from January 1 to December 31, 1937, by the eight state and private land camps allotted to the Department by Civilian Conservation Corps:

Truck trails	72.6	Mi.
Horse trails	3.7	Mi.
Vehicle bridges	19	
Telephone lines	47.5	Mi.
Fire suppression	5,959	Man-days
Road and trailside clearing	65.5	Mi.
Fire hazard reduction	3,000	Acres
Lookout towers, with ground houses	5	
Fire halls	7	
Nursery	3,623	Man-days
Surveys	937	Man-days
Tree planting	437	Acres

The Civilian Conservation Corps also supplied the labor and material for maintenance of approximately 1,500 miles of road, 800 miles of trail, 600 miles of telephone line and 29 lookout towers. The CCC has become an integral part of forest fire protection and it will be extremely difficult to carry on the forestry development program without this useful and efficient organization.

Land Classification

Approximately 36,500 acres of cutover lands, situated in Clallam, Cowlitz, Grays Harbor, Jefferson, King, Kitsap, Lewis, Mason, Pierce, Pacific, Snohomish and Thurston counties, were examined for classification in accordance with provisions of the Reforestation Act.

Public hearings prior to final classification of these lands will be advertised and held in the various counties during the early part of 1938.

Slash Disposal

Selective logging has created many new problems of slash disposal that will undoubtedly require modification of existing statutory regulations.

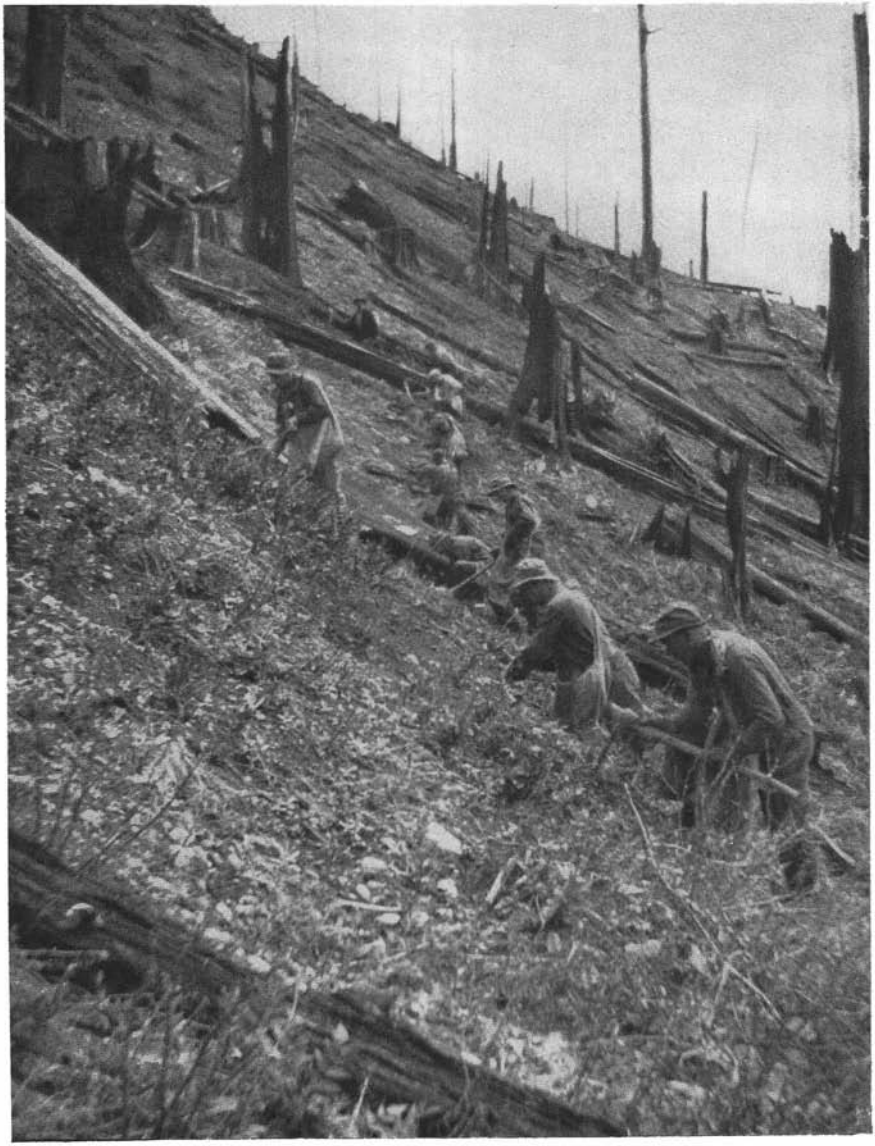
Many of the operators took advantage of favorable burning weather in September and October and consequently disposed of some 75,000 acres of accumulated logging slashings, with a comparatively small amount of loss and damage. The past season has conclusively demonstrated that slashing fires can be controlled and satisfactory results obtained from broadcast burning by advance planning, more adequate preparation, and frequent contact with the Weather Bureau.

Slash disposal in the pine areas of eastern Washington was confined to spot, strip, and pile burning, while in western Washington broadcast burning is still apparently the only practical method for disposing of slashings that result from clear cutting operations.

After a thorough inspection, certificates of clearance were issued upon 59,000 acres of land from which slashings had been disposed in accordance with provisions of law. Conditional clearances were granted in some cases where slashings were light, did not constitute serious fire hazards and remaining second growth timber would be destroyed by burning slash.

Buildings and Equipment

During 1937 new lookout towers and ground houses were constructed near Laurel, Klickitat County; on Porcupine Ridge, Thurston County; Ohop, Pierce County; Crescent Bay, Clallam County, and on Boyer Mountain, Pend



Planting Crew on State Land.

Oreille County. Telephone lines and roads have been completed to each of these lookouts.

Fire halls of frame construction, with suitable office quarters, kitchen, car and truck storage space, shop and equipment rooms on ground floor, and dormitory for housing fire crews of twenty men on the second floor, have been completed at Kelso, Glenwood, Forks, Sedro Woolley, Sultan, and Enumclaw. Authorization has been secured to erect similar halls at Montesano, Shelton and Raymond during 1938.

Aside from the normal replacement of small fire fighting tools and equipment, three one and a half ton and two one-half ton trucks were purchased. Two of the trucks were for Port Angeles district; one each for Colville and Ellensburg districts and the other one-half ton pick-up truck is for emergency use at the forestry shop and warehouse in Olympia.

Seven of the latest model portable fire pumpers and 3,700 feet of light weight rubber-lined hose were purchased to replace worn out equipment. Six staff compasses were also ordered for use in establishing boundary line markers and checking trespass on newly acquired state forest lands. A Johnson outboard motor was supplied the fire warden of San Juan County to facilitate transportation between the numerous islands in that district. A Model No. 4 Osborne Fire Finder was purchased to equip the new Boyer Mountain lookout in Pend Oreille County.

Land Acquisition

The State Forest Board continued its land acquisition program and during 1937 examined and accepted title to an additional 121,015.23 acres of tax delinquent forest lands, situated in Clallam, Clark, Cowlitz, Klickitat, Lewis, Skagit, Skamania and Thurston Counties.

For the purpose of enlarging and blocking out the Capitol Forest, general utility bonds bearing a low rate of interest were issued for the purchase of 2,011.33 acres in Grays Harbor County and 2,209.30 acres in Thurston County. This particular forest now comprises approximately 50,000 acres in one solid ownership.

Capitol Forest Nursery No. 1

The following developments and projects were completed at the nursery during current year. Dormitory and mess halls were rearranged for accommodation of forty men. A new warehouse and packing shed, 26 feet by 84 feet, and oil house were constructed. The two four-inch hydraulic rams that supply water for nursery were supplemented by a gasoline driven auxiliary pump. The nursery was entirely surrounded by a four-wire fence. An additional four acres of land have been cleared and prepared for seed beds and the overhead sprinkling system extended to meet new demands. Spring sowing for an anticipated production of 2,500,000 trees was also completed.

During the year 1,250,000 two-year seedlings were taken from the beds, bundled, packed and shipped for planting to certain cutover areas in Clallam, Grays Harbor, Snohomish and Thurston Counties that had been repeatedly burned and there was little, if any, evidence of natural restocking.

Through a special allotment from the Civilian Conservation Corps, six university forestry students were employed during the summer for making

a survey of site quality and regrowth on some 14,000 acres situated within the Capitol State Forest. This information is necessary for future planting operations.

Christmas Tree Waste

In spite of the fact that approximately 2,000,000 Christmas trees are annually shipped from the State of Washington to nearly every state in the Union and to Honolulu and the Philippine Islands, there have been absolutely no regulations governing the selection and cutting of these trees.

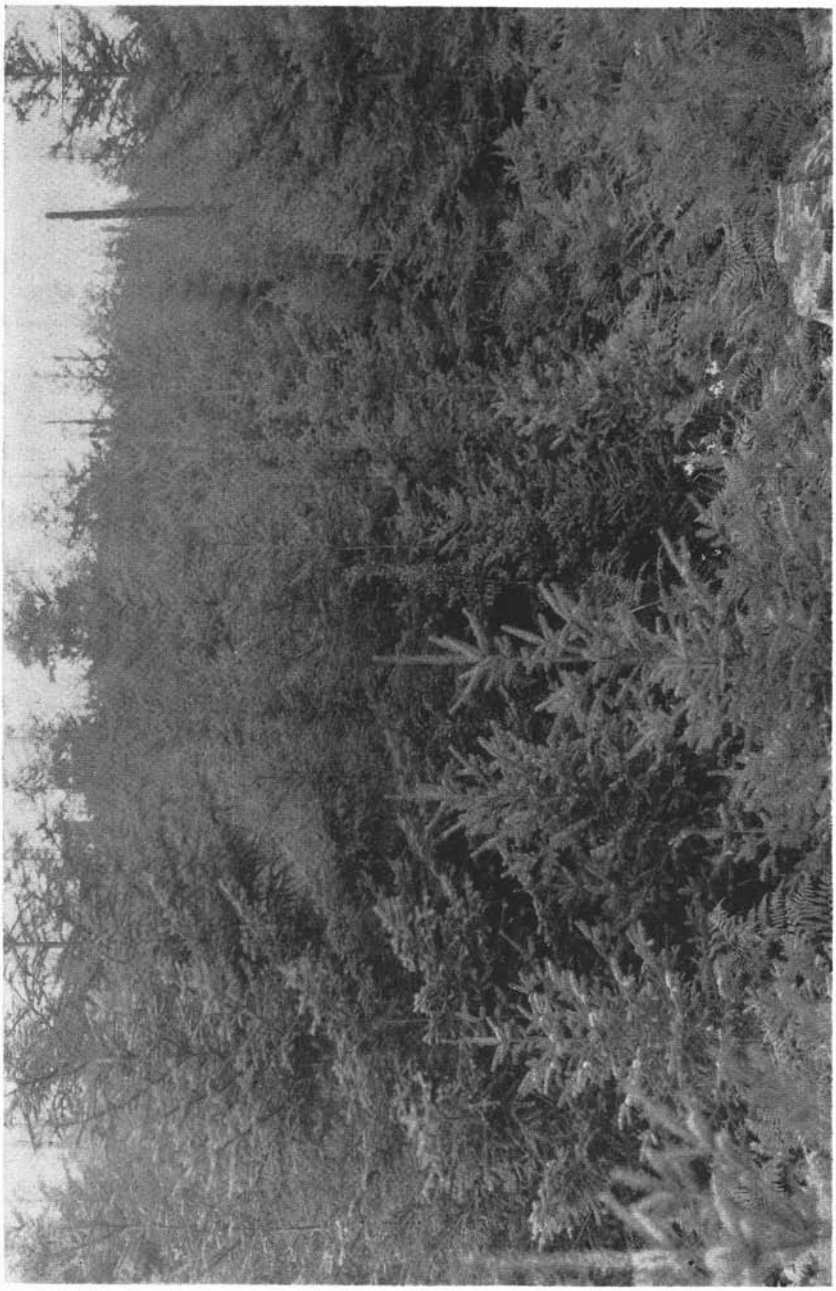
The larger Christmas tree shippers come in to Washington in the early part of October from points outside the state, hire a lot of transient cutters, each having his own idea as to what constitutes a suitable Christmas tree, harvest their crop and leave the state about ten days before Christmas. In the meantime, they contribute absolutely nothing to the general taxes of Washington or to administration and protection of the crop from which they make their profit.

The average stumpage price paid for trees ranges between 1¢ and 1½¢ per tree. Cutting, bundling and hauling to point of shipment runs the cost of trees to from 5¢ to 10¢. It is assumed the average selling price of trees at point of destination is between 75¢ and $1.50. Transportation charges are by far the greatest expense connected with the Christmas tree industry.

The present system of cutting Christmas trees is a menace to the future growth of Washington's forests. The most perfect trees are naturally selected for cutting and after one crop of Christmas trees has been removed, cutters begin topping off the larger trees, leaving the bushy stump which will never develop into a merchantable tree. These stumps simply occupy space and prevent growth and development of other trees. The Christmas tree shippers have assumed no responsibility whatever for their cutters and have refused to inspect trees until after they are cut, when an exceedingly high percentage is culled.

The only statutory requirement is that an individual, firm or corporation shipping Christmas trees outside the state secure an annual license, the cost of which is $10.00. This is a very unfair law, since the larger concerns that ship from five to 150 carloads of trees pay exactly the same license fee as a man who hauls one truckload or less. For the past three sessions of the Legislature the State Forestry Department has endeavored to put through some legislation that would compel the Christmas tree shipper to contribute something in the form of taxes to the State; also, regulations that might stop the enormous waste and place the selection of trees for cutting under proper supervision. The Christmas tree shippers naturally resent any statutory regulations that may interfere with their cutting operations and have, up to the present time, been instrumental in suppressing all attempts by the Forestry Department to secure adequate regulatory measures for removal and shipment of Christmas trees.

In February, 1937, a bill amending the license fee and providing that shippers pay the State of Washington 1¢ for every Christmas tree shipped outside the state was introduced to the Senate, passed without a dissenting vote, was later passed by the House with an overwhelming majority, and was signed by the Governor. Chapter 112, Session Laws of 1937, provided that shippers purchase tags from the State Director of Licenses. Trees may be



Natural Douglas Fir Regrowth—Age 10 Years.

tagged individually, by bundles, truckload or carload lots. Both the shipper and transportation company are required to submit bills of lading for each shipment to the State Forestry Department. The shipper is further required to supply the State Supervisor of Forestry with description of property from which trees are removed, number of trees cut from each parcel of land, and point of destination. While this was but an initial step toward regulating and conserving the growing forests of Washington, it would have been effective in eliminating some of the present waste. However, this law was challenged by Christmas tree shippers and declared unconstitutional by Judge Wilson of Thurston County Superior Court and is therefore ineffective.

Another bill, in the form of an excise tax, is being prepared for introduction in the next Legislature and will be followed with further proposals requiring the Christmas tree buyers and shippers to select and tag the trees while standing.

This would give the owner an accurate count of the trees harvested from his land and the cutter would know definitely the number of trees for which he should be paid. When the buyer realizes he must pay both the landowner and cutter for each tree removed, there will be few trees wasted and the buyer will be more careful in the selection of his trees. This procedure will very largely eliminate the enormous waste of culled trees which now exists. It is further proposed to recommend legislation that will prohibit the practice of topping trees above a certain height and also require that all stumps be cut flush with the ground surface.

Table No. 1—ORIGIN, NUMBER AND CLASSIFICATION OF FIRES—1937

COUNTIES	Light-ning	Incen-diary	Camp-ers	Smok-ers	Slash-ing	Log-ging	Brush Burni'g	Rail-roads	Misc.	Total
Chelan	2	.....	1	3	.....	.....	.....	1	1	8
Clallam	1	2	2	9	1	4	4	.....	7	30
Clark	3	1	.....	2	.....	3	4	1	1	15
Cowlitz	15	4	4	8	.....	3	1	1	1	37
Ferry	6	.....	.....	6	.....	.....	6	.....	.....	18
Grays Harbor	.....	8	10	23	.....	3	5	3	10	62
Island	1	1	13	4	.....	.....	.....	.....	1	20
Jefferson	.....	7	8	4	.....	.....	4	.....	3	26
King	9	4	8	31	.....	1	9	10	14	86
Kitsap	.....	13	6	5	.....	.....	3	.....	.....	27
Kittitas	5	.....	3	8	1	.....	1	.....	3	21
Klickitat	7	2	.....	12	1	6	3	2	3	36
Lewis	9	7	3	11	1	2	2	.....	14	49
Lincoln	1	.....	.....	.....	.....	.....	.....	.....	.....	1
Mason	.....	17	4	12	2	2	1	1	7	46
Okanogan	27	.....	5	2	.....	.....	2	.....	5	41
Pacific	.....	.....	3	4	.....	4	1	2	5	19
Pend Oreille	31	1	4	8	.....	2	3	1	8	58
Pierce	14	11	8	23	.....	2	6	3	6	73
San Juan	.....	.....	1	3	1	.....	.....	.....	2	7
Skagit	9	5	6	11	.....	6	1	8	7	53
Skamania	.....	.....	2	4	1	.....	2	3	3	15
Snohomish	3	4	8	26	2	3	8	5	5	64
Spokane	7	4	6	36	.....	.....	2	7	17	79
Stevens	39	1	6	17	2	.....	15	3	21	104
Thurston	1	5	.....	8	.....	3	4	4	3	28
Wahkiakum	2	.....	.....	2	.....	1	1	.....	.....	6
Whatcom	1	1	3	6	.....	.....	.....	1	3	15
Yakima	6	.....	1	6	1	.....	.....	.....	.....	14
Totals	199	98	115	294	13	45	88	56	150	1,058

Classification of Fires: Class A (¼ acre or less), 534; Class B (¼ to 10 acres), 405; Class C (over 10 acres), 119.

Table No. 2—ACREAGE BURNED OVER—1937 FIRES

COUNTIES	FOREST LAND			NOT REFORESTED			NON-FOREST LAND			Total
	Merch-antable Timber	Reproduction		Old Burn	Cutover Land		Pas-ture	Brush	Other	
		Cut Over	Old Burn		Slash Un-burned	Slash Burned				
Chelan	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Clallam	4	.....	.....	.....	2,563	.....	.....	4	.....	2,571
Clark	1	25	10	112	26	11	.....	5	5	195
Cowlitz	.....	.....	123	20	149	7	.....	2	.....	301
Ferry	58	1	.....	.....	9	6	.....	.....	.....	74
Grays Harbor	51	210	1,107	2,295	853	1	72	303	40	4,932
Island	.....	5	2	5	.....	.....	.....	1	.....	13
Jefferson	14	22	10	30	2	2	17	5	1	103
King	.....	5	31	146	789	73	3	161	31	1,239
Kitsap	.....	.....	3	3	652	5	.....	30	.....	693
Kittitas	.....	3	.....	.....	.....	.....	5	.....	.....	8
Klickitat	8	1	23	.....	3	.....	6	14	.....	55
Lewis	131	28	40	3	417	198	.....	39	152	1,008
Lincoln	2	.....	.....	.....	.....	.....	.....	.....	.....	2
Mason	190	707	543	64	4	9	.....	284	55	1,856
Okanogan	12	2	.....	.....	3	22	40	4	17	100
Pacific	40	14	.....	4	128	.....	.....	6	.....	192
Pend Oreille	1	74	3	6	15	.....	.....	.....	.....	99
Pierce	7	268	1	2	174	5	77	524	32	1,090
San Juan	.....	.....	.....	1	.....	12	.....	.....	.....	13
Skagit	41	333	1,729	1,066	640	1	3	11	.....	3,824
Skamania	.....	.....	40	50	166	.....	.....	3	.....	259
Snohomish	.....	3	10	2	5	14	10	75	3	122
Spokane	37	26	.....	.....	.....	.....	5	8	36	112
Stevens	10	72	6	.....	2	2	3	32	10	137
Thurston	.....	15	.....	.....	97	3	62	37	2	216
Wahkiakum	.....	1	.....	4	340	2	.....	.....	.....	347
Whatcom	.....	1	10	6	95	30	.....	2	.....	144
Yakima	2	.....	.....	.....	300	.....	77	27	.....	406
Totals	609	1,816	3,691	3,819	7,432	403	380	1,577	384	20,111

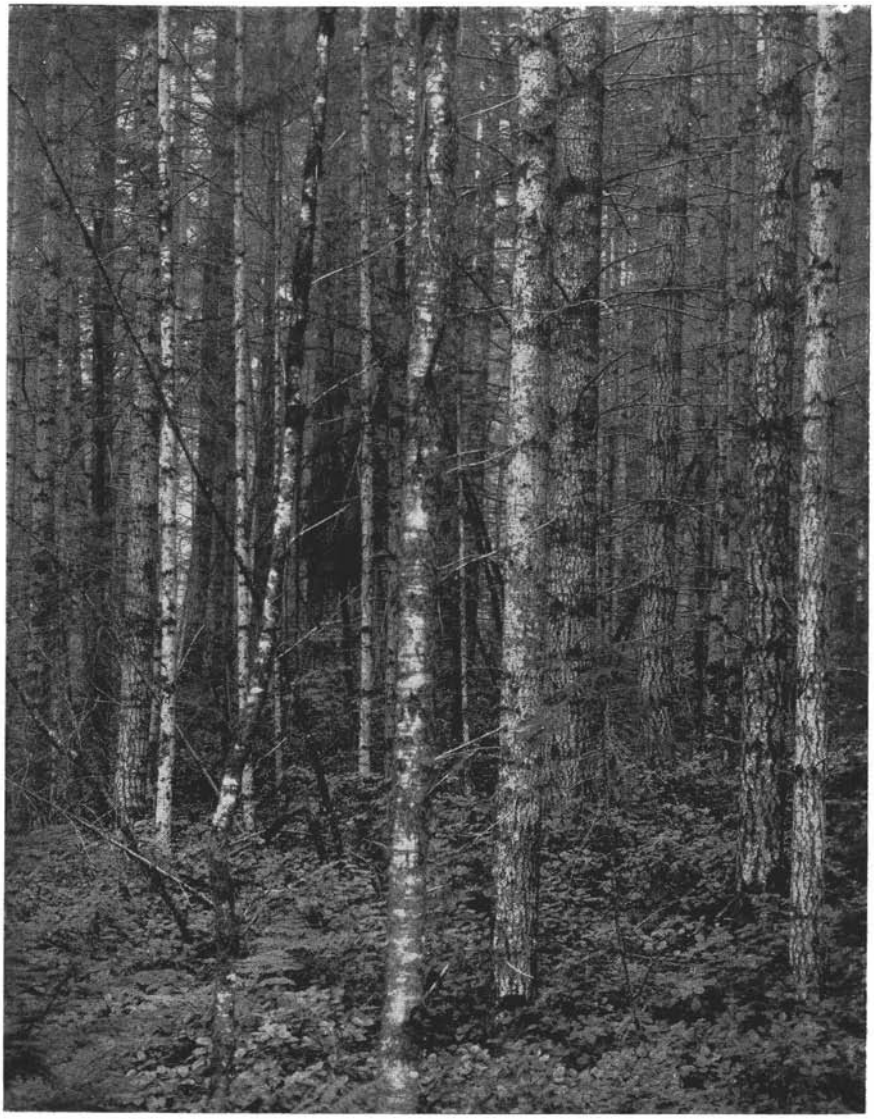
Table No. 3—LOSS AND DAMAGE—1937 FIRES

COUNTIES	MERCHANTABLE TIMBER			LOGS	LOSS AND DAMAGE TO PROPERTY	
	Timber Killed M. B. M.	Timber Salvable M. B. M.	Timber Destroyed M. B. M.	Logs Destroyed M. B. M.	Logging Equipment	Settlers and Others
Chelan						
Clallam	252	188	64	55	$857 00	
Clark	5	4	1	18	55 00	
Cowlitz					240 00	
Ferry	174		174			
Grays Harbor				3,745	12,380 00	$1,950 00
Island						
Jefferson	2		2			
King	10		10	10	1,500 00	
Kitsap						
Kittitas	1		1			10 00
Klickitat				4		
Lewis	220	160	60	950	473 00	
Lincoln						
Mason				98	25 00	
Okanogan						200 00
Pacific				150	2,750 00	
Pend Oreille	8	2	6	5		800 00
Pierce	100	95	5	50	240 00	130 00
San Juan						
Skagit	1,200	1,000	200	275	710 00	
Skamania						
Snohomish	10		10		360 00	
Spokane						432 00
Stevens	31	2	29			1,470 00
Thurston					150 00	
Wahkiakum						
Whatcom	3		3			175 00
Yakima					200 00	
Totals	2,016	1,451	565	5,360	$19,940 00	$5,167 00

Total loss and damage to all classes of property—$58,216.00.

Table No. 4—BURNING PERMITS, CLASSIFICATION AND ACREAGE OF LAND BURNED UNDER PERMIT—ARRESTS AND FINES—1937

COUNTIES	BURNING PERMITS				ARRESTS & FINES	
	Permits	Camp Fire Permits	Protection Acres	Agriculture Acres	Number	Fines and Costs
Asotin	4		1,320	120		
Chelan	101	1	98	90		
Clallam	694	25	3,104	1,601		
Clark	753	71	185	3,825		
Cowlitz	1,194	132	3,997	3,342		
Ferry	72	53	138	139		
Grays Harbor	820	18	3,883	828	8	$110 50
Island	221	1	127	334		
Jefferson	407	216	98	352		
King	2,437	151	1,863	2,090		
Kitsap	1,113	141	2,561	3,001		
Kittitas	24	45	124	222		
Klickitat	403	73	5,455	1,381		
Lewis	2,782	51	9,661	11,064		
Mason	831	199	3,352	940		
Okanogan	244	68	200	2,847		
Pacific	295	20	394	939	1	2 50
Pend Oreille	490	221	2,581	1,160	4	37 50
Pierce	1,407	29	7,704	3,318		
San Juan	154	69	229	1,319		
Skagit	712	63	3,243	2,086		
Skamania	78	19	87	131		
Snohomish	1,711	10	2,597	10,051		
Spokane	781	48	1,887	4,412	3	37 00
Stevens	1,470	432	4,877	8,496	15	139 00
Thurston	1,343	11	4,201	6,175		
Wahkiakum	297	26	1,029	1,073		
Walla Walla	3		2	5		
Whatcom	1,194	33	481	2,687		
Yakima	1	64				
Totals	22,036	2,290	65,478	74,028	31	$326 50



Fully Stocked Stand Douglas Fir Second Growth—Age 35 Years.

1938—ANNUAL REPORT

An unusual drought, extending from May 9 to October 24, was responsible for one of the longest and most critical fire seasons ever recorded in the State of Washington.

A total of 2,359 fires was reported on State and privately owned lands and from 100 to 1800 fire fighters were continuously engaged in suppression and control work. The season of 1938 marked the greatest concentration of men and equipment ever assembled at a single fire. On several occasions there were 1200 fire fighters and six bulldozers working on one fire. For the first time, large type bulldozers were successfully used for construction of fire trails in rugged, steep country. They proved very effective and will undoubtedly replace, to a great extent, axe and shovel crews.

The unsurpassed number of fires during the past season is discouraging. However, the actual area burned over and resultant loss and damage were much less than for some preceding years in which there were less than half the number of fires. Continued improvements in the protective organization and fire fighting equipment made it possible to meet and control the emergency that existed during the entire summer of 1938 without loss of life and with only nominal property damage.

A majority of the larger fires started in unburned slashings or upon lands that had been logged during the past five years. Consequently, loss and damage to merchantable timber or second growth was comparatively small. The most serious property damage was to logs and logging equipment, and resulted from accidental fires in the operations. The greatest damage to standing timber occurred in selectively cut areas with undisposed slashings. Invariably these fires crowned and killed the remaining timber which is of little commercial value.

Enrollees from the Civilian Corps put in 43,038 man-days of suppression work. They performed the major part of fire fighting and were on fires continuously from early spring until late fall. These men did their work willingly and effectively and deserve a lot of credit for preventing what might have developed into major conflagrations. The people of this state received one hundred cents from every dollar invested in state and private land CCC camps during the summer of 1938. At times fires became so numerous and scattered it was necessary to supplement CCC crews with civilian fire fighters. The latter were used almost exclusively for patrolling fire lines.

The largest and most damaging fire of the season was accidentally started from a logging operation in Cowlitz County. It originated in unburned slashings and spread over 22,000 acres of previously burned lands, requiring 1200 men and approximately 60 miles of trail to control. Another very damaging fire was set July 13 from logging operations on the Toandos Peninsula in Jefferson County. This fire also started in unburned slashings and killed the remaining timber on some 6,000 acres which had been selectively logged. A combination of accumulated slashings, strong northeast winds and low humidity caused a crown fire that was extremely difficult to control. The third serious fire was set by a careless camper in Kitsap County and burned over 5,000 acres of recently cut-over lands. An unusually heavy concentration of men and equipment was required to keep this fire from spreading into nearby settlements.

The first serious fires of the season occurred May 19 and 20 in Grays Harbor and Kitsap Counties, following which there were several days of low humidity, high temperature and strong northeast winds. By May 24 there were numerous fires scattered throughout western Washington. Hazardous fire weather continued until June 16, when the first measurable rain in 36 days was recorded in western Washington, ending the longest May and June dry spell on record. Then there were three days of comparatively cool, cloudy weather. On June 27 the temperature reached 90 degrees, with accompanying low humidity and northeast winds. This was the beginning of the longest and most critical fire period experienced in western Washington during the past 25 years. New fires were reported daily until August 11, when there were scattered showers that registered .05 of an inch of rain. It was during this period that most of the large and damaging fires occurred. Often as many as 1800 men were fighting fires at one time. On July 8 and 9 a dry lightning storm set 19 fires in Pierce, Lewis and Skamania Counties, all of which were in high country and difficult to reach with control crews.

By July 13 the situation had become so critical that, for the first time in Washington, a general order was issued closing down all logging operations July 14, 15 and 16. July 19 to 25 were terrific fire days—extremely low humidity, high temperature and hard northeast winds. Many fires swept over the trails and it became necessary to supplement the CCC crews with large numbers of civilian fire fighters. From August 11 to 13 there were scattered light showers that brought some relief to parts of western Washington. August 14 brought a resumption of hazardous fire weather that continued to September 5, on which there was a light general rain, accompanied by a lightning storm that set 20 fires in Whatcom, 37 in Skagit, and eight in Snohomish County. While this rain did not penetrate the forest cover, it materially helped check fires and afforded the opportunity to widen fire lines and prepare for the next outbreak.

On September 8 some operators started burning slashings, after which the weather again turned hot and dry, sending numerous fires beyond control. By September 13 the entire state was covered by a heavy pall of smoke and again all available CCC crews were called upon to fight fires that threatened serious property damage to settlers. On September 14 logging operators were cautioned to discontinue all slash burning and get existing fires in shape for another period of critical fire weather. September 18 the weather clouded and brought scattered light showers. Special patrolmen and lookouts were laid off for the season. From September 19 to October 11 there were alternating days of fire weather and cloudy, cool intervals with occasional scatterd showers. During this time the logging operators effectively disposed of a lot of accumulated slashings. On October 12 there was a hard general rain sufficient to check fires, followed by three days of cloudy weather. After the rain, additional slashings were set afire and on October 20 it was necessary to put a number of district wardens back on payroll to help with slashing fires which were out of control and threatening vast stands of second growth timber.

A general rain on October 24 definitely terminated a strenuous and critical fire season. The unusual features of the 1938 fire season may be summarized as follows:

1. Unprecedented drought and critical fire weather.
2. Concentration of extraordinarily large fire crews and equipment.
3. Extensive use of bulldozers for fire line construction.

4. Increased number of fires (exceeded all previous records).
5. A 354% increase of incendiary fires.
6. Comparatively small property loss and damage.
7. Prevention of major conflagrations.

Climatological data compiled by the United States Weather Bureau indicate atmospheric conditions during summer of 1938.

Month	Average Precipitation for the State (Inches)	Below Normal (Inches)	Above Normal (Inches)	Western Washington			Eastern Washington		
				Clear	Partly Cloudy	Cloudy	Clear	Partly Cloudy	Cloudy
April	2.38	0.04	.....	10	10	10	15	9	6
May	1.09	0.87	.....	15	8	8	16	9	6
June	0.76	0.84	.....	16	7	7	17	9	4
July	0.36	0.34	.....	21	5	5	24	5	2
August	0.34	0.51	.....	16	9	6	24	5	2
September	0.92	0.94	.....	13	7	10	19	7	4
October	3.55	.....	0.36	10	7	14	13	7	11

Cooperation

Acknowledgment for helpful assistance is herewith made to the following cooperators: United States Forest Service, Civilian Conservation Corps, United States Weather Bureau, Pacific Northwest Forest Experiment Station, Washington Forest Fire Association, Foresters of the West Coast Lumbermen's and Western Pine Associations. The mobile weather station unit, dispatched by United States Weather Bureau to all the larger fires, provided invaluable assistance. Establishment, organization and maintenance of fire camps and rationing of men by the United States Army is particularly commendable. The fire wardens, rangers, and technical field personnel of Civilian Conservation Corps are entitled to much credit for going through the fire season without loss of a human life or serious injury to any of the thousands of men who fought fire under their direction.

Civilian Conservation Corps

The following is a consolidated progress report of activities by state and private land CCC camps for the period January 1, 1938, to October 31, 1938.

Truck trails	53.8	Miles
Horse trails	3.	Miles
Vehicle bridges	10	
Telephone lines	21.5	Miles
Fire suppression	43,038	Man-days
Road and trailside clearing	9.9	Miles
Fire breaks	5.7	Miles
Fire hazard reduction	9,057	Acres
Lookout towers	1	
Fire halls	5	
Nursery	5,750	Man-days
Survey	902	Man-days
Tree planting	1,322	Acres

Land Classification

Field examination was made of 21,137 acres of cut-over land in Pacific County and 23,696 acres in Cowlitz County, all of which have been recommended to the State Tax Commission for classification under the Reforestation Act.

Slash Disposal

A slow lumber market greatly curtailed log production and many logging camps remained closed throughout the fire season. Resultant slashings for the current year are therefore much less than usual. It was unsafe to burn slashings before the middle of October, after which there was too much rain for successful slash disposal. In spite of unfavorable weather conditions, the operators burned over approximately 73,000 acres. The costs of slash disposal were unusually high, as many of the fires escaped and required a lot of trail construction and patrol to put under control.

Certificates of clearance were given for 62,760 acres of land from which slashings had been disposed of in accordance with statutory requirements. A thorough field examination and inspection is required before certificates are issued.

Buildings and Equipment

A new lookout tower and ground house were constructed on Incline Mountain, northeast of Cathlamet in Wahkiakum County.

Grounds around several of the fire halls have been landscaped.

A forestry headquarters site, consisting of approximately 20 acres situated along Pacific highway five miles east of Olympia, was purchased, upon which an office building consisting of four rooms, caretaker's residence, a four-car garage, a crew house with dormitory accommodations for 30 men, gasoline and oil shed, four warehouses each 50 by 80 feet, and combination machine shop and storage garage are in process of construction. Some of these buildings are already completed and the balance should be ready for occupancy by beginning of next fire season.

In addition to usual replacements of small fire fighting equipment—hose, pumps, hand tools, etc.—one new Chevrolet coupe was purchased.

Five new lookouts were completely equipped with furnishings; such as fire finders, telephones, lightning arresters, stoves and other essentials.

A tractor-plow, disc, and spike-toothed harrow were bought for the nursery.

Land Acquisition

Of the tax delinquent forest lands examined during 1938, a total of 69,935.34 acres was approved and accepted by the State Forest Board. These lands are situated in King, Klickitat, Skamania, Snohomish, Thurston, Wahkiakum and Clark Counties.

With the exception of a right of way granted in 1925, the first sale on lands acquired from counties was made in January of 1937, and since that time 94 transactions, involving timber sales, leases, trespass, etc., have been acted upon by the Board. From the completed transactions, $5,506.87 was returned to the counties, $249.80 placed in general fund, and $883.11 in the forest development fund. These figures will be materially increased when pending sales are completed. This is a creditable start, considering that most of the land is cut or burned over and the bulk of the sales involved salvage operations of scattered trees left after logging, fire-killed and down timber for wood and shingle bolts, pulpwood and cedar poles. Leases for grazing, oil, gas, coal, and mineral prospecting have added proportionately to the receipts.

Many applications for timber were rejected on account of damage to second growth that would result from removal of merchantable trees. The Board also rejected some leases, where grazing would be detrimental to the production of forest crops.

Pursuant to provisions of Chapter 77, Laws of 1937, two exchanges involving 140.91 acres of forest land were made for purpose of consolidating state forest land ownership—the first with a private company, the other with Clallam County. These exchanges are the first consummated under the new exchange law.

The Board accepted a gift of 600.08 acres and purchased 280 acres at 75¢ per acre and 4,267.31 at 50¢ per acre, with general utility bonds bearing 2% interest. The higher priced acreage supports a stand of advanced second growth timber. All of these lands are situated within boundaries of Capitol State Forest.

Capitol State Forest Nursery

Improvements at the nursery during the current year have been confined principally to conversion of four acres of raw stump land into additional seed bed space, construction of bird screens and shade frames to meet new requirements, installation of irrigation equipment proportionate with increased seed beds, the location and clearing of right of way and construction of power line from Gate City to the nursery—a distance of two and one-half miles. Plans are under way for construction of a 42,000 gallon concrete reservoir for irrigation purposes, supplementing the present system.

One million Douglas fir two-year seedlings were planted this fall on state lands situated in Skagit, Snohomish, Thurston and Wahkiakum Counties. Another million is available and will be set out in the spring of 1939. Spring sowing of 1,333 beds 4 by 12 feet for production of four million Douglas fir seedlings was completed and stock will be ready for planting on State land during fall and spring of 1939-40.

Severe drought together with excessive rodent damage caused a high mortality of stock planted during the fall of 1937 and spring of 1938, resulting in only 50% to 70% survival. In order to reduce rodent damage, equipment for spraying poison on all nursery stock has been purchased. This equipment will be available for treatment of the 1939 planting stock.

Preparatory to planting operations, an intensive survey of 9,240 acres of State Forest Board land was made to determine percentage of natural stocking. At present, planting operations are confined to lands less than 50% restocked by natural means.

Some experimental work is being carried on at the nursery in propagation of tung trees (aleurites fordii). Tung oil, which is produced from the nuts of the tung tree, is one of the principal ingredients used in high grade paints and varnishes. Since the usual supply from the Orient is not available, experimentation for production of tung trees is very timely. The nuts were planted last spring and the seedlings are making a vigorous growth. If winter temperatures are not too severe for this species, some interesting developments may result.

Additional experiments are being made with propagation of black walnut (juglans nigra), butternut (juglans cinerea), cascara (cascara sagrada), shagbark hickory (hicoria ovata), pignut hickory (hicoria glabra), and beech (fagus Americana).

Port Orford cedar (chamaecyparis lawsoniana) transplanted in Snohomish County and Capitol State Forest in the spring of 1936 has made fair growth. It appears hardy, having survived this year's drought better than native species, such as Douglas fir, western red cedar, hemlock and spruce. It is interesting to note that some of this stock, now five years old, produced cones this year and a cutting test of the seed showed it fairly well filled.

This fall 700 sacks of Douglas fir cones were collected, yielding 650 pounds of seed, which, with a small amount left from previous years, is sufficient supply for three years.

Recommendations

Slash disposal on selectively logged lands in the Douglas fir region has created a rather complex problem that will undoubtedly necessitate a liberalization of present statutory regulations. The law now requires broadcast burning after logging operations have been completed. There should be an exception provided for lands on which the timber has been selectively cut, since very often 50% of the original volume is left standing and would be killed by broadcast burning, resulting in another hazard. On the other hand, it is far too expensive to dispose of slashings by piling and burning. There should be a medium between these two extremes that would recognize spot, strip or other forms of partial burning and, in some instances, no burning should be required.

Since the Christmas tree bill passed by 1937 Legislature was declared unconstitutional, it should be redrafted, eliminating any interference with interstate commerce and providing an excise rather than an export tax. Unless some form of regulation governing Christmas tree cutting is immediately enacted, thousands of acres supporting thrifty stands of reproduction will be entirely ruined.

At present, no other forestry legislation is needed.

Table No. 5—ORIGIN, NUMBER AND CLASSIFICATION OF FIRES—1938

COUNTIES	Light-ning	Incen-diary	Camp-ers	Smok-ers	Slash-ing	Log-ging	Brush Burni'g	Rail-roads	Misc.	Total
Chelan	11	.....	3	14	.....	.....	.....	4	2	34
Clallam	2	4	3	17	.....	4	3	1	12	46
Clark	.....	6	3	22	1	.....	12	1	7	52
Cowlitz	3	22	5	40	1	6	24	3	11	115
Ferry	12	.....	1	2	.....	.....	.....	1	.....	16
Grays Harbor	.....	30	9	64	1	.....	3	3	5	115
Island	3	7	16	7	.....	.....	1	.....	1	35
Jefferson	5	10	7	17	.....	3	4	1	2	49
King	9	48	14	111	1	2	37	13	21	256
Kitsap	3	13	8	21	.....	.....	15	.....	1	61
Kittitas	11	.....	2	12	.....	.....	5	2	5	37
Klickitat	6	7	1	21	.....	12	2	1	8	58
Lewis	4	57	6	21	.....	5	19	4	33	149
Mason	.....	43	6	15	2	3	2	2	10	83
Okanogan	56	.....	.....	7	.....	.....	.....	.....	1	64
Pacific	.....	17	7	11	.....	5	1	.....	.....	41
Pend Oreille	8	22	3	15	.....	.....	.....	8	14	70
Pierce	14	50	4	91	2	1	27	4	17	210
San Juan	1	.....	1	4	.....	1	1	.....	2	10
Skagit	34	21	9	34	1	8	6	5	11	129
Skamania	4	1	1	4	1	1	2	2	1	17
Snohomish	9	22	9	73	1	5	22	4	16	161
Spokane	10	6	13	76	.....	.....	3	9	16	133
Stevens	70	9	8	33	2	.....	9	5	19	155
Thurston	1	40	3	42	3	1	23	7	7	127
Wahkiakum	.....	1	2	2	.....	.....	1	.....	3	9
Whatcom	25	9	12	22	2	1	13	1	14	99
Yakima	19	.....	1	6	.....	1	.....	.....	1	28
Totals	320	445	157	804	18	59	235	81	240	2,359

Classification of Fires: Class A (¼ acre or less), 824; Class B (¼ acre to 10 acres), 1,003; Class C (over 10 acres), 532.

Table No. 6—ACREAGE BURNED OVER—1938 FIRES

COUNTIES	FOREST LAND			NOT REFORESTED			NON-FOREST LAND			
		Reproduction			Cutover Land					
	Merch-antable Timber	Cut-Over	Old Burn	Old Burn	Slash Un-burned	Slash Burned	Pas-ture	Brush	Other	Total
Chelan	.....	.....	.....	.....	.....	.....	.....	23	139	162
Clallam	.....	21	15	.....	193	.....	.....	42	.....	271
Clark	19	169	25	2	37	.....	85	118	.....	455
Cowlitz	551	1,666	913	2,010	3,368	10,842	8	544	42	19,944
Ferry	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Grays Harbor	73	9,764	1,017	2,402	4,261	104	46	240	7	17,914
Island	2	42	5	.....	2	10	2	192	1	256
Jefferson	4,320	29	58	108	1,688	.....	5	5	3	6,216
King	1	82	165	634	3,946	68	901	2,267	49	8,113
Kitsap	187	5	990	405	3,311	1,920	59	248	105	7,230
Kittitas	1	419	.....	.....	.....	.....	84	82	18	604
Klickitat	18	92	28	5	13	3	2	26	11	198
Lewis	823	4,851	5,463	916	3,454	12,108	936	723	4	29,278
Mason	276	276	534	4,131	2,188	.....	1	81	5	7,492
Okanogan	2	.....	2	.....	.....	.....	25	.....	318	347
Pacific	503	124	5	2	3,923	122	.....	46	5	4,730
Pend Oreille	8	113	2	.....	46	11	.....	15	4	199
Pierce	85	1,069	157	40	2,524	1,874	733	5,042	58	11,582
San Juan	.....	35	8	.....	.....	.....	.....	4	.....	47
Skagit	7	22	25	16	985	75	70	111	.....	1,311
Skamania	9	80	401	.....	30	2	1	23	.....	546
Snohomish	21	314	336	391	5,233	2,252	928	3,053	8	12,536
Spokane	88	1,031	.....	.....	100	.....	171	198	1,624	3,212
Stevens	381	537	1,011	.....	215	405	15	46	12	2,622
Thurston	43	280	483	134	545	174	468	1,769	166	4,062
Wahkiakum	.....	.....	.....	.....	5	.....	.....	2	1	8
Whatcom	395	51	212	89	3,363	8	56	874	7	5,055
Yakima	.....	1	2	.....	7	.....	112	1	.....	123
Totals	7,813	21,073	11,857	11,285	39,437	29,978	4,708	15,775	2,587	144,513

Table No. 7—LOSS AND DAMAGE—1938 FIRES

COUNTIES	MERCHANTABLE TIMBER			LOGS	LOSS AND DAMAGE TO PROPERTY	
	Timber Killed M. B. M.	Timber Salvable M. B. M.	Timber Destroyed M. B. M.	Logs Destroyed M. B. M.	Logging Equipment	Settlers and Others
Chelan	3	.....	3	.....	.....	.....
Clallam	20	.....	20	1,000	.....	$30 00
Clark	57	27	30	10	.....	659 00
Cowlitz	150	57	93	400	$7,250 00	66 00
Ferry	.....	.....	.....	.....	.....	.....
Grays Harbor	789	150	639	2,500	100 00	.....
Island	.....	.....	.....	.....	.....	.....
Jefferson	40,000	36,000	4,000	1,510	5,500 00	.....
King	.....	.....	.....	120	1,000 00	50 00
Kitsap	.....	.....	.....	280	.....	1,431 00
Kittitas	3	.....	3	.....	.....	500 00
Klickitat	54	8	46	5	4,950 00	2,324 00
Lewis	3,281	1,984	1,297	795	20,600 00	1,395 00
Mason	2,950	2,850	100	130	6,250 00	.....
Okanogan	1	.....	1	.....	.....	.....
Pacific	52	.....	52	1,860	23,540 00	.....
Pend Oreille	52	40	12	.....	.....	57 00
Pierce	197	53	144	200	.....	1,647 00
San Juan	.....	.....	.....	.....	200 00	1,500 00
Skagit	.....	.....	.....	.....	250 00	1,000 00
Skamania	5	3	2	3	1,300 00	.....
Snohomish	15	.....	15	200	90 00	1,290 00
Spokane	5	5	.....	.....	.....	870 00
Stevens	89	41	48	.....	.....	330 00
Thurston	225	.....	225	.....	20 00	1,530 00
Wahkiakum	3	.....	3	20	.....	.....
Whatcom	7,247	4,639	2,608	250	4,255 00	50 00
Yakima	4	.....	4	.....	.....	.....
Totals	55,202	45,857	9,345	9,283	$75,305 00	$14,729 00

Total loss and damage to all classes of property—$157,973.00.

Table No. 8—BURNING PERMITS, CLASSIFICATION AND ACREAGE OF LAND BURNED UNDER PERMIT—ARRESTS AND FINES—1938

COUNTIES	BURNING PERMITS				ARRESTS AND FINES	
	Permits	Camp Fire Permits	Protection Acres	Agriculture Acres	Number	Fines and Costs
Chelan	193	7	1,820	624	.....	.....
Clallam	591	1	5,247	1,472	.....	.....
Clark	1,643	46	216	10,595	8	$20 40
Cowlitz	1,884	167	8,892	6,430	1	.....
Douglas	1	.....	.....	2	.....	.....
Ferry	160	6	1,376	1,541	.....	.....
Grays Harbor	1,366	62	3,426	1,518	20	379 60
Island	382	4	202	1,296	1	.....
Jefferson	413	154	189	593	.....	.....
King	2,666	143	225	2,851	.....	.....
Kitsap	1,091	149	476	2,950	.....	.....
Kittitas	96	14	1,223	619	.....	.....
Klickitat	503	101	4,781	2,750	.....	.....
Lewis	3,662	413	4,981	14,085	.....	.....
Mason	1,081	248	14,998	1,766	4	2 50
Okanogan	254	7	1,602	4,779	.....	.....
Pacific	753	48	5,627	2,753	2	27 50
Pend Oreille	708	156	2,238	1,986	1	12 50
Pierce	1,321	39	2,783	3,173	1	12 50
San Juan	208	56	660	1,531	.....	.....
Skagit	1,220	73	786	4,147	1	27 50
Skamania	140	41	138	374	.....	.....
Snohomish	2,706	168	2,590	9,168	3	45 60
Spokane	839	42	3,605	6,164	2	26 00
Stevens	1,829	370	2,949	14,027	3	17 50
Thurston	1,962	10	1,704	5,025	.....	.....
Wahkiakum	445	17	59	1,236	.....	.....
Walla Walla	3	.....	20	10	.....	.....
Whatcom	1,688	21	458	3,977	1	27 00
Yakima	1	55	.....	.....	2	12 50
Totals	29,809	2,618	73,271	107,442	50	$611 10

Table No. 9—STATE APPROPRIATION—GENERAL FUND
December 1, 1936, to March 31, 1937

	EMERGENCY FIRE FIGHTING		SALARIES AND WAGES		OPERATIONS	
BALANCE (1935-37 Appropriation)		$14,311 95		$2,083 01		$6,219 38
EXPENDITURES—						
Salaries and Wages:						
Office			$2,024 03			
Wardens and patrolmen			52 31			
Operations:						
Traveling expense					$97 44	
Office supplies					235 32	
Telephone and telegraph					123 10	
Postage, freight and express					315 95	
Printing					391 48	
Industrial insurance					536 55	
Equipment and tools					4,519 37	
Total Expenditures				$2,076 34		$6,219 21
Balance March 31, 1937 (Reverted)		$14,311 95		$6 67		$ 17

Table No. 10—STATE APPROPRIATION—GENERAL FUND
April 1, 1937, to March 31, 1938

	SALARIES AND WAGES		OPERATIONS	
BALANCE (1937-39 Appropriation)		$150,000 00		$50,000 00
EXPENDITURES—				
Salaries and Wages:				
Office	$11,898 56			
Land classification	174 75			
Nursery	493 86			
Warehouse and shop	443 86			
Wardens and patrolmen	41,141 76			
Fire protection contracts	3,500 00			
Operations:				
Traveling expense			$5,439 27	
Office supplies			177 74	
Telephone and telegraph			210 13	
Postage, freight and express			212 74	
Printing			930 88	
Miscellaneous			128 36	
Industrial insurance			3,699 35	
Equipment and tools			3,867 77	
Improvements			161 61	
Total expenditures		$57,652 79		$14,827 85
Balance March 31, 1938		$92,347 21		$35,172 15

Table No. 11—STATE APPROPRIATION—GENERAL FUND
April 1, 1938, to November 30, 1938

	SALARIES AND WAGES		OPERATIONS	
BALANCE (1937-39 Appropriation)		$92,347 21		$35,172 15
EXPENDITURES—				
Salaries and Wages:				
Office	$6,597 04			
Land classification	334 80			
Nursery	769 07			
Warehouse and shop	729 07			
Wardens and patrolmen	50,136 49			
Fire protection contracts	4,000 00			
Operations:				
Traveling expense			$6,019 88	
Office supplies			95 12	
Telephone and telegraph			204 41	
Postage, freight and express			1,130 15	
Printing			533 05	
Miscellaneous			101 82	
Industrial insurance			2,440 94	
Equipment and tools			1,957 29	
Improvements			349 06	
Total expenditures		$62,566 47		$12,831 72
Balance November 30, 1938		$29,780 74		$22,340 43

Table No. 12—FEDERAL ALLOTMENT—CLARKE-McNARY FUND

	December 1, 1936 to March 31, 1937		April 1, 1937 to March 31, 1938		April 1, 1938 to November 30, 1938	
BALANCE		$97,903 89		$88,411 18		$109,360 76
Reimbursement				86,746 00		88,092 35
Credits		30 75				12 35
Totals		$97,934 64		$175,157 18		$197,453 11
EXPENDITURES—						
Salaries and Wages:						
Office	$1,159 03		$890 00		$1,580 00	
Land classification	846 08		451 46		720 18	
Nursery	479 28		1,945 74		867 91	
Warehouse and shop	550 03		1,573 92		919 48	
Christmas tree trespass	1,114 77		2,966 73		394 52	
Wardens and patrolmen	3,467 70		40,439 85		47,452 45	
Fire fighters	241 39		750 89		13,958 51	
Fire protection contracts			7,223 57		8,016 72	
Operations:						
Traveling expense	1,179 95		6,345 08		4,880 73	
Office supplies	34 24		27 82		23 87	
Postage, freight and express			288 00		8 52	
Printing			11 46			
Miscellaneous	37 34		41 45		51 87	
Equipment and tools	331 10		926 60		680 19	
Improvements	73 57		1,901 38		1,107 63	
Fire fighting expense			12 47		2,238 59	
Total expenditures		$9,523 46		$65,796 42		$82,901 17
Balance		$88,411 18		$109,360 76		$114,551 94

Table No. 13—SPECIAL ASSESSMENT FUND

	December 1, 1936 to March 31, 1937		April 1, 1937 to March 31, 1938		April 1, 1938 to November 30, 1938	
BALANCE				$7,557 92		$10,923 42
Receipts		$7,557 92		$16,039 89		4,795 15
Totals		$7,557 92		$23,597 81		$15,718 57
EXPENDITURES—						
Salaries and Wages:						
Wardens and patrolmen			$11,278 43		$6,023 04	
Fire fighting			9 20		14 37	
Operations:						
Traveling expense			1,272 65		1,152 04	
Equipment and tools			60 07		34 99	
Improvements			54 02		66 19	
Fire fighting expense					105 84	
Total expenditures				$12,674 39		$7,396 47
Balance		$7,557 92		$10,923 42		$8,322 10

Table No. 14—FOREST ASSESSMENT FUND

	December 1, 1936 to March 31, 1937		April 1, 1937 to March 31, 1938		April 1, 1938 to November 30, 1938	
BALANCE		$50,787 96		$62,415 30		$99,681 18
Receipts—Collections		22,784 13		140,156 62		61,825 87
Recovery		100 00				
Totals		$73,672 09		$202,571 92		$161,507 05
EXPENDITURES—						
Salaries and Wages:						
Wardens and patrolmen	$234 57		$5,522 17		$2,196 24	
Fire fighting	4 78		31 00		198 04	
Fire protection contracts	10,086 97		90,733 28		40,556 73	
Operations:						
Transfers—Clerks fund	930 47		5,977 35		743 90	
Traveling expense			620 06		561 54	
Equipment and tools			4 00			
Fire fighting expense					30 82	
Refund			2 88			
Total expenditures		$11,256 79		$102,890 74		$44,287 27
Balance		$62,415 30		$99,681 18		$117,219 78

Table No. 15—CLERKS FUND

	December 1, 1936 to March 31, 1937		April 1, 1937 to March 31, 1938		April 1, 1938 to November 30, 1938	
BALANCE		$24,924 13		$24,510 85		$28,998 52
Transfers from Forest Assessment Fund		930 47		5,977 35		743 90
Totals		$25,854 60		$30,488 20		$29,742 42
EXPENDITURES—						
Salaries and Wages:						
Office	$635 00		$519 10		$736 64	
Wardens and patrolmen	708 75		509 04			
Operations:						
Office supplies			109 29		139 50	
Postage, freight and express			197 00			
Miscellaneous			97 20		9 50	
Equipment and tools			58 05			
Total expenditures		$1,343 75		$1,489 68		$885 64
Balance		$24,510 85		$28,998 52		$28,856 78

Table No. 16—RECOVERY FUND

	December 1, 1936 to March 31, 1937		April 1, 1937 to March 31, 1938		April 1, 1938 to November 30, 1938	
BALANCE		$117 97		$68 62		$68 72
Receipts		81 40		14 70		594 30
Totals		$199 37		$83 32		$663 02
EXPENDITURES:						
Fire fighting salaries			$14 60		$111 62	
Transfers—Clarke-McNary fund	$30 75					
Transfers—Forest assessment fund	100 00					
Total expenditures		$130 75		$14 60		$111 62
Balance		$68 62		$68 72		$551 40

Table No. 17—STATEMENT SHOWING NUMBER OF ACRES OF PRIVATELY OWNED FOREST LANDS ASSESSED FOR PROTECTION COSTS

COUNTIES	1937	1938
Asotin	15,418	15,358
Chelan	151,836	148,978
Clallam	120,684	122,025
Clark	65,031	41,697
Columbia	25,239	25,239
Cowlitz	109,047	95,384
Ferry	43,742	43,552
Garfield	7,520	7,520
Grays Harbor	307,649	256,890
Island	21,493	21,493
Jefferson	81,384	71,586
King	141,745	138,239
Kitsap	36,812	39,655
Kittitas	251,595	253,226
Klickitat	234,611	244,062
Lewis	174,667	175,212
Mason	159,812	125,135
Okanogan	94,755	94,538
Pacific	125,502	110,505
Pend Oreille	160,341	162,327
Pierce	85,047	86,046
Skagit	152,889	167,496
Skamania	93,454	95,713
Snohomish	132,544	121,684
Spokane	176,125	169,371
Stevens	423,417	420,794
Thurston	110,073	107,555
Wahkiakum	40,659	26,927
Walla Walla	7,021	7,021
Whatcom	98,094	96,394
Yakima	93,812	93,902
Totals	3,742,018	3,585,524

NOTE—1938 acreages not balanced with county assessors.

Table No. 18—STATEMENT SHOWING FOREST ASSESSMENT COLLECTIONS RECEIVED FROM COUNTY TREASURERS
December 1, 1936, to March 31, 1937

COUNTIES	1928	1929	1930	1931	1932	1933	1934	1935	1936	Total
Asotin	.....	$3 20	$12 83	$8 18	$22 65	$28 33	$15 74	$36 93	$28 65	$156 51
Chelan	$15 88	9 07	33 12	55 58	71 47	77 45	56 98	511 43	193 74	1,024 72
Clallam	63 02	54 62	75 92	83 59	57 45	54 51	57 48	323 89	43 54	814 02
Clark	1 29	10 31	13 65	18 00	16 07	19 51	19 28	88 62	49 17	235 90
Columbia	.....	4 40	8 85	11 12	23 12	13 52	19 92	63 48	.....	144 41
Cowlitz	1 57	6 22	53 04	64 63	83 97	27 40	22 80	169 67	112 91	542 21
Ferry	.....	.....	17 26	25 08	10 32	8 40	13 32	66 28	54 99	195 65
Garfield	.....	.....	.....	.....	.....	.....	1 60	14 00	25 48	41 08
Grays Harbor	6 98	2 02	10 78	17 01	27 16	28 87	32 02	246 02	28 79	399 65
Island	7 70	7 00	11 00	10 00	14 34	4 74	4 20	47 32	34 85	141 15
Jefferson	27 75	39 07	11 61	12 12	26 34	33 71	43 04	238 87	175 99	608 50
King	95 47	34 85	109 91	41 62	12 73	33 77	41 91	469 31	9 71	849 28
Kitsap	1 13	.....	12 00	12 00	14 00	25 65	18 32	54 47	21 01	158 58
Kittitas	.....	.....	1 22	7 12	1 81	22 83	17 67	406 27	45 69	502 61
Klickitat	142 03	75 23	136 72	144 33	102 46	94 55	226 99	442 86	170 14	1,535 31
Lewis	61 04	71 30	85 00	90 10	92 48	85 69	69 84	247 08	.....	802 53
Mason	21 34	18 36	64 85	68 60	40 23	34 86	36 45	388 41	11 45	684 55
Okanogan	205 12	125 31	134 44	121 00	103 41	94 20	107 85	391 37	83 38	1,366 08
Pacific	40 44	11 34	6 00	18 00	9 80	29 97	78 77	249 04	.....	443 36
Pend Oreille	85 79	52 23	209 26	197 42	196 32	281 70	354 39	1,045 75	142 35	2,565 21
Pierce	68 73	31 42	26 98	24 75	31 23	30 39	41 61	119 73	5 00	379 84
Skagit	141 10	115 28	130 37	32 59	24 78	36 27	16 54	433 33	90 28	1,020 54
Skamania	.....	.....	.....	.....	46 40	7 17	15 77	126 04	90 94	286 32
Snohomish	37 16	56 77	17 51	44 61	51 33	78 96	60 76	435 79	70 64	853 53
Spokane	.....	.....	.....	.....	.....	.....	.....	553 02	258 11	811 13
Stevens	30 03	31 59	471 74	535 06	498 43	581 61	641 67	1,735 61	383 61	4,909 35
Thurston	40 48	66 69	77 79	25 53	30 56	36 23	48 32	291 07	85 30	701 97
Wahkiakum	.....	.....	.....	.....	3 32	1 65	25	12 79	7 72	25 73
Walla Walla	.....	3 20	3 36	2 56	2 55	2 55	5 58	12 64	4 24	36 68
Whatcom	1 35	31 60	4 80	13 38	8 76	26 15	59 24	329 95	88	476 11
Yakima	.....	.....	.....	40	3 80	3 80	40	53 62	9 60	71 62
Totals	$1,095 40	$861 08	$1,740 01	$1,684 38	$1,627 29	$1,804 44	$2,128 71	$9,604 66	$2,238 16	$22,784 13

Table No. 19—STATEMENT SHOWING FOREST ASSESSMENT COLLECTIONS RECEIVED FROM COUNTY TREASURERS
April 1, 1937, to March 31, 1938

COUNTIES	1929	1930	1931	1932	1933	1934	1935	1936	1937	Total
Asotin	$3 36	$17 18	$35 85	$37 95	$45 46	$49 30	$46 51	$223 70	$24 99	$484 30
Chelan	18 00	143 79	215 63	250 74	417 61	541 91	717 90	3,372 92	126 62	5,805 12
Clallam	34 88	209 77	381 48	423 62	473 47	415 91	637 46	1,247 97	38 91	3,863 47
Clark	96 80	174 05	1,233 05	932 14	849 41	708 74	1,054 67	1,159 86	66 29	6,275 01
Columbia	80	80	29 40	41 70	73 90	43 78	93 74	371 16	64 93	720 21
Cowlitz	10 40	185 71	221 60	176 83	191 90	423 56	977 66	2,330 29	143 29	4,661 24
Ferry	.....	36 48	152 24	236 44	253 62	269 10	93 42	514 03	93 44	1,648 77
Garfield	.....	.....	1 60	4 20	4 20	6 60	17 00	75 44	22 84	131 88
Grays Harbor	365 57	614 53	2,926 56	2,784 67	2,650 11	2,200 15	3,284 05	3,835 08	73 10	18,733 82
Island	31 83	13 14	11 19	23 14	11 85	12 88	29 75	235 20	39 09	408 07
Jefferson	.....	108 34	313 46	331 38	304 61	268 53	391 33	1,008 09	205 12	2,930 86
King	47 73	214 22	662 32	716 27	678 24	757 87	1,117 22	2,549 27	106 57	6,849 71
Kitsap	1 13	29 03	63 65	42 13	80 78	73 90	124 81	344 63	7 99	768 05
Kittitas	.....	31 19	58 02	85 78	107 65	113 72	105 78	4,584 05	33 04	5,119 23
Klickitat	836 61	210 10	378 80	285 20	266 29	377 24	520 74	3,203 76	240 20	6,318 94
Lewis	35	301 24	472 57	426 72	605 47	579 49	889 94	1,966 20	154 20	5,396 18
Mason	64 76	95 59	478 94	321 02	383 06	397 14	631 39	1,796 78	93 92	4,262 60
Okanogan	.....	57 80	134 32	185 04	220 48	236 04	309 74	1,682 00	128 07	2,953 49
Pacific	320 60	759 96	1,163 47	883 21	954 00	856 67	1,296 43	2,398 80	112 22	8,745 36
Pend Oreille	90 58	242 30	499 54	468 13	601 95	639 89	625 70	2,853 00	222 15	6,243 24
Pierce	23 96	107 58	139 53	240 85	255 92	295 24	388 66	959 82	11 03	2,422 53
Skagit	50 19	281 44	711 97	794 18	848 93	738 82	1,046 82	2,624 81	73 75	7,170 91
Skamania	.....	.....	600 72	104 49	136 96	156 95	297 86	1,180 86	110 48	2,588 32
Snohomish	189 88	452 30	588 53	642 90	673 71	651 40	982 14	1,976 07	134 21	6,291 14
Spokane	.....	.....	.....	.....	.....	.....	.....	4,470 34	22 77	4,493 11
Stevens	.....	1,142 60	802 42	651 65	902 41	987 02	1,242 43	6,092 82	843 55	12,664 90
Thurston	.....	185 10	332 37	304 88	373 81	361 24	705 75	1,851 98	90 41	4,205 54
Wahkiakum	6 42	4 60	17 17	60 45	59 40	52 56	85 38	222 83	5 91	514 72
Walla Walla	.....	4 14	5 74	6 54	10 34	9 72	51 13	95 51	4 80	187 92
Whatcom	244 07	269 01	376 26	684 61	650 82	577 73	1,040 52	1,549 12	.....	5,392 14
Yakima	38 28	12 80	51 78	19 82	23 22	10 22	23 62	1,726 70	.....	1,905 84
Totals	$2,476 14	$5,904 79	$13,060 18	$12,166 68	$13,109 58	$12,813 32	$18,828 95	$58,503 09	$3,293,89	$140,156 62

Table No. 20—STATEMENT SHOWING FOREST ASSESSMENT COLLECTIONS RECEIVED FROM COUNTY TREASURERS
April 1, 1938, to November 30, 1938

COUNTIES	1929	1930	1931	1932	1933	1934	1935	1936	1937	Total
Asotin	.....	.....	$12 76	$22 40	$11 76	$3 76	$5 36	$15 14	$145 90	$217 08
Chelan	.....	.....	50 47	34 76	25 51	29 62	83 77	136 71	2,268 35	2,629 19
Clallam	.....	.....	27 15	19 23	17 82	14 73	20 76	27 04	912 40	1,039 13
Clark	$5 52	$13 90	47 65	15 11	14 50	30 30	36 00	42 93	1,179 19	1,385 10
Columbia	.....	.....	1 60	13 92	4 80	6 20	7 80	35 04	185 05	254 41
Cowlitz	16 00	60 35	185 65	59 52	77 78	84 50	126 49	89 16	1,764 78	2,464 23
Ferry	14 61	20 94	10 59	10 34	8 35	55 68	62 16	419 04	601 71	
Garfield	.....	.....	1 60	1 60	1 60	1 60	1 60	6 80	55 88	70 68
Grays Harbor	.....	38 25	63 29	67 70	59 96	34 60	71 86	86 23	2,801 94	3,223 83
Island	70 48	19 22	52 35	8 47	9 51	5 07	31 26	7 92	220 43	424 71
Jefferson	.....	8 00	30 82	27 19	37 42	30 15	34 43	42 81	789 32	1,000 14
King	.....	.....	.....	223 82	65 39	129 26	211 28	222 37	2,132 18	2,984 30
Kitsap	1 13	6 88	27 11	8 51	22 31	20 78	36 36	42 42	235 08	400 58
Kittitas	1 41	5 81	58 38	20 21	29 94	44 50	39 98	45 17	3,792 23	4,037 63
Klickitat	30 58	61 90	169 73	111 17	122 71	137 99	165 77	339 73	2,684 74	3,824 32
Lewis	.....	10 49	125 50	79 98	82 45	67 92	140 87	128 23	2,037 20	2,672 64
Mason	80 13	29 53	38 10	45 56	33 33	33 19	41 78	46 35	1,332 82	1,680 79
Okanogan	.....	11 20	52 92	29 07	78 93	67 17	106 08	164 11	1,067 42	1,576 90
Pacific	107 93	24 94	32 93	39 25	36 16	48 50	120 75	133 84	2,079 36	2,623 66
Pend Oreille	4 80	12 00	105 22	49 20	96 51	160 59	180 57	190 76	2,274 13	3,073 78
Pierce	9 45	20 59	76 52	44 39	55 40	47 09	98 12	106 46	979 83	1,437 85
Skagit	.....	139 15	471 91	64 79	53 04	50 26	106 19	112 35	2,259 88	3,257 57
Skamania	.....	.....	74 42	.....	134 99	79 54	94 80	123 24	1,467 65	1,974 64
Snohomish	–1 01	16 57	19 68	19 51	26 02	22 77	47 60	53 49	1,698 54	1,903 17
Spokane	.....	.....	.....	.....	.....	.....	.....	.....	3,505 44	3,505 44
Stevens	.....	.....	484 64	194 64	183 39	310 51	333 24	695 37	5,475 90	7,677 69
Thurston	.....	.....	95 14	45 10	50 17	55 36	101 83	87 18	1,740 02	2,174 80
Wahkiakum	8 07	25 55	32 00	39 36	25 24	36 79	59 49	51 96	257 24	535 70
Walla Walla	.....	.....	.....	.....	– 80	.....	4 80	8 13	59 12	71 25
Whatcom	27 32	31 86	47 45	42 72	40 30	33 01	83 84	73 14	1,008 06	1,387 70
Yakima	40	40	6 70	9 59	9 50	13 40	13 40	48 50	1,613 36	1,715 25
Totals	$362 21	$551 20	$2,412 63	$1,347 36	$1,415 98	$1,607 51	$2,461 76	$3,224 74	$48,442 48	$61,825 87

DIVISION OF RECLAMATION

John Brooke Fink, Director

HISTORY OF RECLAMATION IN WASHINGTON

Irrigation—Private Development

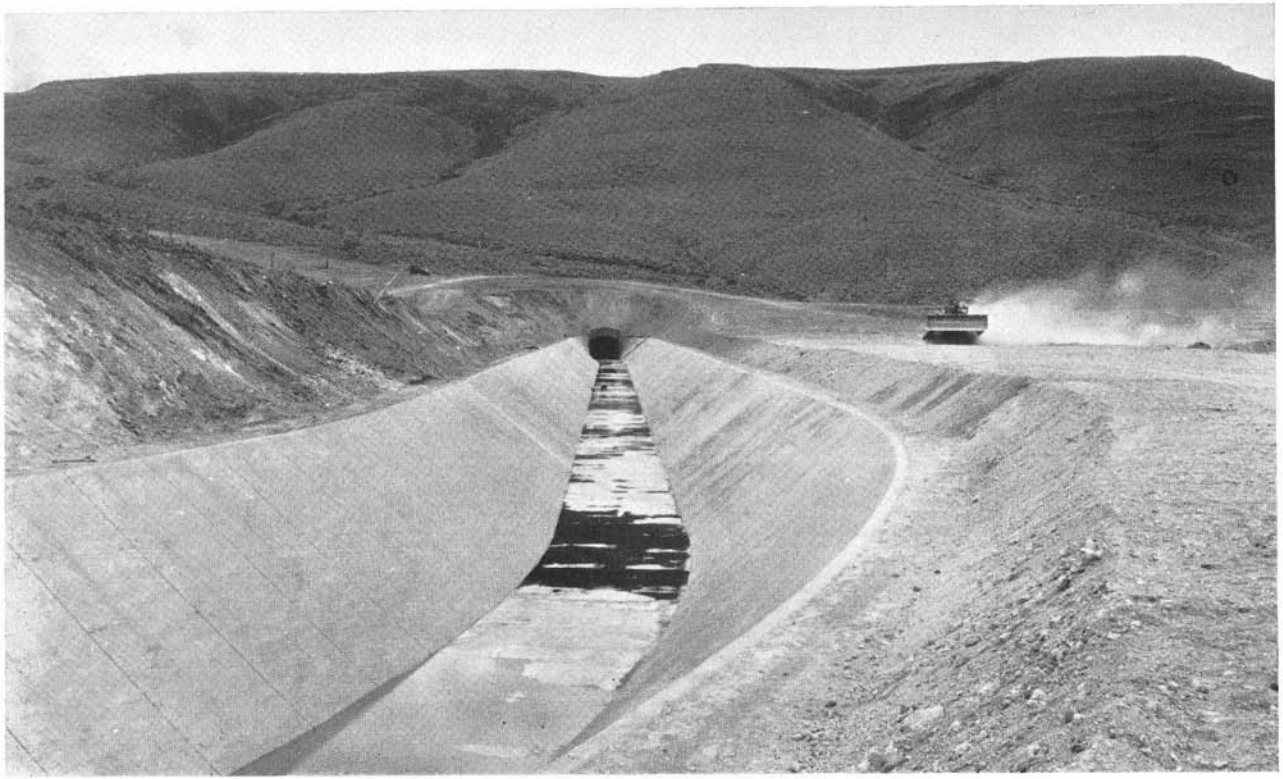
The first reclamation of arid lands in this state by irrigation probably occurred about one hundred years ago. Records of this department show that Dr. Marcus Whitman constructed a ditch in 1846 to divert water from Doan Creek for irrigation of lands of the Whitman Mission Donation Land Claim, located six miles west of the City of Walla Walla. Although Dr. Whitman's settlement had been established ten years previous to that time and it is understood that agricultural crops were produced during that ten year period, such crops undoubtedly obtained moisture from sub-irrigated lands.

Our next record of early irrigation development was on Ahtanum Creek in the Yakima Valley. In 1847, the Oblate Fathers established a mission on that stream and prior to 1852 constructed a ditch to divert water from Ahtanum Creek for the irrigation of the mission's lands.

In north central Washington, we find that Hiram (Okanogan) Smith settled on Osoyoos Lake in Okanogan County and in 1858 constructed a ditch to divert water from Nine Mile Creek to irrigate lands on which 1,200 apple trees had been planted. This was probably the first irrigated orchard in the state.

From this period to the early nineties the practice of irrigation was developed by individuals and small groups, diversions being for the most part from creeks and small streams, with a few from the various rivers. Such systems were easily constructed and comparatively inexpensive. The peak of this type of development was reached during the eighties. By the early nineties most of the waters of the small streams in central and eastern Washington had been appropriated and those irrigation systems most easily constructed had been built. Attention was, therefore, turned to the larger enterprises, the construction of which was necessarily undertaken by corporations and irrigation districts. The first irrigation district law was enacted in 1890.

Most of the larger projects were promoted by private groups and corporations often principally for land promotion purposes. In such cases, the irrigation works were likely to be flimsy, constructed with cheap materials and consequently short-lived. As soon as the raw lands had been sold, frequently at fabulous prices, the promoters sold the irrigation system to a water users' association or irrigation district organized for that purpose. In some cases the capacity of the ditch was inadequate to serve all the lands under it; in others, the available water supply was insufficient for the lands on the project. The settlers on these projects, after taking over the irrigation works, were immediately confronted with the necessity of constructing adequate and more lasting irrigation works. This cost, added to their investment in unimproved lands, the cost of land development, and the obligation incurred in the purchase of the original inadequate irrigation system and water rights, totalled more than much of the land could bear. The settlers were unable to pay their assessments, and consequently some lost their total investment, a condition which was sufficiently prevalent to reflect severely on the economics of irrigation farming for many years.



ROZA PROJECT CONSTRUCTION

Section of canal and north portal of tunnel No. 3, 4 miles north of Yakima. Canal is lined with 4 inch thickness of concrete; side slopes, 1¼:1; base, 14 feet wide; water depth, 11.2 feet; and capacity, 2,200 cubic feet per second. Tunnel is of horseshoe type; inside diameter, 17 feet; 16 inches of concrete in lining; length, 9,600 feet; capacity, 2,200 cubic feet per second. (Picture courtesy U. S. Bureau of Reclamation, Roza Division, May, 1938.)

In the year 1917 the State Water Code was enacted, giving central authority over the water resources of the state to the Supervisor of Hydraulics and providing a means of establishing definite water right titles, so necessary for the successful operation of irrigation projects.

Today there are ninety-nine irrigation districts and forty-three incorporated irrigation ditch companies in the state, very nearly all of which are in good financial condition, as the conditions above described have been corrected by refinancing and other adjustments. The area reclaimed under the canals of these districts and companies, together with lands reclaimed under private and partnership ditches, is estimated to be 600,000 acres. According to the United States Census Reports, there were 15,949 irrigated farms in the state in 1930, having a value of $208,738,027.

Irrigation—Federal Development

In 1893 the United States Geological Survey established the first gaging stations in the State of Washington, located on the Yakima and Naches rivers. These stations were installed principally for the purpose of determining the quantity of water available for irrigation projects.

In 1902 the Federal Reclamation Act was passed, providing for the appropriation of receipts from the sale and disposal of public lands in certain states and territories into a special fund, to be reserved for survey, construction, etc., of irrigation systems for the reclamation of arid lands in those states. In 1903 preliminary investigations were commenced by the United States Reclamation Service on the Okanogan, Yakima, and Palouse projects. The construction of the Sunnyside (enlargement of the then existing canal) and Tieton units of the Yakima project was authorized by the Secretary of the Interior in 1905. The Sunnyside Canal was purchased in 1906, following the enactment in 1905 of state legislation withdrawing from appropriation all waters of streams which would supply projects under investigation by the U. S. Reclamation Service, and reserving water for such projects if they proved feasible. By the same law, State lands were reserved for use in connection with such projects, in the event they should be required. Congress in 1924 appropriated the first funds for construction of the Kittitas unit of the Yakima project, to reclaim 70,000 acres, completed in 1929.

To date, $32,100,000 has been expended by the Federal Government through the Bureau of Reclamation for completed irrigation systems in the State of Washington. In addition, $7,000,000 has been appropriated for the Roza project, now under construction, and approximately $8,000,000 more will be required to complete it. These figures do not include any Federal expenditures for the Grand Coulee dam and Columbia Basin project.

It is of interest to note what might be termed the first move in behalf of the Columbia Basin development. Our first State Legislature, during the winter of 1889-90, sent a memorial to Congress requesting an appropriation of $50,000 to drill artesian test wells in Yakima, Klickitat, Douglas, Adams, and Walla Walla counties, in the hope of finding an adequate water supply for irrigation. The following is quoted from the memorial, "And should said wells prove successful, this vast domain which is now but sparsely settled, would in a few years be thickly studded with large fields of grain, with a thousand orchards bearing nearly every kind of fruit, and many a happy home."

The first investigation of the project was made by the U. S. Bureau of Reclamation in 1903.

During Governor Lister's term of office, beginning in 1918, the State made the first complete surveys and studies of both the gravity and the pumping project, the plan most favorably considered at that time being a gravity system, with water to be diverted from the Pend Oreille River for irrigation of Basin lands.

The U. S. Corps of Engineers, in 1929, began an exhaustive investigation of the proposed Columbia Basin project and completed their report in 1931. By this investigation, the feasibility of the Grand Coulee pumping project was determined and the Army report recommended that plan rather than the gravity plan. In 1934 Congress set aside $63,000,000 for the beginning of construction of Grand Coulee Dam, to be expended under the direction of the Bureau of Reclamation. This amount has been expended and further appropriations made for the continuation of the project, which, in addition to its power, navigation, and flood control features, will provide water for the reclamation of 1,200,000 acres of arid land in the state.

Diking and Drainage

Diking and drainage systems have also played an important part in land reclamation in the State of Washington. Reclamation of this class of land undoubtedly began with the early settlement of the state, particularly west of the Cascade Mountains. Laws were enacted as early as 1890 relating to the construction of dikes for protection of lands against overflow from tidal waters and river freshets, and in 1895 the first diking and drainage district laws were enacted.

A large portion of this type of reclamation works is located west of the Cascade Mountains, and a greater part of the acreage so reclaimed is along Puget Sound and the Columbia River in southwestern Washington. Practically all of the lowlands on rivers and tidal waters are diked against overflow, most of the districts west of the Cascade Mountains being provided with drainage systems, including pumping plants, for the purpose of lifting water from the low-lying drainage ditches inside the dikes. In eastern Washington most of the diking and drainage systems are located along the Colville and Pend Oreille rivers.

Drainage of lands has been an important feature on irrigation projects, also, as drainage of irrigation seepage water is essential to the preservation of developed lands for agricultural purposes. The U. S. Census Reports for 1930 indicate that 172,039 acres of this type of land are drained. Seventy-eight drainage districts have been established for this purpose and have constructed and are maintaining drainage systems.

There are a total of more than two hundred diking and drainage districts in the state, including those on irrigation projects. According to 1930 Census Reports, the capital outlay invested in diking and drainage works in the State is $4,637,576 and the area of land in such enterprises is 367,242 acres. No records are obtainable of the area of land reclaimed by diking and drainage through individual or community efforts, but a great area has been made suitable for agricultural purposes, particularly west of the Cascade Mountains, through such efforts.

THE STATE RECLAMATION ACT

During the World War and the years immediately following, farm products brought high prices, and consequently farming and reclamation development were stimulated. But the time had arrived when all the most easily developed projects had been constructed, largely by private capital, leaving the more costly projects which could be financed only with Federal or State aid. In addition to new projects, extensions, improvements, and refinancing were found necessary for existing projects that had originally been financed by private capital. But little or no money was available from that source for this need. In order to promote further reclamation of lands and to save existing projects and wealth created under them, it was found desirable to enact a State Reclamation Law, Chapter 158, Laws of 1919, which provided for the creation of the State Reclamation Board and the establishment of the Reclamation Revolving Fund, revenue for which was to be derived from an annual general tax of one half mill, to be used, in accordance with the law, for reclamation purposes. This tax was levied from 1919 to 1925, but each Legislature since that time has suspended it. The amount collected from it totalled $3,994,173.19 as of September 30, 1938. Since the Reclamation Revolving Fund was established, approximately eighty irrigation, diking and drainage districts have received financial assistance from it, in the amount of $5,459,685.56.

Although the Reclamation Act provides that moneys from the Reclamation Revolving Fund shall be used for the purpose of assisting reclamation districts in their construction, improvement and refinancing problems, each Legislature appropriates money from that fund for other purposes, such as seed wheat, the soldiers' settlement at White Bluffs, forestry, an inter-state water suit, cooperative activities with the U. S. Geological Survey, and the Columbia Basin project. Nearly $1,000,000 has been expended from the Reclamation Revolving Fund for such miscellaneous purposes, and very little of it has been repaid to the fund.

Probably the greatest benefit which has come from the Reclamation Act is the financial aid that the State has given to reclamation districts during the several recent depression years, the refinancing of the districts making it possible for many farmers to remain on their land and retain their independence who would otherwise have become relief charges. The expenditures for such purposes are in the form of loans to reclamation districts and are secured by bonds, payable over a period of years, issued by the districts and delivered to the Department of Conservation and Development.

ADMINISTRATION

The law provides for the appointment of a Supervisor of Reclamation and engineering and clerical assistants to carry on the work of the Division of Reclamation. However, in recent years the work of this division has been handled by the Director, assisted by the Supervisor of Hydraulics and his staff. This manner of administering the Reclamation Revolving Fund effects a substantial saving to the fund of moneys that would otherwise be expended for office maintenance. It is now apparent that it would be to the best interests of the State, the taxpayer, and the districts, if this Department had jurisdiction not now authorized by law, over districts in which

the State has funds invested and, for that reason, additional legislation and a small personnel, although not full administrative organization, is sought by the Department for the Division of Reclamation.

APPLICATIONS FOR LOANS

Fewer applications for loans from the Reclamation Revolving Fund have been filed during the past two years than during the four years immediately preceding. This condition is the result of extensive refinancing from the fund during the earlier part of the present administration, at a time when many districts, constructed at the peak of high prices, were facing bankruptcy because of the deflation of farm income without relative reduction in district indebtedness.

The first step in considering an application for moneys of the Reclamation Revolving Fund is to make a physical and financial investigation of the district in question, to determine the necessity for the loan and the district's ability to repay. In the case of a refinancing application, the investigation includes a determination of the per acre indebtedness which the district can bear, in order to decide what price can reasonably be offered for the outstanding bonds. Upon this investigation and the availability of funds for the purpose, a decision is made regarding the application for a loan.

ALLOTMENT OF FUNDS

Refinancing Loans

The sixteen districts listed below have received moneys from the Reclamation Revolving Fund for refinancing purposes during the period from October 1, 1936, to October 1, 1938:

COUNTY	DISTRICT	Par Value of Old Indebtedness Purchased	Percentage of Par Paid	Amount Paid April 1, 1933, to Oct. 1, 1936	Amount Paid Oct. 1, 1936, to Oct. 1, 1938
Cowlitz	Diking Improvement District No. 11	$82,500	42.42–65	$34,684 81	$1,563 48
Cowlitz	Diking Improvement District No. 13	22,000	50–100	9,750 00	3,516 08
Cowlitz	Diking Improvement District No. 15—Bonds	32,500	50		
	Mortgages	25,107	50		28,750 00
Lewis and Thurston	Joint Drainage Improvement District No. 7	25,000 + interest	15–100	4,558 00	504 60
Yakima	Drainage Improvement District No. 3, Sub. 7	71,500	54		38,610 00
Yakima	Drainage Improvement District No. 9	17,500	50		8,750 00
Yakima	Drainage Improvement District No. 9, Sub. J	10,000	30		3,000 00
Yakima and Benton	Joint Drainage Improvement District No. 1	124,000	31.8725 + interest	37,109 90	4,328 02
Clallam	Agnew Irrigation District—Bonds	172,700	30–50		
	Warrants	5,040	100		56,950 00
Chelan	Chelan Falls Irrigation District	27,700 + interest	70		24,544 41
Clallam	Cline Irrigation District	20,100	70–100	70 00	20,000 00
Stevens	Fruitland Irrigation District	265,200	24.5	64,949 08	401 06
Chelan	Lake Chelan Reclamation District	402,500	50–85	192,020 06	22,656 56
Okanogan	Larrabee Irrigation District	5,000	100 less interest adjustment		4,671 48
Okanogan	Oroville-Tonasket Irrigation District	817,000	25	203,500 00	750 00
Benton	Priest Rapids Irrigation District—Bonds	94,500	70		
	Construction debt	4,870	70	65,611 00	6,136 13
Thurston	Yelm Irrigation District—Bonds	214,200	33–100		
	Warrants	78,000	35	99,685 58	5,000 00
Total par value of refunded obligations		$2,516,917			
Average percentage of par value paid			37.43		
Total paid prior to Oct. 1, 1936, under refinancing agreements incomplete as of that date				$711,938 43	
Total paid during biennium from Oct. 1, 1936, to Oct. 1, 1938, to refinance districts					$230,131 82

Note—Refinancing agreements entered into and consummated prior to Oct. 1, 1936, are not listed.

The refinancing of the above districts has been completed, or practically so, and the landowners within these districts should be able to pay their taxes and district assessments under the new set-up.

The Department has entered into an agreement with Cowlitz County Drainage Improvement District No. 1 to assist in the refinancing of that district, but no funds have yet been advanced under that contract.

Loans for Repairs and Construction

Funds for construction, repair and improvement of reclamation works were advanced during the biennium, October 1, 1936, to October 1, 1938, to the following districts:

COUNTY	DISTRICT	Amount of Contracts Under Which These Advances Are Made	Advances Prior to Oct. 1, 1936	Advances Oct. 1, 1936, to Oct. 1, 1938
Cowlitz	Diking Improvement District No. 11	$20,000 00	$14,345 72①	$5,465 00
Cowlitz	Diking Improvement District No. 15	10,000 00	6,491 59①	3,933 76
King	Drainage District No. 14	3,200 00	.....	2,539 87
Pierce	Drainage District No. 19	1,450 00	923 45	353 66
Snohomish	Diking District No. 1	1,000 00	.....	985 54
Clallam	Agnew (formerly Lindsay) Irrigation District	3,800 00	899 80	2,845 12
Spokane	Hutchinson Irrigation District	28,000 00	.....	25,590 45
Benton	Kennewick Irrigation District	17,000 00	.....	16,000 00
Chelan	Lake Chelan Reclamation District	40,000 00	32,438 33	6,341 72
Okanogan	Oroville-Tonasket Irrigation District	10,183 12②	.....	9,444 03
Spokane	Otis Orchards Irrigation District	48,500 00	48,210 19	660 42
Yakima	Snipes Mountain Irrigation District	10,000 00	8,380 54	1,541 07
Total construction contracts since April 1, 1933, under which advances were made during biennium October 1, 1936, to October 1, 1938		$193,133 12		
Total paid under said contracts prior to October 1, 1936		.....	$111,689 62	
Total advances for repairs, etc. during biennium October 1, 1936, to October 1, 1938, from Reclamation Revolving Fund		.....	.....	$75,700 64

NOTE—Contracts made and closed prior to October 1, 1936, are not listed.
① These figures include direct grants to the districts from appropriations for flood control purposes.
② Adjusted balance under former contracts and direct bond purchases for construction purposes.

The loans to several of the above listed districts constitute the sponsors' share of Works Progress Administration and Public Works Administration projects. These loans have placed the districts in a position to reap very material benefits which they would otherwise have been unable to secure. For example, one diking district, with a loan of $20,000 from the State, secured a W. P. A. project in the amount of $220,000. This latter amount is a direct grant from the Federal Government and will not have to be repaid. The diking system of the district has been reconstructed and improved at a cost to the district of only $20,000, which will be repaid to the State over a period of years. Otherwise, the district would have been unable to finance the construction, would eventually become inoperative, and considerable taxable wealth would be stricken from the tax rolls.

Contracts for loans have been executed with, but no advances have yet been made to the following districts, for construction purposes:

District	Amount of Contract
Goransen Ditch, Thurston Co.	$5,000
Drainage Dist. No. 22, Pierce Co.	4,000
Oroville-Tonasket Irrigation Dist.	5,000
Otis Orchards Irrigation Dist.	5,000
Spokane Valley Irrigation Dist.	10,000
Total	$29,000

Two of the above listed contracts are for payment by the State of the districts' share, as sponsors, of W. P. A. projects.

REFUNDING OF STATE-OWNED BOND ISSUES

Upon examination of records and inspection on the ground of certain reclamation districts whose bonds were purchased by the State many years ago, it was apparent that, in order to save a portion of the State's investment and to keep the lands in those districts on the tax rolls, at least a portion of their indebtedness would have to be written off as a loss. Therefore, exhaustive examinations were made by the Department of Conservation and Development to determine the amount of the assessments the lands can bear, and the districts' bonded debts have been scaled down to the amounts which can be paid by assessments based on our studies. The districts involved and the amounts of their bond issues are listed, as follows:

DISTRICT	OLD ISSUE		REFUNDING ISSUE		Per Cent of Discount
	Date	Amount	Amount	Date	
First Creek Irrigation District	1932	$18,500	$10,000	1937	46
Methow Valley Irrigation District	1927	165,150	75,000	1938	54
White Salmon Irrigation District	1931	30,000	15,000	1936	50
Whitestone Reclamation District	1928	253,805	40,000	1938	84.24
Wolf Creek Reclamation District	1929	90,000*	25,000	1938	72.23
Totals	.....	$557,455	$165,000		

* The refunding of this bond issue had not been completed as of October 1, 1938, but was virtually completed at that time.

The assessments necessary under the old set-up were prohibitive and would have resulted in bankruptcy for both the districts and the landowners. The districts were, for the most part, not even attempting to levy assess-

ments for bond service, and their issues were in default. The action of the Department in these matters, taken in accordance with provisions of Chapter 121 of the Laws of 1929, was, therefore, merely an official acknowledgment of losses previously sustained. By reducing the district debt, we have encouraged the districts and the landowners to make an effort toward rehabilitation, and have saved the State a portion of its investment, which would otherwise have been a total loss.

This situation is similar to that of other districts whose bond issues the State has bought at a discount, except that in this case the loss is suffered by the Reclamation Revolving Fund rather than private bondholders.

COLLATERAL TRUST BOND ISSUE

During the years 1933, 1934 and 1935, the demands by irrigation, diking and drainage districts on the Reclamation Revolving Fund for refinancing and rehabilitation were very great and the fund was temporarily depleted. Consequently, the Director of Conservation and Development, under authority vested in him by Chapter 13, Laws of the Extraordinary Session of 1933, enacted to provide for such an emergency, pledged State-owned reclamation district bonds as security for a loan in the form of a bond issue. The revenue from the sale of these collateral trust bonds has made possible further financial assistance to distressed districts.

Following is a brief description of the Department's collateral trust issue:

Authorized and issued:.....$600,000
Dated: .....September 1, 1935
Interest rate:.....4% per annum, payable semi-annually March 1 and September 1 at Chemical Bank & Trust Co., New York.
Due: .....In varying amounts each September 1, 1936, to 1947, inclusive, at Chemical Bank & Trust Co.
Outstanding September 30, 1938:.....$333,000
Unsold September 30, 1938:.....$55,000
Trustee: .....Peoples National Bank of Washington, Seattle.
Offered: .....By H. P. Pratt & Co., Seattle.
Tax status:.....Exempt from all Federal income taxes.

Under the trust agreement, bonds may be retired in advance of maturity on any regular interest paying date, provided that tenders are advertised for at least two weeks before said date. The following schedule shows retirements to September 30, 1938:

Date of Retirement	Unsold Bonds Cancelled	Retired at Maturity	Retired in Advance of Maturity
Sept. 1, 1936	.....	$6,000	.....
June 5, 1937	$53,000	.....	.....
Sept. 1, 1937	.....	12,000	$60,000
March 1, 1938	.....	.....	42,000
Sept. 1, 1938	.....	17,000	22,000
Totals	$53,000	$35,000	$124,000

The collateral trust issue was secured by $1,265,569.38 par amount of bonds of twenty-three reclamation districts in the state, which had been acquired in the regular course of business of the Department. The principal amount of the pledged securities has been reduced, by regular maturities

and prepayment of bonds, to $1,116,574.38 as of September 30, 1938. All income (both principal and interest) from the bonds pledged is held by the trustee for prompt payment of principal and interest on the collateral trust issue.

The indenture provides that at all times there shall remain on deposit with the trustee a par amount of district bonds in good standing equal to at least twice the par value of the collateral trust bonds at the time outstanding, and a supplemental indenture further provides that the Director of Conservation and Development shall keep free and unpledged eligible reclamation district bonds the par value of which shall be at all times at least one half the par value of the collateral trust bonds then outstanding, to be substituted for any pledged bonds which may at any time default in payment of principal or interest or both.

With $124,000 collateral trust bonds retired in advance of maturity and sufficient cash in the trust account to pay principal and interest due during the next year, without consideration of income during that period from bonds held as collateral, our collateral trust bond issue is in excellent condition.

RECLAMATION DISTRICT BONDS OWNED BY THE STATE OF WASHINGTON

Following is a list of reclamation district bonds owned by the Department of Conservation and Development of the State of Washington on September 30, 1938, on deposit with the Peoples National Bank of Washington, Seattle, as security for the $600,000 collateral trust bond issue hereinabove referred to:

COUNTY	DISTRICT	Par Value	Interest Rate
Jefferson	Drainage District No. 1	$14,600 00	2%
Snohomish	Drainage District No. 1	6,000 00	2%
Snohomish	Drainage District No. 2	4,000 00	2%
Yakima	Drainage Improvement District No. 35	29,000 00	2%
Yakima	Drainage Improvement District No. 41	4,599 38	2%
Yakima	Drainage Improvement District No. 43	7,375 00	2%
Spokane	Bacon Tracts Irrigation District	1,900 00	2%
Kittitas	Cascade Irrigation District	40,000 00	6%
Stevens	Fruitland Irrigation District	57,400 00	2%
Yakima and Benton	Grandview Irrigation District	5,500 00	2%
Benton, Klickitat and Yakima	Horse Heaven Irrigation District	24,000 00	4%
Chelan	Icicle Irrigation District	253,800 00	2%
Benton	Kennewick Irrigation District	200,700 00	1%
		24,000 00	2%
Benton	Kiona Irrigation District	17,750 00	2%
Spokane	Otis Orchards Irrigation District	20,000 00	2%
Yakima	Outlook Irrigation District	13,500 00	2%
Benton	Richland Irrigation District	139,000 00	2%
Yakima	Snipes Mountain Irrigation District	18,750 00	1%
		6,500 00	2%
Chelan	Stemilt Irrigation District	75,000 00	1%
		31,000 00	2%
Benton	Sunnyside Irrigation District	93,600 00	1%
Yakima	Union Gap Irrigation District	8,000 00	2%
Yakima	Wenas Irrigation District	13,100 00	2%
Chelan	Wenatchee-Chewawa Irrigation District	7,500 00	2%
	Total State-owned bonds held as collateral	$1,116,574 38	

The following reclamation district bonds are owned by the Department and are on deposit with the State Treasurer:

COUNTY	DISTRICT	Par Value	Interest Rate
Cowlitz	Diking Improvement District No. 5	$17,500 00	4%
Cowlitz	Diking Improvement District No. 11	36,000 00	4%
Cowlitz	Diking Improvement District No. 11, Sub. A	11,500 00	4%
Cowlitz	Diking Improvement District No. 13	18,000 00	4%
Cowlitz	Diking Improvement District No. 15	37,500 00	4%
Grays Harbor	Diking and Drainage Improvement District No. 4	38,000 00	4%
King	Drainage District No. 14	3,200 00	5%
Lewis and Thurston	Joint Drainage Improvement District No. 7	3,200 00	4%
Snohomish	Diking District No. 1	20,000 00	1%
		20,000 00	2%
Snohomish	Diking District No. 2	5,985 00	2%
Yakima	Drainage Improvement District No. 3, Sub. 7	33,000 00	4%
Yakima	Drainage Improvement District No. 3, Sub. 8	10,200 00	2%
Clallam	Agnew Irrigation District	5,040 00	4% to 1-1-42; 3% to 1-1-45; 2% remainder of term
Chelan	Chelan Falls Irrigation District	22,500 00	4%
Clallam	Cline Irrigation District	20,000 00	4%
Benton	Columbia Irrigation District	9,000 00	2%
Chelan	First Creek Irrigation District	10,000 00	2%
Franklin	Franklin County Irrigation District No. 1	15,026 96	5%
Spokane	Hutchinson Irrigation District	27,500 00	5% to 7-1-41; 3% to 7-1-51; 2% remainder of term
Benton	Kennewick Irrigation District	15,000 00	4%
Chelan	Lake Chelan Reclamation District	100,000 00	1%
		118,000 00	1%
		178,350 00	2%
Okanogan	Larrabee Irrigation Dist	14,000 00	4%
Okanogan	Methow Valley Irrigation Dist	75,000 00	2%
Okanogan	Oroville-Tonasket Irrigation Dist	41,000 00	2%
Spokane	Otis Orchards Irrigation Dist	3,500 00	2%
Benton	Priest Rapids Irrigation Dist	92,500 00	5% to 1-1-42; 3% to 1-1-47; 2% remainder of term
Yakima	Snipes Mountain Irrigation Dist	500 00	2%
Chelan	Wenatchee-Chewawa Irrigation Dist	4,500 00	2%
Chelan	Wenatchee Heights Reclamation Dist	81,000 00	2%
Klickitat	White Salmon Irrigation Dist	8,000 00	1%
Okanogan	Whitestone Reclamation Dist	40,000 00	1% to 1-1-48; 4% remainder of term
Okanogan	Wolf Creek Reclamation Dist	25,000 00*	2%
Thurston	Yelm Irrigation Dist	138,500 00	2%
		5,000 00	2%
	Total	$1,303,001 96	

* Bonds of this district are listed at refunded value, although the refunding and exchange of bond issues had not actually been completed prior to Oct. 1, 1938.

The following bonds of various districts are State-owned, having been purchased at a discount, but refunding operations have not yet been completed. The par value of the bonds purchased and their purchase prices are listed. These discounted bonds will later be exchanged for refunding bonds in amounts approximating the amounts expended for the bonds, plus accrued interest and incidental expenses.

COUNTY	DISTRICT	Par Value	Purchase Price	Interest Rate on Investment
Clallam	Macleay-Lindsay (now Agnew) Irrigation Dist.	$172,700	$53,824 86	4% to 1-1-42; 3% to 1-1-45; 2% remainder of term
Okanogan	West Okanogan Valley (now Oroville-Tonasket) Irrigation Dist.	$11,000	202,750 00	2%
Yakima	Drainage Improvement Dist. No. 9	17,500	8,750 00	4%
Yakima	Drainage Improvement Dist. No. 9, Sub. J.	10,000	3,000 00	4%
Yakima and Benton	Joint Drainage Improvement Dist. No. 1	124,000	39,570 31	4%
	Total	$1,135,200	$307,895 17	

A summary of the above reveals that the Department of Conservation and Development of the State of Washington owns a total of $3,554,776.34 par value, reclamation district bonds. Of this total, $2,419,576.34 bonds are not involved in active refinancing agreements. A total of $307,895.17 has been paid for the remaining $1,135,200, and it may reasonably be assumed that, including accrued interest and expenses incidental to refinancing, these bonds will be exchanged for at least $308,000 bonds of refunding issues. Using this figure ($308,000) rather than the par value ($1,135,200), the total reclamation district bonds owned by the Department may be said to be as follows:

Total State-owned bonds held as collateral for trust issue, by Peoples National Bank of Washington	$1,116,574.38
Other State-owned bonds not involved in active refunding operations	1,303,001.96
Bonds purchased for refunding purposes:	
Par value, $1,135,200; purchase price, $307,895.17; approximate refunding bonds to cover such refunding operations	308,000.00
Total	$2,727,576.34

RECOMMENDATIONS

There are fewer demands upon the Reclamation Revolving Fund for financing and refinancing of reclamation districts than during the early years of the present administration. However, a certain amount of refinancing and other financial assistance must be expected and it is important that sufficient funds be made available from the Reclamation Revolving Fund for such purposes as these emergencies arise. For that reason, we recommend an appropriation of $250,000 from the Reclamation Revolving Fund for financing and refinancing of irrigation, diking and drainage districts. This, of course, merely means authority to use any part of this sum as it becomes available in the fund from payments of principal and interest on State-owned reclamation district bonds.

We recommend, also, legislation to give the Department some authority over districts in which State funds are invested, and an appropriation ade-

quate to maintain a small personnel to deal with and to protect the State's interests in such districts.

We earnestly request that power license fees, amounting to about $35,000 each year and collected under provisions of Chapter 105 of the Laws of 1929, be credited to the Reclamation Revolving Fund instead of to the General Fund as is now done, or, in lieu thereof, that appropriations for cooperative activities with the U. S. Geological Survey covering the study and investigation of our natural resources be made from the General Fund rather than the Reclamation Revolving Fund as is now done. This suggestion is indorsed by those who agreed to and sponsored the act providing for power license fees, who at the time understood that such fees would be used in the study and investigation of our natural resources and not as an additional general tax; also by the State Grange and the Washington Irrigation Institute, both of which oranizations at their annual meetings have repeatedly passed resolutions urging such action.

DIVISION OF HYDRAULICS AND WATER RESOURCES

CHAS. J. BARTHOLET
Supervisor of Hydraulics

Waters of springs, streams, lakes and underground sources comprise one of the State's greatest natural resources and one which is inexhaustible. The abundance of this resource when put to beneficial use will go far toward further development of the State, both for commercial and recreational purposes. Already the capital outlay for construction in connection with irrigation and power represents an investment of more than $212,000,000. In addition to this, large investments have been made for the use of water for municipal, domestic, fish propagation, industrial, mining, and other purposes.

The State has approximately 600,000 acres of land now under irrigation and there are 1,981,000 acres in planned projects for which a water supply is available. In addition, thousands of acres on the West Side of the Cascade Mountains will be irrigated through individual efforts.

The State also has over 20% of the potential water power of the Nation and leads all other states by a margin of 4,000,000 horse power. Only about 6% of this water power is now being utilized, with a power concentration over nine times that of the average in the Nation and a population density of only a little over half of that of the Nation; and with an abundance of unutilized natural resources, much room is afforded for agricultural, industrial and recreational expansion.

THE WATER CODE

Prior to the enactment of the Water Code in 1917, rights to the use of surface waters in the State were in a chaotic condition. A great many conflicting and indefinite chapters of law, scattered throughout the statutes, relative to rights to the use of water, were responsible for continuous disputes and litigation among the water users throughout the State. The State Legislaure in 1917 repealed the various laws relating to this subject and enacted a compact code of forty-four sections (Chapter 117, Laws of 1917) covering the entire subject of water rights, providing procedure for determination of existing rights and establishment of new rights, and for centralized administration. This law has proved very successful, and few amendments have been found necessary.

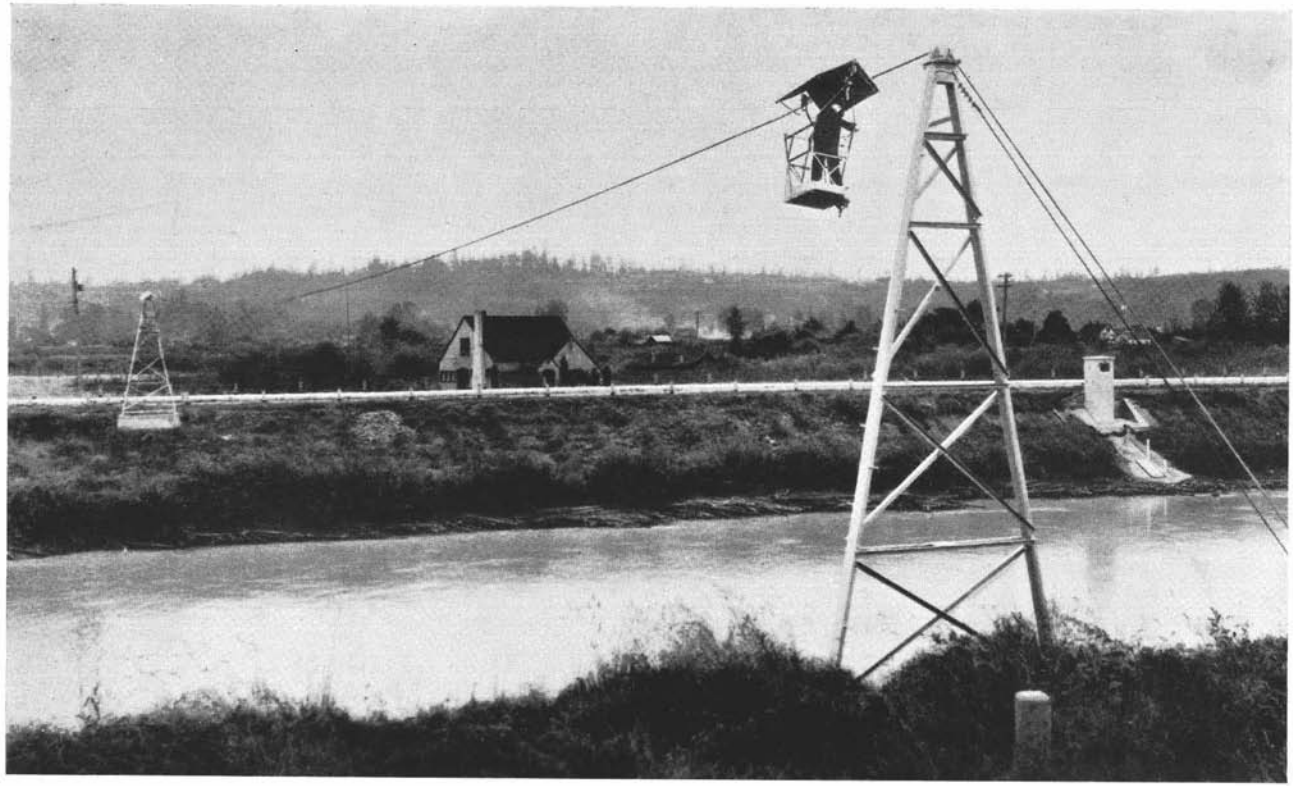
The Water Code gave central authority over the regulation and supervision of the State's water resources to an officer known as the State Hydraulic Engineer, but in 1921, under the Administrative Code, this authority was transferred to the Supervisor of Hydraulics under the Department of Conservation and Development.

ADMINISTRATION

The work of the Division of Hydraulics is divided into eight major activities, five of which are provided for in the Water Code and three under other statutes.

Those provided for in the code are:

1. Supervision and regulation of use of water.
2. Determination of existing water rights.
3. Initiation of new water rights.
4. Collection of hydrographic data.
5. Examination of plans for proposed dams and inspection of hydraulic work.



STREAM GAGING STATION

Gaging station on Puyallup River at Puyallup, Washington, showing aerial cable and car from which measurements are made and, at the extreme right, a small shelter in which automatic water-stage recorder equipment is housed. (Picture courtesy Water Resources Branch, U. S. Geological Survey, Tacoma.)

Other activities:

1. Establishment of flood zones and regulation of proposed structures which might adversely affect flood conditions.
2. Cooperation with the U. S. Geological Survey in making utilization surveys of streams and lakes.
3. Cooperation with the U. S. Geological Survey in making an inventory of ground water resources.

Each of these activities will be discussed in the following pages.

1. Supervision and Regulation of Use of Water.

Sec. 8, Paragraph 3 of the Water Code provides that the Supervisor of Hydraulics shall regulate and control the diversion of water in accordance with the rights thereto.

To properly regulate and deliver water, particularly for irrigation purposes, the water masters and stream patrolmen must be thoroughly familiar with provisions of court decrees by which water rights are fixed, and with permits issued out of this office for the appropriation of water. During periods when the waters of a stream have reached such a stage that there is not sufficient for all of the water users, great care must be exercised that those who are entitled to the water are not shut off, as an error may immediately lead to a law suit in which damages would be sought by those injured.

Waters are regulated on sixty streams in the State, all of which furnish water for irrigation, though none furnish an adequate supply during the entire irrigation season, making it necessary to shut off inferior water rights in order that higher rights may be supplied.

Regulation of waters of these streams has been carried on during the past biennium with the assistance of the following water masters, stream and ditch patrolmen. Four of these water masters have served in this capacity for more than ten years, others have served for more than four years. These officers have often, without the assistance of this office, successfully and tactfully handled many difficult problems.

WATER MASTERS

COUNTY	YEAR 1937	YEAR 1938
Asotin	Jack Justice	Jack Justice
Chelan	O. M. Bise	O. M. Bise
Clallam	Dick Duncan	.....
Columbia	Ben Magill	Ben Magill
Ferry	C. A. Ledgerwood	C. A. Ledgerwood
Garfield	M. H. Dixon	M. H. Dixon
Kittitas	Benjamin Vaughn	Benjamin Vaughn
Klickitat	.....	August Hanson
Okanogan	Calvin Casteel	Calvin Casteel
Spokane	George Stewart	.....
Stevens	C. A. Ledgerwood	C. A. Ledgerwood
Walla Walla	Harlow Barney	Harlow Barney
Yakima	Loyd F. Fairbrook	Loyd F. Fairbrook

STREAM PATROLMEN

STREAM	COUNTY	YEAR 1937	YEAR 1938
Ahtanum Creek	Yakima	Wallace Owen	Wallace Owen
Beaver Creek	Okanogan	Tom Tuttle	Randall Thurlow
Bird and Frasier Creeks	Klickitat	Ivan McCumber	Alvin Berglund
Libby Creek	Okanogan	John Holman	.....
Menashtash Creek	Kittitas	George Meek	George Meek
Nanum Creek	Kittitas	Andy Bunger	John Watson
Peshastin Creek	Chelan	H. H. Kelly	.....
Reecer Creek	Kittitas	M. A. Moen	M. A. Moen
Squilchuck Creek	Chelan	T. R. Hawkins	T. R. Hawkins
Stemilt Creek	Chelan	W. O. Quinn	W. O. Quinn
Taneum Creek	Kittitas	Ed Olson	Ed Olson
Wilson Creek	Kittitas	Andy Bunger	.....

DITCH PATROLMEN

Name of Ditch	Stream From Which Water Is Diverted	County	Year 1937	Year 1938
East Selah Ditch	Yakima River	Yakima	.....	Wm. Swisher
Plummer Ditch	Methow River	Okanogan	.....	Wm. Johnson

2. Determination of Existing Rights.

Water rights which were established before the Water Code became effective, June 15, 1917, are determined in a proceeding provided for in that act, in which the priority date and the quantity of water are fixed for each water user, after which a certificate is issued which represents a water title. Any water right desired on a stream after its waters have been adjudicated can be obtained only by securing permits from this office to appropriate water. Such a right is inferior to the adjudicated rights.

As the cost of water right determinations must be borne by the water user, whose financial condition during the past two years has not placed him in a position to stand such an expense, little work in this field has been carried on during the past biennium.

Although the rights to waters of some sixty streams, on which there are 3300 water rights for 191,500 acres of land, have been adjudicated, there remain many more streams supplying water for irrigation and other purposes on which the water rights must eventually be determined in order to establish titles and permit an orderly regulation of such rights. Among these are two of the largest irrigation streams in the State, namely, the Yakima and Methow rivers and their tributaries.

During the biennium from October 1, 1936, to October 1, 1938, only two cases for determination of water rights have been completed: Thomason Creek in Stevens County, involving 31 rights for stock and domestic use and 12 rights for irrigation of a total of 62.18 acres; and Bull Dog Creek, also in Stevens County, involving 11 rights for irrigation of a total of 282.35 acres and 11 rights for domestic use. This latter case had been inactive for a number of years but was finally completed in accordance with terms of a stipulation between the various claimants to the use of water.

The Magee Creek adjudication, commenced in the preceding biennium, was dropped, temporarily at least, at the request of the attorney representing a majority of the petitioners.

The adjudication of Crab Creek between Sylvan Lake and Odessa, commenced in the preceding period, was carried to the Supreme Court upon a decree of dismissal entered by the Superior Court. The decision was reversed by the higher court, but a decree in accordance with its ruling has not yet been entered by the Superior Court.

The South Fork of Crab Creek case is also awaiting the decision of the Superior Court.

No new cases have been initiated during the biennium, although surveys have been started for use in connection with the determinaion of rights on Renshaw Creek in Pend Oreille County and the Little Klickitat River in Klickitat County.

3. Initiation of New Water Rights.

Applications are made on forms provided by this office. After being checked for accuracy, a notice for publication is made out and sent to the applicant, who must have three consecutive weekly publications made in a newspaper of general circulation published in the county seat of the county or counties in which the storage, diversion and use are to be made. Copies of notices are also sent to the State Land Office, the departments of Game and Fisheries, and in special instances to the State Board of Health and the Federal Power Commission.

In order that persons affected may be given an opportunity to protest applications should they desire to do so, a period of thirty days after date of last publication is allowed to elapse before an examination is made on the ground. Examinations are made by an engineer of the Division of Hydraulics who ascertains the quantity of water flowing in the stream, the number and extent of other rights, and the quantity required and available for applicant's use. At this time protests are examined and their merits discussed with the protestants.

In cases where it is found that there is no public water available for appropriation, or that issuance of a permit would constitute an infringement on the rights of another or others, or in any way be detrimental to the public interest, permits are denied.

When a permit is granted certain specified times are given the permittee in which to begin and complete construction and to make complete application of water to the proposed use. If work is not completed in the time specified, extensions to a later date are frequently allowed when sufficient cause for such action is shown.

After the terms of a permit have been complied with, a certificate of water right is issued and the right becomes appurtenant to the land on which it was used, as described in the permit. Such rights, as well as those acquired by use prior to the enactment of the Water Code, remain appurtenant to the land and may not be transferred to other land or to other uses except with the approval of the Supervisor of Hydraulics. Such transfers may be either seasonal or permanent, though only in the latter case is publication of notice required.

The following table shows the number of applications filed and permits and certificates issued, as well as the cancellations of applications and permits,

since the enactment of the Water Code, both for the period June 15, 1917, to October 1, 1936, and during the past biennium:

	June 15, 1917, to October 1, 1936	October 1, 1936, to October 1, 1938	Totals
Application for permits to appropriate water and construct reservoirs	4,299	342	4,641
Permits to appropriate water	2,301	287	2,588
Permits to construct reservoirs	120	2	122
Final water right certificates	952	171	1,123
Certificates of change (Change of point of diversion, and/or place and purpose of use of water)	151	9	160
Applications cancelled	1,204	234	1,438
Permits cancelled	137	175	312

Owing to the almost entire absence of precipitation during the summer of 1938 there was a large increase in the number of applications for permits, particularly from Western Washington, where farmers are beginning to appreciate the benefits derived from irrigation. This is particularly true of dairy farmers, many of whom are requesting permits for irrigation of pasture land.

4. Collecting and Recording Hydrographic Data.

Among the State's varied natural resources, water is one of major promise. It holds considerable prominence in the present development of the State and will gradually become of more and more consequence as further utilization proceeds. Unlike some of the other resources it is constantly replenished, year after year and season after season, so that its use does not exhaust the supply permanently. Reasons why water resources should be investigated may be summarized briefly as follows:

(1) That the water supply may be accurately determined for the development of lands yet to be irrigated as room is afforded for much agricultural expansion.

(2) To determine the quantity of water which will be available for future power development, as only 6% of the State's potential water power is now being utilized.

(3) Ample supplies of water for domestic, municipal, fish propagation, and industrial use, will become increasingly important in the future.

(4) The menace of uncontrolled rivers to life, property, transportation, and industry was emphasized by the devastating floods of December, 1933, and January, 1934.

(5) Stream pollution should be curtailed, or regulated, in the interest of public health and to preserve fish and other wild life.

As Washington has become more densely settled, problems relating to hydroelectric power, irrigation, water supply for domestic, municipal, or industrial purposes and fish life, adjudication of water rights, flood damages, soil erosion, stream pollution, and drainage have become more complex and more pressing. The collection and publication of daily records of stream flow is a prime requisite in solving those problems, in appraising the value of our water resources, and in planning for the future.

Fortunately, responsibility of the Supervisor of Hydraulics for the collection of daily records of stream flow, as required by the Water Code

(Sec. 8), can be furthered quite advantageously by cooperating with the United States Geological Survey. Since 1909 successive State Legislatures have made appropriations for "Hydrographic Surveys" which have been matched by the Government. Most of the Government appropriation is restricted to, and contingent upon, cooperation with the states on a fifty-fifty basis. When such cooperation is effective the entire cost of publishing results annually is borne by the Government.

At the outset stream-flow records were obtained primarily to study feasibility of irrigation projects. Soon, however, the State's predominance in water power possibilities became apparent so that records were started for that purpose. Other needs have arisen, the latest being of vital urgency in making plans for adequate control of floods.

The available water supply must be determined far in advance of actual need. It is the most important question arising when hydraulic projects are contemplated, because all other physical features can be determined within a relatively short time. Daily records of stream flow covering a period of twenty years or more are prerequisites for proper design and plans for operation. The enormous capital outlay required for hydraulic development makes it necessary to anticipate the need of records several decades in advance of development. A number of hydraulic projects have failed because they were placed in operation when only a scant knowledge of the water supply had been secured. Others designed on the basis of short-time records have levied an enormous toll on the public, due to uneconomical operation during periods of unexpected seasonal variation of flow.

Daily records of stream flow are obtained at 122 gaging stations located on the principal streams in the State. The present investment in gaging station structures amounts to about $200,000. Equipment for obtaining records suitable for all purposes includes recording gage installations and facilities for making measurements. Data so gathered is published annually in water supply papers of the United States Geological Survey, making it possible for engineers in any part of the country to appraise the water resources of the State. A total of eight new gaging stations were placed in operation during the biennium. In July, 1938, a P. W. A. allotment of $51,000, which did not need to be matched with State funds, was made available for improvement of equipment at existing gaging stations. About seventy additional gaging stations should be provided to accommodate future needs. They will be installed as rapidly as Federal and State funds permit.

The December 1933 flood made apparent the need for more complete data on streams causing flood hazards. Accordingly, seven first class permanent gaging stations have been constructed since that time for that purpose, and the equipment at five other gaging stations has been reconstructed more substantially to insure against lapse of records during floods that will occur in years to come. Much needs to be done to supply the facts required for studying the best methods to prevent flood damage.

The Department of Conservation and Development, cooperating with the State Planning Council and the United State Geological Survey, has attained two other important objectives during the biennium: (1) A bibliography of water resources information, furnishing references to date on 1,100 streams and including an index to legal decisions on water use and control; and (2) a compilation of miscellaneous measurements on 2,500 streams that have been made from time to time in the past to supplement gaging station

data for appraising possibilities, for adjudicating and administering water rights, and for defining differences in run-off characteristics.

We are grateful to Mr. G. L. Parker, District Engineer of the Water Resources Branch of the U. S. Geological Survey, and his staff for the consideration and assistance they have given in matters pertaining to cooperative affairs.

5. Examination of Hydraulic Works and Structures.

The Water Code provides that, to the extent necessary to insure safety to life and property, the Supervisor of Hydraulics shall inspect dams and other hydraulic structures, both during construction and during subsequent maintenance and operation. Whenever complaints are received or defects otherwise come to our attention, inspections are immediately made and necessary corrections arranged for.

Dams are inspected at such intervals as are deemed necessary in each individual case, but we aim, in general, to keep well posted on the current condition of all of them. During the 1936-1938 biennium we have inspected 48 of the 65 dams in the State which store ten or more acre-feet of water.

The following tabulation includes what may be termed the major dams in the State and gives pertinent information as to each. They are almost uniformly of comparatively recent and modern construction. None of them give cause for apprehension in regard to safety.

MAJOR DAMS IN THE STATE OF WASHINGTON

Name	Type	Height Feet	Storage Capacity Acre-Feet	Purpose	Lake or River	Ownership
*Nine Mile	Concrete, gravity	58	5,210	Power	Spokane River	Washington Water Power Co.
*Long Lake	Concrete, gravity	250	229,000	Power	Spokane River	Washington Water Power Co.
*Little Falls	Concrete, gravity	66	4,250	Power	Spokane River	Washington Water Power Co.
*Lake Chelan	Concrete, gravity	30	640,000	Power	Lake Chelan	Washington Water Power Co.
Rock Island	Concrete, gravity	86	25,000	Power	Columbia River	Puget Sound Power & Light
*Baker River	Concrete arch	264	140,000	Power	Baker River	Puget Sound Power & Light
Diablo	Concrete arch	325	90,000	Power	Skagit River	City of Seattle
*Cedar Lake	Concrete, gravity	160	52,500	Power	Cedar River	City of Seattle
*Cushman No. 1	Concrete arch	275	440,000	Power	Lake Cushman	City of Tacoma
*Cushman No. 2	Concrete arch	240	7,300	Power	Skokomish River	City of Tacoma
*Elwha	Concrete, gravity	110	6,000	Power	Elwha River	Northwestern Power & Light
*Glines Canyon	Concrete arch	210	37,000	Power	Elwha River	Northwestern Power & Light
Ariel	Concrete arch	200	220,000	Power	Lewis River	Inland Light & Power Co.
*Keechelus	Earth, rolled fill	100	152,000	Irrigation	Lake Keechelus	U. S. Bureau of Reclamation
*Kachess	Earth	63	210,000	Irrigation	Lake Kachess	U. S. Bureau of Reclamation
*Cle Elum	Earth	123	360,000	Irrigation	Lake Cle Elum	U. S. Bureau of Reclamation
Tieton	Earth, semi-hydr. fill	222	202,500	Irrigation	Tieton River	U. S. Bureau of Reclamation
*Bumping Lake	Earth	42	34,000	Irrigation	Bumping Lake	U. S. Bureau of Reclamation
*Salmon Lake	Earth, hydr. fill	33	10,500	Irrigation	Salmon Lake	U. S. Bureau of Reclamation
*Conconully	Earth, hydr. fill	62	14,400	Irrigation	Conconully Lake	U. S. Bureau of Reclamation
†Bonneville	Concrete	170	.....	Power and Navigation	Columbia River	U. S. Government

* Inspected during 1936-1938 biennium.

† Partly in state of Oregon.

The only failure of a dam in this State since the enactment of the Water Code occurred in the spring of 1938, with the destruction of the storage dam of the Pleasant Valley Water Users Association on Loop Loop Creek, North of the Town of Malott in Okanogan County. The dam was built in 1920 of earth fill, was 50 feet high and created a storage capacity of about 600 acre-feet. The watershed back of the dam normally has a very small run-off in proportion to the area. Until this spring the reservoir never had been filled. The greatest discharge previously measured was 75 cubic feet per second, while the spillway capacity was twice that much. This last spring an extraordinary combination of heavy rains, warm winds and rapidly melting deep snow caused a run-off in Loop Loop Creek far beyond anything that could have been reasonably anticipated. Apparently the spillway became overloaded and the earth embankment was destroyed. The damage below the dam at Malott was considerable but fortunately there was no loss of life.

OTHER ACTIVITIES

1. Regulatory Control of Works and Structures Placed in Stream Channels or on Flood Plains.

Man-made works and structures improperly placed in the channels or upon the flood plains of our rivers have in the past contributed no small share of the damages occasioned during periods of high water and floods. In recognition of this fact, and in an effort to minimize future preventable flood damage, the Legislature passed Chapter 159, Laws of 1935, which provides for the establishment of Flood Control Zones, within which no works or structures may be placed unless and until plans therefor have been approved and permit for construction issued by the Supervisor of Hydraulics. Sixteen zones were established prior to October 1, 1936.

During the biennium just ending lack of funds prevented extension of operations, and no new zones were established. The desirability of extending this beneficial activity to more stream systems is very evident.

To date 115 permits have been issued under the provisions of the act, 45 of which were issued during the past biennium.

The following zones have been established:

Puyallup Zone No. 1.....Puyallup, Carbon, Stuck and White Rivers.
Green River Zone No. 2.....Green, Black and Duwamish Rivers.
Cedar River Zone No. 3.....Cedar River.
Sammamish Zone No. 4.....Sammamish River watershed.
Snohomish Zone No. 5.....Snohomish, Pilchuck, Snoqualmie, Skykomish, Sultan and Wallace Rivers.
Stilaguamish Zone No. 6.....Stilaguamish River and its two forks.
Skagit Zone No. 7.....Skagit, Baker, Sauk, Cascade and Samish Rivers.
Nooksack Zone No. 8.....Nooksack River and its three forks and the Sumas River.
Yakima Zone No. 9.....Yakima River and its tributaries, Naches, Teanaway, Cle Elum and Kachess Rivers.
Walla Walla Zone No. 10.....Walla Walla and Touchet Rivers and Mill, Yellowhawk and Garrison Creeks.
Nisqually Zone No. 11.....Nisqually River and Ohop Creek.
Deschutes Zone No. 12.....Deschutes River.
Chehalis Zone No. 13.....Chehalis, Wynooche, Satsop, Black, Skookumchuck and Newaukum Rivers.
Cowlitz Zone No. 14.....Cowlitz, Toutle, Tilton and Cispus Rivers and Coweeman and Olequah Creeks.
Lewis River Zone No. 15.....Lewis River and its two forks.
Skokomish Zone No. 16.....Skokomish River and its two forks.

After more than three years of experience in its administration, we believe that the act has more than justified itself, and that its continued constructive administration will be a major factor in successfully dealing with the State's flood control problems.

In its administration of the act the Division of Hydraulics has uniformly met with the wholehearted cooperation of all parties concerned.

2. River Utilization Surveys.

These surveys are made by the Conservation Branch of the United States Geological Survey and the resulting maps and reports published by that organization. The maps are topographic maps of the stream valleys on a larger scale than the standard topographic quadrangles and show greater detail. These maps may be used to determine (1) the location of dam sites and the type and size of dam suitable to the site; (2) the location, area, and capacity of possible reservoir sites; (3) available fall for hydro-electric power; (4) topography of water conduit locations; (5) area and character of irrigable lands; and (6) areas subject to flood overflow and probable methods of flood control.

During the period April 1, 1937, to September 30, 1938, $3,000 of State funds was expended for this work and this was matched by the Federal Government.

During the above period the following surveys were made:

Tolt River and Tokul Creek, Snohomish County: From Stosset Creek to forks, 1 mile; North Fork, 13 miles; South Fork, 14 miles; Canyon Creek and Beaver Creek, tributaries of Tokul Creek, 5 miles. Detailed surveys were made of four dam sites, one on the main river, one on the North Fork, one on the South Fork, and one on Canyon Creek.

Nooksack River, Whatcom County: From forks near Deming to mouth, 40 miles.

Klickitat River, Yakima County: From Diamond Fork upstream 3 miles; Diamond Fork, from mouth upstream 5 miles; from Diamond Fork downstream 3 miles. (This survey still in progress on September 30. About 30% complete on that date.)

Mr. Arthur Johnson, hydraulic engineer, is in direct charge of this work. We appreciate the consideration he has given this Department in cooperative affairs in connection with this work.

3. Inventory of Ground-Water Resources.

Beginning in 1937, a very modest start has been made on an inventory of ground-water resources in the State in cooperation with the United States Geological Survey (Division of Ground Water). An inventory of this sort is fundamental to planning for prudent use of the underground water where (1) no other source is available for public supplies or other uses; (2) the safe yield of the ground-water basins is influenced by the manner of utilizing the streams; and (3) the use of ground-water has some particular advantage in relation to industrial use, such as lower temperature, uniformity in chemical composition, or absence of suspended matter.

A very large quantity of ground-water is used in the State for various purposes. Thus, approximately 26% of the people in the State reside in communities that are supplied wholly or in part from wells and springs.

This does not include a scattered rural population, fairly large in the aggregate, which has no other source of water for domestic purposes and for stock. Thousands of acres are irrigated from wells. In addition, many industrial plants rely wholly on wells. Outstanding among these are certain pulp products mills, each of which requires several million gallons of water a day.

Both the number of users and the total consumption of ground-water have increased steadily, so that there is a well founded concern as to the safe yield of certain ground-water basins. Yet estimates of the safe yield, if they are to be dependable, must be based on systematic measurements of the fluctuation in ground-water level and of the yearly replenishment, natural discharge, and use of ground-water over a number of years. Also owing to increasing use, a problem in adequate and prudent legal control of ground-water supplies is arising.

Progress in the cooperative ground-water inventory to date (September 1938), includes the following:

Public supplies: A State-wide canvass of public water supplies from wells and springs has been made by correspondence and is now being supplemented by field reconnaissance. This canvass will assemble all data now available as to the general character of the source, quantity of water used, and permanence of the supply. It should be essentially completed by December, 1938. In conjunction, observation wells are being established for quarterly measurements of the ground-water level.

Spokane Valley: Since 1909, the yearly draft by the City of Spokane from its municipal wells has been from 7,098 to 13,655 million gallons (21,784 to 41,906 acre-feet). In the surrounding valley, some 8,000 acres of land are irrigated from wells. Also, the ground-water return to the Spokane River in the western part of the valley is at times as much as 1,000 cubic feet a second, a flow which largely determines the firm power available from the several hydroelectric plants. Owing to these several uses and to the possibility of increasing use, the source, magnitude, and dependability of this large ground-water underflow are critical factors in the prudent utilization of water in the valley. To study the inherent problems, basic data gathered by the City of Spokane, the Great Northern Railroad, and the Washington Water Power Company during the last three decades have been assembled and are being compiled for release. Supplemental observations of ground-water level are being made currently. Also, a survey to determine the channel capacities of the Spokane River is soon to be undertaken; this survey will afford certain essential data, not now available, for a dependable estimate of the ground-water return to the lower river. On the present scale of operations, several years will be required to finish the basic investigation.

Record of Wells: Under the Civil Works Administration, Washington Emergency Relief Administration, and Works Progress Administration, a project to compile the drillers' records of water-supply wells in the State was carried on intermittently and then was suspended in 1937 before completion. To salvage the useful data from this project, the records of about 500 wells have been assembled and released by the Geological Survey.

Mr. Arthur M. Piper, Geologist, a specialist in ground-water supply, is

in direct charge of obtaining information and data pertaining to this resource. Mr. Piper, in behalf of the U. S. Geological Survey, has cooperated to the fullest extent with this office, which is much appreciated by the Department.

MISCELLANEOUS ACTIVITIES

1. Litigation.

We are pleased to report that during the biennium no appeals to the Superior Court have been made from determination or orders of the office or of water masters or stream patrolmen; nor have any arrests been made for interference with orders of the office or regulation by these officials, notwithstanding the fact that we have just passed through one of the driest years within the period of rainfall record. During such periods controversies over water are of more frequent occurrence than during periods of normal supply.

Litigation in such matters is not only costly to the State but to the water users as well.

2. Waters in State Withdrawn from Appropriation.

Chapter 88, Laws of 1905, provides that, on notification by the U. S. Bureau of Reclamation, any waters which the Bureau may require for any Federal reclamation project shall be withdrawn from appropriation for any other purpose.

The withdrawal of water is for a period of one year in order to permit the preparation of plans for the project. As soon as plans are completed the waters reserved must be appropriated by the United States in the same manner as any other prospective water user. If plans are not completed within one year and the project appears to be feasible, the Supervisor of Hydraulics may grant further extensions of time for three year periods to permit completion of plans.

Streams on which waters have been withdrawn from appropriation are as follows:

Yakima River and all tributaries—reserved for use of Yakima Project.

Columbia River, above Grand Coulee—reserved for use on Columbia Basin Project.

Wenatchee River, 300 second-feet, with definite quantities reserved from certain tributaries for use in connection with salmon propagation in order to preserve Columbia River salmon, as the Grand Coulee dam will not permit them to reach their natural spawning grounds.

3. Power License Fees.

In 1929 the Legislature enacted the Power License Law (Chapter 105, Laws of 1929), which provides for the payment to the State of an annual license fee for the use of water for power purposes, both on developed and undeveloped projects of over fifty theoretical horse power. The fee is based on the theoretical horse power produced by the quantity of water claimed and the operating head of water involved. The fee for undeveloped projects is one-half of the rate specified for projects in operation.

The revenue from this source has diminished during the last few years because many who were holding water rights for future power developments relinquished them when construction of the Grand Coulee and Bonneville projects made uncertain the future market for power developed by private

interests. The Government is exempt from paying fees on Government-owned hydroelectric plants.

It was the mutual intent of the framers of the act and those who pay the fees that the proceeds therefrom should be used to carry on surveys and investigations of natural resources of the State. Unfortunately, however, instead of being used for that purpose the receipts were placed in the general fund of the State.

Since the enactment of this law the following fees have been collected:

YEAR	Number of Claims on Which Fees Were Paid	Amount Collected
1929	125	$45,645 63
1930	137	42,354 20
1931	136	42,960 00
1932	126	42,392 64
1933	116	39,961 28
1934	121	41,513 88
1935	105	38,011 34
1936	101	37,321 26
1937	96	34,356 53
1938	91	34,506 34
Total		$398,963 10

4. Cooperation with the three State Departments of Game, Fisheries, and Health.

Naturally the settlement and development of any new country tends to disrupt both game and fish life. The abundance of these resources has already been greatly diminished in this State and careful consideration should be given to preserving these assets.

The State and Federal Governments are expending annually large sums of money in the construction of fish hatcheries, stream improvements, and fishways, and for patrolling streams in the interest of fish life. It is understood that the annual value of the salmon industry in this State is approximately $6,000,000. Salmon and game fish are a great recreational asset, not only to the citizens of the State, but to tourists. This office, therefore, aims to cooperate to the fullest extent in preserving both salmon and game fish in the streams of this State.

This biennium the Division of Hydraulics inaugurated the practice of furnishing both the Game and Fisheries departments notices of all applications filed for permits to appropriate water. When it is found by either of these departments that the proposed diversion or works necessary to divert water would be detrimental to fish life, careful consideration is given to what facilities may be used in the diversion works so that water may be diverted without hindering the migration of fish. A permit is then issued on condition that such works be installed. It may also be found that the quantity of water to be diverted may at times dry up a stream used for fish migration, in which event the permit is denied. In other cases where there is a conflict, before a water right is granted this department and the Game and Fisheries departments attempt to arrive at a compromise which

will best serve the combined interests of the water user, fish life, and the general public. Some permits are issued, also, with a provision that water shall be returned to the stream in an unpolluted condition.

Of the last 304 applications for water rights, notices of which have been sent to the Game and Fisheries departments, those offices have filed objections to only twenty-one, of which seven were merely provisional protests to the effect that the protest would be withdrawn provided that screens, etc., are installed to protect fish life. If permits are issued, these provisions will be made a part of each permit. Of the fourteen remaining applications which were protested, two have been cancelled and two have been granted permits. The others have not yet been acted upon.

Heretofore the principal interference has been caused by obstructions, such as dams, which prevent normal migration, and by unscreened diversions, which permit fish to enter irrigation and other ditches and canals. A steadily increasing demand for permits to divert water from streams for domestic, industrial and irrigation purposes, especially on some of the smaller streams West of the Cascade Mountains, indicates that our chief problem in the future may be the retention of sufficient flow in the streams to satisfy the minimum requirements of fish life.

There are no statutes specifically authorizing the Supervisor of Hydraulics to reserve any portion of the flow of streams for fish life. Any such action so far taken has been based on the provision of the Water Code, which authorizes the Supervisor of Hydraulics to deny applications when the granting thereof would be detrimental to the public interest.

We believe that the time is ripe for a study of the various streams with a view to ascertaining the necessity and justification for definite reservation of a fixed minimum flow in the various streams in the interest of fish life, and possibly definite statutory provisions governing allocations of water for that purpose.

The State Department of Health is advised of pending applications for domestic water supplies for communities, resorts, etc., where a group of people are to be served.

5. Water Use Problems.

The increasing appreciation of the role which water plays in our present day civilization is amply reflected in numerous inquiries received at our office from personal callers and by mail. These inquiries range all the way from matters of simple hydraulic engineering to those of elementary laws and regulations governing small water supplies.

When, as is usally the case, the project and problems involved are too small to justify the owner in engaging professional services, we gladly give such advice as is possible without field examinations. Considerable time and correspondence are devoted to this type of service, because we believe that it not only assists the individual in solving his specific problems, but also imparts much needed education as to use of water by the individual for irrigation, domestic and allied purposes.

EXPENDITURES

The following table shows expenditures under the supervision of the State Supervisor of Hydraulics for the biennium from October 1, 1936, to October 1, 1938, as compared to those for the previous biennium.

PURPOSE	Expended From Oct. 1, 1934, to Oct. 1, 1936	Expended From Oct. 1, 1936, to Oct. 1, 1938
Administration of water code, flood zoning, etc. (Chap. 150, L. 1933)	$23,398 33	$30,996 29
Flood zoning (Chap. 159, L. 1935)	8,123 42	.....
*Hydrographic surveys	21,411 71	27,983 21
*River utilization surveys	8,311 30	2,755 81
*Underground water surveys	.....	2,028 79
Case of Washington vs. Oregon	9,369 88	.....
Totals	$70,614 64	$63,764 10

*Expenditures for these purposes are made under cooperative agreements with the U. S. Geological Survey and are matched by Federal funds.

RECEIPTS

The following table shows receipts for the biennium from October 1, 1936, to October 1, 1938, as compared to those for the previous biennium.

SOURCE	Received Oct. 1, 1934, to Oct. 1, 1936	Received Oct. 1, 1936, to Oct. 1, 1938
Examination fees:		
Initial	$1,315 00	$1,710 55
Additional	1,853 60	1,344 00
Filing and recording fees:	1,752 99	2,359 46
Permits	247 80	285 55
Certificates	32 00	82 10
Miscellaneous	110 60	77 15
Miscellaneous copying	3,264 57	4,320 68
Extension of time for beginning of construction	3,139 92	1,946 95
Adjudication of water rights	20 00	84 35
Dam inspections	$11,736 48	$12,210 79
Power license fees	75,474 21	68,862 87
Totals	$87,210 69	$81,073 66

DIVISION OF GEOLOGY

HAROLD E. CULVER
Supervisor

DIVISION OF GEOLOGY

Harold E. Culver, Supervisor

INTRODUCTION

Under the civil administrative code of 1921, the Division of Geology is specifically required to direct its activities to the development and conservation of the State's mineral resources. Hence, the Division is organized to function as a fact-finding bureau as an aid in the economic development of the metallic and nonmetallic resources of Washington. The first duty of such an agency is to ascertain the real mineral wealth of the State; the second is to make its findings known to the public so that efficient exploitation may follow.

In Washington, the ordinary geologic sequence of erosion and deposition of rock formations is complicated by a long history of mountain building, and intricate oceanic invasions, as well as extensive volcanic and glacial action. Under these conditions, it is not surprising that the true geologic relations of rock masses and their accompanying valuable deposits can be determined only through long-continued and intelligent application of geologic principles. Most of the difficulty met in special study of local deposits can be satisfactorily settled only if the general relations of the enclosing rocks is understood.

During the past thirty-eight years, the Division of Geology and its predecessors, the State Geologist and the State Board of Geological Survey, have been accumulating this necessary background of facts, but many years more work are necessary before all of our mineral resources can be intelligently prospected. As rapidly as the compilation of data has permitted, investigations of local districts or specific deposits have been undertaken, and the extensive list of reports published by the Division is an indication of the scope and magnitude of this work. During the past biennium funds have not been available for the publication of reports already written. Hence, during the coming biennium it will be desirable to plan for the printing of this material as well as the additional reports which will become available in the next two years.

In this Biennial Report, Divisional activities will be presented under the natural subdivisions of **topographic mapping, economic geology, basic geology,** and **technical services.**

TOPOGRAPHIC MAPPING

The preparation of large-scale topographic maps was begun in Washington by the Federal Government in 1893. Since then the mapping has been continued without marked interruption although the size of the areas mapped from year to year has varied as the funds available varied. Much of the independent work by the Federal Government has been in connection with lands controlled by the Government, but, beginning in 1904, recognition of the desirability of speeding up this work led to the initiation of cooperative work between the State and Federal Governments. Under the agreement made for each biennium, State and Federal funds are matched dollar for dollar. A total of nearly sixty per cent of the State's area has been completely mapped, and under the independent Federal program, preliminary work on much of western Washington is now under way. During the first half of 1937 no State funds were available for this cooperative work,

but in the 1938 season about $12,000 was allocated for cooperative mapping, and two fifteen minute quadrangles in the vicinity of Yakima are being mapped. The first unit will probably be completed this fall and the second next season.

The economy of doing topographic mapping by areal units rather than by specific projects is well understood by all of those engaged in any engineering project of whatever nature. Likewise, the urgent need for carrying the topographic mapping program on to completion is apparent to all well-informed persons. If the present biennial appropriation of $25,000 could be continued, and the money actually made available, it would still require many years to complete the mapping of the State.

ECONOMIC GEOLOGY

Such investigations by the Division of Geology as are listed under the head of economic geology include those specifically related to a single deposit or a single substance, differing thus in character and scope from those presented below under the heading "basic geology." The purpose of these specific investigations is to determine the geologic facts with reference to certain deposits. Studies have been undertaken in both the metallic and nonmetallic fields. These are primarily intended as an aid to prospectors and present operators. During the past biennium, such studies have been made of deposits of manganese, chromium, and quicksilver in the metallic field, and clays, magnesium, coal, oil, and gas in the nonmetallic field. They include not only field studies but also laboratory and office work.

Manganese. Taking advantage of the W. P. A. exploration work which was under the supervision of Mr. C. S. Fowler, the Division was able to make excellent progress in working out the character and size of several typical manganese deposits of Clallam County. From the data he obtained, Mr. W. A. G. Bennett of the Division staff has been able to formulate a theory of origin for these ores which should be of exceptional value in further exploration in the Olympic area. In 1938 the U. S. Geological Survey began detailed studies in the Mt. Constance-Lake Crescent area, and the work of the State Division has been stopped to avoid unnecessary duplication.

Chromium. Begun late in 1937 and completed in 1938, a field investigation of the chromite deposits in the Sisters Mountain area, Whatcom County, by Mr. Bennett provides data for a preliminary report on this important resource. It is planned to include studies on all other known deposits in a complete report on chromite in Washington. This should be ready for publication in the coming biennium.

Quicksilver. In 1937 Mr. E. P. Hougland completed a preliminary study of the quicksilver district of Morton, Lewis County. Although no other areas are producing quicksilver at the present time, several promising occurrences are known. These will be studied in the coming biennium so that a comprehensive report on quicksilver in Washington may be prepared.

Clays. During the present biennium, Mr. S. L. Glover has completed a revision of his unpublished report on the clay resources of Washington. The original report, completed in 1921, was based on field examination of every known deposit of clay in the State and included complete description of each, together with tables showing physical and chemical character, re-

sults of refractory tests, and all related data. Through additional field studies and revision of the text in the light of present tendencies in the clay industry, this report constitutes an authoritative statement on the clays of Washington. It is ready for publication as Bulletin 24 of the Division series.

Magnesium. Recent advances in the technology of magnesite and the proposed establishment of a pilot plant at Chewelah, Stevens County, lend importance to the estimation of the State's magnesite and dolomite resources which was begun last biennium and has been continued during 1937-9 by Mr. Bennett. The complete bulletin, No. 36, showing the location, size, and character of all known deposits of magnesite and dolomite, should be ready for printing by the end of the coming biennuim.

Coal. Nearly forty years ago a report on the coals of the State was prepared by the late Henry Landes and published by the State Geological Survey, of which he was then the head. Subsequently, detailed reports on the several coal districts have been published but no comprehensive report has been compiled. It is proposed to bring together, in usable form, not only the essential data of these earlier reports, but all the new developments in this field. This compilation has been begun but it is unlikely that the work can be completed in the coming biennium.

Oil and Gas. With the report on oil and gas possibilities in Skagit County waiting publication for lack of funds, no attempt has been made to complete detailed studies in any of the other promising areas. Instead, general real studies have been begun which are discussed under the heading "basic geology." During the biennium it has been possible to continue the monthly inspection of all drilling operations in the State, and the Division is glad to record the cordial cooperation of practically all operators in the collection of drill logs and well samples. These have been systematically studied and filed in the Division offices. The rapidly growing file of well cuttings now totals between 8,000 and 9,000 samples and constitutes an invaluable working tool in the examination and correlation of current drilling operations. Through the acquisition of these data, furnished voluntarily by the oil men of the State, the Division is rapidly attaining a position which will enable it to be of conspicuous service to those carrying on drilling tests in the future.

Mines Studies. In addition to the investigation of specific deposits noted in the preceding paragraphs, a thorough study of the geology of all mines and prospects has been begun. For the past four years the preliminary office work has been going on leading to the completion of all recorded geologic data on all mining operations in the State. The resulting card index file, comprising some 13,000 items, lists all known published references to all mines and mining claims, the metals reported to occur, the rock formations, veins, and structures of the area, values produced, and names of operators. This invaluable file, largely compiled by Mr. E. P. Hougland, serves as a basis for the field study of metal mines begun this year by Mr. J. W. Melrose, vice Mr. Hougland resigned. The object of this study is to gain first-hand information as to the geologic situation of every mining operation at whatever stage of development. Only on the basis of this personal knowledge of the mining men and their geologic problems can the Division hope to be of maximum assistance to the mining industry. The

cordial reception afforded Division staff members by the mining men throughout those counties entered this season has been most gratifying and suggests a real appreciation of the value of this activity. As fast as unit areas of the State are completely covered, summary reports will be issued in the series of Reports of Investigations. It is possible that reports on at least two county units will be ready for publication during the coming year.

BASIC GEOLOGY

Structural Studies in the Olympic Peninsula. One of the most promising areas showing oil and gas possibilities in Washington lies on the west side of the Olympic Mountains where a number of expensive drilling tests have already been made. In spite of the fact that a considerable amount of reconnaissance geologic work as well as some detailed work has been done during the past thirty-five years, the data available to drillers do not permit them to determine the age, stratigraphic relation, or structure of the beds they penetrate. Detailed stratigraphic work back from the coast line is rendered almost impossible on account of the heavy cover of glacial drift and vegetation which almost totally conceals bedrock.

During this biennium a detailed examination of the coastal strip from Cape Flattery to Moclips has been undertaken. Recent topographic mapping by the U. S. Army and other agencies has provided a base on which detailed plane-table surveys have been made, rock sections measured, and structures determined. While far from complete, the present state of the study indicates the possibility of working out a satisfactory stratigraphic column from which it will be possible to correlate the results of drilling tests of the past as well as those contemplated for the future. A complete report of this work should be ready for publication before the end of the coming biennium.

Quadrangle Surveys. Because of the complexity of local geologic conditions throughout the State, it has been found advantageous to defer detailed studies of specific areas until topographich maps were available. These maps, appearing as fifteen minute or thirty minute quadrangles, furnish an excellent base for unit studies of the geology. For a number of years past, geologic surveys have been under way in the Chewelah and Colville quadrangles, partly as Division activity and partly privately financed. Completed reports on the Chewelah quadrangle and the south half of the Colville quadrangle are now available to the State Division for publication. Similar studies in the Metaline area of Pend Oreille County and the Mt. Constance area in the Olympic Mountains are in progress by geologists of the U. S. Geological Survey. The State Division has cooperated in this work through field and office conferences but not financially, and the reports will appear as bulletins of the Federal Survey. This type of report is of exceptional value since it presents, in compact form, the whole geological set-up of each area, thus making available all necessary information for detailed exploration of mineral deposits.

Underground Water. The collection and study of data on underground water is of increasing importance in this State. Even in the western part of Washington springs and wells furnish the water supplies of approximately 53 per cent of the municipalities. In eastern Washington 77 per cent of the

towns are so supplied. With the growth of population, particularly when the Grand Coulee power and irrigation project goes into operation, the drain on underground water resources will be far greater. In answer to present need and in anticipation of future problems, the Division is collecting all available data on ground water and is making a continued study of this resource.

Bibliography. As noted in the Eighth Biennial Report of the Division, work has been going forward for several years on the compilation of a complete bibliography and index of all articles dealing with the geology and mineral resources of Washington. During the present biennium this work has been completed and is scheduled for publication early in 1939.

TECHNICAL SERVICES

While all of the activities of the Division of Geology might properly be classed as technical services, there is included here only that group of miscellaneous activities by which the facilities of this Division are placed directly at the disposal of the citizens of Washington.

Identification Service. More and more generally it is becoming known that rocks and minerals found in the State may be submitted for examination without charge. Neither assays nor chemical analyses are made; hence, there is no infringement on the field of the commercial chemist, rather, by direct suggestion, the sender is advised as to what metals his sample should be tested for and how to go about any warranted development. A mimeographed sheet, copy of which is subjoined, is sent in response to a request for examination.

Department of Conservation and Development

DIVISION OF GEOLOGY
Harold E. Culver, Supervisor
Pullman, Washington

IDENTIFICATION SERVICE

The Division of Geology will examine and classify substances submitted by citizens of the State, but does not make chemical analyses or assays. A letter or post card should be sent at the same time as the sample, specifying just what information is desired.

This work is done without charge as a State service. In making suggestions as to possible use of the substance, it is usually helpful to know where the sample has been found. If you want such advice, we shall be glad to have you fill out the location form below and return it promptly. Otherwise, the specimen will only be identified for you.

This service is strictly confidential and no information regarding the classification or location will be made public except with the sender's permission.

Very truly yours,
DIVISION OF GEOLOGY
By John W. Melrose
Geologist in charge.

Please fill out and return:

This sample is from the.....¼ of section....., township..... North, range.....East West. (If section location is not known, please describe by distance and direction from known place or points.)

I do not desire all data kept confidential.

Name.....

Address.....

.....

The popularity of this service is attested by the fact that during the present biennium nearly 1,000 samples have been received and examined at the Division laboratories.

Field Service. Closely related to the identification service is the aid given in the field to prospectors and others in the exploratory work necessary to proper development of mining claims. In the coming biennium, it is planned to extend this service which is so warmly welcomed by all interested in the furtherance of our mineral industry. Here again the policy is not to supplant the professional consultant, but to aid exploratory work by suggestions in cases where neither a mining engineer nor geologist would normally be employed.

Oil Legislation. In all States where oil is produced commercially, it has been found necessary to introduce certain regulatory measures to prevent waste and uneconomic development of this valuable resource. In view of the extensive and continuing drilling program in Washington, it has been

felt that some preliminary regulations should be provided by law. On the request of the Director, therefore, the Division has compiled a preliminary draft which incorporates such provision for control of drilling and oil development as seems desirable to meet present and future situations. It is hoped that some enactment including these provisions will be passed at the next session of the Legislature.

ACKNOWLEDGMENTS

Although space does not permit recording individual names, it is a pleasure to acknowledge the splendid cooperation of a large number of public-spirited citizens in the activities of the Division of Geology. Included in this list are private citizens, industrial representatives, and officials of our State and Federal governments.

Cordial cooperative relations with many agencies of the national government, the several state departments, and institutions of higher education have provided invaluable aid in furthering the work of the Division of Geology.

DIVISION OF MINES AND MINING

THOMAS B. HILL
Supervisor

FOREWORD

The Division of Mines and Mining in the biennium ending December 31, 1938, has been active in its functions, as provided by law, giving special consideration to the following:

1. Compilation and dissemination of information on mining in the state. This includes completion of transcription of mineral claim records from the books of county auditors; compilation of a directory of mining properties, with information on production and active development work; preparation of federal and state mining laws, ready for printing and distribution; distribution of publications of Department of Conservation and Development relating to mining; furnishing special information in reply to hundreds of inquiries by letter and by visitors to the office.

2. Supervising a W. P. A. project for investigations of certain minerals in various parts of the state. This is referred to in greater detail later in this report.

3. Cooperating with prospectors and miners in their work of organization in order that they may give united consideration to their common problems.

4. Continuing to add to collection of mineral specimens from mining properties of the state.

5. Continuing to add to library of books and bulletins on mining, milling and metallurgy.

6. The Division has continued to cooperate with state and federal departments and institutions in furnishing information on the mineral industry of the state. It has cooperated with State Progress Commission to obtain material for general exhibits at the expositions at San Francisco and New York.

HISTORICAL NOTE ON MINING IN WASHINGTON

The first official mention of mineral resources in what is now the State of Washington was made by Dr. William Fraser Tolmie of the Hudson's Bay Company in 1833, and the first actual mining in this state was in 1848 when a small amount of lignite was dug from the banks of the Cowlitz river by Hudson's Bay Company's men. The first gold and silver that was mined in the state was at Fort Colville in 1855. From that time for a period of ten years there was considerable activity in gold mining in what was then Washington Territory at Oro Fino, the Boise Basin now in Idaho, and in the western part of Montana. It is reported that in 1861 nearly $3,000,000 in gold was mined in that territory and in eastern Oregon, and that gold shipments through Walla Walla in 1862 were about $7,000,000. Following this activity in the early 1860's there was little further expansion in mining, excepting of coal, in this state for the next twenty years.

About 1880 there was a renewed interest in mining in Washington, and for the following two decades until 1900, there was much activity in prospecting and in developing mining properties, although at no time was there heavy production except in coal. Thousands of claims were located throughout the state during this period, particularly in the Cascades and in the northern tier of counties, and development work was done on hundreds of these.

Aerial view of the concentrating plant of the Chelan Copper Division of the Howe Sound Company, located on Railroad Creek near Lake Chelan in Chelan County. This plant was put in operation in April, 1938, and is milling and concentrating 1,800 tons of raw ore per day. The ore carries values in copper and some gold. The concentrates are refined at the Tacoma smelter. (Picture courtesy Northwest Mining.)

EARLY DEVELOPMENT

In 1897, L. K. Hodges wrote a book on "Mining in the State of Washington," of which there are only a few copies now available. In this book is published a description of practically all of the more important mineral discoveries and the development work that was done on them. The manuscript embraced about 200 typewritten pages and covers 34 mining districts in 15 counties. Hundreds of properties are described. It is evident from this record that there was widespread activity throughout the state, hundreds of men being employed, and hundreds of thousands of dollars being spent in development work.

This unusual activity in exploring and developing the mineral resources of Washington came to an end when gold was discovered in Alaska, because the reports of the rich placer deposits on the Yukon attracted practically all of the prospectors and miners of the state. Interest in mining was not again revived to a marked degree until within the last ten years. During all of this time, however, there had been some mining development, and there had been a few mines producing on a substantial scale.

MINING AN IMPORTANT INDUSTRY

That mining has been an important industry in Washington, is indicated by the fact that the total production of gold, silver, copper, lead, zinc and coal from 1860 to 1937, inclusive, is valued at $430,518,523. Figures on production of all the other metallics and non-metallics are not available, but total mineral production for the state since earliest settlement is estimated at upwards of three-quarters of a billion dollars.

Throughout the history of mining in this state, coal has been predominant until its peak year, 1918, when 4,128,424 tons were produced. There was then a steady decline until 1934, when 1,382,991 tons were produced. Coal mining is again on the increase, as indicated by the following figures on production:

1935	1,559,206 tons
1936	1,812,104 tons
1937	2,018,036 tons

REVIVAL IN MINING

The revival of mining in general in this state began about 1933. There were many contributing causes. The increase in the price of gold and silver, and higher metal prices in general, resulted in increasing activity. Interest on the part of the public was materially promoted by reason of an allotment of funds by the Emergency Relief Administration to the Department of Conservation and Development for stream gauging, river surveys, topographic mapping and geological and mineral investigations. The total amount of this allocation was $80,000, and a considerable part of it was used in connection with federal funds through CWA and WERA projects to develop and compile information on mineral resources. The Division of Mines and Mining was created in 1935 and has continued this work. The combination of economic factors, and a greater interest on the part of the public, are responsible for the progress that is being made in mining in this state.

The mineral production of Washington for 1937, has been compiled by the Division of Mines and Mining from various sources, but chiefly from the

1938 Minerals Year Book, published by U. S. Bureau of Mines. It is believed that these figures are substantially correct. The following table shows the mineral production of Washington for 1937, as compared with the production for 1936:

MINERAL PRODUCTION IN WASHINGTON 1936-1937

PRODUCT	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Gold, oz.	12,217	$427,609	36,310	$1,270,850
Silver, oz.	66,900	51,814	126,304	97,696
Copper, lbs.	204,000	18,768	128,000	15,488
Lead, lbs.	1,680,000	77,280	5,660,000	333,940
Zinc, lbs.	8,806,000	440,300	8,232,000	535,080
Iron, tons	9,082	36,361	10,044	32,859
Manganese	.....	.....	(1)	(1)
Molybdenum, ore, tons	.....	.....	3,000	(1)
Tungsten (concentrates) tons	48	36,294	63	47,636
Mercury	(1)	(1)	(1)	(1)
Antimony	(1)	(1)	(1)	(1)
Coal, tons	1,812,104	5,504,000	2,018,036	6,404,174
Coke, tons	28,680	172,368	14,993	74,965(2)
Briquets, tons	(2)	(2)	19,086	114,516(2)
Peat	1,052	14,595	(1)	(1)
Petroleum	.....	.....	(1)	(1)
Natural gas, cu. ft.	141,000,000	99,000	142,578,000	99,803
Carbon dioxide gas	.....	.....	(1)	(1)
Cement, bbls.	(1)	(1)	4,107,432	8,830,798
Stone, tons	2,321,710	2,279,405	2,027,420	1,909,604
Sand and gravel, tons	8,970,849	5,942,080	9,376,644	6,818,154
Lime, tons	36,638	340,724	65,272	647,692
Fire clay	.....	.....	28,787	46,161
Miscellaneous clay, tons	.....	.....	21,071	45,118
Clay products	.....	1,262,525	(1)	(1)
Magnesite, tons	(1)	(1)	(1)	(1)
Diatomite, short tons	880	10,579	(1)	(1)
Pulpstones and grindstones	(1)	(1)	(1)	(1)
Talc and soapstone	462	1,805	(1)	(1)
Gem stones	.....	.....	(1)	(1)
Mineral waters	.....	.....	(1)	(1)
Miscellaneous (estimated)	.....	$6,609,926	.....	$4,000,000
Totals	.....	$23,092,007	.....	$31,135,053

(1) Included in miscellaneous.
(2) Not included in state total.

The total value of gold, silver, copper, lead and zinc produced in Washington in 1937 was $2,253,054, as compared with $1,015,771 in 1936, and $394,041 in 1935. The output of these metals for 1938 will show a material increase over 1937. The Chelan Copper Division of Howe Sound Company, which began production in April of 1938 is milling 1,800 tons of ore a day, and recovering substantial copper and gold values. The Arlington Mine in Okanogan county also began operation in the spring of 1938 and is reported to have produced over 80,000 ounces of silver, 64¼ ounces of gold, and nearly 33,000 pounds of copper by December 1. Other smaller mines have come into production in the current year, and most of the established producers of gold, silver, lead and zinc increased their operations.

DIRECTORY OF MINES

Following is a list of the metallic mines of the state on which information has been obtained:

Name	*County*	*Product*
Admiral Consolidated Mining Co.	Stevens	S.G.
Aichan Bee Mine	Stevens	S.L.Z.
Aladdin Mines, Inc.	Stevens	G.S.C.L.Z.
†Alder Mining & Smelting Co. (See Chelan Mining Co.)		
*American Manganese Corp.	Jefferson	Manganese
†American Rand Corp.	Okanogan	G.S.L.C.
†American Tungsten Mines, Inc.	Stevens	Tungsten
Anacortes Gold Mining Co.	Whatcom	G.S.
†Apache Gold Mines, Inc.	Okanogan	S.C.G.
†Apex Gold Mines, Inc.	King	G.S. Arsenic
†Apex Mercury Mines, Inc.	Lewis	Mercury
†Ark Mines Co.	Stevens	G.S.C.Z.
†Arlington Mines, Inc.	Okanogan	S.G.
†Asbestos Talc Products of Washington, Inc.	Skagit	Talc
Aurora Mining Co.	Okanogan	G.
†Aurum Mining Co.	Ferry	G.S.
†Azurite Mine (American Smelting & Refining Co.)	Whatcom	G.
†Bailey-Hanson		L.
*Baltimore Mines, Inc.	Whatcom	G.
†Barnum & Patterson Mercury Co.	Lewis	Mercury
*Bear Creek Property	King	C.G.
Beaver Mine	Okanogan	G.S.
†Ben Hur Mine (See Mountain Lion Consolidated Mining Co.)		
*Big Chief Mine	King	G.C.
†Big Iron Mining Co.	Stevens	Magnetite
*Big Silver Mining Co.	Ferry	S.G.C. Arsenic
*Billy Goat Mine	Okanogan	G.
Black Canyon Mining Co. (See President Mining Co.)		
Black Rock Zinc Mine	Stevens	Z.
*Black Rosauer Mines Co.	Grant	G.S. Bismuth Molybdenum
†Black Tail	Ferry	G.
*Black & White Mining Corp.	Chelan	G.S.
†Blaine-Republic (See Eureka Mining & Milling Co.)		
†Blewett Mine	Chelan	G.
Blue Ridge Mine	Stevens	G.S.Z. Iron
†Boucher, B.	Stevens	L.
†Boundary Gold Placers, Inc.	Okanogan	G.
Boundary Red Mountain (See International Gold Mines, Ltd.)		
†Bringham & Simonson	Stevens	L.
British Mining Co.	Skagit	
Brown, E. C. & Associates	Skamania	S.G.Z.L.
*Bruder Mining Co.	Pend Oreille	S.L.
†Bryan Mine	Stevens	S.L.G.
Buckhorn Mining Co.	Okanogan	G.S.

†Reported As Producing
*Reported As in Active Development
Inactive

G—Gold
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S—Silver
Z—Zinc

DIRECTORY OF MINES—Continued

Name	*County*	*Product*
Burcham Mine	Kittitas	G.
*Burrus, J. W., Mine	Stevens	G.S.L.Z.
†Cascade Chief Mining Co.	Kittitas	G.
†Cascadian Gold Syndicate Corp.	Okanogan	G.
†Central Mine	Okanogan	
Chancellor Mine	Okanogan	G.
*Chelan Mining Co.	Okanogan	G.
*Chewelah Eagle Mining Co.	Stevens	L.S. Lime
*Chief Barnaby Mines Co.	Ferry	G.
†Chinto Copper Mining Co.	Stevens	S.G.C.
*Christensen, B.	Ferry	G.
*Chromium Corp. of America	Whatcom	Chrome
*Cleveland	Pend Oreille	
†Cleveland Mine	Stevens	S.L.
Cliff Gold Mining Co.	Okanogan	G.
Coffin Mine	Stevens	Z.L. Molybdenum
Columbia Mountain Mines	Snohomish	G.S.C. Antimony
†Columbia River Copper Co.	Stevens	C.S.L.Z.
Columbia Tungsten	Stevens	
†Colville Queen Mining Co.	Stevens	S.L.Z.
†Coney Basin Gold Mines	King	G.S.L.
*Consolidated Mines & Smelting Co.	Ferry	G.S.C. Molybdenum
Consolidated Silver Mountain Mines	Stevens	S.C. Iron Arsenic
*Continental Gold Silver Mining Co.	Okanogan	G.S.C.L.
†Copper Mining Co.	Yakima	C. Tungsten Molybdenum
†Copper Zone	Okanogan	C.
Covered Wagon Mine	Snohomish	G.C.S.
Crescent Marble Mining Co.	Skagit	Limerock
Cross, Joe	Okanogan	G.S.
*Cuprite Mining Co.	Stevens	G.S.C.L.
*Custer Mining Co.	Snohomish	
*Damon & Pythias Gold Silver Mine	King	G.S.
*Dan Lee Mines	Okanogan	
†Davidson Property	Okanogan	
†Deer Park Natural Pigments Corp.	Stevens and Grant.	Clay Diatomite
*Deer Trail Group	Stevens	S.
†Deer Trail Monitor Mines	Stevens	Molybdenum
*Dia-Cousti-Lite Products Co.	Grant	Diatomite
†Doblasua Lime & Mining Co.	Ferry	Limestone
Double Eagle Mining Co.	Stevens	C. S. Magnesite
Dutch Miller Mine	King	G.S.C.L.
Echo Mining Co., Inc.	Stevens	S.L.
†El Caliph	Ferry	G.
†Electric Point Mining Co.	Stevens	L.
†Espin, A. & J. Johnson	Stevens	L.
Eureka Gold Mining Co.	Whatcom	G.
†Eureka Mining & Milling Co.	Ferry	G.
*Evans-Smith-McKittrick-Hammond Co.	Stevens	G.S.L.
†Everett Lime Co.	Snohomish	Limerock
*Evergreen Mines Co.	Whatcom	G.
Faithful Surprise Mining Co.	Ferry	G.
†Farmer Mine	Stevens	

†Reported As Producing
*Reported As in Active Development
Inactive

G—Gold
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DIRECTORY OF MINES—Continued

Name	*County*	*Product*
Ferry Mining Co.	Ferry	
†First Thought Mine Corp.	Stevens	G.S.
*Flag Hill Mines	Ferry	G.
†Florence Rae Copper Co.	Snohomish	G.S.C.
Forty-Five Mines, Inc.	Snohomish	S.G. Arsenic
Four Metals	Okanogan	S.G.L.
*Frisco-Standard Mining Co.	Stevens	S.L.G.
*Garrett Property (See Walsh, Garrett)	Ferry	C. Silica Bornite
Gem Gold Mines, Inc.	Stevens	G.
†General Electric	Stevens	Tungsten
*Georgia May Mines, Inc.	Ferry	L.G.S.
*Glacier Peak Mining & Smelting Co.	Snohomish	C.G.S. Molybdenum
†Gladstone Mountain Mine	Stevens	L.S.
*Golconda Mining & Milling Co.	Okanogan	G.C.
*Gold Arrow Mines, Ltd.	Pend Oreille	G.S.L.
*Gold Axe Mine	Okanogan	G.
*Gold Bar Mining Co.	Stevens	L.G.C.
†Gold Bond Mining Co.	Chelan	G.
*Gold Cup Mining Co.	Ferry	C.
Gold Hill Consolidated Mining Co.	Yakima	S.C.G. Tungsten
Gold Hill Operating (See Northern Cascade Mines)		
*Gold Reef	Stevens	G.
Golden Chariot Mining Co.	Okanogan	G.S.C.
Golden Eagle Mine	Snohomish	C.
Golden Fleece	Kittitas	G.
†Golden Harvest Mining Co.	Ferry	G.S.
*Golden Hope Mining Co.	Okanogan	G.S.
†Golden King Mining & Development Co.	Chelan & Okanogan	G.S.
*Goldstake Mining Corp.	Ferry	G.
*Good Hope Gold & Copper Mining Co.	Snohomish	G.S.C.L.
Gopher Mining Co.	Stevens	Iron
†Grand Coulee Mines, Inc.	Okanogan	G.S.
†Grand Summit Mining Co.	Okanogan	G.S.
†Grey Eagle Lead Mining Co.	Okanogan	L.
*Gubser Mine	Okanogan	
*Hatfield, John	Okanogan	Tungsten
Heald, Geo. (Sunrise Mine)	Snohomish	C.G.S.
*Hilo Group	Okanogan	G.S.
Holden Gold Mines, Inc.	Okanogan	G.S.C.
*Hoover Mining Co.	Pend Oreille	Z.L.
†Howe Sound (Chelan Division)	Chelan	C.G.
†Index Gold Mines, Inc.	Snohomish	S.G.L.Z. Tin
†Indiana Mine	Whatcom, Okanogan	G.S.
Industrial Mining, Inc.	Whatcom	Chromite
International Gold Mines, Ltd.	Whatcom	G.
†Interstate Mining Co.	Lewis	Mercury
†Iowa Mine (See Sultan Basin, Geo. G. Startup)		
*Jay Dee Mining Co.	Stevens	S.
*Joamco Mining Co.	King	C.G.
†John Judge Gold Mining Association	Okanogan	G.
†Jordon, Clarence	Kittitas	G.
*Jordon, Ollie	Kittitas	G.

†Reported As Producing
*Reported As in Active Development Inactive

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DIRECTORY OF MINES—Continued

Name	*County*	*Product*
†Judy Mine	Okanogan	
*Juno Echo Mine	Stevens	Molybdenum C.
Justham, S. R. (Huckleberry Mine)	Kittitas	G.S.C.
*Kaaba Texas Mining Co.	Okanogan	S.G.
†Kearney, C. A. Co.	Okanogan	Epsom Salts
Kelly C. H., Claims	Snohomish	G.S.C.
†Kemp Ross Co.	Okanogan	Marl
*Kettle River Gold Mining Co.	Stevens	G.S.
†Keystone Lead Mining Co.	Stevens	L. Iron
Keystone Mining Co.	Yakima	Tungsten C.
King Solomon Claims	Okanogan	
†Kittitas Diatomite Co.	Kittitas	Diatomite
†Knob Hill Mines, Inc.	Ferry	G.
†Knowles, M.	Snohomish	C.
*Kromona Mines, Inc.	Snohomish	G.S.C.
Krug Gold & Copper Mining Co.	Stevens	S.C.G.L.
†Last Chance Mine	Stevens	L.S.
*Laycock, J. R., & Associates	Okanogan	G.S.L.Z.
†Leadhill Mines Co.	Stevens	L.
*Lenox Mining & Development Co.	King	G.S.
†Liberty Mines, Inc.	Kittitas	G.
*Lilman Mine	Okanogan	S.G.C.
Little Noisy Mining Co.	Pend Oreille	L.Z.C.S.G.
*Lockwood Property	Snohomish	G. Iron Sulphur
Lombardine, Mrs. Anna & Josephine	Klickitat	C.
Lone Jack	Whatcom	G.
†Lone Pine	Ferry	G.
Lone Pine Surprise (Aurum Mining Co.)	Ferry	G.S.
Lucky Lady, Inc.	Okanogan	G.
Mackinaw Metals Co.	Snohomish	Nickel
Madeline Manganese Mine	Clallam	
*Magma Mines & Metals	Stevens	Z.L.C.G. Molybdenum
†Magnesia Co.	Okanogan	Epsom Salts
†Magnetic Mining Co.	Okanogan	Magnetite
Maloney, John (Cleopatra Mine)	King	G.S. Antimony
†Mammoth Gold Mines Corp.	Whatcom	G.
Manitau Mining & Milling Co.	Yakima	G.S. Iron
Marcus Mining & Milling Co.	Stevens	G.S.
†Mazama Gold Mines Consolidated, Inc.	Okanogan	G.S.
†Melrose Mining Co.	Stevens	G.S.C.
Mercer Mine	Kittitas	G.
Merchant Mine	Snohomish	C.G.S.
*Metaline Contact Mines	Pend Oreille	Z.L.
†Metaline Mining & Leasing Co.	Pend Oreille	Z.L.
*Mexico Claim (Silver Basin Mining Co.)	Stevens	
†Middleport Mine	Stevens	Z.L.G.S.
*Mineral Center Mining Co.	Snohomish	G.S.C.L.
*Mineral Creek Copper Co.	Kittitas	G.S.C.
Mineral Hill Mines, Inc. (See Seven Devils Mine)		
Mineral Mines, Inc.	Snohomish	C.
*Molybdenum Mining Co.	Okanogan	G. Molybdenum
†Monica Mining Co.	Whatcom	G.
Montana Mine	Ferry	G.

†Reported As Producing
*Reported As in Active Development
Inactive

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DIRECTORY OF MINES—Continued

Name	*County*	*Product*
*Monte Carlo Mine	King	G.S. Molybdenum
†Morning Glory Mines, Inc.	Ferry	G.
†Morning Star Mining Co.	Ferry	G.S.C.
†Morris Mine	Kittitas	
Mortenson, Orin A.	Ferry	S.L.C.
†Mother Lode Mine	Okanogan	G.C.L.
Mount Colman Gold Mining Co.	Ferry	G.
Mount Fairy Mining Co.	Pend Oreille	G.S.L.
Mount Saint Helens Consolidated Mining Co.	Skamania	C.
*Mountain Beaver Mine	Okanogan	G.C.
*Mountain Cedar Mine	Snohomish	G.S.C.
†Mountain Daisy Mine	Kittitas	G.
†Mountain Lion Consolidated Mining Co.	Ferry	G.
*Mule Deer Mining Co.	Pend Oreille	G.S.L.
*McDonald, Archie & Donald	Stevens	S.L.
†McKenzie Mine	Okanogan	
†McNally Mine	Ferry	S.L.
†Napoleon	Stevens	Iron
†Neutral	Okanogan	Iron
*New California Mining Co.	Ferry	G.
*New Deal Mining Co.	Benton	G.
*New England Mine	Stevens	L.Z.G. Cobalt
New Light Gold Mine (See Monica Mines, Inc.)		
*Nighthawk Mines, Inc.	Okanogan	G.S.
No Monicker	Okanogan	G.
*Northern Cascade Mines, Inc.	Whatcom	S.L.G.Z.
†Northern Gold Corp.	Okanogan	G.
†Northwest Magnesite Co.	Stevens	Magnesite
†Old Dominion	Stevens	S.L.C.
*Old Gray Mare Mine	Snohomish	
Ore Recoveries, Corp.	Snohomish	G.S.
*Orient-Eureka Gold Mining Co.	Ferry	G.
†Overtop Mining Corp.	Okanogan	G.
†Owasco Mine	Okanogan	G.
*Pacific Mutual Silver Lead Co.	Ferry	S.L.C. Tungsten
*Pacific Nickel Co.	Skagit	Nickel
Pacific Sulphur Mines, Inc.	Yakima	Sulphur
Patterson Mines, Inc.	Ferry	G.S.
Peerless Mining Co.	Kittitas	Chrome G.S.C.
†Pend Oreille Mines & Metals	Pend Oreille	L.S.Z.
*Pend Oreille Premier Co.	Pend Oreille	L.S.Z.
*Pend Oreille Silver Corp.	Stevens	S.
†Peterson Mine	Okanogan	
*Pitney Butte Mine	Stevens	S. Tungsten Molybdenum
*Plamondon Indian Mines, Inc.	Skamania	G. Platinum
*Pocahontas Mining Co.	Skagit	S.L.
†Poland China Mine (See Overtop Mining Co.)		
Polar Star Mining Co.	Lewis & Skamania	Iron C.
†Poor Man Mine	Pend Oreille	L.Z.
Porcupine Mines	Okanogan	
*President Mining Co.	Stevens	
*Primary Gold Co.	Skamania	G.S. Platinum

†Reported As Producing
*Reported As in Active Development
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DIRECTORY OF MINES—Continued

Name	*County*	*Product*
†Queen Seal Mining Co.	Stevens	S.
Quilp Mine (See Eureka Gold Mining Co.)		
†Quincy Products Co.	Grant	Diatomite
Rainbow Mining Co.	Skamania	Vanadium L.C.
†Randle Property (See Mazama Gold Mines Cons.)		
*Reco Gold Mining Co.	Okanogan	G.S.
†Red Shirt Mining Co. (See Cascadian Gold Syndicate Corp.)		
†Red Top Mining Co.	Stevens	S.L.Z.
*Rex Mine	Chelan	G.S.
*Rick, W. D.	Ferry	G.S.
Robinson Mines Co.	King	G.S.C.
†Roosevelt Mine	Stevens	G.S.
*Roy Mining Co.	Lewis	Mercury
Royal Development Co.	Chelan	C.S.
†Ruby Mountain Mining Co.	Okanogan	S.
*Russell & Smith	Skagit	Iron
†Scheel, H. P. & Co.	Skagit	Silica
†Seattle	Ferry	G.
*Seven Devils Mine	Okanogan	G.S.L.
*Shamrock Silver Lead Mine, Inc.	Ferry	S.L.
*Silver Basin Mining Co.	Stevens	S.
*Silver Creek Mining Co.	Kittitas	G.S.
Silver Creek Copper Mining Co.	Snohomish	G.S.
*Silver Key Mines Corp. (Big Chief Group)	Stevens	S.L.
Silver Mountain Mining Co.	Stevens	S.L.
†Silver Queen Mine (Operated by Ark Mine Co.).	Stevens	
Silver Star Mining Co.	Clark	G.S.C.Z.
*Silver Tip Mining Co.	Whatcom	G.S.C.
*Silver Trail Mining Co.	Stevens	S.L.
†Skagit Talc, Inc.	Skagit	Talc Soapstone
*Skrinde, W. E.	Snohomish	G.S.C.
†Sleight & Moon Co.	Stevens	Barite
S. M. P. Mining Co.	Snohomish	G.S.C.L.Z.
Snoqualmie Mining Co.	King	C.I.G.S.L. Molybdenum
†Sonny Boy Mine (Operated by Ruby Mountain Mining Co.)		
*Spokane Molybdenum Mines	Stevens	Molybdenum
Spokane Tin Mines	Spokane	Sheelite, etc.
*Square Deal Claim	King	
†Square Shooter	Whatcom	G.
†State Products Co.	Yakima	Diatomite
†Sterling Zinc Lead Co.	Pend Oreille	Z.L. Iron
*Sultan Basin Mining Co.	Snohomish	G.S.C. Molybdenum
Sultan King Mining Co.	Snohomish	G.S.C. Molybdenum
Summit Gold Mines, Inc.	Chelan	G.
*Sunset Syndicate Corp.	Snohomish	C.S.G.
*Sunshine Chief Mine	Okanogan	G.
†Surprise Lease (Operated by Aurum Mining Co.)	Ferry	G.
*Swauk Mining & Dredging Co.	Kittitas	G.

†Reported As Producing
*Reported As in Active Development
Inactive

G—Gold
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DIRECTORY OF MINES—Continued

Name	*County*	*Product*
*Ten Bells Mining Co.	Whatcom	Placer
*Thomason, R. C.	Stevens	S.C. Iron
*Thompson, Clara Property	Snohomish	C.S. Iron
*Thunder Creek Silver Lead Mines	Skagit	S.G.L. Molybdenum
†Tom Thumb Mine (Operated by Aurum Mining Co.)	Ferry	G.
Treasure Gold Mining Co.	Stevens	G.S.
*Triangle Mining & Development Co.	Cowlitz	
†Triune Mine	Okanogan	G.S.
True Fissure Gold Mines	Kittitas	G.
*Tungsten Corporation, Inc.	Stevens	Tungsten
†Tungsten Products, Inc.	Stevens	Tungsten
*Tyler, Glenn E. Property	Whatcom	G.S.
*United Copper Mine	Stevens	S.C.
Vanguard Metals	Snohomish	G.S.C.
†Van Stone Mine	Stevens	G.S.L.C.
*Walsh, Garrett	Ferry	C. Bornite Silica
Washington Cascade Mining Co.	Pierce	G.S.
*Washington Gold Company, Inc.	Kittitas	G.
*Washington Metals, Inc.	Stevens	Tungsten
*Washington Nickel Mining & Alloys Co.	Chelan	C. Iron Molybdenum
†Webley, E. J., Mines	Grant	Diatomite
*West King Mining Co.	Stevens	G.S.
†Whistler	Whatcom	G.
White Horse Mining Co.	Stevens	C.G.S.
*Wilson, R. W.	Benton	G.
*Young America Mine (See Cuprite Mining Co.)		
Zala M Mining Claims	Ferry & Okanogan.	G.

†Reported As Producing
*Reported As in Active Development
Inactive

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W. P. A. PROJECTS

The Division of Mines and Mining has supervised two W.P.A. projects sponsored by the Department of Conservation and Development. Under one of these projects the records of mining claims were transcribed in the offices of the county auditors of the state, and then assembled for reference in the office of the division. Under the other project investigations of certain strategic minerals are being made, to determine their extent and quality. The primary purpose of this project is to obtain information on minerals, the development and reduction of which will furnish a market for power generated at Grand Coulee and Bonneville, and to obtain information as to geologic structures, formations, etc.

TRANSCRIPTION OF MINERAL CLAIM RECORDS

This project was put into operation early in 1936. From time to time as arrangements could be made workers were assigned to each of thirty-two counties of the state. The number of workers in each county varied from one to four, depending upon the number of claims that had been located

in the county. The essential information in each location notice recorded in the county auditor's office was transcribed and sent to the office of the Division of Mines and Mining, where from two to four workers, assigned for this purpose, classified and typed these records and placed them in form for ready reference.

The results obtained are summarized in the following table:

MINING CLAIMS LOCATED IN WASHINGTON

COUNTY	Date①	Coal	Oil	Mineral	Survey②	Patent③	Total
Adams	1-03	.....	.....	83	.....	.....	83
Benton	4-37	.....	317	354	1	.....	671
Chelan	11-34	14	18	8,794	112	55	8,826
Clallam	5-37	18	2,145	832	.....	.....	2,995
Clark	5-36	8	.....	867	.....	.....	875
Columbia	1-98	.....	.....	17	.....	.....	17
Cowlitz	10-36	.....	.....	503	1	.....	503
Douglas	7-19	.....	.....	242	1	.....	242
Ferry	7-37	3	.....	14,853	427	358	14,856
Franklin	8-93	.....	.....	51	.....	.....	51
Grant	12-36	2	77	370	.....	.....	449
Grays Harbor	10-37	704	302	1,855	.....	.....	2,861
Jefferson	12-36	11	2,239	1,205	4	3	3,446
King	7-37	72	.....	5,755	132	104	5,827
Kittitas	5-38	33	3	12,678	134	90	12,714
Klickitat	10-05	97	33	115	.....	.....	245
Lewis	11-37	54	.....	2,588	3	.....	2,642
Lincoln	6-37	.....	16	980	1	.....	996
Mason	2-37	.....	81	1,147	.....	.....	1,228
Okanogan	7-37	.....	.....	4,404	507	383	4,404
Pend Oreille	7-31	.....	.....	2,960	139	93	2,960
Pierce	12-36	61	21	3,736	23	15	3,818
San Juan	7-06	.....	.....	368	7	4	368
Skagit	1-37	.....	.....	3,787	111	91	3,787
Skamania	10-37	1	.....	2,728	171	105	2,729
Snohomish	7-37	27	2	12,876	557	407	12,905
Spokane	10-37	11	112	543	.....	.....	666
Stevens	10-37	6	37	21,322	282	216	21,365
Thurston	1-37	.....	.....	54	.....	.....	54
Walla Walla	9-34	.....	.....	125	.....	.....	125
Whatcom	6-37	155	1	10,690	84	37	10,846
Yakima	7-37	6	.....	2,142	14	14	2,148
Total	.....	.....	.....	.....	.....	.....	125,702

① Date of last transcription.
② Surveyed for patent.
③ Claims patented.

The seven counties, Asotin, Garfield, Island, Kitsap, Pacific, Wahkiakum and Whitman, not included, are those in which few mining claims have been located.

About 70 persons from relief rolls have been employed on this project, the time of service varying from a few months to the entire life of the project. The amount of federal funds authorized to be spent on the project was $80,199. When the project is completed, about 35 per cent of the amount authorized will have been expended, or about $28,000. The sponsor contributed supervision, some clerical service, use of typewriters, incidental materials, and obtained the cooperation of county auditors and their staffs.

It is recommended that provision now be made to obtain from county auditors mineral claim records as filed. The complete records will then be available for reference at any time in the files of the Division.

MINERAL INVESTIGATION

A W. P. A. project for the purpose of making investigations with respect to certain minerals, sponsored by the Department of Conservation and Development and the Commissioner of Public Lands, was approved and placed in operation in February, 1936. Until March 31, 1937, it was supervised by the Division of Geology. It has been continued, with certain modifications, since that time under the supervision of the Division of Mines and Mining.

The purpose of this project is to investigate the extent and quality of certain minerals on public lands. The investigations have been made chiefly in relation to those minerals, in the mining and reduction of which, large amounts of electrical power will be used. This will indicate a potential market for some of the power to be generated at Coulee Dam and Bonneville, and by other plants both publicly and privately owned. Men trained in geology and mineralogy have been in direct charge of the field work, assisted by men assigned from relief rolls.

Federal funds expended on the project from February 1, 1936, to September 30, 1938, amounted to $167,573. The number of men employed has averaged over one hundred. The sponsors have provided general supervision, and have contributed equipment of various kinds, laboratory supplies, transportation, etc. The counties in which the project has operated have cooperated closely, and have assisted in providing needed transportation, equipment, etc.

PROGRESS OF INVESTIGATION

Progress reports on the investigations are made from time to time, but final reports cannot be made until the project is closed. Then the field work and analyses of samples will be coordinated, and all of the valuable information that has been obtained will be made available to the public. Following is a summary of the work to date:

INVESTIGATIONS IN 1936

Whatcom County—Four complete sections of the Mount Sumas area were investigated for occurrences of dunite, which is the host rock of chromite. This investigation was carried on throughout the year 1936 under the supervision of S. H. Green, with a crew of eleven men.

King County—Geological reconnaissance was carried on in the northeastern part of King county for the purpose of aiding in future prospecting of the area. A crew of 13 men operated from January to May, 1936, under the supervision of the late M. C. Butler, and from June to November, 1936, under the supervision of Frank Klopsic.

Snohomish County—An investigation was undertaken in eastern Snohomish county to check on reports of glass sand, limestone, dunite, feldspar, molybdenum, chromite and to develop further geological information. A crew of 13 men was employed under the supervision of P. E. Crane from January to May, 1936, and under J. O'Connor from May until November, 1936.

Spokane County—An extensive investigation of clays in eastern Spokane county was made. An area embracing approximately 440 square miles was investigated and mapped, and a total of 451 samples of clay was obtained and

analyzed. A crew of 13 men was employed under supervision of F. M. Handy from January to June, 1936, and under Robert Meyer from June to September, 1936.

Pierce County—Geologic conditions and the reported occurrence of gold deposits were investigated in eastern Pierce county near the summit of the Cascades. Eight square miles were thoroughly investigated. On this work a crew of 13 men under the supervision of Amos Slater was employed from January, 1936, until October, 1936.

Clark County—Mineralized dikes in the northern part of Clark county were investigated for geological information and for mineral occurrences. A crew of 13 men under R. S. Penrose was engaged in this work from January to October, 1936.

Ferry County—Two investigations were made in Ferry county. The first covered the limestone deposits in the western part of the county, and the other made a study of fossils in an area near Republic for the purpose of developing important geologic information. A crew of 11 men was employed under the supervision of J. P. Isaacs, from January until June, 1936, and under the supervision of Roy Anderson from June until October, 1936.

Kittitas County—An investigation was made of reported large deposits of diatomite in southeastern Kittitas county. Some time was also spent in the investigation of a reported cinnabar deposit in the northwestern part of the county. A crew of 11 men was employed under the supervision of Paul H. Knowles from January until June, 1936.

INVESTIGATIONS IN 1937

Snohomish County—A large pyrite deposit on state land in this county was carefully investigated, the area mapped and many samples taken. In addition, a reconnaissance of 150 square miles west of Monte Cristo was made to determine general geologic relations with the view to aid future prospecting and mining. There was a crew of 18 men under the supervision of P. E. Crane, and operations were continuous from January to December, 1937.

Skagit County—An investigation was made of a reported nickel deposit in the western part of the county. Three sections of land were covered by this investigation which included development of geologic information. Operations were begun for investigation of iron deposits in Central Skagit county, but were stopped when the project was suspended for a time. A crew of 11 men, under the supervision of P. E. Crane carried on the Skagit county work from January to December, 1937.

Lewis County—Investigation of deposits of coal and cinnabar on state lands was conducted in Lewis county, covering an aggregate of about nine square miles. The work was done by a crew of 23 men under the supervision of J. O'Connor, from June to December, 1937.

Cowlitz County—The report of coal deposits on state land in Cowlitz county was the basis for an investigation by a crew of 15 men under the supervision of J. F. O'Connor, from January to June, 1937.

INVESTIGATIONS IN 1938

Clallam County—As part of the investigations to determine the approximate extent and quality of the manganese deposits on the Olympic Peninsula,

a unit of the project was assigned to Clallam county in March, 1937. Since the opening of the project at least 16 square miles have been carefully examined west of Lake Crescent. A crew of from 40 to 50 has been at work on this area under the supervision of S. H. Green.

Jefferson County—A unit of the project, supervised by S. H. Green, operated for about two months in this county investigating a considerable area in northeastern Jefferson county.

Grays Harbor County—A unit of the project was set up in the Quinault area of this county and has been working since that time investigating manganese deposits. There have been about 30 men in the crew, under the supervision of Amos Slater.

Whatcom County—A crew of 15 men under the supervision of E. J. Dailey, investigated the chromite and dunite of the Twin Sisters area between June and November, 1938. In the northern side of Twin Sisters, 22 miles of the dunite contact was accurately surveyed, and several square miles examined for new chromite deposits, with representative samples taken.

Thurston County—A unit of the project under the supervision of E. J. Dailey, with a crew of about 20 men was engaged in November, 1938, in investigating iron deposits on state land in the Black Hills area. The area is being mapped by means of magnetic dip needle.

FUTURE OF MINING IN WASHINGTON

The mining industry in Washington is on a sound, substantial basis, and an increase in production may be expected each year. It has experienced no boom, but has been developing in a normal manner. It desires no subsidy, nor other special consideration, but there are various services that the state should render in order that the development of our mineral resources may be further stimulated.

It is felt that this is not an unreasonable suggestion because all other basic industries, agriculture, forestry and fisheries, are receiving aid from both State and Federal governments to an extent far out of proportion to the small amount now being given to mining.

One of the most serious obstacles to mineral development, lack of transportation facilities, can be removed by the State, and its political subdivisions, by a comparatively small annual expenditure of funds for the construction of roads. Some of the most highly mineralized areas of the State are practically untouched because of the lack of even crude transportation facilities. Development work would immediately begin on hundreds of promising properties as soon as there was official assurance that roads would be built, and mines would be in operation immediately following actual construction. In view of the fact that the traffic on roads used in mining operations pays a heavy gas tax, such roads would soon pay for themselves. Roads into mineralized areas are urgently needed, and should be provided as quickly as possible. This would be a greater benefit to the State than to individual mine owners.

More rapid advance in mineral development would be made if greater support were given to the matter of investigation, experimentation and research in the field of metallurgy and the general treatment of Washington ores. Good work is now being done by the University and State College, and some exceptional work has been done at the State Electrometallurgical

Laboratory at Pullman by Director A. E. Drucker, and small staff, with the co-operation of the U. S. Bureau of Mines. This laboratory was equipped through a contribution of $10,000 from the Department of Conservation and Development, but this is only a beginning. Better equipment and a larger staff should be provided so that the many problems awaiting solution may be attacked. This is especially important now because of the great quantities of power that will soon be available from Coulee Dam, Bonneville, and the many other public and private hydroelectric plants. The combination of research and cheap power will mean much in the future of Washington mining.

There should be two competent mining engineers attached to the Division of Mines and Mining to act as field men to serve the mining industry, much as the Extension Service of Washington State College and the U. S. Department of Agriculture serves the agricultural industry. In addition to aiding and cooperating with prospectors, small mine owners and operators, these field men would obtain accurate information on mines, mining properties, operations, production, etc. Their service would be invaluable in promoting sound mineral development.

CONCLUSION

The Division of Mines and Mining acknowledges the cooperation it has received from the mining industry in Washington, from prospector and small mine owner to operator, as well as from individuals, groups and organizations interested in mining. Without this cooperation it would not have been possible for the supervisor and his small staff to have obtained much valuable information or performed such service as has been rendered.

The cooperation of the University of Washington in providing use of a part of its chemical laboratory, and of county commissioners, county engineers, and county auditors, is acknowledged as having made possible the successful operation of the W. P. A. projects supervised by the Division.

Dean Milnor Roberts of the College of Mines of the University and Dean A. E. Drucker of the College of Mines and Geology of the State College, and their staffs, have given most helpful advice and service, which has been deeply appreciated.

FLOOD CONTROL

Lars Langloe, Flood Control Engineer

A State Flood Control Policy was established by enactment of chapter 163, Laws of 1935, and its administration delegated to the Director of the Department of Conservation and Development. The act authorizes the director, in cooperation with any agency of the United States, any official agency or institution of the state, and flood control districts and counties acting singly or jointly, to act for the state in the formulation of plans for control of floods and to consider the extent of state participation in such projects as affect the state generally

The formation of flood control districts is authorized by two laws, enacted in 1935 and 1937, respectively. Each provides that the Director of Conservation and Development, with the aid of a commission appointed by the director and at the expense of the state, shall investigate and determine the feasibility and advisability of the creation of any district petitioned for. He shall determine its boundaries and do all other things prescribed or, in his opinion, necessary for the guidance of the electors who, at an election called by the director, shall determine whether or not the district shall be established. No district has yet been formed or petitioned for under the 1937 act. Four districts were established in 1936 under the 1935 act, two of which have remained inactive. The Hoquiam Flood Control District has completed its works, with W. P. A. assistance; the Walla Walla county Mill Creek Flood Control District has made channel improvements under a W. P. A. project, and its major program has been approved as a Federal project and will soon be under construction.

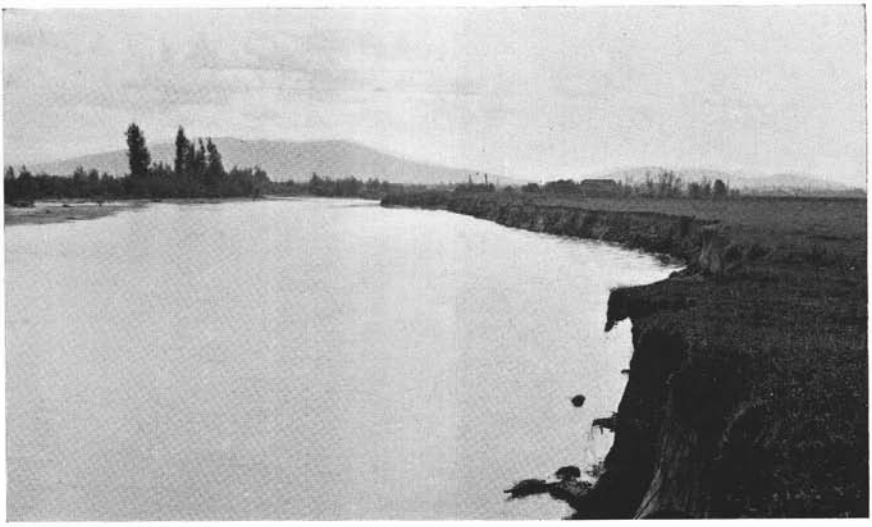
During the past two years, or subsequent to October 1, 1936, substantial progress has been made toward solution of the state's most pressing flood control problems. Since no specific funds for participation in flood control matters were appropriated to the department, its principal activities have necessarily been confined to such assistance as its limited regular staff has been able to render to other agencies of the state and its subdivisions and to those departments of the Federal government actively engaged in flood control work.

As a matter of general public information and record, the activities of the several agencies during the past biennium are here briefly recorded.

EMERGENCY FLOOD CONTROL PROJECTS

The program of emergency flood control work, inaugurated during the previous biennium, has been continued during the past two years by the Federal Works Progress Administration under the immediate supervision of the United States Corps of Engineers. Most of the projects operated under this program were originally planned and set up by the Department of Conservation and Development as related in the Eighth Biennial Report. Many projects were later extended to include additional work.

Streams upon which W. P. A. flood control projects have been supervised by the Corps of Engineers include the Nooksack, Samish, Skagit, Sauk, Stilaguamish, Pilchuck, Snohomish and its two tributaries, the Snoqualmie and Skykomish, Cedar, Green, White-Stuck, Puyallup and Carbon, Deschutes, Chehalis and tributaries, Quinault, Hoh, Dosewallips, Skokomish, Cowlitz, and Lower Columbia rivers, together with several small streams in Clallam county, all in western Washington, and on Mill creek in Walla Walla county.



Bank Erosion on Nooksack River.

Same River Bank Protected by Standard Brush Revetment.
(Pictures courtesy of District Engineer, U. S. Corps of Engineers, Seattle.)

Several minor projects were supervised directly by the W. P. A. Others, such as those on the Yakima river in Kittitas and Yakima counties, were supervised partly by the counties. The King-Pierce inter-county river improvement supervised projects on the Puyallup and Stuck rivers.

The work performed under these projects is of many types. Channel improvements have embodied snagging, cable barriers and bank revetments built of brush mats, rock riprap, wire and rock sausages or timber cribs. Improvements to dikes have involved clearing and grubbing, construction of dike embankments, and the placing of riprap rock on dike slopes as a protection against erosion. Drainage inside of dikes and elsewhere has been improved by excavation of ditches and, in at least five instances, by construction or reconstruction of pumping plants.

As an indication of the work involved in some of these W. P. A. flood control projects as well as for the purpose of recording the accomplishments for future reference, the following are abstracted from the reports of the Seattle and Portland district offices of the U. S. Corps of Engineers, showing quantities involved in work completed in this state under their supervision, as of September 30, 1938: Snagging 565 miles of stream bed; brush revetments, 971,143 square yards; rock revetments, 218,786 cubic yards; log cribs, 2,944 lineal feet; embankment placed in levees and dikes, 2,331,446 cubic yards; culvert pipe placed, 344 lineal feet; drainage canal excavation, 53,392 cubic yards; pumping stations constructed or improved, 5.

The total cost of the works supervised by the U. S. army engineers, including the above major items as well as the numerous minor works and items not shown here, was $3,945,000. The above figures do not include either quantities or cost of the Mill Creek project in Walla Walla county, which has been prosecuted with W. P. A. funds under supervision of the Bonneville district office of the U. S. Corps of Engineers at a total cost, to date, of about $556,000.

These works performed by W. P. A. labor are beneficial and important. They have, among other things, arrested bank erosion and thus saved hundreds of acres of our best soils as well as other valuable property. During the three or four years the program has been in operation, foremen and crews have become well trained in this type of work. Methods and designs have been steadily improved. Labor is the preponderant item of cost. The principal materials in brush-and-willow and in rock revetments, for instance, are generally available close to the work at a minimum of cash outlay; and other materials, principally cement, wire, and steel cable, as well as equipment for excavation and transportation, require outlays in cash, which must be contributed largely by the counties or other sponsors of the projects.

The funds which the sponsors have been able to furnish have been the factor limiting the amount of work accomplished under this W. P. A. program. On many streams where there is an urgent need for prevention of bank erosion and other forms of destruction by flood waters, the inability of local interests to provide sponsor's funds has either limited the work to an insignificant portion of what it otherwise might have been, or else made it impossible to do any work whatever.

In view of the great need for this type of work and the benefits that accrue both locally and to the state at large, it would seem highly desirable

that some plan be devised whereby additional sponsors' funds can be made available so that the W. P. A. may be permitted to engage more extensively in this beneficial and successful part of its program.

The following tabulation, based on official data as of August 31, 1938, shows the amounts expended on W. P. A. flood control projects in the several counties, and the share contributed by the sponsors.

WORKS PROGRESS ADMINISTRATION FLOOD CONTROL PROJECTS BY COUNTIES AS OF AUGUST 31, 1938

COUNTY	Total Expenditures	Sponsors' Expenditures
Clallam	$109,217 06	$28,641 99
Cowlitz	1,138,587 00	100,943 43
Garfield	7,929 75	3,156 56
Grays Harbor	360,490 44	29,404 83
Jefferson	48,144 30	4,194 93
King	471,018 54	134,494 91
Kittitas	29,413 98	8,655 90
Lewis	30,346 11	879 00
Lincoln	3,795 72	595 00
Mason	41,260 76	1,407 07
Pacific	1,067 51	316 75
Pend Oreille	25,969 39	775 23
Pierce	281,190 30	34,819 96
Skagit	443,464 93	62,359 84
Snohomish	1,002,119 78	51,728 93
Thurston	62,134 19	.....
Wahkiakum	29,785 12	850 50
Walla Walla	569,802 96	116,971 00
Whatcom	302,581 56	55,402 84
Whitman	17,293 00	3,815 79
Yakima	114,137 56	8,342 13
Statewide	279,748 68	36,539 00
Totals	$5,369,498 64	$684,295 59

THE FEDERAL FLOOD CONTROL PROGRAM

A project for the improvement of flood conditions on the Lower Stilaguamish River was authorized by Congress and funds for its construction allocated prior to the passage of the Federal Flood Control Act of 1936. The construction work, under the Army Engineers, has been prosecuted and completed during the past biennium. No obligations were assumed by local authorities in connection with this work, except that the State Department of Highways purchased the rights of way necessary for two cut-offs in Cook Slough, a branch of the river which in the past has frequently menaced the Pacific Highway and other valuable property.

The only actual construction work so far accomplished or undertaken under the Federal Flood Control Act involved the improvement of diking and drainage districts along the Lower Columbia River. The estimated cost of projects in this locality, approved in 1936, was $1,325,300. Construction on Cowlitz County Diking Improvement Districts No's 2, 5, 11 and 13 and on Drainage Improvement District No. 1 has been completed at a total cost of $443,360. In Wahkiakum County, work is under way on Diking District No. 1, with an expenditure to date of $42,800. Other approved projects in this area which will presumably soon be under way include Consolidated Diking District No. 1 at Longview and Diking District No. 4 in Wahkiakum County.

At this point special attention is called to the significant fact that these projects, already constructed or about to be undertaken, are all within organized and functioning local improvement districts which are authorized and able to assume the local responsibilities imposed by the Federal Act.

Other projects with definite sponsoring organizations back of them are expected to be placed under construction shortly. The Mud Mountain dam and reservoir, sponsored by the King-Pierce Inter-County River Improvement, is ready to be placed under construction as soon as the final design of dam is approved. The approved Mill Creek project, backed by the Walla Walla County Mill Creek Flood Control District, is expected to receive an allotment of funds for construction from the next Federal appropriation for flood control purposes.

Projects approved by Congress in 1936, but remaining inactive for want of assurance of local participation, include a project on the Upper Puyallup River, the project on the Puyallup River through the City of Tacoma, and the Avon cut-off on Skagit River. Others approved in 1938, for which local sponsorship is still uncertain, include protective works for the cities of Yakima and Spokane.

During the past biennium, under authorization of the Federal Act, preliminary examinations and reports have been made by the United States Corps of Engineers and final surveys subsequently authorized on the Nooksack, Skagit, Stilaguamish, Snohomish, Sammamish, Cedar, Green-Duwamish, Nisqually, Chehalis, Cowlitz, and Yakima rivers. Many of these final surveys are now under way. The recommendations of the district and division engineers for final surveys on the Green-Duwamish and Cedar rivers were for some reason originally disapproved by the Board of Engineers for Rivers and Harbors. At the request of Governor Martin, Director J. B. Fink, together with representatives from the areas involved, made a trip to Washington, D. C., where, at a special hearing before the Engineering Board, they succeeded in gaining approval of the surveys. Preliminary investigations have also been authorized and are under way on the Naselle, Willapa and Colville rivers and on the lowlands along the Columbia River in Clark County below the city of Vancouver.

For the purpose of obtaining the views of local people and other interested parties, many joint public hearings have been held at convenient points by the United States Corps of Engineers and the U. S. Department of Agriculture. The Department of Conservation and Development aided local interests in gathering and presenting pertinent data at these hearings on fourteen important stream systems. Since very limited funds are available to the Federal agencies for these preliminary investigations, they have welcomed such facts and information as this Department, in cooperation with the various local agencies, has been able to assemble and present for their consideration.

The district engineers' preliminary reports have recommended and the Chief of Engineers has approved final surveys of all except one of the streams reported on to date. Final surveys are already under way on many of the rivers, and reports, plans and cost estimates will become available on all the important streams which are subject to severe floods as rapidly as funds for the purpose are made available by Congress.

LOCAL PARTICIPATION IN COST OF FEDERAL PROJECTS

The attainments under the Federal flood control program have so far been most gratifying and speak well for those agencies charged with the administration of the program. The progress made locally toward devising ways and means for meeting the local responsibilities imposed by the Federal Flood Control Act is less satisfactory. As already stated, several projects are approved but allocation of funds for their construction must await definite proof of willingness and ability of local bodies to meet their share of costs. This share for Washington projects already approved by Congress now amounts to $3,565,000.

As amended in 1938, the Federal Flood Control Act would appear to relieve local interests of participation in costs of dams and reservoirs or channel improvements or channel rectification. The effect of this amendment upon our local situation is not yet quite clear. It has been ruled, so we understand, that the provisions of the amendment are not applicable to a project like the Avon cut-off on Skagit River. Even the most liberal interpretation of the present Federal law will, in all probability, require local participation in most projects to the extent of costs of all or portions of rights of way, damages, and maintenance. The extent to which our state is likely to benefit from the Federal program will, no doubt, depend on our readiness and ability to assume the local burden.

Counties are unable to finance the entire program under present taxing laws. The amounts which can be raised by river improvement levies would in most cases prove entirely inadequate. Many counties have never made such a levy, and future levies are likely to be precluded or limited by requirements for mandatory purposes.

The Supreme Court's decision in the case of Weyerhaeuser v. Banker limits flood control districts to the territory directly benefited, thus nullifying the effectiveness of the plan underlying the 1935 Flood Control District Act. The law subsequently enacted by the 1937 Legislature conforms to principles which have been tried and tested in our state and elsewhere, and would enable flood-ridden localities to organize for any flood control purposes, including that of assuming part or all of any burden which may be imposed by a Federal flood control project. To date, no move has been made toward organizing under this law, even in localities where local participation remains the sole obstacle to final Federal action. In view of the benefits which accrue to exposed property when protection is provided by worthwhile flood control works, it would seem reasonable to expect the owners of such property to assume a small part of the cost, as long as the major outlay is provided from public funds. Only through the formation of a local improvement district is it possible to apportion costs equitably among the several benefited property owners.

Diking districts, and in some instances drainage districts, are in a position to contribute to flood control projects which are beneficial to such districts. The local responsibilities imposed by the Federal Act were assumed by eight diking and drainage districts along the Lower Columbia River, and in those districts Federal projects are under way or already completed. Their ability and readiness to assume these responsibilities were the important factors in obtaining prompt approval and construction.

The wide contact which this Department has had with owners of flood-

ridden property reveals a belief, prevalent among many of them, that the State of Washington should bear all or a substantial portion of local costs in connection with Federal flood control projects. Admittedly, comprehensive flood control works, especially in the more important valleys, render substantial benefits of a general rather than special nature. Participation by the State to the extent justified by benefits to its highways and to general commerce and trade would seem reasonable and in conformity with the policy heretofore declared by the Legislature.

To enable our state to gain full benefits from the Federal flood control policy, it would seem necessary for local property owners, through district organization, to join with the counties and the State in assuming the local responsibilities in proportion to the benefits that would appear to accrue to each. We are satisfied that the public must be thoroughly aroused to its responsibility in this respect before the Federal program, now well initiated, can proceed to ultimate consummation.

MAINTENANCE OF CHANNELS AND IMPROVEMENTS

While exact figures are not available, it is known that during the past four or five years more than six million dollars has been expended by various Federal agencies on flood control works in the State of Washington. Of this amount approximately three-quarters of a million dollars has been contributed by the State and its sub-divisions.

The maintenance of works thus constructed within organized assessment districts is generally taken care of. In unorganized territory where the projects were sponsored and the obligation nominally assumed by the counties, maintenance work has been almost entirely neglected. The observations of this Department, as verified by the U. S. Corps of Engineers, reveal that brush bank revetments and other works recently completed in many localities are undergoing gradual destruction because accidental injuries by log rafts, driftwood and other causes receive no attention. Willow plantings which failed to grow have not been replanted, and the brush mats are likely to decay before willows can become established for permanent protection. If this negligent attitude is maintained by the sponsors of the projects and no other provision is made for maintenance, a substantial part of the work accomplished will soon be destroyed. Timely and diligent maintenance is the essence of all river improvement work. The destruction following failure of protective works quite often exceeds the damage which might have been wrought, were nature permitted to take its course in the first place.

The sponsors of W. P. A. projects, in consideration of the benefits to be derived from the improvements made, virtually enter into contracts with the Federal Government to maintain the works after completion. Under these circumstances, county commissioners should keep faith with the government, with the owners of lands directly protected, and with the general public. They should find room within their budgets for a levy sufficient to meet the small amounts necessary for timely maintenance of the Federally constructed works.

Bank erosion is apparently the cause of the major portion of all flood losses in rural areas. Once banks are deprived of their natural protective covering, the destruction continues even at moderate river stages. Almost

without exception the trouble starts from small and apparently insignificant causes such as the up-rooting of a tree on the bank, the gouging of the bank by driftwood, or the deflection of currents by a log jam, often due to negligence of the landowner. Whatever the beginning, if discovered and repaired at once the problem is simple and the cost insignificant. If neglected and allowed to run its course, the situation grows from its small beginning to one that is generally referred to as being "beyond the financial ability of the local property owners." Other forms of flood damage to lands are also quite generally of a progressive character and may be prevented, to a large extent, by systematic and timely minor repairs.

Based upon its state-wide observations, the Department is firmly convinced that systematic patrol and timely maintenance of natural stream channels and of flood control works already constructed should be the first and foremost item in the State's flood control program. Implemented by proper legislation, modest provisions for funds and diligent administration, this policy would save property from destruction and reduce to a minimum future expenditures for flood control purposes. Once a definite and effective maintenance policy is established the State will be in a better position, in cooperation with the Federal Government, to proceed with those larger projects which are now being studied and surveyed and which are so necessary for the protection of life and property and for the general welfare of the state.

Various proposals for legislation along the lines indicated are being studied by the Department and others interested, and it is hoped that constructive suggestions may be presented for consideration by the 1939 Legislature.

GENERAL ACTIVITIES

Fortunately, no major floods have occurred in any part of Washington during the past biennium. That destruction of property by bank erosion and otherwise is nevertheless going on is amply evidenced by the numerous calls upon our office from property owners seeking aid and advice. It is small comfort to these people to be told by us that preliminary or even final surveys have been authorized and that in due time, if all goes well, the Federal Government may protect their property. Not infrequently their answer is that by that time there may be little left to protect.

A major flood such as occurred in December, 1933, and the damage wrought by it in a few short days are spectacular and arouse intense though short-lived general public interest. The slow but persistent, inch by inch, eating away of the river bank by the numerous small freshets which usually recur throughout the rainy and snow-melting seasons is not spectacular, nor does it usually challenge the attention of anyone but the landowner, who helplessly watches his land go down the river.

This Department has made it a uniform practice to respond to appeals for aid with the best advice at its command. Whenever possible, trouble zones are examined on the ground, and occasionally we have been able to suggest simple remedies which have rendered at least temporary relief.

We have also attempted, with modest success, to aid in coordinating the resources and efforts of the many parties at interest. Representatives of the Department have attended and taken part in deliberations at numerous

public gatherings assembled for the purpose of discussing and clarifying objectives, methods and means. Much has been accomplished by these gatherings and by public discussion along unifying and educational lines. Many able and public spirited citizens have devoted much time and energy toward the unification of ideas and the formulation of definite programs of flood control. Our delegation in Congress has effectively placed our most pressing projects in line for participation in the benefits under the Federal flood control program, and the United States Corps of Engineers, through its district and division engineers, is diligently and sympathetically effectuating authorizations by Congress and other Federal authorities in behalf of our problem.

Younger by a year than ours, the Federal program has out-distanced us. But at a certain point short of final accomplishment, the Federal program must stop unless we, locally, do our share. A practical and realistic attitude toward flood control matters is indicated as a profitable policy for our State and its sub-divisions to pursue during the coming biennium.

COLUMBIA BASIN PROJECT

John Brooke Fink, Director

The Columbia Basin Survey Commission was created by the State Legislature in 1919, and commenced a survey of the proposed Columbia Basin project. This was continued after 1921 by the Division of Columbia Basin Survey of the Department of Conservation and Development. For several years immediately prior to 1933, State activities in connection with the project were limited, but in 1933 the Columbia Basin Commission, of which the Director of Conservation and Development is ex-officio chairman, was created and assumed the administration of the State's activities leading up to the actual construction of the dam, power house, and reclamation works, which was undertaken by the Federal Government through its Bureau of Reclamation in the fall of 1934. The 1937 Legislature made no appropriation for the Commission and State activities relating to the project again devolved upon the Department of Conservation and Development, to which $20,000 was appropriated for "Columbia Basin Operations."

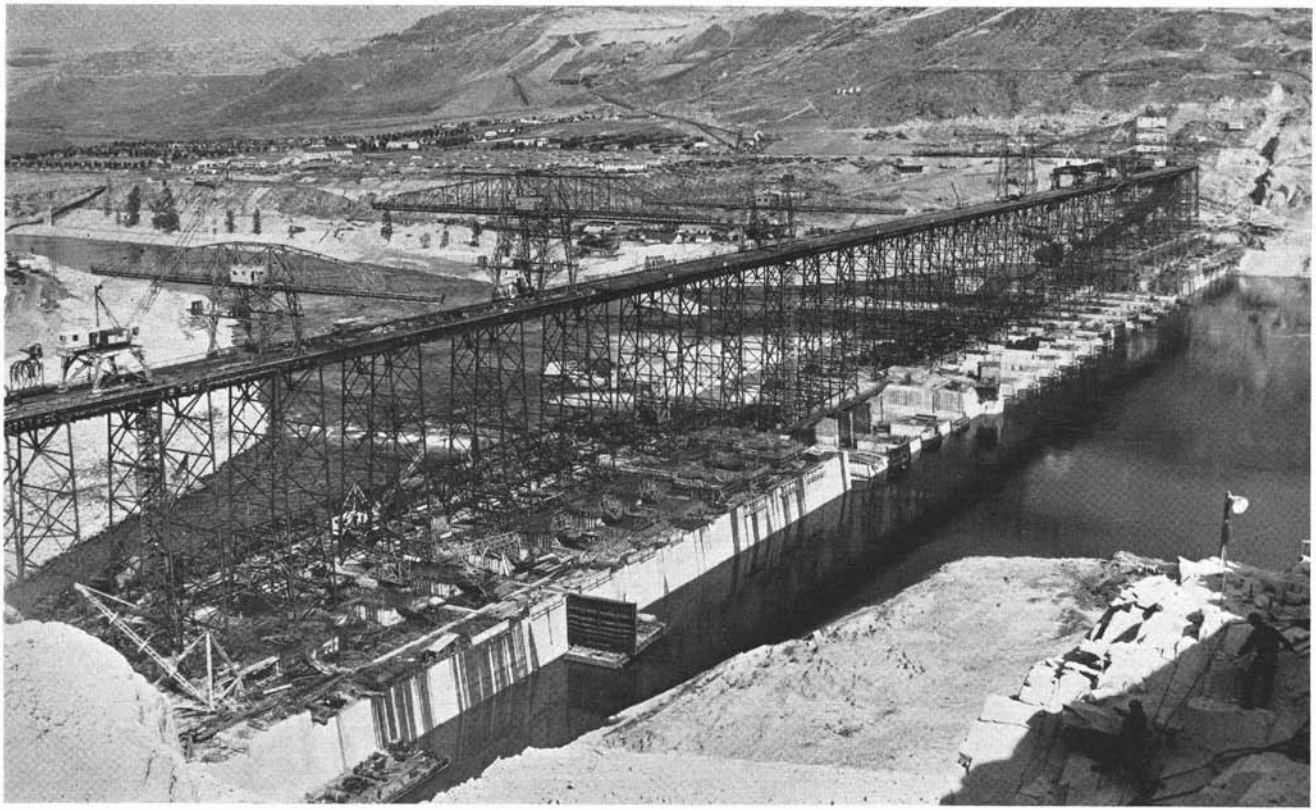
The Department has assisted our delegation in Congress in its efforts to secure adequate appropriations from the Federal Government for the dam, and has also done much, in cooperation with the U. S. Bureau of Reclamation, in connection with the organization of the Columbia Basin area into irrigation districts, as required by the Federal Anti-speculation Act, in order that these districts may contract with the Federal Government for water for irrigation purposes.

The State Government has two primary interests in connection with this development—first, the welfare of the state as a whole and, second, the protection and welfare of the landowners and prospective settlers—and its position has been consistent since the project was first suggested. It has regarded the project as one great development, which it is. The cost is so great that the project could not be undertaken for reclamation alone, and was approved only after it had been demonstrated that some of the power revenues would be applied to the cost of the reclamation works. If the entire construction cost were to be assessed against the lands, the charge would amount to $170 an acre or more, but with approximately one half the cost paid from power revenues, the lands will bear a reasonable construction charge, probably between $85.00 and $90.00 an acre, payable over a period of forty years, without interest.

The heavy costs in connection with the reclamation works are in the pumping plant, the balancing reservoir, and the main canals, all of which must be constructed of a size sufficient to furnish an adequate water supply to the maximum acreage of irrigable land. Therefore, the Federal Government must be committed not only to construct the entire project at its maximum size, but must require that all lands to be irrigated be pledged by contract to repay the costs allocated to them, before any money may be expended on the construction of any of the reclamation works. That is regarded as the only sound business basis upon which the work can proceed.

ANTI-SPECULATION ACT

In connection with the irrigation project, which is but one part of a great undertaking that includes river control, power, navigation, reclamation, and flood control features, we have to consider the conditions laid down by Con-



GRAND COULEE DAM

Upstream face of dam from west abutment, showing steel trestle across dam, constructed during summer of 1938 at cost of $1,000,000. Completed dam will be 130 feet higher than this trestle, which will be buried within it. At far end of dam is concrete mixing plant from which concrete is hauled on flat cars and lowered to the construction by huge cranes. Closure gates are shown in position across diversion slots and another gate is on a barge about to be placed. Sand and gravel supply is shown near top of hill in distance. It is brought down by conveyor belts to mixing house. (Picture courtesy U. S. Bureau of Reclamation, Coulee Dam.)

gress and which must be met before funds can be expended for construction of any of the reclamation works.

The Anti-speculation Act requires appraisal of raw lands on the basis of present worth as dry lands, and sale to settlers at that price. It also provides that water will be furnished to not more than forty acres to a single person.

All of the lands will be appraised and surveyed as to irrigability and soil quality, and water will not be furnished to lands classified as non-irrigable. Surveys are now under way for these purposes and for the canals.

Also, all of the lands to be irrigated under the project must be organized into an irrigation district or districts, in order to contract with the Federal Government for repayment of the costs of the reclamation works allocated to the lands.

The State must ratify and adopt the Anti-speculation Act in so far as any of its provisions come within the scope of State jurisdiction.

IRRIGATION DISTRICT ORGANIZATION

The organization of the entire Columbia Basin area presents problems that have not existed in any previous irrigation district organization. This is due to the size of the area and the dissimilarity of soils, topography, and other conditions on various parts of the project, and to the fact that the reclamation works can be constructed only as rapidly as appropriations are obtained and the lands settled. In the meantime, the districts must be maintained and the costs incident to their administration must, under our present laws, be paid by the landowners. Unless costs of administration are kept at a minimum, their payment over a period of years prior to the time irrigation water is available will work a serious hardship on the landowners, and the possibility of having to pay unreasonable assessments might endanger district organization.

The State recognizes the right of the landowners to organize into irrigation districts, and has provided the method of procedure. However, the statutes provide that the Director of Conservation and Development "may in his discretion advise as to the formation and assist in the organization of reclamation districts under the laws of this state."

In the spring of 1937, at a meeting at Coulee Dam, a statement was made that the next step to be taken in the development of the Columbia Basin project was the organization of the entire area into an irrigation district, in order that the land-owners might enter into contracts with the Federal Government for repayment of the costs apportioned to the reclamation project. In July, 1937, at a meeting called at Ephrata, the sponsors of the meeting proposed to have petitions signed for immediate organization of the entire project into one district. The Department advised against hasty action on the grounds that the landowners on the various parts of the project should be given an opportunity to learn all the facts and conditions in order that a favorable vote might be assured, that consideration should be given to the various problems which would arise due to different conditions in various sections of this huge area, and that immediate action without previous consideration of the questions and problems which would be raised might result in a serious set-back to the project. It was, therefore, agreed that a committee be appointed representing the landowners, and that the

matter of organization be referred to this committee. A committee of five was appointed, representing the communities of Stratford, Ephrata, Quincy, Othello, and Pasco, and it was the duty of this committee to canvass the situation with respect to organization, and to make recommendations.

The committee held public meetings with landowners at Neppel, Quincy, Warden, Lind, Connell, and Pasco, which were attended by representatives of the Bureau of Reclamation and the Department of Conservation and Development. As a result of these meetings, the committee found as follows:

1. That, because of widely differing conditions in different sections of the project, there should be at least two districts, rather than one, as previously suggested.

2. That the irrigation district laws should be amended to provide for director divisions within large districts, to insure representation for all sections of such districts on the board of directors. Otherwise, due to the size and present sparse population on large portions of the area, it would be possible for all of the directors to be elected from one populous community, leaving the remainder of the district without direct representation.

3. That a law should be enacted limiting annual assessments by irrigation districts on the projects to not more than two cents an acre until water is available. Because of the size of the project, some sections will not receive water for many years, but under our present laws, when they are organized into irrigation districts, all of the lands will be subject to annual assessments up to one dollar an acre. Such a situation might raise doubts in the minds of the landowners as to the advisability of being in a district, particularly those whose lands will probably not receive water for many years.

It was therefore agreed by the landowners' committee, with representatives of the Bureau of Reclamation and the Department of Conservation and Development concurring, that it would be inadvisable to attempt organization of any of the Columbia Basin irrigation districts until the State Legislature enacts these amendments and passes a law confirming, ratifying, and approving the Federal Anti-speculation Act. This conclusion was reached after discussion from which it appeared that actual development of the project would probably be advanced, rather than retarded, by postponement of district organization until these various measures are enacted.

If organization of districts over the entire area is begun early next spring, the entire area no doubt can be organized and approved by the courts by the end of the year, and the districts will be in a position to enter into the necessary contracts. Under this plan, the landowners will be protected from excessive assessments before water is available, all parts of the district will be represented by reason of subdivision of the districts into director divisions, and the State and landowners will be assured that the district organization will meet the requirements of the Fedral Government and that provisions of the Anti-speculation Act will have been complied with.

The Department of Conservation and Development will render all possible leadership, assistance, and cooperation in the orderly organization of the districts, and will render such other assistance to the project, in matters relating to soil surveys, settlement, etc., as its funds will permit. To this end, an adequate appropriation is sought for Columbia Basin activities during the coming biennium.

GRAND COULEE DAM ACTIVITIES

Following is a resume of Grand Coulee dam activities during the period from January 1, 1937, to September 30, 1938. Activities prior to 1937 are outlined in reports of the Columbia Basin Commission:

Engaged in building the foundation for the Grand Coulee Dam, Columbia Basin project, the Mason-Walsh-Atkinson-Kier Company on January 1, 1937, had progressed well beyond the half-way mark. Fifty per cent of the contract time had elapsed, and sixty-nine per cent of the contract was completed. Major items of work remaining were the completion of cross-river cofferdams, foundation excavation amounting to approximately 2,500,000 cubic yards, and placement of nearly 2,700,000 cubic yards of concrete.

Major Events of the Two-Year Period. With the exception of a cold-weather shutdown during January and February, 1937, the contractors carried on an intensive construction program which did not stop until their contract was completed on March 21, 1938, one year and 12 days ahead of schedule. On February 7, 1938, a contract for the completion of the Grand Coulee dam, the left power house, and the foundation for the pumping plant was awarded to the Consolidated Builders, Inc., on their bid of $34,442,240. The incorporation is made up of the following firms:

Silas Mason Company, New York, New York;
Walsh Construction Company, Davenport, Iowa;
Atkinson-Kier Company, San Francisco and San Diego, California;
Henry J. Kaiser Company, Oakland, California;
McDonald & Kahn Company, San Francisco, California;
Utah Construction Company, Ogden, Utah;
Morrison-Knudsen Company, Boise, Idaho;
J. F. Shea Company, Portland, Oregon;
General Construction Company, Seattle, Washington;
Pacific Bridge Company, Portland, Oregon.

Closure of the M. W. A. K. Company contract and authorization for the C. B. I. to proceed involved the transfer of certain items of unfinished work, which was accomplished by the issuance of orders for changes in both contracts. The M. W. A. K. Company construction plant, transmission line, and camp were purchased by the Government and transferred to the C. B. I., as provided in the specifications. The Government also took over, and reserved for its own use, a section of Mason City which contained 59 houses. These transactions cleared the way for the C. B. I. to commence work, and that company immediately began rehabilitating the construction plant and camp preparatory to entering into a heavy construction program in the fall of 1938.

Other important contracts awarded during 1937 and 1938 are as follows:

Bulkhead gate and bulkhead gate frame and track assemblies for outlet works—American Bridge Company, Denver, Colorado; Trashrack metalwork for outlet works—A. J. O'Leary and Son Company, Chicago, Illinois; Steel penstocks and pump-inlet pipes—Western Pipe and Steel Company, San Francisco, California; Three generators, 108,000 kva—Westinghouse Electric and Manufacturing Company, Pittsburgh, Pennsylvania; Two hydraulic turbines, 14,000 h. p.—Pelton Waterwheel Company, San Francisco, California; Two generators, 12,500 kva—Westinghouse Electric and Manufacturing Company, Pittsburgh, Pennsylvania; Two oil pressure governors—Woodward

Governor Company, Rockford, Illinois; Liners for 102" conduits—Puget Sound Machinery Depot, Seattle, Washington.

Specifications No. 786 covered three 150,000 h. p. hydraulic turbines and governors for the first three generating units.

Construction Facilities. During 1937, the Mason-Walsh-Atkinson-Kier Company made no significant changes in construction plant or equipment. The conveyor system for excavation was used until April, 1937, when most of the common excavation work was completed. The sand and gravel plant with its 4⅛ miles of conveyor system continued in use. The plant was equipped to handle raw material at the rate of 2,500 tons per hour and to process and deliver finished aggregates at the rate of 1,250 tons per hour. Two mixing plants, one at each end of the dam, were designed to manufacture a total of 15,000 cubic yards of concrete per day. Nine storage silos of 5,000-barrel capacity each and two silos for blended cement, together with blending apparatus and pumps capable of delivering cement at the rate of 1,200 barrels per hour, were provided. Concrete was delivered by railroad over steel trestles that spanned the site of the dam. Mammoth cranes handled materials and concrete for placement in the structure. The contractor also owned a 30-mile, 110,000-volt transmission line and a construction camp (Mason City) for 3,000 people. Specifications provided that the Government purchase, at the expiration of its contract, certain of the M. W. A. K. Company construction plant and its camp, and that the same be made available to the C. B. I. Equipment not included in the transfer was acquired by direct purchase from the M. W. A. K. Company by the Consolidated Builders, Inc., which thereafter launched a program of repair and replacement that occupied the spring and summer months of 1938.

Placing Trestle. Upon completion of the base of the dam, the trestle used by the M. W. A. K. Company was no longer useful for continuing construction to higher levels; and, consequently, the C. B. I. prepared plans for a higher trestle (deck elevation 1180). A subcontract for furnishing steel, and for fabricating and erecting the trestle, was awarded to the Bethlehem Steel Company. This company commenced erecting the structure on June 13, 1938. In the meantime, the C. B. I. had dismantled what remained of the old trestle. The new trestle is 3,600 feet long, 180 to 220 feet high, and 43 feet wide; and it contains 8,990 tons of structural steel. On its deck are rails for traveling gantry cranes, and four standard gauge railroad tracks. The structure was completed on September 12, 1938.

Cranes and Auxiliary Transportation Equipment. Equipment used for transporting and handling materials and concrete was thoroughly overhauled by the C. B. I., and much new equipment was added. The Colby Steel and Engineering Company received from C. B. I. a contract for building three larger and improved gantry cranes, and for enlarging the four cranes used by M. W. A. K., makin a total of seven double-cantilever type cranes—four 319 feet wide, and three 356 feet wide. Three whirley-type cranes were mounted on high gantry frames for service on the construction trestle.

At the westerly end of the dam, the contractor has built an inclined transfer track for lowering loaded railroad cars from the construction railroad (elevation 1310) to the trestle deck (elevation 1180). Its use is expected to facilitate greatly railroad deliveries to the dam.

Aggregate Plant. Under the operation of the M. W. A. K. Company, the aggregate plant produced 8,299,615 tons of finished aggregates. Raw materials excavated in the gravel pit, during about 2½ years of operation, totaled approximately 9,000,000 cubic yards. After a brief period of operation by Consolidated Builders, Inc., the plant was closed for a complete overhauling to put it in shape for producing another 11,000,000 tons of sand and gravel. The original dewatering system in the aggregate plant was abandoned, and in its place was built a sand classifier plant in which all equipment used for separating sand and water and for processing sand was housed in one building. In it were installed three new Dorr hydro-separators and the three Dorr sand classifiers which had been formerly used. Scales for weighing sand as it moved out on belt conveyors were added, and other facilities for blending sand were improved. Heavier and more efficient screening machinery was installed in the screen house, and the entire conveyor system was rebuilt. The main delivery conveyor from the gravel plant to stock piles near the mixing plant was reconstructed in one unit 4,968 feet long, and the unloading tripper was raised five feet so as to provide greater storage capacity for aggregates.

One of the first jobs undertaken by the C. B. I. was the dismantling of the suspension bridge and conveyor formerly used for transporting aggregates and cement across the river. This bridge had been one of the outstanding features of the construction plant, but having served its purpose it was removed prior to the high-water season of 1938.

The Brett gravel pit was opened at a lower level (elevation 1650), and new 25-yard dump carts were put in use. Shovel dippers were increased from 5-yard to 7-yard size, and a giant crusher for breaking boulders was installed in the pit.

Intermittent operation began in August, 1938; and by October, the plant was running quite satisfactorily.

Concrete Mixing Plants. Under the Mason-Walsh-Atkinson-Kier system, one concrete mixing plant was located on each side of the river. Known as Eastmix and Westmix, they produced all of the concrete for the M. W. A. K. contract, and under slightly different conditions are destined to manufacture nearly 6,000,000 cubic yards of concrete for the Consolidated Builders, Inc. The new layout combines the two plants in one at a new location on the east side of the river at elevation 1130. The new contractors graded the new site, dismantled both mixing plants, and rebuilt them at the new location. Practically all of the former M. W. A. K. equipment was thoroughly overhauled before rebuilding the mixing plants. Construction of the new plants progressed rapidly, and by October 1, 1938, they were in full time operation.

Shops and Storage Yard. The area directly north of the mixing plants was graded and laid out for shops and storage yard. Railroad spurs were built from the yard to the construction trestle, and temporary shop buildings were constructed. Included in this group were a porous drain tile manufacturing plant, and a sand drying plant. This work was completed in the late summer of 1938, and the tile plant began operating in August.

River Diversion Undertaken by M. W. A. K. Near the close of 1936 the M. W. A. K. Company undertook construction of the cross-river cofferdams, which was the final and probably most difficult stage of the entire river control program. Construction of these structures proceeded rapidly and

without unusual incident. They were made up of heavy timber crib pockets, built in sections, floated into place, loaded with gravel for sinking to the river bed, and then faced on the river side with steel sheet piling.

On March 17, 1937, a leak developed near the extreme west end of the downstream cross-river cofferdam. Developing in a few days into a flow of 30,000 g. p. m., the leak undermined a cofferdam cell causing it to collapse. For a time, the flooding of the entire enclosure as well as the undermining of the central conveyor tower foundation was threatened. However, a disastrous delay in construction was averted by the prompt and vigorous action of the contractor. All possible methods and equipment were pressed into service. Working at top speed for two weeks, the contractor succeeded in plugging the leak, and the crisis was safely passed. Repair cells and drainage wells were constructed; and, thereafter, no further trouble was experienced. A summary of materials used by M. W. A. K. in cofferdam construction shows the magnitude of the job:

Steel piling	18,606	tons
Miscellaneous steel	2,822	tons
Lumber	18,500,000	f. b. m.
Fill material	1,502,735	cu. yds.
Excavation	1,328,735	cu. yds.
Contractor's reported cost	$5,864,177.32	

Removal of the cross-river cofferdams was started in July, 1937. The contractor was busily engaged on this phase of work up to the completion of his contract in March, 1938. While the cross-river cofferdams were in place, the river flowed through diversion channels in that part of the base of the dam which had been built inside the west cofferdam. Following the high-water season of 1937, the M. W. A. K. Company completed placement of concrete in the four diversion slots. For this purpose, the contractor constructed four wooden closure gates, each 54 x 52½ feet in size and weighing 150 tons. Two gates were built upstream and two downstream at convenient locations on the east bank. When completed, they were launched and floated into position; the upstream gates blocked the entrance of the diversion channels and the downstream gates closed off the outlets. The slots were then pumped out, and concrete was thereafter placed to final contract height.

While it is expected that the handling of the river will present no major difficulties to Consolidated Builders, Inc., they are confronted with the problem of closing off diversion channels without undue delay and as frequently as desired. Already built and in use are eight 70-ton, steel closure gates which are more easily placed than the former M. W. A. K. Company wood units. To date, they have proved quite satisfactory, and apparently they are capable of meeting all requirements.

Excavation. With the exception of one deep ravine in the east-side foundation rock, which required excavation to elevation 761.5 (about 200 feet below river level), no major difficulties were encountered by the M. W. A. K. Company. At the end of their contract, a total of 17,177,042 cu. yds. of all classes had been removed.

Under the contract with C. B. I., excavation will be mainly rock work, of which the pumping plant foundation and pumping plant discharge tunnels will require the most excavation. On October 1, 1938, excavation by C. B. I. had amounted to 334,130 cu. yds.

Concrete Placing. Concrete placing operations were at their peak during 1937, beginning in March, and continuing until January 10, 1938. During that period, the M. W. A. K. Company placed 2,664,377 cu. yds. of concrete, or an average of approximately 9,000 cu. yds. per day. A world's record of 15,844 cu. yds. was made on August 28, 1937, which to date has not been broken. During their contract, the M. W. A. K. Company placed 4,524,209 cu. yds. of concrete. The new contractor placed a small amount of concrete in the spring of 1938, and has just recently started on an intensive concrete placing program. To October, 1938, the Consolidated Builders, Inc., have placed 135,538 cu. yds. of concrete.

Penstocks and Pump Inlet Pipes. On January 3, 1938, the Bureau awarded a contract to the Western Pipe and Steel Company, of San Francisco, California, for steel penstocks and pump inlet pipes. The work included furnishing materials, and fabricating and installing 16,546,000 pounds of steel, made into: eighteen, 18-foot diameter, main unit penstocks; three 6-foot diameter, station service penstocks; and twelve, 14-foot diameter, pump inlet pipes. For this work the company bid $1,456,624, and they acknowledged the Government's notice to proceed on March 4, 1938. In the next four months the contractor built a fabrication plant at Electric City, approximately two miles from the dam. The plant contains the most modern equipment available for welding heavy plate steel, together with X-ray equipment for examining welds. Standard machinery for mechanical strength testing, and special equipment for hydraulic pressure testing of finished pipe are included. The plant began operating in July, 1938, and good progress has been made in the manufacture of pipe.

Migratory Fish Control. On April 3, 1937, the Bureau of Reclamation and the Department of Fisheries, State of Washington, entered into an agreement whereby the State of Washington contracted to carry out the necessary experiments, investigations, and surveys to determine the best means of protecting and of continuing the propagation of migratory fish. This work was completed and a report submitted to the Bureau in January, 1938. The general plan adopted is to trap the fish at Rock Island dam and transport them to a main hatchery located at Leavenworth, Washington. Other small hatcheries at suitable locations on near-by tributary streams are also suggested. Designing and planning for the fish control project is being done in the Denver office of the Bureau of Reclamation.

Columbia River Reservoir Area Surveys and Land Appraisal. All surveying work in connection with locating the reservoir boundary and retracing property lines was completed in May, 1937. This work was in progress about three years, and involved both geodetic and plane surveying on a large scale. Precise triangulation networks, covering nearly 4,000 square miles, were surveyed, approximately 600 miles of reservoir boundary were traversed, and thousands of property corners established.

Highway and railroad relocation surveys have been in continuous progress since January 1, 1937. The purpose of this work is to relocate sections of roads and railroad which will be inundated. To date, surveys and plans have been made for relocating 86 miles of primary highway and 55 miles of secondary roads, as well as 30 miles of the Great Northern Railroad branch line.

Land appraisals in the Columbia River Reservoir area were, in general, completed by January 1, 1937. Of the property to be acquired, there are approximately 18,300 acres of Indian land, 6,800 town lots, and 52,000 acres of other land. By October 1, 1938, exclusive of Indian lands, about 70 per cent of the acreage and town lots required had been purchased, involving an expenditure of nearly $1,500,000.

Clearing of the reservoir area has been set up as a Works Progress Administration project. Under this plan, labor is to be furnished by the W. P. A., wih the Bureau of Reclamation providing equipment and materials. No clearing work has been performed to date, but the administration personnel has been appointed, and plans for the work are developing rapidly.

Economic Surveys in the Columbia Basin Irrigable Area

Engineering. Engineering surveys, including retracement of property corners, monumenting, and topographic mapping within the proposed irrigation area of the Columbia Basin, were started in the fall of 1935, and have been carried on continuously since that time. As of October 1, 1938, topographic mapping has been completed over 948,710 acres. The section covered is approximately the northern half of the irrigable area. Retracement and monument work has been completed over nearly 1,500,000 acres.

Land Classification. A general land classification program was started in August, 1937, the purpose of which is to classify all project lands with reference to their adaptability to agriculture and irrigation farming. The arable lands will be divided into three classes based upon standards adopted by an advisory committee on land classification. Field investigations include soil tests on each 40-acre tract to determine its texture, depth, and chemical composition. The topography of each tract is considered in relation to the application of water and to leveling required. Drainage conditions are also reported. To date, favorable progress has been made, with 402,315 acres classified.

Land Appraisal. Land appraisal in the Columbia Basin irrigable area was started in August, 1938. Values will be determined after a comprehensive study of the subject has been made, with a view to establishing fair values for raw lands of various classes. Improvements as well as raw land will be appraised. The purpose of the appraisal is to establish values whereby the provisions of the Anti-Speculation Act, which was passed by Congress on May 27, 1937, may be carried out. To date, 8,520 acres have been appraised.

Improvements in Government Camp. Improvements included two tennis courts and a modern swimming pool built by C. C. C. forces in the recreation area.

In June, 1938, two leases of sites for commercial purposes were approved. One was for a restaurant concession which was awarded to Mr. C. D. Newlund who erected a modern restaurant building and opened it for business on August 29, 1938. The other lease was with Standard Oil of California which constructed a $12,000 service station.

The Bureau of Reclamation took over 59 houses in Mason City, the change of ownership taking place March 21, 1938. Soon thereafter, government forces repainted and reconditioned the houses for occupancy by government employees.

Major Improvements in Mason City. When Consolidated Builders, Inc., took over the Mason City town site in March, 1938, they immediately launched an extensive rebuilding program. The theatre, hotel, restaurant, and general store were renovated and enlarged, and all camp buildings were repainted. A new high school building, new service station, several private residences, and a new gymnasium were built during the summer months.

General landscape improvements, including a small park about the gymnasium, have so greatly improved the appearance of the town site that it little resembles the usual type of construction camp.

Future Work. The principal contracts for completion of the dam, left power house, and foundation for the pumping plant, together with penstocks and machinery for three main and two station service power units have either been awarded or are in the planning stage, preparatory to an early call for bids. The general program looks forward to completion of the dam, power house, and first units in 1942.

Construction of the dam will have reached such a stage in 1939 that water will be backed up in the reservoir area, thus calling for the clearing of some reservoir lands and the construction of some sections of roads and railroads to replace others which will be inundated. The clearing work has already been launched as a W. P. A. project to be carried forward vigorously. Preliminary studies of the road and railroad program are practically completed, and construction work is to be carried out in cooperation with the Washington State Highway Department and Great Northern Railway Company.

The higher dam also presents the problem of caring for migratory fish during the next year. Plans for fish trapping works to be constructed at the Rock Island dam, 13 miles below Wenatchee, Washington, and a hatchery at Leavenworth, Washington, are moving forward rapidly, and sufficient facilities will be ready to handle the next salmon run.

Engineering and geological investigations in the Grand Coulee reservoir area, together with economic surveys in the Columbia Basin irrigation area, will be continued to the fullest extent possible.