State of Washington
ARTHUR B. LANGLIE, Governor

Twelfth Biennial Report

of the

Department of Conservation and Development

October 1, 1942 -- September 30, 1944

ED DAVIS
DIRECTOR

OLYMPIA
STATE PRINTING PLANT
1944

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LETTER OF TRANSMITTAL

DEPARTMENT OF CONSERVATION AND DEVELOPMENT

Olympia, Washington, October 21, 1944.

To His Excellency, Arthur B. Langlie,
Governor of the State of Washington.

Sir:

There is submitted herewith, pursuant to law, the Twelfth Biennial Report of the Department of Conservation and Development, covering the period from October 1, 1942, to September 30, 1944.

Respectfully,

ED DAVIS,
Director.

INTRODUCTION

During the past biennium the Department of Conservation and Development has sincerely endeavored to assist the war effort in every way possible and at the same time to carry on its regular duties. As a result our activities have been greatly increased. Due to the natural shortage of help in war times, the entire personnel has worked many long hours at their tasks, for which the Director is deeply appreciative. We are proud of our record, briefly conveyed herein.

DIVISION OF RECLAMATION

LARS LANGLOE
Department Engineer

Operations during the past report-biennium have been confined to the routine management of the reclamation revolving fund. Men and materials have not been available to reclamation districts except for emergencies. Replacements and betterments have, therefore, had to be deferred and the customary demands upon the reclamation fund for loans for those purposes have been virtually absent.

The satisfactory financial condition reported to be prevalent in the majority of State-financed reclamation districts two years ago has continued during the past biennium. Not only have these districts generally met their obligations promptly, but many of them have retired substantial amounts of obligations ahead of maturity dates. This is partly responsible for the very substantial decrease in investments and the corresponding increase in uninvested cash. The favorable cash position of the reclamation revolving fund will stand the State well in hand as soon as conditions permit reclamation districts to undertake necessary but long-deferred replacements and improvements to their systems. Many districts are now accumulating funds for this purpose and may require little, if any, credit; others, though financially sound, have for various reasons been unable to accumulate the necessary reserves for post-war needs. To them loans from the reclamation fund may be made available promptly and without the delays incident to private financing. In due course the department may then dispose of these credits to private investors where the securities of developed, sound reclamation enterprise properly belong.

As reported two years ago, several of the State-financed districts appear to be, for various reasons, unable to meet their obligations to the reclamation revolving fund. Adjustments are inevitable, not only for the benefit of the enterprises involved, but also in order to remove the cloud resting over reclamation enterprise and credit as a whole by reason of the defaulting few. Adjustments have been deferred during the past two years in the belief that they can be more equitably made when we again return to times more normal than the present.

The rapidly increasing practice of supplemental irrigation west of the Cascade Mountains is, in certain localities, creating water supply problems requiring early study and solution. Withdrawal of any considerable quantities of water from the limited natural summer flow of many of our west-side streams is detrimental to and may often totally destroy game fishes as well as important runs of migratory food fishes.

Since it is necessary, in the public interest, both to preserve our food and game fisheries and to facilitate supplemental irrigation, the department proposes to undertake thorough surveys and studies of critical streams and areas in order that interested State agencies may jointly work out plans for the conservation and harmonious use of their waters. Requests for funds for this purpose will probably be made of the coming legislature.

THE RECLAMATION REVOLVING FUND

The following statement of assets and liabilities of the reclamation revolving fund gives values as of September 30, for both 1942 and 1944:

ASSETS AND LIABILITIES OF RECLAMATION REVOLVING FUND
September 30, 1942, and 1944

	1942	*1944*
Assets:		
Cash on hand with State Treasurer	$212,784.77	$474,329.50
Cash on hand with Peoples National Bank of Washington, Trustee	191,358.88	304,324.98
Total Cash	$404,143.65	$778,654.48
Bonds on hand, book value, with State Treasurer	$1,702,079.56	$1,450,071.55
Bonds on hand, book value, with Peoples National Bank of Washington	749,449.38	597,066.05
Total Bonds, book value	$2,451,528.94	$2,047,137.60
Advances to reclamation districts (against future delivery of bonds)	$184,879.32	$171,845.20
Sub-total (cash, bonds and advances)	$3,040,551.91	$2,997,637.28
Miscellaneous book assets	33,714.38	33,714.38
Total Book Assets	$3,074,266.29	$3,031,351.66
Liabilities:		
Collateral trust bonds outstanding	$218,000.00	$89,000.00
Net Book Value of Reclamation Revolving Fund	$2,856,266.29	$2,942,351.66
Net gain, September 30, 1942, to September 30, 1944		$86,085.37

The cash held in the state treasury, when appropriated for the purpose, may be invested in reclamation district securities. Cash held by the Peoples National Bank, Seattle, as trustee for the collateral bond issue is surplus accumulated from interest on and redemption of bonds deposited as collateral. None of it can be withdrawn prior to final redemption of collateral trust bonds on September 1, 1947.

The bonds owned by the reclamation fund, including those held by the trustee and marked with asterisks, are listed as follows:

RECLAMATION DISTRICT BONDS OWNED BY DEPARTMENT
September 30, 1944

District	*Interest Rate*	*Par Value*
Agnew Irrigation District (Issue A)	4%, 3%, 2%	$41,600.00
Agnew Irrigation District (Issue B)	4%, 3%, 2%	3,960.00
Agnew Irrigation District (Issue C)	4%, 3%, 2%	2,380.00
* Cascade Irrigation District	3%	40,000.00
Chelan Falls Irrigation District	4%	23,000.00
* Cline Irrigation District (Issue A)	4%	12,300.00
Columbia Irrigation Dstrict	2%	3,500.00
Cowlitz County Diking Improvement District No. 5	4%	17,500.00
Cowlitz County Diking Improvement District No. 11	4%	8,500.00
Cowlitz County Diking Improvement District No. 11, Sub-district A	4%	4,500.00
Cowlitz County Diking Improvement District No. 13	4%	18,000.00
Cowlitz County Diking Improvement District No. 15	4%	24,000.00
First Creek Irrigation District	2%	9,500.00

District	*Interest Rate*	*Par Value*
Franklin County Irrigation District No. 1	5%	3,536.55
* Grandview Irrigation District	2%	5,000.00
Grays Harbor County Diking and Drainage Improvement District No. 4	4%	38,000.00
* Hutchinson Irrigation District	5%, 4%, 3%, 2%	12,000.00
* Icicle Irrigation District	2%	152,100.00
Kennewick Irrigation District	1¼%	234,700.00
King County Drainage and Irrigation Improvement District No. 12	4%	3,500.00
King County Drainage District No. 14	5%	640.00
* Kiona Irrigation District	2%	12,500.00
Lake Chelan Reclamation District (Third Issue)	1%	100,000.00
Lake Chelan Reclamation District (Fourth Issue)	1%	118,000.00
Lake Chelan Reclamation District (Fifth Issue)	2%	153,000.00
Larrabee Irrigation District	4%	8,000.00
Lewis-Thurston Counties Joint Drainage Improvement District No. 7	4%	400.00
Methow Valley Irrigation District	2%	72,000.00
Oroville-Tonasket Irrigation District	2%	258,000.00
Oroville-Tonasket Irrigation District	2%	60,000.00
* Otis Orchards Irrigation District	2%	17,000.00
* Outlook Irrigation District (1933 Issue)	2%	10,125.00
Outlook Irrigation District (1939 Issue)	4%	1,000.00
* Pasadena Park Irrigation District	4%	14,400.00
* Snipes Mountain Irrigation District (1932 Issue)	1%	11,250.00
* Snipes Mountain Irrigation District (1934 Issue)	2%	2,500.00
Snipes Mountain Irrigation District (1934 Issue)	2%	1,500.00
Snohomish County Diking District No. 1 (1932 Issue)	1%	13,000.00
Snohomish County Diking District No. 1 (1934 Issue)	2%	20,000.00
Snohomish County Diking District No. 2	2%	855.00
* Stemilt Irrigation District	1¼%	71,400.00
* Sunnyside Irrigation District	1%	77,000.00
* Wenas Irrigation District	2%	13,100.00
Wenatchee Reclamation District, Local Improvement District No. 1	4%	1,400.00
* Wenatchee-Chewawa Irrigation District	2%	7,500.00
Wenatchee-Chewawa Irrigation District	2%	500.00
* Wenatchee Heights Reclamation District	2%	69,000.00
White Salmon Irrigation District	1%	4,500.00
Whitestone Reclamation District	1%, 4%	40,000.00
Wolf Creek Reclamation District	2%	23,500.00
* Yakima County Drainage Improvement District No. 3, Sub-district No. 7	4%	17,500.00
* Yakima County Drainage Improvement District No. 3, Sub-district No. 8	2%	6,200.00
* Yakima County Drainage Improvement District No. 35	2%	15,000.00
* Yakima County Drainage Improvement District No. 41	2%	4,599.38
* Yakima County Drainage Improvement District No. 43	2%	6,625.00
* Yakima and Benton Counties Joint Drainage Improvement District No. 1	4%	21,500.00
Yelm Irrigation District (1933 Issue)	2%	137,600.00
Total		$2,048,670.93 †

† Note difference between the "par value" and the "book value" is $1,533.33.

Advances to reclamation districts represent sums advanced to districts for various purposes authorized by law against contracts for delivery of bonds when issued by the district and called for by the department. Often these accounts are paid in full without issuance of bonds.

ADVANCES TO RECLAMATION DISTRICTS BY DEPARTMENT
September 30, 1944

District	*Interest Rate*	*Balance Sept. 30, 1944*
Agnew Irrigation District	4%	$5,431.52
Burbank Irrigation District		39,417.88
Kittitas Reclamation District		1,210.59
Lake Chelan Reclamation District (Apple-box contract)	2%	110,408.21
Moses Lake Irrigation District	4%	1,355.97
Otis Orchards Irrigation District	4%	5,599.27
Snohomish County Diking District No. 1	2%	6,974.54
Snohomish County Diking District No. 1	4%	1,300.48
Thurston County Drainage Improvement District No. 9	4%	146.74
Total		$171,845.20

Miscellaneous book assets consist of three items totaling $33,714.38. They consist of expenditures made from the reclamation fund pursuant to legislative appropriations and mandates as described in detail in the department's eleventh biennial report, where it was recommended that these uncollectible amounts be disposed of in such manner as the legislature deems best. The department will draft specific recommendations for presentation to the 1945 legislature in the hope that the books may be cleared of these long-standing accounts.

The liabilities of the reclamation fund consist solely of unredeemed 4 per cent collateral trust bonds in the amount of $89,000, $39,000 of which mature September 1, 1945, $40,000 on September 1, 1946, and the balance, $10,000.00, on September 1, 1947. Efforts at redemption or purchase of these non-callable bonds ahead of maturity have so far failed.

The gross interest income received by the reclamation fund during the report-biennium was $117,149.17. This means an earning rate of slightly less than 2 per cent per annum on the average gross amount of assets, exclusive of the non-productive "miscellaneous assets."

Interest paid on collateral trust bonds amounted to $14,960.00. Net interest earnings of the reclamation fund during the biennium was, therefore, $102,189.17, or approximately 1.75 per cent per annum on the average net assets, exclusive of non-productive "miscellaneous assets."

Financial Transactions

1. Completing commitments made many years ago involving the refunding of outstanding bonds, the department purchased from the Yelm Irrigation District at par $3,100.00 of its refunding bonds.

2. Fulfilling a contract entered into with the district in 1940, the department exchanged $258,000 par value 2 per cent bonds of the Oroville-Tonasket Irrigation District for a similar face amount of the district's 2 per cent refunding bonds. This transaction enabled the district to extend the redemption of its bonds over a longer period.

3. The department purchased from the Wenatchee-Chewawa Irrigation District $500.00 par value of its 2 per cent bonds, proceeds from which were used, with other district funds, for betterments to its irrigation system. All prior bonds of the district are held in the reclamation fund.

Field auditing of reclamation districts, described in detail in the eleventh bennial report, has been continued during the past two years. This closely

maintained contact has proved mutually beneficial to the department and the districts.

RECOMMENDATIONS WITH RESPECT TO THE STATE RECLAMATION LAWS

Chapter 16, Laws of 1933 (Sections 4482-1 to 4482-6, Rem. Rev. Stat.), was passed to meet an emergency then by the legislature found to be prevalent. Fortunately, that emergency is now past, and our reclamation districts are no longer suffering from any "wide-spread and critical financial depression." The measure appropriated from the reclamation fund $1,250,000, and although there is good reason to believe that the legislature intended the act to be applicable solely to the expenditure of that appropriation, it is still held to be operative. Under this measure it is permissible in bond refunding operations to use the reclamation fund for relieving private interests of their sometimes unfortunate reclamation investments. That, we believe, is contrary to sound public policy and to the interest and purpose of the state reclamation act.

We therefore earnestly recommend that said Chapter 16, Laws of 1933, be repealed by the 1945 legislature.

DIVISION OF HYDRAULICS AND WATER RESOURCES

CHAS. J. BARTHOLET
Supervisor

ADMINISTRATION OF THE WATER CODE

The administration of the Water Code is divided into five major activities and four related activities. Those provided in the water 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 works.

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.
4. Snow surveys in cooperation with the U. S. Department of Agriculture.

1. Supervision and Regulation of Use of Water

The administration has been carried on mostly during the last two years with the assistance of county water masters and stream patrolmen, but many problems dealing with water right regulations are handled directly from this office. There are four special agents employed part time to represent this office. Ninety-five per cent of water right regulations in the State are east of the Cascade Mountains where water is used for irrigation. Clallam County has the only water master west of the mountains, but with increased irrigation activities in this section of the State, more service for the protection of vested water rights must be given by this office, either directly from it, or by county water masters. Owing to the increased number of water rights and the extreme shortage of irrigation water supply throughout the State during the last irrigation season, the work of water right regulations has been greater than ever before.

During the biennium many regulations of water have been made by water masters and stream patrolmen and numerous decisions and orders have been rendered by this office affecting the use of water all over the State, without any appeal being made to the courts from such orders.

There are 68 streams on which irrigation water rights have been adjudicated, furnishing a water supply for approximately 225,000 acres over which the control of water comes under the jurisdiction of the Supervisor of Hydraulics. Likewise, this office has jurisdiction over the regulation of water under rights that have been granted by permits from this office.

2. Determination of Existing Water Rights

During the biennium no proceedings have been instituted to determine the extent and priority of water rights established before June 15, 1917.

However, there are still many important streams in the State on which the water rights have not been determined. It appears from the interest which has been shown in the adjudication of rights on several of these streams that as soon as the war is concluded petitions will be filed for such proceedings, and we believe there is a real need for such water right determinations on account of the friction and confusion among the water users where these rights have not been determined.

3. Initiation of New Water Rights

During the first half of the biennium the number of applications for permits to appropriate water was well below normal. The reason for this slump was due to the shortage of man power, materials and equipment caused by the war; but during the last half of the biennium the number of applications was well above normal, as much of the water will be used in post-war projects. This has also been stimulated by increased irrigation west of the Cascade Mountains and it is expected that after the present war there will be a great increase in the number of water right applications, as many individual irrigation projects are now being planned.

This office complies with requirements of Chapter 127, Laws of 1939, in submitting all applications for permits to appropriate water to the State Game and Fisheries departments. We find that in the interest of protecting both game and food fish in the streams, these departments are increasing the numbers of protests against granting the applications where the proposed use is for irrigation. However, in some instances the protests are withdrawn when the amount of water applied for is reduced, but where the protest is allowed to stand the water right application is denied.

The State Department of Health is notified when applications for water rights are filed for domestic use where several prospective water users are involved or where water is intended for municipal or community use.

Notices of all applications are filed with the State Land Commissioner to keep them advised of possible trespass on State lands. The U. S. Bureau of Reclamation is notified of applications filed in the Yakima River drainage basin and the Federal Power Commission is notified of applications filed for power purposes on U. S. Forest reserves or on navigable streams.

The following table shows number of applications filed for permits to appropriate water, together with proposed use, also the number of permits and final water right certificates issued.

Purpose	*No. of Applications*
Irrigation	189
Domestic	177
Power	18
Mining	5
Industrial	27
Miscellaneous	12
Storage	6
Total	434
Total number of permits issued	312
Total number of final water right certificates	195
Applications and permits cancelled	58
Certificates to change point of diversion and place of use of water	11

4. Collecting and Recording Hydrographic Data

With successive State legislatures making provision for carrying on hydrographic surveys since 1909, cooperation between the Washington State Division of Hydraulics and Water Resources and the United States Geological Survey has continued in effect during the last biennium. As a result of this cooperation a district office of the Geological Survey has been maintained within the State. The availability of this office and its facilities has influenced other State, Federal, and municipal agencies to make use of its services to expand their programs so that returns to the State have been greatly in excess of those purchased by its dollar-for-dollar cooperation.

> The biennium was marked by greatly increased interest and activity in the collection of stream-flow records, with new emphasis placed upon the smaller streams. In consequence of this continued and increased interest of the various Federal, State, and municipal agencies, the 162 gaging stations in operation at the close of the last biennium had increased to 203 by September 30, 1944; during the biennium 93 stations were established and 50 discontinued. In connection with the operation of these regular gaging stations 2,594 discharge measurements were made and in addition 1,383 miscellaneous discharge measurements were obtained on other streams, results of which along with the daily discharge records from the regular gaging stations are being published entirely at Government expense in Water-supply Papers and are made available to the general public.
>
> The streams of western Washington normally reach their lowest discharges during the months August to October, with another low water period often occurring during February and March. If storage is not considered, the natural low flows occurring during those periods are the governing factor for many of the important water utilization possibilities of this region such as domestic and industrial use, power, fisheries, irrigation, navigation, and pollution control. From July to September the normal precipitation in western Washington is low whereas water diversions from the multitude of small streams reach their maximum during this period.
>
> Applications for water rights are being received continuously by the State and their number is expected to increase greatly in the post-war period due to the large expansion of population and industry. Water supplies are already critical in some locations and this condition will doubtless become more widespread in the future. Because of the need for safeguarding the interests of the water users and bringing about the most suitable distribution of the State's water resources, a program has been evolved embodying the gathering of miscellaneous and short-term records and correlating these with long-term records at base gaging stations together with precipitation records. Although emphasizing the summer low-flow season, this program still meets practically all needs for continuous year-around records, the latter not being economically feasible on a long-term basis at the large number of places on the smaller streams for which reliable information is needed.
>
> It is desirable that the need for stream-flow records be foreseen in advance by several years so that they will be available when required. Progress and growth of the State demand the continued expansion of the present stream-gaging program.

The above statement was prepared by Fred M. Veatch, District Engineer, Water Resources Branch of the U. S. Geological Survey.

We wish to take this opportunity to express our appreciation of the manner in which F. M. Veatch, District Engineer, Arthur Johnson, Hydraulic Engineer, and Arthur M. Piper, District Geologist, and their staffs, all of the U. S. Geological Survey, have directed and carried on the cooperative activities with this office during the biennium. We are also grateful to James C. Marr, Irrigation Engineer of the U. S. Department of Agriculture, for his consideration in carrying out and directing the work on snow surveys in this State.

5. Examination of Plans of Proposed Dams and Inspection of Hydraulic Works

During the biennium only two small dams, which required our approval of the plans as to safety, have been constructed. These were both for the purpose of creating mill ponds. On account of the shortage of material and man power, little construction of this nature has been carried on during the biennium.

There exist 71 dams in the State of many types, ranging from small earth dams to the largest concrete structure in existence, the Grand Coulee Dam. We endeavor to keep posted at all times as to the current condition of these dams. All of the structures and appurtenant works have functioned properly during the biennium, so that it has been unnecessary to issue orders for improvements on any dams in order to insure safety to life and property.

OTHER ACTIVITIES

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

Chapter 159, Laws of 1935 (Sec. 9663 A-1 to Sec. 9663 A-20, Remington's Revised Statutes), provides for the establishment by the Supervisor of Hydraulics of flood control zones within which it shall be unlawful to construct or maintain any works or structures which may affect flood conditions, without a permit from said Supervisor of Hydraulics.

Since the effective date of the act, 16 zones have been established and 220 permits issued, 17 during the past biennium.

Maps and description of each zone are on file in the office of the Supervisor of Hydraulics at Olympia, and, for the convenience of the public, copies have been furnished to the respective county engineers, where they may be inspected.

2. River Utilization Surveys

The river surveys made by the Conservation Branch (Water and Power Division) of the U. S. Geological Survey during the period from October 1, 1942, to September 30, 1944, in cooperation with the Department of Conservation and Development are summarized below.

Salmon Creek (Clark County)

A reservoir site near Venersborg, covering an area of about 3 square miles, was mapped and a detailed survey made of the dam site for same.

Green River (King County)

A detailed survey was made of a dam site located about one mile downstream from Eagle Gorge station.

Okanogan River (Okanogan County)

A detailed survey was made of the Okanogan River from the outlet of Osoyoos Lake to the first channel of the Similkameen River, a distance of 2½ miles. This survey was made to serve as a base for the backwater studies to be made on this stream.

Columbia River

Mapping of the section between Priest Rapids and Rock Island Dam, 55 miles, was completed. Mapping of the section from the Rocky Reach dam site to the Foster Creek dam site, 70 miles, was nearing completion at the end of September.

In addition to the cooperative work considerable work was done with only Federal funds on the geologic investigation of dam sites on the Cowlitz River.

During the biennium, maps resulting from previous cooperative work were published for the Spokane River, Cowlitz and Tilton rivers, Skookumchuck and North Fork Newaukum rivers, and Chehalis River.

The foregoing statement was made by Arthur Johnson, Hydraulic Engineer for the U. S. Geological Survey, under whose direction the work is done.

3. Investigations of Ground-water Resources

The following statement was prepared by Arthur M. Piper, District Geologist, U. S. Geological Survey.

During the biennium, the inventory of ground-water resources in Washington has been carried forward by the Geological Survey, United States Department of the Interior, in cooperation with the State Department of Conservation and Development. Activities that supplement or that serve as integral parts of this inventory have also been carried on by the Geological Survey in cooperation with Snohomish County and with the City of Tacoma. All these activities have been curtailed somewhat because experienced personnel have been transferred to war activities or have entered the armed forces; nevertheless, the fundamental elements of the inventory have not lapsed. Progress in all these lines of investigation is summarized below.

Canvass of public water supplies and State-wide net of observation wells. The canvass of public water supplies from wells and springs and the State-wide skeleton net of observation wells for which basic field work was done in the biennium ending September, 1940, have been covered into a manuscript for publication by the Geological Survey.① A preliminary release of this report is contemplated whenever facilities can be made available for preparing duplicate copies. The report will embody records of water-level measurements in observation wells through 1942, so far as not otherwise published heretofore.

From time to time the initial skeleton net of observation wells has been amplified in those parts of the State where other ground-water studies were under way. For certain of these areas the records of ground-water levels in 1941 have been published,② those for 1942 await publication by the Geological Survey as part of Water-Supply Paper 948, and those for 1943 have been compiled for publication.

Spokane Valley Investigation. The investigation in the Spokane Valley, which in June, 1940, was curtailed greatly in favor of a reconnaissance in the Columbia Basin, was reactivated during the biennium and the basic field work completed in a scope somewhat less comprehensive than initially contemplated. A moderately comprehensive report on the area was far advanced when further progress was interrupted by the loss of personnel to the war. Completion of this report will be undertaken at the first opportunity. During the biennium, however, records of ground-water levels in the Spokane Valley through 1938 were published.③

Columbia Basin Project area. As brought out in previous biennial reports of the Department of Conservation and Development, a preliminary reconnaissance of the Columbia Basin Project area with respect to the availability of ground water for domestic supplies was started in August, 1940. In this reconnaissance early attention was given to the sub-divisions of the project area then considered most likely first to be supplied with irrigation water. During the biennium 1942-44, this reconnaissance was completed and a factual report of its findings was released.④ An interpretative report has been drafted; its release awaits the availability of facilities for duplication. Also in the biennium 1942-44, a modest start was made on the intensive phase of the investigation in the Columbia Basin, whose objective is to determine the relation of ground-water

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① La Rocque, G. A., Jr., Piper, A. M., and others, Public water supplies from wells and springs in Washington, with a discussion of the general ground-water features of the State: U. S. Geol. Survey Water-Supply Paper ——.

② Meinzer, O. E., Wenzel, L. K., and others, Water levels and artesian pressure in observation wells in the United States in 1941; Part 5, Northwestern States: U. S. Geol. Survey Water-Supply Paper 940, pp. 133-151, 1942.

③ Piper, A. M., and La Rocque, G. A,. Jr., Water-table fluctuations in the Spokane Valley and contiguous area, Washington-Idaho: U. S. Geol. Survey Water-Supply Paper 889-B, pp. 83-139, 1944.

④ Taylor, G. C., Jr., Factual data pertaining to wells and springs in the Columbia Basin Project area, Washington: U. S. Geol. Survey duplicated report, 85 pp., January, 1944.

conditions to the development and operation of the irrigation project. As facilities permit, it is contemplated that this intensive phase will be carried forward in accord with the need and in advance of settlement.

Lake Washington area. With respect to the availability of ground water to supply the domestic requirements of the growing community along the east shore of Lake Washington, in King County, a reconnaissance of that area and its vicinity was carried out in February and March, 1944. The general findings of this reconnaissance have been conveyed informally to interested groups; also, a report for release to the public is far advanced.

Snohomish County. In cooperation with Snohomish County Public Utility District No. 1, in July, 1944, the Geological Survey began an inventory of the ground-water resources of that county with respect to their availability for domestic, irrigation, industrial and other purposes. Currently the work is of small scope and is being directed toward the assembly of basic factual information, with the interpretative phase deferred and contingent on the future availability of experienced personnel. It is contemplated that this inventory in Snohomish County ultimately will be integrated into an appraisal of ground-water resources in all the Puget Sound region which has been proposed for the post-war period.

Tacoma area. In cooperation with the City of Tacoma, the Geological Survey in late 1937 undertook a comprehensive investigation with respect to the practicability of utilizing ground water to meet the increasing municipal demand at Tacoma. The intensive phase of this investigation has passed and a comprehensive report is pending. During the current biennium the routine observation of water-level fluctuations was continued; also, certain factual data from the intensive phase were released to the public.[5] Although supported throughout its term by allotments of municipal funds, this intensive investigation in the Tacoma area is of substantial interest to the State as a whole, because it will serve as a key to the complex ground-water conditions of all the Puget Sound region.

Investigations related to the war. In accord with an understanding with the State Department of Conservation and Development, the Geological Survey has directed some of its cooperative effort into local studies to assure dependable water supplies for military establishments, war industries, public-housing developments, and related projects. This effort has been of substantial immediate benefit to the Nation's war program; also, it has yielded factual information that ultimately will be integrated into the State-wide cooperative program.

4. Snow Surveys

Since 1935 the Division of Irrigation of the Soil Conservation Service, U. S. Department of Agriculture, has been responsible for coordinating and expanding the snow survey and streamflow forecasting of the West. In 1942, the State Division of Water Resources entered into formal agreement with this department to assist in financing the program in the State of Washington. Under the present program $800 per biennium is allotted to this work, which amount has been substantially over-matched by the Federal Government during the past period.

At the present time there are over 200 snow courses located in the Columbia Basin with approximately 50 of these in the State of Washington. Those drainages covered most intensely include Yakima, Chelan, Skagit, White, and Lewis River basins.

Snow depth and water content of the snow is determined on many of these courses at the first of each of the first five months of the year. Measurements on some of the less accessible courses are made only once or twice a year, namely April 1; or April 1 and May 1.

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[5] Robinson, J. W., Piper, A. M., and others, Water levels in observation wells and stages in certain lakes of the Tacoma area, Washington: U. S. Geol. Survey duplicated report, 227 pp., January, 1943.

A snow survey report is issued by the Boise office on the tenth of the month following each set of measurements, and on April 10 forecasts of the following six months' run off are made and released to all interested parties. Throughout the winter months information on what the water conditions of the ensuing summer may be is given out to the people through the papers and by radio.

Numerous Government agencies and private companies assist in gathering the snow survey data, some by making personnel available for the field work and others by direct monetary contributions.

In the past two years a number of important courses have been established in the State of Washington, and it is expected that others will be added when materials now necessary for war activities again become available for equipment manufacture.

On April 10, 1943, the April to September flow of the streams in the State was forecast as being one of the highest on record. Likewise, on April 10, 1944, the forecast was for a relatively low flow similar to that of 1940 and 1941. Stream-flow measurements by the U. S. Geological Survey indicate these forecasts to be fairly accurate.

With the increased demand for power in connection with war activities, the expansion of irrigation and the growth of the cities and their resultant increased culinary uses an early spring inventory of the summer's water supply becomes increasingly important. Regulation of storage reservoirs for either drought or flood conditions can be guided by the snow surveys. Planting of proper crops, flood control, and power interchange throughout the Northwest is based largely on snow survey results.

This work is carried on under the direction of James C. Marr, Irrigation Engineer, Division of Irrigation, U. S. Department of Agriculture, and the above statement was prepared by him.

RECEIPTS

Following are the receipts collected by the Division of Hydraulics for the biennium from October 1, 1942, to September 30, 1944:

Receipts from fees collected under Sec. 44 of the State Water Code, and deposited in General Fund	$5,934.91
Receipts from power license fees collected under Chapter 105, Laws of 1929, and deposited in the Reclamation Revolving Fund	$59,409.46
Stream Gaging Fund (Trust Fund collected under Chapter 30, Laws of 1943)	$3,194.57

EXPENDITURES

The following table shows expenditures under the supervision of the State Supervisor of Hydraulics for the biennium from October 1, 1942, to September 30, 1944:

From the General Fund:		
Administration of the Water Code		$25,675.28
From the Reclamation Revolving Fund (Power License Fee Deposits) (Matched on a 50-50 basis with monies expended by the U. S. Geological Survey)		
Hydrographic Surveys	$28,784.30	
River Utilization Surveys	2,546.38	
Underground Water Surveys	5,352.10	
* Topographic Surveys	18,474.84	
** Snow Surveys	527.65	
		55,685.27
From Stream Gaging Fund (Matched on a 50-50 basis with monies expended by U. S. Geological Survey)		
Hydraulic Surveys		2,739.64
		$84,100.19

* Expended under supervision of Supervisor of Division of Geology.

** Matched on a 50-50 basis with monies expended by the United States Department of Agriculture.

DIVISION OF FLOOD CONTROL

LARS LANGLOE
Supervisor

Under the provisions of the so-called flood control maintenance act (Chapter 204, Laws of 1941) the 1943 legislature appropriated $100,000 to the department for participation with local governmental units in flood control maintenance. Certain provisions of the 1941 act prevented any expenditures from this appropriation prior to January 1, 1944. For the current calendar year the department received applications for participation in flood control maintenance from six counties and one city. Under agreements for State participation to the extent of 40 per cent of the cost, work is now under way in six of these seven governmental units. The units, available local funds, amounts of allotted State participation, and expenditures to September 30, 1944, are shown in the following tabulation.

Local Governmental Unit	*Local Funds Available*	*State Participation Total Allotted*	*State Participation Expended to Date*	*Streams*
City of Colfax	$1,650.00	$1,100.00	*	Palouse River
King County	50,000.00	33,333.33	**	Snoqualmie, Green and Sammamish rivers
Kittitas County	2,128.27	1,418.85	$1,418.85	Yakima River
Pierce County	32,000.00	21,333.33	13,223.79	Puyallup, Carbon and Nisqually rivers
Skagit County	22,000.00	14,666.67	4,597.52	Skagit River
Snohomish County	25,000.00	16,666.67	5,944.79	Snohomish, Stilaguamish, Pilchuck and Wallace rivers and Olney Creek
Whatcom County	7,200.00	4,800.00		Nooksack River
TOTALS	$139,978.27	$93,318.85	$25,184.95	

* Job under way.
** Reimbursement claims in amount of $11,830.84 approved but not yet paid.

Shortage of labor and other causes have somewhat retarded the maintenance work. Some, if not all, of the counties will probably be unable to complete their current program by the end of the year; but since unexpended local funds will remain available for 1945 expenditure, it is anticipated that by the end of the current biennium the State appropriation will have been fully expended.

The work carried on by the counties and participated in by the State is devoted almost wholly to protection of river banks against erosion and resulting shifting of channels. Rock riprap is the method most commonly employed. Timber piling was used at Utopia on Skagit River. The work on Palouse River at Colfax will be removal of brush, debris and silt from the channel at lower end of town.

The control of our occasional major floods is a sizable task which the public seems willing to postpone until our economic development and resources more nearly warrant the undertaking. But the ever present and continuous destruction by bank erosion of first-class farm lands along the rivers is an evil which the public believes can be controlled and eventually stopped by continuing vigilance and a reasonable expenditure of public funds for timely repairs.

DIVISION OF FORESTRY

T. S. GOODYEAR
Supervisor

1943 ANNUAL REPORT

There were three extended and rather critical dry periods during 1943. The first occurred between the dates of February 12 and March 11, during which there was no rain, almost constant northeast winds, and very low humidity. Permits were not required and many fern fires, set by ranchers and for road right of way clearing, got beyond control and burned over large areas of cutover land, destroying quantities of young trees.

Most of the regular patrol force was in the field six weeks earlier than usual, in order to cope with the abnormal fire situation. Public appeals to discontinue setting of fern fires were of little or no avail. The Governor issued a proclamation advancing the closed fire season from April 15 to March 5, after which no open fires could be set without first obtaining a written burning permit from authorized forest officers. Restrictions imposed by the proclamation were extremely effective and provided an opportunity to control existing fires by preventing the setting of new ones. By the end of April most of the lookouts were manned and the entire regular force in the field. Green ferns and brush were well leafed out and the ground screened with a good protective cover against fires. Rain and cloudy weather were well distributed throughout the month of May.

Army orders prohibiting open fires, except for military and defense projects, became effective May 1.

By June 10 the regular protective organization was supplemented by 800 high school boys, who, during the school year, had received some preliminary fire fighting training. They were distributed in fire fighting emergency crews—of which there were 5 25-man, 43 10-man and 12 5-man crews—and the balance were stationed, either in pairs or singly, out on observation points or in areas of extreme fire risk. There was very little fire weather during June and consequently few fires. The emergency crews spent most of the time on improvement work, such as road, trail and telephone line maintenance.

The second spell of bad weather occurred between the dates of July 17 and 30. During this time there were several hot, dry days with low humidity and strong northeast winds. A number of fires was set by donkey engines in fresh logging slashings, and railroad fires were a daily occurrence, particularly east of the Cascades; roadside fires were not uncommon. Fortunately, none of the fires during this period reached serious proportions.

As to weather, August was about average—possibly a little above normal in precipitation. There were 12 fire days with comparatively high temperatures and low humidities. The Kosmos fire was set on August 13 by sparks from a donkey engine and spread rapidly through adjoining tie slashings. A heavy concentration of emergency fire fighting crews and equipment was used on this fire, which covered approximately 1,100 acres before it was entirely controlled.

The Kosmos fire was the first and practically the only fire during the summer upon which emergency crews got a real test. About 150 boys were employed and they performed very well. By September 1 most of the boys

who composed the emergency fire crews had returned to school and there were no available fire fighters.

The third and longest dry period occurred throughout the entire month of September. There was more hazardous fire weather during that month than in all the rest of the fire season. Nearly everything happened. The weather was critical and the manpower shortage acute. A special hunting season was opened during the latter part of September in parts of Mason, Kitsap and Clallam counties. Twenty-three fires resulted and it became necessary to draw on the regular field force and equipment from adjoining counties in order to take care of these hunters' fires. It was during this time that five slashing fires broke out simultaneously in the Morton area, in very steep, rugged country in which there were some 40 tie mill operators and large areas of accumulated slashing. The crews who controlled these fires were composed of approximately 250 soldiers from a combat division at Fort Lewis, 80 conscientious objectors from camps in Oregon, 60 convicts from the penitentiary wood camp at Onalaska, 40 students previously with the emergency crews, who were released by high schools, and 50 loggers from nearby camps. This was a cosmopolitan but effective fire crew and most of these fires were controlled before they burned into green timber.

Continued critical fire weather, coupled with serious labor shortage, made it advisable to close down all logging camps in western Washington on two different occasions. The first shutdown order was for September 9 and 10; the second, September 15 and 16. By September 22, weather conditions had somewhat improved the fire situation and the forest protective agencies, after discussions with Army and Navy authorities, lifted the ban on issuance of burning permits. A limited amount of burning was permitted, where applicants had taken proper precautions or had facilities available to keep fires under control.

A brief comparison with the 1942 fire season is somewhat enlightening. For instance, 1942 had an especially wet spring, with few long dry periods during the summer. In 1943 February and March were especially dry with many days of critical fire weather. May, June, July and August of 1942 and 1943 were somewhat similar, with unusually favorable fire weather. September of 1942 was about average, while almost all of the fire season of 1943 was concentrated in September. In 1943 there were 161 more fires reported than in 1942; railroad fires increased from 91 to 277, incendiary fires from 69 to 110, land clearing fires from 97 to 192. On the other hand, lightning fires decreased from 266 in 1942 to 69 in 1943; there was also a slight decrease in smokers' and slashing fires. Total acreage burned in 1942 was 19,727 against 30,349 in 1943.

By midsummer approximately 8,000 men and women throughout the rural districts of the state had received at least 12 hours of instruction and preliminary training in forest fire prevention and suppression and were subsequently enrolled in the Forest Fire Fighters Service of the Office of Civilian Defense. In some counties, particularly those of eastern Washington, these enrollees rendered outstanding service by taking initial action and, in some instances, completely controlling threatening forest fires in their respective communities.

Fire detection facilities in western Washington were augmented by the operation of at least 65 aircraft warning posts, which proved extremely helpful in reporting fires that occurred in areas not covered by the regular lookouts.

The forest protection program was again coordinated through activities of Washington State Defense Council, composed of members from all forest protective agencies, with representatives from the Army, Navy and Coast Guard acting in a supervisory capacity.

Pre-fire suppression meetings were held in each of the western Washington counties—under the direction of foresters from West Coast Lumbermen's Association, Washington Forest Fire Association and the State Division of Forestry—for the purpose of acquainting logging operators with fire prevention and suppression plans. The meetings were well attended by representatives of the logging industry.

Climatological data for the months of February to October inclusive follow:

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
February	3.11	0.73	.....	11	6	11	9	6	13
March	3.96	.....	0.56	9	6	16	11	9	11
April	2.89	.....	0.61	8	9	13	11	9	10
May	1.81	0.17	.....	7	11	13	11	11	9
June	1.78	.....	0.18	10	9	11	12	10	8
July	0.53	0.15	.....	14	9	8	23	6	2
August	1.03	.....	0.22	12	9	10	21	7	3
September	0.43	1.38	.....	17	7	6	24	4	2
October	4.09	.....	1.17	7	8	16	10	8	13

The following summary of fires by months indicates the direct relationship to atmospheric conditions:

	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Western Washington	51	156	60	33	50	133	151	158	32	3	1	828
Eastern Washington	.....	1	8	10	30	123	142	108	40	.....	.....	462
Totals	51	157	68	43	80	256	293	266	72	3	1	1,290

The exceptionally early dry spring, the greatly increased number of logging operations (due to excessive demands for forest products), the resulting accumulated slashings, the inability to obtain any kind of automotive or other power fire fighting equipment (or even replacement parts), and the critical manpower shortage were somewhat compensated by unusually favorable weather during the summer months, reduced public travel in the woods, the Army ban on open fires, very few lightning storms, the fact that everyone was occupied, with little idle time to spend in the forests, increased patrol made available through special appropriations by Congress for protection of forests and war industries in the coastal states, and the splendid cooperation from Army, Navy and Coast Guard detachments in both detection and suppression of forest fires.

The Keep Washington Green Committee, through its director Mr. Stewart Holbrook, supplied a steady barrage of fire warnings to the public through the newspapers and radio. It was also instrumental in organizing the Junior Forest Wardens, composed mostly of boys under high school age, who were

taught some of the fundamentals of forestry, such as the value of trees and importance of protecting them against fire.

While the fire record of 1943 is far short of the goal set for adequate forest protection, there was no loss of human life and no serious injuries, no conflagrations; the acreage burned over was not excessive, and the property loss and damage was nominal.

Cooperation

In addition to agencies previously mentioned, cordial cooperation was received from the United States Forest, Park and Indian Services, United States Weather Bureau, Pacific Northwest Forest and Range Experiment Station, Washington Forest Fire Association, West Coast Lumbermen's Association and Western Pine Association.

Law Enforcement

There were 105 arrests for burning without permit, 68 for illegal entry into closed areas, nine for tool deficiencies in logging operations, two for unauthorized cascara bark peeling, and two for tossing lighted cigarettes from automobiles. A total of 186 arrests resulted in 185 convictions, with fines aggregating $2,573.50. The law enforcement officers, in addition to their regular duties, made many collections for trespass on State Forest Board lands and also recovered the costs of controlling numerous fires on non-contributing lands.

Equipment

Owing to scarcity of material and difficulties in obtaining priorities, equipment purchases were limited to necessary replacements. These consisted of two standard Chevrolet coupes, six Type Y Pacific portable pumpers, one Dewalt power saw complete, tents, cooking utensils, 175 sleeping bags for emergency fire crews, six staff compasses, five Abney hand levels, and a nominal amount of small fire fighting tools and office equipment.

Radio

During the 1943 fire season radio communication played an important part on the three fires in the Kosmos-Morton area. The Morton fire is cited as an example of the operation of radio communication on fires. Within thirty minutes of the time the central dispatcher at Olympia received report of the fire at Morton (which was transmitted to Olympia headquarters by radio through Porcupine Lookout) a radio technician in a radio-equipped car was on his way to the fire. He took with him five portable two-way radiophones, which upon arrival he gave out to as many fire line bosses with instructions to keep him informed as to their individual activities. The radio car also established communication with Porcupine Lookout. Since there were no telephone facilities within miles of the Morton fire, all information was passed on to the central dispatcher at Olympia by radio and, in turn, the central dispatcher was able to send messages to any part of the fire at will. On this fire all materials, supplies and progress reports were handled in a highly satisfactory manner through the use of radio communication.

A complicated system of automatic relay radio stations was installed and maintained for the Aircraft Warning Service. This system is entirely separate from the regular fire control radio, and consisted of sixteen installations covering all of western Washington.

Construction of new equipment was carried on throughout the year but, due to the very slow delivery of parts, only thirty of the six pound two-way portable radiophones were completed.

All radio work is handled by two men and the volume of work performed warranted the addition of a new room and basement to the present radio shop.

Slash Disposal

Favorable weather conditions resulted in a considerable slash disposal increase over the previous year. Applications were received in 1943 for certificates of clearance on 146,348 acres. Examinations were made and clearances issued covering 137,513 acres, while 8,835 acres were rejected.

State Forest Land Acquisition

Due to heavy purchases of county-owned lands by the lumber industry for the establishment of tree farms, the state acquisition program is limited to blocking forest units already under Forest Board administration.

During 1943 only 792.19 acres were acquired by the State Forest Board—240 acres were deeded by Clark county and 552.19 acres were exchanged in Lewis and Grays Harbor counties.

A fire hall site at Darrington was also acquired by donation from the townspeople interested in forest fire protection.

Sales of timber and leases on State Forest Board lands consisted of 139 transactions, totaling $86,724.00, of which approximately 84 per cent was returned to the counties in lieu of taxes. The various participating counties have come to realize that returns received from their tax delinquent lands are far greater through State Forest Board management and are apparently satisfied with the manner in which these lands are handled.

A forest type survey was started on Forest Board lands, wherein the necessary data for proper management will be accumulated and recorded. This study will be continued until all Forest Board lands are catalogued.

Classification

Two applications for land classification were received from timber land owners who were establishing tree farms. Field examinations were made, public hearings advertised and held, and 59,285.58 acres were recommended as eligible for classification. The State Tax Commission ordered these lands put aside for reforestation purposes.

In addition, 468.70 acres in Mason and Grays Harbor counties were examined and rejected as not eligible for classification under provisions of the Reforestation Act.

State Forest Nursery and Planting

In view of acute labor shortage caused by the war and the fact that this condition will probably not be alleviated for at least two years, sowing of seed beds at the nursery was somewhat curtailed. Spring sowing started April 5 and was completed May 12, during which time 551 beds, 4′ x 12′ (an estimated production of 1,350,000 seedlings), were sown to Douglas fir.

A three wire electric fence, which was put into operation in April, 1942, proved unsuccessful in keeping deer out of the seed beds and heavy damage resulted to the seedlings from browsing. It was therefore necessary to con-

struct one mile of 8-foot woven and barbed wire deer fence around the entire nursery. This fence was completed in the fall, early enough to stop deer damage which is usually heaviest from January to April each year.

In the past, planting statistics have been recorded by calendar years. This procedure was confusing and difficult for the reason that a planting season starts during the fall of one year and carries over into the spring of the following year. In the future, planting statistics shown for any calendar year will be for the previous planting season; that is, planting statistics for 1943 will include those trees planted during the 1942-43 planting season.

This year a total of 809,821 Douglas fir 2-0 seedlings was planted on the King Creek plantation in Clark county, Fraley Mountain in Skagit county, Sherman Valley in Capitol State Forest, Thurston county, and Galbraith Hill in Whatcom county. Fifty-nine per cent of this planting was done by hired civilian crews, thirty-three per cent by Cavanaugh Honor Camp inmates from Monroe Reformatory, and eight per cent by Bellingham High School pupils. Owing to labor shortage, not more than twenty-five per cent of available nursery seedlings was planted, the remainder being held over for another year with the view of using part as 3-0 stock.

Planting by Bellingham High School was by far the largest project of this type ever undertaken in one year by any high school in Washington. The project involved 125 pupils, who planted 66,500 seedlings on 125 acres of State Forest Board land on Galbraith Hill in Whatcom county. A great deal of interest and enthusiasm was shown by the students and interested people throughout the community, and indications point toward a continuation of this project in future years.

Examination of 22,385 acres, planted since 1937, shows an average survival of 58.2 per cent. This appears to be a low figure. However, after considering the condition of much of this land at time of planting and all other factors which increase seedling mortality, it compares very favorably with planting done by other agencies.

The cone crop for 1943 was very poor in the Douglas fir region and only fair in parts of the ponderosa pine area.

Counties	Number of Trees Planted			Number of Acres Planted		
	Previous to 1943	1943	Total	Previous to 1943	1943	Total
Clallam	490,634	.....	490,634	984	.....	984
Clark	110,050	56,400	166,450	174	78	252
Cowlitz	1,647,002	.....	1,647,002	2,744	.....	2,744
Grays Harbor	2,410,051	.....	2,410,051	3,905	.....	3,905
Lewis	1,407,335	.....	1,407,335	2,174	.....	2,174
Mason	47,700	.....	47,700	100	.....	100
Pacific	657,424	.....	657,424	1,052	.....	1,052
Pierce	1,203,446	.....	1,203,446	1,462	.....	1,462
Skagit	1,905,430	271,975	2,177,405	2,891	440	3,331
Snohomish	1,558,400	.....	1,558,400	2,285	.....	2,285
Thurston	1,635,933	342,956	1,978,889	2,799	628	3,427
Wahkiakum	718,430	.....	718,430	1,373	.....	1,373
Whatcom	7,000	138,450	145,450	11	267	278
Totals	13,798,835	809,781	14,608,616	21,954	1,413	23,367

Table No. 1—ORIGIN, NUMBER AND CLASSIFICATION OF FIRES—1943

Counties	Lightning	Incendiary	Campers	Smokers	Slashing	Logging	Brush Burni'g	Railroads	Miscellaneous	Totals
Chelan	3	.....	.....	2	.....	.....	.....	2	4	11
Clallam	1	1	1	19	.....	1	1	5	8	37
Clark	2	2	.....	8	.....	2	13	3	17	47
Cowlitz	.....	14	.....	11	1	2	9	4	4	45
Ferry	3	.....	.....	5	.....	2	2	.....	1	13
Grays Harbor	.....	14	1	11	.....	2	1	1	2	32
Island	.....	.....	4	7	1	.....	2	.....	4	18
Jefferson	.....	1	1	6	.....	.....	2	1	4	15
King	1	9	1	25	.....	3	34	13	23	109
Kitsap	.....	.....	1	22	.....	.....	18	.....	19	60
Kittitas	.....	2	2	24	.....	2	1	127	16	174
Klickitat	3	6	.....	12	.....	4	.....	1	4	30
Lewis	3	11	.....	7	2	13	6	7	7	56
Mason	9	3	2	9	.....	.....	10	2	12	47
Okanogan	9	.....	2	5	.....	.....	.....	.....	1	17
Pacific	.....	7	.....	3	.....	3	.....	1	5	19
Pend Oreille	3	.....	2	5	.....	.....	.....	2	5	17
Pierce	1	9	4	20	1	1	16	10	13	75
San Juan	1	.....	2	2	.....	.....	.....	.....	12	17
Skagit	4	1	2	5	.....	1	20	4	7	44
Skamania	.....	1	.....	4	.....	3	2	6	2	18
Snohomish	3	4	2	9	.....	3	27	6	17	71
Spokane	2	9	1	18	.....	1	5	53	41	130
Stevens	14	1	2	13	1	1	1	1	15	49
Thurston	.....	13	2	13	1	1	10	27	13	80
Wahkiakum	.....	.....	.....	2	.....	.....	2	.....	.....	4
Whatcom	3	1	3	8	.....	1	8	.....	10	34
Yakima	4	1	1	8	.....	.....	2	1	4	21
Totals	69	110	36	283	7	46	192	277	270	1,290

Classification of fires: Class A (¼ acre or less), 568; Class B (¼ acre to 10 acres), 507; Class C (over 10 acres), 215.

Table No. 2—ACREAGE BURNED OVER—1943 FIRES

Counties	FOREST LAND			NOT REFORESTED			NON-FOREST LAND			
		Reproduction			Cutover Land					
	Merchantable Timber	Cutover	Old Burn	Old Burn	Slash Unburned	Slash Burned	Pasture	Brush	Other	Total
Chelan	16	.....	.....	.....	.....	.....	961	.....	107	1,084
Clallam	.....	1	.....	.....	74	.....	9	5	.....	89
Clark	.....	.....	430	56	.....	.....	289	75	.....	850
Cowlitz	4	1,922	1,220	405	14	.....	172	44	.....	3,781
Ferry	4	.....	.....	.....	1	.....	34	13	1	53
Grays Harbor	.....	2	155	52	.....	.....	38	.....	3	250
Island	3	1	.....	15	1	.....	2	12	.....	34
Jefferson	.....	.....	304	.....	.....	.....	5	2	.....	311
King	3	439	419	265	324	60	146	221	18	1,895
Kitsap	.....	116	.....	.....	28	17	20	10	2	193
Kittitas	17	28	.....	.....	5	8	4,197	489	219	4,963
Klickitat	7	48	.....	.....	28	13	10	.....	.....	106
Lewis	681	1,235	11	1	2,519	.....	.....	844	10	5,301
Mason	.....	52	15	.....	.....	15	23	10	4	119
Okanogan	142	.....	15	.....	.....	.....	87	.....	.....	244
Pacific	.....	.....	33	1	.....	.....	2	1	.....	37
Pend Oreille	.....	1	.....	.....	.....	.....	.....	2	.....	3
Pierce	.....	368	11	.....	52	4	108	274	118	935
San Juan	.....	39	2	7	.....	.....	51	26	16	141
Skagit	.....	32	652	.....	70	.....	9	46	151	960
Skamania	303	300	1,680	.....	61	.....	8	37	140	2,529
Snohomish	.....	1	5	8	16	14	168	266	70	548
Spokane	235	1,332	25	.....	.....	1	514	133	848	3,088
Stevens	51	79	.....	.....	3	.....	331	1	25	490
Thurston	.....	47	25	.....	99	7	535	255	4	972
Wahkiakum	.....	.....	.....	.....	.....	30	.....	5	.....	35
Whatcom	.....	31	.....	43	.....	.....	15	7	8	104
Yakima	1	27	.....	.....	.....	.....	1,130	31	45	1,234
Totals	1,467	6,101	5,002	853	3,295	169	8,864	2,809	1,789	30,349

Table No. 3—LOSS AND DAMAGE—1943 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	15	.....	15	.....	.....	$300 00
Clallam	.....	.....	.....	197	.....	.....
Clark	.....	.....	.....	.....	.....	2,220 00
Cowlitz	10	.....	10	29	$5,900 00	40 00
Ferry	12	12	.....	2	.....	72 00
Grays Harbor	.....	.....	.....	.....	.....	1,500 00
Island	.....	.....	.....	.....	.....	.....
Jefferson	.....	.....	.....	.....	.....	.....
King	.....	.....	.....	500	4,000 00	385 00
Kitsap	.....	.....	.....	.....	.....	4,700 00
Kittitas	1	.....	1	.....	.....	1,335 00
Klickitat	.....	.....	.....	40	80 00	50 00
Lewis	4,383	3,936	447	540	13,675 00	1,210 00
Mason	10	5	5	.....	.....	.....
Okanogan	6	.....	6	.....	.....	.....
Pacific	1	.....	1	.....	2,500 00	.....
Pend Oreille	.....	.....	.....	.....	.....	500 00
Pierce	.....	.....	.....	.....	50 00	880 00
San Juan	.....	.....	.....	.....	.....	100 00
Skagit	.....	.....	.....	5	200 00	1,725 00
Skamania	960	864	96	55	9,500 00	785 00
Snohomish	.....	.....	.....	.....	25 00	17 00
Spokane	500	375	125	10	700 00	3,880 00
Stevens	6	3	3	.....	.....	425 00
Thurston	.....	.....	.....	.....	.....	730 00
Wahkiakum	.....	.....	.....	.....	.....	.....
Whatcom	.....	.....	.....	.....	.....	.....
Yakima	1	1	.....	96	.....	.....
Totals	5,905	5,196	709	1,474	$36,630 00	$20,854 00

Total loss and damage to all classes of property—$78,504.00.

Table No. 4—BURNING PERMITS, CLASSIFICATION AND ACREAGE OF LAND BURNED UNDER PERMIT—ARRESTS AND FINES—1943

COUNTIES	BURNING PERMITS				ARRESTS AND FINES	
	Permits	Camp Fire Permits	Protection Acres	Agriculture Acres	Number	Fines and Costs
Chelan	283	2	249	85	.....	.....
Clallam	597	.....	467	1,269	.....	.....
Clark	59	.....	4	159	7	$162 00
Columbia	8	.....	11	2	.....	.....
Cowlitz	676	5	6,270	2,634	.....	.....
Grays Harbor	1,130	4	1,404	1,053	13	181 50
Island	387	.....	380	342	1	12 50
Jefferson	242	.....	22	128	.....	.....
King	4,447	.....	4,288	1,925	24	369 50
Kitsap	3,059	.....	1,132	409	9	92 00
Kittitas	579	1	904	3,841	5	45 00
Klickitat	141	1	75	1,274	1	27 00
Lewis	2,088	3	17,579	7,149	2	27 50
Mason	2,004	3	4,655	1,114	41	617 75
Pacific	541	.....	2,452	570	7	193 50
Pend Oreille	647	1	1,087	729	.....	.....
Pierce	1,858	2	6,093	3,548	9	151 50
San Juan	159	.....	290	144	2	105 00
Skagit	1,969	3	4,693	6,541	22	371 00
Skamania	17	.....	41	.....	.....	.....
Snohomish	3,191	.....	1,198	6,209	15	258 65
Spokane	854	5	1,339	56,034	1	7 50
Stevens	2,769	15	2,024	21,799	2	20 00
Thurston	1,220	2	1,076	1,587	11	165 00
Wahkiakum	274	.....	83	929	.....	.....
Whatcom	1,606	.....	3,894	3,874	13	174 50
Yakima	.....	.....	.....	.....	1	7 50
Totals	30,805	47	61,710	123,348	186	$2,988 90

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February: February was a wet cloudy month with heavy frosts and one day of light snow. No difficulty was encountered from fern fires.

March: March was exceptionally dry with less than one-half of the average rainfall. A very intensive publicity campaign was conducted, through the radio and newspapers, against broadcast fern burning. The public was warned early in March that written permits would be required for open fires in or adjoining the forests. On March 13 district wardens were authorized to employ temporary patrolmen for the purpose of stopping uncontrolled spring fires. A comparatively small number of fern fires was set, the largest of which covered 25 acres. Considering the dry weather and unusually heavy crop of winter-killed ferns, gratifying progress was made in the reduction of these damaging early spring fern fires.

April: On April 5 and 6 a meeting of district and assistant district wardens was held in Olympia, and instructions for the fire season were discussed. Wardens recommended that, since the Army had lifted the burning restrictions in force during 1942 and 1943, the State Supervisor of Forestry issue an order that no burning permits be issued during July and August, except for military projects. Hard, steady rains April 7, 8, 11, 13, and a rank growth of green ferns and brush definitely ended the threat of further spring fern fires.

May: There was critical fire weather during the first seven days of May. The temperature climbed to 80 degrees and humidity dropped to 14 degrees, with strong east and northeast winds. In western Washington numerous fires resulted from land clearing operations. Several forest fires spread from burning tie and shingle mills. One hundred soldiers were dispatched from Fort Lawton to help combat a 600-acre fire near Beaver Lake in King county. A 500-acre fire was set by sparks from a donkey engine in Whatcom county and caused considerable damage to logging equipment and down timber. By May 8, when there was a hard general rain, most of the larger logging operators had voluntarily shut down their operations.

On May 16 the Washington Forest Defense Council met with representatives of the Army, Navy and Coast Guard. Agreements were reached for uniform rentals of fire fighting equipment, and standard wages set for fire fighters and emergency crews. Procedure for obtaining soldiers from the Army for fire fighting was outlined and explained to officials of the various forest protective agencies.

By the middle of May all the regular field force—including wardens, rangers, patrolmen, dispatchers and lookouts—was on duty. During the balance of the month there were frequent rains and cloudy days, with few fires.

June: Between June 1 and 10, 600 high school boys from 16 to 18 years of age were hired and distributed in emergency fire crews, consisting of from five to 20 boys. Each crew was in charge of an experienced foreman. The boys were given about five days of training and then put to work on telephone line, road, and trail maintenance. During June 8, 9 and 10, winds were from the northeast, the humidity dropped to 28 degrees and temperature went to 90 degrees. There were numerous slashing fires and some fires were set by the railroads. The emergency crews had their first chance

to perform control work on fires and they did very well. From June 11 to 18 the weather was cloudy with several light showers. On the night of June 19 there was a severe electrical storm that set 25 fires, scattered along the west slope of Cascade Mountains, which were controlled by the emergency fire crews before they could spread. A warning was sent out urging farmers to get their burning done before July 1, after which no permits would be issued for open fires. The balance of June was more or less cloudy with relatively high humidity. Although an unusual number of burning permits was issued for land clearing operations, very few fires got away.

July: July was extremely dry with no general rains or showers. The entire month was critical fire weather. On July 10 an 80-acre fire was set in fresh slashings of Northern Timber Company in the Bald Hills district, Thurston county. Seventy-five men from nearby emergency fire crews were immediately dispatched to this fire and confined it to a comparatively small acreage, with no loss to adjoining standing timber which surrounded the slashing on four sides. By July 18 the temperature reached 95 degrees and humidity had dropped to 27 degrees. Several tie mill fires started in eastern Lewis county and a rather serious fire broke out in operations of the Blue Mountain Logging Company, Whatcom county. This fire required the services of 75 W.F.F.C. men, some of whom were sent from Grays Harbor county. Fires set by railroads and logging operations were prevalent throughout the month. July 31 was the 44th consecutive day without rain.

August: August generally was hot and dry with several short periods of critical fire weather. Light scattered local showers were recorded on August 7, 9, 13 and 25. Numerous fires from railroads and logging operations continued throughout August and kept the emergency fire crews working night and day. On August 4 a 100-acre fire broke out in unburned slashings in Mason county and a concentration of men and equipment was required to control it. On August 27 a 275-acre fire started in one of the larger logging operations in Cowlitz county. Prompt action by the logging crew and the outside help supplied by wardens prevented a major conflagration. The loss and damage to logging machinery and felled and bucked logs was high. Continued high temperature and low humidity accompanied by a 30-mile northeast wind drove numerous fires in western Washington beyond control and required the combined manpower and equipment of all protective agencies to combat.

September: A general rain during the morning of September 1 temporarily relieved a very critical fire situation in several western Washington counties. By September 5 most of the boys who comprised the emergency fire fighting crews had returned to school. Logging crews and fire wardens were the only available source of fire fighters. During the next 10 days there was a period of the worst fire weather that has occurred in many years. Temperature remained between 80 and 90 degrees, the humidity went as low as 10 degrees and fuel moisture was practically zero. Humidity remained comparatively low during the nights and there were continuous northeast winds. Fire weather warnings were sent to all logging operators on September 5 and 6 and again on September 8 and 9. By September 10 all available manpower and equipment was out on some 30 fires and most of the larger logging operations were shut down. On the afternoon of September 10 an order was issued by the State Supervisor of Forestry closing

down all industrial operations in or immediately adjacent to the woods west of Cascade Mountains, and all burning permits were canceled. This drastic action to some degree reduced the risk of new fires starting until some of the existing fires were controlled. By evening of September 11 heavy fogs were drifting into the coastal areas and the order closing logging camps operating in western Clallam and Jefferson counties and all of Grays Harbor, Pacific and Wahkiakum counties was rescinded, effective at midnight. For the remaining western Washington counties the closure order automatically expired at midnight of September 12 and industrial operations were resumed on September 13. During this critical fire weather several major fires developed. One 2,300-acre fire in a Cowlitz county logging operation burned the decking off several main line bridges, damaged considerable felled timber, and destroyed some seed areas. However, most of the acreage burned over was accumulated logging slashings. Another 3,000-acre fire started in a private patrol area in Kittitas county. It burned through approximately 2,500 acres of young timber and was very costly to control. The damage to standing timber was excessive. On September 11 a fire in Spokane county was set by a railroad locomotive and burned over approximately 3,500 acres of submarginal land. Some 300,000 board feet of timber was killed and a number of buildings destroyed. By September 13 there were general rains in western Washington and by September 16 rain had fallen in all parts of the state. The weather changed just in time to prevent one or more disastrous forest fires. During the balance of September the weather was cloudy or there were hard showers. No serious fire threats occurred during the last 15 days of September.

October: From the standpoint of weather, October was about normal with alternate clear, overcast and rainy days. There were no lengthy periods of continuous dry weather. Consequently, less slash burning than usual was done in October. However, October 27, 28 and 29 were bad fire weather days with northeast winds. One large logging company operating in Pierce county suffered considerable damage to railroad bridges, logging equipment and felled timber from a slashing fire.

November: As late as November 10 the wardens in northeastern Washington were fighting numerous fires caused by hunters and land clearing operations.

At the time of writing this report, 1,609 fires on state and privately owned lands had been recorded, seven of which reached major proportions and might easily have developed into disastrous conflagrations. The unusual number of railroad and logging operation fires may be accounted for as follows. Abnormal war traffic on railroads necessitated use of old coal-burning equipment without proper spark arresters. Trains were dispatched so frequently and ran so close together that it was impractical to operate the customary speeder patrols. Burning restrictions and labor shortages made it difficult to keep the rights of way cleared of inflammable material. There was unusual activity in the woods to meet lumber requirements prescribed for the armed services. Much of the logging was done by small contractors who did not have the necessary manpower or equipment to prevent or control fires in their logging operations. A substantial percentage of logging crews, both large and small, was composed of inexperienced men and the critical labor shortage reduced the usual number of watchmen and special

fire wardens in logging camps. Lightning fires during 1944 were nearly three times the number reported in 1943. There was a gratifying decrease in incendiary fires, due possibly to more rigid enforcement of the forest protection laws. There was a marked increase in the number of campers, smokers and slashing fires. More travel in the woods by the public during 1944 and the extremely long, dry summer season may account for the increase from these causes.

The large increase of acreage burned in 1944 and the high loss and damage to property, compared with 1943, may be attributed to the greater number of fires (319), the abnormally dry weather prevalent throughout the summer and the unusual number of logging operation fires. Logging fires generally start and spread in unburned slashings, are extremely difficult to control, and burn over comparatively large acreages, damaging adjoining equipment and logs. These fires increased from 46 in 1943 to 82 in 1944.

Considerable progress was made in development of better relations between sportsmen and timber land owners. The latter granted many concessions in the matter of restricted and closed areas. For instance, many logging operators and timber land owners entirely eliminated corridors along fishing streams from their closures. In some cases, the public was permitted access to lakes within closed areas. Many areas previously closed in the early spring were left open until June 1 or even later to give the fishermen a break. Previously, 2,339,840 acres of forest land were closed to the public prior to June 1. This year only 725,760 acres were closed before June 1. At the beginning of the fall hunting season, October 8, all closures were lifted by request of the land owners. Apparently the sportsmen appreciated the privileges extended to them and reciprocated by exercising extreme care with fire while hunting and fishing in the woods. There is ample opportunity and encouragement in this year's experience to promote much closer cooperation between the forest land owners and fishermen and hunters in the matter of fire prevention. The meetings between land owners and sportsmen were sponsored by the Keep Washington Green Committee. This committee, through its director, also organized local Keep Washington Green committees, composed of responsible and representative business men in 17 communities throughout western Washington. These local committees were very effective in publicizing the fire prevention campaign.

The ban on burning permits during the months of July and August increased the visibility and usefulness of the lookouts by 40 per cent and allowed the wardens, patrolmen and emergency crews to concentrate their entire efforts on control of accidental fires. The public generally recognized that, with the labor shortage and demand for uninterrupted production of critical war material, the additional risk of permit fires was unwarranted. There were few complaints and much public cooperation in the enforcement of this restriction. It is difficult to estimate the actual number of fires which might have spread beyond control if permit fires had been authorized through the critical fire months of July and August.

In one eastern Washington county, which is well covered by lookouts, the district warden relied entirely on the lookouts for detection and abandoned ground patrol. The wardens and patrolmen were all kept at headquarters and immediately available for fire call. The restriction on burning permits greatly increased the efficiency of lookouts and they did a splendid job of detecting and reporting fires. Wardens were immediately dispatched to fires

and the results were excellent. No fires spread to serious proportions and there was a saving of considerable time and expense that normally goes into ground patrol, a lot of which is blind and ineffective as soon as the patrolman passes through his district. The lookout method of detection and fire control warrants further investigation.

According to weather records, 1944 was the driest summer in 54 years. Most of the fire fighting was done by inexperienced boys under 18 years of age. There was a critical shortage of available labor and power fire fighting equipment. Replacements for repair of equipment were most difficult to obtain and often required delayed priorities. Both the office staff and field force of the State Division of Forestry were short of experienced and trained help. They were obliged to carry on under most difficult and trying circumstances. Their loyalty and devotion to duty is hereby recognized and commended.

The following is a condensed table of climatological information compiled from official reports of the United States Weather Bureau for the period January 1 to October 31, 1944. Note that the average precipitation for all months, except April and September, was below normal.

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
January	3.29	1.64	.....	8	7	16	9	10	12
February	2.84	0.90	.....	6	7	16	6	9	14
March	2.09	1.36	.....	8	9	14	12	11	8
April	2.77	.....	0.62	5	10	15	10	9	11
May	1.70	0.31	.....	9	10	12	13	10	8
June	1.47	0.12	.....	9	9	12	13	11	6
July	0.22	0.45	.....	14	10	7	22	7	2
August	0.40	0.44	.....	11	8	12	20	8	3
September	2.32	.....	0.57	14	6	10	17	7	6
October	1.56	1.48	.....	12	7	12	19	7	5

A summary of fires by months in eastern and western Washington indicates the direct relationship between atmospheric conditions and forest fires.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Total
Western Washington	1	3	28	66	163	110	315	274	177	18	1,155
Eastern Washington	.....	.....	6	5	30	56	150	126	63	18	454
Totals	1	3	34	71	193	166	465	400	240	36	1,609

Cooperation

Acknowledgment is herewith made to the following cooperators: the United States Army, the Army Air Corps, Navy and Coast Guard, the Keep Washington Green Committee and contributors, the Pacific Northwest Forest and Range Experiment Station, the Washington Forest Fire Association, the West Coast Lumbermen's and Western Pine Associations, the United States Weather Bureau, the National Park and Indian Services. The Washington State Patrol rendered outstanding service in reporting fires, stopping cars of occupants who tossed burning cigarettes out along the highways, and en-

forcement of the fire laws in special hunting areas. The National Forest Service was very helpful in securing radio parts, fire fighting equipment, and permitting the state to make direct purchases from the Forest Service warehouse. War forest fire control activities were financed by direct federal allotments, distributed through the Forest Service. The emergency fire crews were paid principally from these funds—$216,047.45 from special allotment and the balance of $89,979.29 from regular Clarke-McNary funds.

Law Enforcement

That the law enforcement officers were alert and on the job is verified by the fact they made, during the 1944 fire season, 196 arrests for violation of the forest protection laws. Of these cases 190 convictions were obtained, four were lost, and two are pending, having been appealed to higher courts. Included in this report is a table showing number of arrests and fines, by counties.

In addition to law enforcement, 17 collections, involving $3,637.39, were made for trespass in the form of illegal timber cutting on State Forest Board lands.

Equipment

Aside from ordinary replacements of small equipment, necessary for operation of the field, office, shop and radios, the Division of Forestry purchased during 1944:

1 2½-ton used Army G.M.C. truck for transporting caterpillar tractor
9 1½-ton new Dodge stakeside trucks
1 ½-ton International pickup } purchased with W.F.F.C. funds from
8 1½-ton Ford stakeside trucks } Bonneville Power Administration
2,500 feet of 1½-inch linen pacolized fire hose
5,000 feet of 1-inch cotton rubber-lined fire hose
5 Type Y Pacific portable power pumpers
1 complete power falling and bucking saw
1 portable grinding set for shop
7 Model 80 Edwards pumps for mounting on fire trucks.

Aircraft Warning Service

For two and one-half years the State Division of Forestry constructed, operated and maintained 79 aircraft warning observation posts for the War Department's Interceptor Command. Twenty-four of these posts were situated at regular state lookout points. The personnel comprised 158 observers, 24 relief observers, 14 communication men, two inspectors and two carpenters. The order came through to abandon this service by July 1, 1944, which necessitated considerable reshuffling and reassignments. Some of the observation posts were taken over by the state and maintained for balance of fire season as regular lookouts, others were moved to new locations and used as secondary lookouts or converted into living quarters for rangers or emergency fire crews, the balance was sold at public auction. It was quite a task, in the midst of the fire season, to remove the occupants and their personal belongings, as well as all government owned fixtures, from the buildings. The State Division of Forestry was given the opportunity of selecting any of the buildings it wished to keep. Most of the telephone lines and some expendable property were also transferred to the state. The department is proud of its contribution to this important service.

Radio

On June 30, 1944, the aircraft warning posts were discontinued and all radio equipment used by that system was transferred to fire control. This was a considerable addition to the existing state forestry radio system and made possible direct contact between headquarters and all of eastern Washington. During the spring of 1944 the forest fire radio activities of Weyerhaeuser Timber Company were taken over by the State Division of Forestry and all installation and maintenance was handled through the central radio shop at Olympia. Radio communication was used on all the larger fires and all standby crews were equipped with radio facilities. Construction of an additional 40 two-way portable radiophones was completed. During the 1944 season 60 per cent of fire detection by lookouts and 50 per cent of the dispatching of fire crews was by radio.

Buildings and Construction

Owing to the difficulty of obtaining priorities for building material, new construction was held to a minimum. It consisted of one new log type fire hall at Spokane, one new lookout tower at Tahuya in eastern Mason county, and a lookout house at Meadow Butte, Klickitat county. A dormitory and garage were built at Darrington from portable camp buildings purchased from the Sauk Timber Company. A new well, pump and water system were installed at the Elbe fire hall. Several aircraft warning observation post buildings were moved to district headquarters for extra housing facilities. Several new garages and woodsheds were constructed. There were minor alterations and improvements. Most of the fire halls were repainted, inside and out, and the grounds received various degrees of landscaping.

Slash Disposal

During 1944 applications for clearance on logging slashings totaled 179,484.72 acres, of which certificates of clearance were issued on 83,232.62 acres, 11,472.10 acres were rejected, and 84,780 acres are pending examination.

The number of conditional clearances issued for unburned slashings increases in direct proportion to the percentage of selective logging. It is unreasonable to require, in selective cutting operations, broadcast burning that either destroys or damages the remaining standing timber, which often results in creation of a greater fire risk than the unburned slashing.

There are indications that regrowth comes in more rapidly on unburned slash in the hemlock-spruce type areas than where slashings are burned. Consequently, some conditional clearances were issued in such areas, even though clear cut, without requiring any slash disposal.

State Forest Land Acquisition

In spite of continued heavy acquisition of delinquent tax lands by lumber companies for tree farms, the counties have deeded 17,322 acres to the State Forest Board, as follows:

Clark	180.00 acres
Grays Harbor	480.00 acres
Kitsap	2,995.67 acres
Mason	4,253.63 acres
Snohomish	5,358.59 acres
Whatcom	4,054.11 acres
Total	17,322.00 acres

All of these lands block into forest units already established and were voluntarily set aside by the counties for the State Forest Board. This is a culmination of the efforts of State Division of Forestry and county planning commissions to bring primarily forest lands back into timber production for future welfare of the counties. Since its inception in 1923 the State Forest Board, by sales of timber products and leases, has returned approximately $287,718.00 to the counties as their portion of receipts, and in lieu of lost taxes. The counties' percentage to date has amounted to about 84 per cent of the gross sales and at present constitutes a net return of 57¢ per acre on all lands deeded, which is more than 50 per cent of the usual price received from tax sales. Good forest practice and intensive fire protection have materially enhanced the value of these lands.

The State Forest Board is now administering 583,316.11 acres of forest land in 19 counties, as shown by the following table.

LANDS UNDER JURISDICTION OF STATE FOREST BOARD AS OF NOVEMBER 1, 1944

Counties	Lands Deeded By Counties In Trust	Gifts	Payment of Liens	Gained Through Exchange	PURCHASED			Total
					Utility Bonds	Forest Dev. Fund	Reclamation Revolv. Fund	
Clallam	85,753.42	2.50	.....	51.05	.....	.....	.....	85,806.97
Clark	27,074.91	.....	.....	.....	3,810.37	.....	.....	30,885.28
Cowlitz	10,425.38	5.00	280.00	.....	.....	160.00	.....	10,870.38
Grays Harbor	.....	1,650.12	.....	490.24	27,524.25	.....	.....	29,664.61
Jefferson	13,396.68	.....	.....	.....	.....	.....	.....	13,396.68
King	23,574.22	3.70	.....	.....	.....	.....	.....	23,577.92
Kitsap	9,175.94	10.00	.....	.....	.....	.....	.....	9,185.94
Klickitat	20,903.68	.....	.....	66.52	.....	.....	.....	21,060.20
Lewis	37,637.69	12.50	.....	458.66	.....	3,080.19	.....	41,189.04
Mason	26,994.88	40.00	550.00	.....	.....	.....	.....	27,584.88
Okanogan	.....	40.00	.....	.....	.....	.....	.....	40.00
Pacific	15,494.84	3,357.82	.....	.....	480.00	.....	4,477.86	23,810.52
Pierce	8,869.53	3.64	.....	.....	3,196.44	.....	.....	12,069.61
Skagit	58,376.87	50.74	.....	.....	.....	.....	.....	58,427.61
Skamania	38,356.75	.....	.....	.....	4,540.85	40.00	.....	42,937.60
Snohomish	60,585.84	.....	.....	362.87	.....	.....	.....	60,948.71
Thurston	21,479.19	300.67	.....	.....	23,197.80	600.08	.....	45,577.74
Wahkiakum	13,441.93	.....	.....	.....	.....	.....	.....	13,441.93
Whatcom	32,040.49	720.00	80.00	.....	.....	.....	.....	32,840.49
Totals	503,672.24	6,196.69	910.00	1,429.34	62,749.71	3,880.27	4,477.86	583,316.11

Classification

Applications have been made for classification as reforestation lands, under Chapter 40, Laws of 1931, of the acreages listed below. Very thorough field examinations have been completed by the State Division of Forestry, and the lands segregated and listed for public hearings.

Clallam	4,633.29 acres
Grays Harbor	8,865.35 acres
Jefferson	649.65 acres
Lewis	6,546.96 acres
Mason	23,139.42 acres
Pacific	360.00 acres
Pierce	1,920.00 acres
Thurston	5,038.69 acres
Total	51,153.36 acres

State Forest Nursery and Planting

Because of the war and uncertainty regarding availability of manpower for planting during 1945-46 season, no seed beds were sown at the nursery in 1944.

For the first time in several years, no damage resulted to seedlings in nursery beds from browsing of deer. An eight-foot fence of woven and barbed wire construction proved successful in keeping deer out of the nursery.

All buildings at the nursery were painted during the summers of 1943 and 1944, with other necessary maintenance being carried out to keep the structures in first class condition.

A new grain drill was purchased for planting soiling crops. This equipment is suitable for sowing vetch, oats, and rye deeper and more uniformly, with the advantage of overcoming difficulty previously experienced from frost heave.

A total of 537,000 Douglas fir 3-0 seedlings was planted during the 1944 season in the Little River plantation of Clallam county, Bear Prairie and Battle Ground plantations of Clark county, Kirkland High School and DeMolay plantations of King county, Winston Creek area of Lewis county, Fraley Mountain area of Skagit county, Sherman Valley plantation of Thurston county, and Bellingham High School, Galbraith Hill, and Mt. Baker High School plantations of Whatcom county. These plantations cover 1,125 acres and were planted by crews including hired civilians, high school pupils, boy scouts, junior forest wardens, and prison and reformatory inmates. A diversity of planting crews is advantageous from a public relations standpoint, especially when younger groups, such as boy scouts, high school pupils and junior forest wardens, are used, as this contact provides an excellent opportunity to impress upon them fire consciousness and the importance of forestry in the economy of Washington.

No seed was collected in 1944 as the cone crop was very spotty, being poor to fair in the Douglas fir region, with no report from the ponderosa pine area.

The following table gives the number of trees, acreage planted and location.

Counties	Number of Trees Planted			Number of Acres Planted		
	Previous to 1944	1944	Total	Previous to 1944	1944	Total
Clallam	490,634	12,000	502,634	984	20	1,004
Clark	166,450	10,040	176,490	252	16	268
Cowlitz	1,647,002	.....	1,647,002	2,744	.....	2,744
Grays Harbor	2,410,051	.....	2,410,051	3,905	.....	3,905
King	16,700*	11,000	27,700	25*	19	44
Lewis	1,407,335	30,000	1,437,335	2,174	42	2,216
Mason	47,700	.....	47,700	100	.....	100
Pacific	657,424	.....	657,424	1,052	.....	1,052
Pierce	1,203,446	.....	1,203,446	1,462	.....	1,462
Skagit	2,177,405	217,650	2,395,055	3,331	570	3,901
Snohomish	1,558,400	.....	1,558,400	2,285	.....	2,285
Thurston	1,978,889	148,630	2,127,519	3,427	272	3,699
Wahkiakum	718,430	.....	718,430	1,373	.....	1,373
Whatcom	145,450	107,980	253,430	278	186	464
Totals	14,625,316	537,300	15,162,616	23,392	1,125	24,517

* Planted during 1940, 1941 and 1942 and not previously recorded.

Recommendations

1. Responsibility for starting or existence of fires is vague and difficult to establish as set forth by Section 2, Chapter 152, Laws of 1937, as follows:

"Any fire on any forest land in the State of Washington burning uncontrolled and without proper precaution being taken to prevent its spread is hereby declared a public nuisance by reason of its menace to life or property. *Any person, firm or corporation responsible for either the starting or the existence of such fire* is hereby required to control or extinguish it immediately * * *."

Suggested amendment, patterned after Oregon forest fire law:

Any fire on any forest land in the State of Washington burning uncontrolled and/or without proper *action being taken* to prevent its spread, *notwithstanding the origin* of such fire, hereby is declared a public nuisance by reason of its menace to life and property. *The owner, operator and person in possession of land, on which a fire exists, or from which it may have spread, or either or any of them, notwithstanding the origin or subsequent spread thereof on his own or other land,* is hereby required to control or extinguish it immediately.

This proposed amendment would greatly strengthen the Washington law by definitely establishing responsibility, thereby making a practical and workable statute.

2. Section 1, Chapter 26, Laws of 1931—the Christmas tree law requiring state license—should be amended to include a provision that all commercial Christmas tree cutters and/or shippers must, while cutting or transporting Christmas trees, have in their possession written permission from the landowner to cut trees, including legal description of property from which trees are removed.

Such an amendment would help eliminate the illegal cutting of Christmas trees which is so prevalent.

3. The existing statute requiring slash disposal after logging operations should be amended and liberalized to the extent that unconditional clearances may be issued where timber has been selectively cut and the burning of such areas would result in destruction of seed trees and second growth; provided, however, that the owner is willing to assume or contract for the additional costs of protecting areas containing unburned slashings.

4. The present statute—Section 5, Chapter 154, Laws of 1923—provides that general utility bonds, issued for purchase of forest lands by the State Forest Board, can be retired only by actual receipts from sales of timber or money received from leases, oil or minerals, on lands covered by the specific bonds. This statute should be amended to state clearly that any money in the forest development fund may be used for retirement of any and all outstanding utility bonds issued by State Forest Board, particularly those bonds bearing the higher rates of interest, or for retirement of bonds in the order of issuance.

At present there is sufficient money on deposit in the forest development fund to retire, one hundred cents on the dollar, all outstanding utility bonds issued for purchase of forest lands. The state should not be required to pay interest on an outstanding bond for 75 years, or until such time as the timber becomes merchantable on the exact piece of land for which bond was issued, because the language of the existing law is ambiguous.

5. Each spring during February and March thousands of acres of young timber are destroyed by uncontrolled fern fires. Many slashing and land clearing fires are often set in the late fall after the closed fire season, which extends from April 15 to October 15 and during which written permits are

required for open fires. Regulated burning can only be accomplished by extending the closed fire season to cover the entire year and requiring written permits from local fire wardens for all open fires set within a forested county.

Table No. 5—ORIGIN, NUMBER AND CLASSIFICATION OF FIRES—1944

Counties	Lightning	Incendiary	Campers	Smokers	Slashing	Logging	Brush Burni'g	Railroads	Miscellaneous	Total
Chelan	6			5			2	10	9	32
Clallam			2	13	1	2	4	4	13	39
Clark	1	1	1	8			10	6	11	38
Cowlitz	4	2	1	12	1	6	6	14	12	58
Ferry	13			1					1	15
Grays Harbor	3	2		11		2	3	8	9	38
Island			6	7			5		4	22
Jefferson	1	2	1	9		1	4	5	4	27
King	11	4	6	29		2	20	22	23	117
Kitsap	1	2	4	36	1	1	31		26	102
Kittitas	1			15	1	3	6	29	14	69
Klickitat	6	4	1	10	2	3	3	3	10	42
Lewis	17	16	7	37	2	32	20	13	14	158
Mason	4	7	3	15	2	1	6	3	30	71
Okanogan	12		1	6					6	25
Pacific	10		1	9	1	5	5	4	3	38
Pend Oreille	11	1		2			1	2	12	29
Pierce	16	13	3	64		3	23	21	40	183
San Juan		5	3	1					1	10
Skagit	2		3	8	1	7	8	1	2	32
Skamania				4	1		2	7	1	15
Snohomish	8	1		6		2	9	7	21	54
Spokane	23	3	2	48		1	5	31	22	135
Stevens	38	1	1	21			6	3	21	91
Thurston	2	16	3	34		5	6	24	16	106
Wahkiakum				2					1	3
Whatcom		2	5	9	1	4	11		12	44
Yakima	3			5	1	2			5	16
Totals	193	82	54	427	15	82	196	217	343	1,609

Classification of fires: Class A (¼ acre or less), 745; Class B (¼ acre to 10 acres), 628; Class C (over 10 acres), 236.

Table No. 6—ACREAGE BURNED OVER—1944 FIRES

Counties	FOREST LAND			NOT REFORESTED			NON-FOREST LAND			
		Reproduction			Cutover Land					
	Merchantable Timber	Cutover	Old Burn	Old Burn	Slash Unburned	Slash Burned	Pasture	Brush	Other	Total
Chelan	322	827	.....	.....	.....	.....	7,963	.....	283	9,395
Clallam	.....	1	.....	.....	14	.....	1	9	2	27
Clark	1	53	.....	.....	48	70	268	59	5	504
Cowlitz	482	129	60	1	1,791	769	93	106	5	3,436
Ferry	13	.....	.....	.....	.....	.....	2	.....	.....	15
Grays Harbor	.....	.....	2	116	12	7	78	12	.....	227
Island	.....	2	10	.....	.....	.....	15	26	5	58
Jefferson	.....	10	45	54	7	.....	2	21	8	147
King	.....	74	75	595	26	3	190	1,379	2	2,344
Kitsap	.....	24	.....	.....	22	9	.....	107	17	179
Kittitas	2,639	3,536	.....	.....	91	17	1,954	1,130	15	9,382
Klickitat	225	42	5	.....	41	.....	495	386	3	1,197
Lewis	215	282	37	330	349	351	367	3,528	14	5,473
Mason	30	39	53	.....	2	2	.....	6	.....	132
Okanogan	556	3	.....	.....	.....	.....	7,859	5	122	8,545
Pacific	1	.....	.....	8	7	3	7	3	.....	29
Pend Oreille	1	15	344	5	.....	.....	.....	.....	.....	365
Pierce	3	146	128	30	229	27	213	456	22	1,254
San Juan	.....	81	3	.....	.....	.....	8	27	30	149
Skagit	2	165	70	.....	437	1	20	13	.....	708
Skamania	24	.....	360	.....	.....	3	.....	39	.....	426
Snohomish	.....	1	.....	2	16	.....	40	58	7	124
Spokane	244	5,461	.....	.....	106	.....	1,446	97	1,441	8,795
Stevens	25	140	.....	8	16	.....	49	12	5	255
Thurston	27	9	108	116	88	.....	430	93	13	884
Wahkiakum	.....	.....	.....	50	.....	.....	.....	.....	.....	50
Whatcom	6	16	155	.....	1,340	.....	7	121	140	1,785
Yakima	.....	14	.....	.....	.....	27	20	3,029	.....	3,090
Totals	4,816	11,070	1,455	1,315	4,642	1,289	21,527	10,722	2,139	58,975

Table No. 7—LOSS AND DAMAGE—1944 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	1,090	904	186	.....	.....	$1,535 00
Clallam	.....	.....	.....	.....	.....	.....
Clark	1	.....	1	.....	.....	1,770 00
Cowlitz	4,000	3,000	1,000	7,715	$39,410 00	.....
Ferry	10	.....	10	.....	.....	.....
Grays Harbor	.....	.....	.....	.....	.....	.....
Island	.....	.....	.....	.....	.....	.....
Jefferson	.....	.....	.....	.....	.....	.....
King	.....	.....	.....	.....	20,000 00	994 00
Kitsap	.....	.....	.....	.....	.....	.....
Kittitas	248	68	180	5	.....	2,215 00
Klickitat	40	10	30	.....	.....	150 00
Lewis	48	42	6	1,172	16,550 00	1,680 00
Mason	80	.....	80	.....	.....	954 00
Okanogan	209	20	189	.....	.....	5,086 00
Pacific	2	.....	2	66	160 00	.....
Pend Oreille	1	.....	1	.....	.....	.....
Pierce	2	1	1	.....	200 00	430 00
San Juan	.....	.....	.....	.....	.....	.....
Skagit	1	.....	1	.....	.....	.....
Skamania	44	23	21	.....	.....	2,500 00
Snohomish	8	.....	8	.....	75 00	50 00
Spokane	392	210	182	.....	.....	15,732 00
Stevens	4	.....	4	.....	.....	300 00
Thurston	168	67	101	40	3,500 00	6,035 00
Wahkiakum	.....	.....	.....	.....	.....	.....
Whatcom	75	60	15	2,170	9,300 00	271 00
Yakima	.....	.....	.....	.....	.....	.....
Totals	6,423	4,405	2,018	11,168	$89,195 00	$39,702 00

Total loss and damage to all classes of property—$273,003.00.

Table No. 8—BURNING PERMITS, CLASSIFICATION AND ACREAGE OF LAND BURNED UNDER PERMIT—ARRESTS AND FINES—1944

COUNTIES	BURNING PERMITS				ARRESTS AND FINES	
	Permits	Camp Fire Permits	Protection Acres	Agriculture Acres	Number	Fines and Costs
Chelan	371	.....	219	200	.....	.....
Clallam	1,211	3	539	3,323	4	$79 50
Clark	13	.....	.....	.....	24	278 00
Columbia	14	.....	48	.....	.....	.....
Cowlitz	977	4	5,259	2,155	1	12 00
Ferry	34	.....	50	157	.....	.....
Grays Harbor	1,160	1	604	809	6	77 50
Island	365	.....	477	698	3	77 50
Jefferson	389	4	100	343	1	27 00
King	4,760	13	2,954	3,657	38	788 25
Kitsap	3,531	22	3,746	503	21	511 00
Kittitas	358	1	1,312	1,290	.....	.....
Klickitat	236	.....	137	1,297	.....	.....
Lewis	3,030	15	6,266	10,697	5	93 60
Mason	2,446	75	3,325	2,474	9	226 00
Okanogan	18	.....	80	509	.....	.....
Pacific	764	1	460	1,825	8	175 75
Pend Oreille	738	11	191	997	.....	.....
Pierce	2,031	84	4,740	2,455	15	175 00
San Juan	134	.....	388	160	.....	.....
Skagit	1,568	3	20,313	12,720	18	367 50
Snohomish	141	.....	.....	749	19	488 75
Spokane	852	21	411	40,615	1	2 00
Stevens	2,193	35	4,986	17,620	1	12 00
Thurston	1,614	2	885	2,428	13	294 50
Wahkiakum	323	.....	30	858	.....	.....
Whatcom	2,268	.....	1,185	7,485	8	191 50
Yakima	20	.....	640	9	1	52 50
Totals	31,559	295	59,345	116,033	196	$3,929 85

DIVISION OF GEOLOGY

HAROLD E. CULVER
Supervisor

GENERAL STATEMENT

The Division of Geology, as specified under the civil administrative code of 1921, is required to direct its activities to the development and conservation of the State's mineral resources. Acting as a fact-finding bureau the duties of the division are to ascertain the real mineral wealth of the State and to make public the facts concerning the various mineral deposits in the State so that efficient exploitation may follow.

During the biennium of 1942-1944 the division's activities have been directed toward the accomplishment of economic objectives. All work has been concentrated on either deposits of strategic minerals or deposits of other important minerals, the development of which would further the war effort. The major part of the division's efforts comprised the investigation of potential sources of magnesium, iron, tungsten, chromium, and oil and gas in Washington. Considerable time was devoted to work on individual deposits of coal, copper, antimony, nickel, molybdenum, mica, quartz crystals, bentonite, and diatomite.

Identification service, established in 1925, has been continued. By this means citizens of the State can receive, free of charge, expert examination of rock, mineral, and ore samples. Quantitative assays and analyses, such as might be furnished by commercial laboratories, are not made, but the material submitted is identified and the sender is advised as to its nature, commercial possibilities, and what quantitative assays or analyses should be made.

Many additions were made to the division's card file (now containing more than 13,000 items) of Washington mining properties and mineral occurrences. A collection of representative ore and wall rock samples from about 500 Washington mining properties has been organized for rapid reference and is being added to continually. Serving as a basis for field studies, the card file and ore collection are invaluable time savers in mineral studies.

Aid and unofficial cooperation were given the various federal agencies working on Washington mineral deposits, namely, the U. S. Bureau of Mines, U. S. Geological Survey, and Reconstruction Finance Corporation. Aid and advice in the prospecting and development of mineral deposits were given to numerous prospectors and miners throughout the State and much information on Washington geology was presented to the general public.

MAJOR ACTIVITIES

Magnesium—Washington is fortunate in its possession of immense quantities of two ores of this important metal. The occurrence of magnesite, the simple carbonate of magnesium, containing over 20 per cent metallic magnesium, is practically restricted to Stevens County, but the quantity there available seems to be enormous. Dolomite, the double carbonate of magnesium and calcium, and therefore a lower grade ore of magnesium, is present in great volume in at least five counties, although the actual calculation of total tonnages has not been attempted. The total amount available in readily accessible areas runs into billions of tons, each ton capable of yielding about 260 pounds of metallic magnesium.

During the early part of the current biennium the Division of Geology Report of Investigations No. 7 on the Turk magnesite deposit of Stevens County was made public. This report demonstrates the existence of over 1,500,000 tons of easily mined, high-grade magnesite in the Turk deposit. Shortly thereafter a comprehensive investigation of the dolomite resources was begun. Detail studies have been completed of the Riverside deposits of Okanogan County, the Old Fort Spokane dolomite deposits of Lincoln County, and the Addy dolomite deposits of Stevens County, and the results of these studies have been published as Report of Investigations No. 13. A general discussion of the geology of each area is followed by complete description of each deposit. In addition there is given the recorded ownership, accessibility for quarrying and shipping, composition shown by chemical analyses, estimated tonnage, and suggested diamond drilling. Both the sample locations and the suggested diamond drilling are shown on the large-scale topographic maps of each deposit.

Very large tonnages of easily mined dolomite of high grade have been mapped, and although the tonnage calculations were of necessity based on incomplete analytical data it is believed certain that the minimum figures will be exceeded, rather than reduced, when all the facts are known. As estimated for this report there are indicated about 290 million tons of easily mined high-grade dolomite in those deposits examined in the Riverside area, some 53 million in the Old Fort Spokane deposits, and about 268 million more in the Addy deposits, a total of over 600 million tons of dolomite for the present and future magnesium industry of Washington. Of some 500 samples selected for analysis only a few could be run prior to the publication of the report. Early in 1945 the tabulation of chemical data for the entire series will be completed and issued as a supplementary report to No. 13.

Other important deposits of dolomite remain to be investigated in the State and a series of reports will present the results of further studies as they are completed.

Iron—Within the past few years, largely because of changes in market and power factors, iron deposits in Washington have acquired new value. Previously considered of little importance because of small size, they are now regarded as potential sources of ore. Scores of iron ore occurrences have been reported in the geologic and mining literature of Washington, but very little has been known as to tonnages of iron ore in most of the deposits. To obtain reliable facts on which to base tonnage estimates the Division of Geology began the determination of the probable dimensions of the known deposits, starting with Buckhorn deposits of Okanogan County in 1942.

During the past two years detail geologic and magnetic studies have been made on the Crystal Butte, Strawberry Mountain, and Pateros deposits in Okanogan County; on the Blewett-Cle Elum deposits in Kittitas and Chelan counties; on the Big Iron, Read, and Connor deposits in Stevens County; and on the Anderson deposit in King County. The economic aspects of the Blewett-Cle Elum iron deposits appeared as Reports of Investigations No. 10 and No. 12, while the information of stratigraphic character is presented as Report of Investigations No. 11. The information on the other above-mentioned iron deposits is now being compiled. In 1943 Report of Investigations No. 8 was published. This report presents the information that was acquired during the summer of 1942 on the Buckhorn iron deposits of Okanogan County. These reports indicate the presence of some 18,000,000 tons of

magnetite ore in the Buckhorn deposits and 5,650,000 tons of hematite-magnetite ore in the Blewett-Cle Elum deposits.

During the past summer the division has done considerable preliminary work on the hematite and limonite deposits of Stevens County. Extremely high-grade hematite ore occurs in the Hill and Brown deposits, and good limonite ore occurs in the Kulzer, Napoleon, Thompson, and Bechtol deposits. Since adequate development work necessary to indicate the extent of the ore has not been done on any of these deposits and since the hematite and limonite ores do not lend themselves well to dip needle studies, it will be necessary to employ some other means of acquiring the necessary data for the bases of tonnage estimations. The hematite deposits contain the best iron ore in Washington, and it appears that the limonite deposits have possibilities of containing remarkably large tonnages. It is recommended that adequate diamond drilling be done on these deposits to prove their extent and that sufficient chemical analyses be made of the core samples to verify the grade of the ore.

Tungsten—Studies of Washington tungsten deposits were begun in 1938 and consisted of field examinations of all known occurrences of the two main ore minerals, wolframite and scheelite. The objective of this work was to determine the quantity of tungsten ore reserves in the State and to establish a working basis for locating new occurrences of tungsten minerals. Several times it was thought that field examinations of all known deposits had been completed only to find that there were newly discovered, unexamined deposits. An unexpected relationship between tungsten, copper, and molybdenum minerals was found and this together with the use of the ultra-violet light has disclosed many previously unknown occurrences of scheelite. A comprehensive report on all of the deposits of tungsten so far examined in the State is now being prepared.

Chromium—Washington has produced only a small amount of chromium ore, but deposits are known to exist in Whatcom, Skagit, Kittitas, and Okanogan counties. None of the occurrences indicates vast deposits of high-grade ore, but some do contain large amounts of low-grade ore that may respond favorably to concentration. During the past biennium the results of previous field work on deposits of chromium ore were compiled and will be published in the form of Bulletin No. 36.

Oil and Gas—Both State and out-of-State interests are again becoming increasingly attracted to Washington as a source of petroleum. This State is commonly regarded as the last untested field in the West from which production may confidently be anticipated.

Ever since the publication of Bulletin No. 13 on the stratigraphy of western Washington, the State Division of Geology has been instrumental in furthering the search for oil and gas. During the past biennium the collection and study of logs and drill samples have been continued.

An earlier study of the entire series of strata along the west coast of the Olympic Peninsula has been completed during the present biennium. The large-scale maps giving the stratigraphic and structural data are essentially ready for publication. This most valuable contribution to the scientific search for oil in Washington will be printed early in 1945.

TOPOGRAPHIC MAPPING

Because of the emphasis on the war effort by both State and Federal agencies, the preparation of topographic maps for Washington has progressed at a reduced rate. So far as State funds are involved, this work has been continued as a cooperative effort by the Department of Conservation and Development and the Topographic Branch, U. S. Geological Survey. Renewed yearly, this contract has provided for the services of the expert federal staff to be used on quadrangles mapped in Washington. In addition to such arrangements, independently financed projects have been under way by the U. S. Geological Survey and the Corps of Engineers, U. S. Army. Through all these agencies about 80 per cent of the area of the State has been mapped in 15- or 30-minute sheets.

During the current biennium cooperative mapping has been confined to the four quadrangles in Asotin County. The Army work has been concentrated on marginal areas.

PUBLICATIONS

The following list of publications, printed and distributed during the current biennium, indicates the scope of the division's major activities for the past two years. Reports now in compilation for publication cover magnetite iron deposits in Okanogan and Stevens counties, tungsten deposits of Washington, the stratigraphy and structure of a part of the Olympic Peninsula, chromite deposits of Washington, and the stratigraphy and structure of the south half of the Colville quadrangle in Stevens County.

Reports of Investigations

7. Character and tonnage of the Turk magnesite deposit, by W. A. G. Bennett. 1943. 22 pp. 1 map.

8. The Buckhorn iron deposits of Okanogan County, Washington, results of a magnetic survey, by W. A. Broughton. 1943. 21 pp. 1 map.

9. Inventory of mineral properties in Chelan County, Washington, by Marshall T. Huntting. 1943. 63 pp. 1 map.

10. The Blewett iron deposit, Chelan County, Washington (with preliminary tonnage estimates), by W. A. Broughton. 1943. 17 pp. 1 map.

11. Stratigraphic aspects of the Blewett-Cle Elum iron ore zone, Chelan and Kittitas counties, Washington, by Ralph L. Lupher. 1944. 63 pp. 2 maps.

12. Economic aspects of the Blewett-Cle Elum iron ore zone, by W. A. Broughton. 1944. 42 pp. 7 maps.

13. Dolomite resources of Washington, Part I, by W. A. G. Bennett. 1944. 35 pp. 12 maps.

RECOMMENDATIONS

The activities of the Division of Geology are planned and carried out with regard to the present war-time need and to the future peace-time development of our mineral resources. These activities have been briefly outlined in the foregoing pages and it can be seen that three lines of service are followed, namely, **strategic and economic investigations, field service,** and **publication of results** of investigations.

1. Several projects including work on iron, copper, molybdenum, mercury, magnesium, aluminum, salines, diatomite, and oil and gas have been

started. The early completion of these investigations, as well as other equally important investigations not yet begun, is temporarily delayed by loss of staff both to the armed services and the more lucrative employment of private industry. Competent and experienced geologists and technicians will be added to the staff as soon as they become available. During the present biennium it has been impossible to obtain adequate assistance for the regular staff geologists. With the relief from man-power shortage, the work of the Division of Geology can be pushed effectively.

Modern methods of mineral exploration should be made available to staff geologists. This would necessitate the purchase of geophysical equipment and the addition of specially trained technicians, but the results would more than compensate for the extra expenditure. Geophysical methods of studying mineral deposits have been demonstrated to be reliable, relatively inexpensive, and great time savers considering that they give definite results that cannot be approximated except by long and expensive development work.

Accurate estimations of ore tonnages must be made for many of the Washington mineral deposits before plans for their development and utilization in industry can be made. This is especially true of the iron deposits, some of which lend themselves readily to magnetic studies and some of which, the hematite and limonite deposits, do not. The State might well provide for the early diamond drilling of these hematite and limonite deposits so that the whole picture of Washington iron ore reserves can be visualized. Drilling programs should also be set up for some of the other mineral deposits such as diatomite and the salines. Supplemented by adequate chemical work, this program should add materially to our understanding of the State's wealth.

2. An important, but little publicized, service of the Division of Geology is the incidental aid and advice rendered to prospectors, miners, and the general public by staff geologists in the course of their field investigations. It is recommended that this service be permitted to expand by the addition of experienced geologists, specialists in their fields, to the present entirely too limited staff.

3. Many worthwhile investigations have been begun and the groundwork for others has been laid. Information obtained by these investigations should be regarded as property of the Washington citizens and should be made available for their use. The most practical and satisfactory method of distributing this information is in the form of published reports. It is therefore recommended that provision be continued for the publication of such bulletins, reports of investigations, and special papers, together with maps and illustrative material, that are necessary to present the results of the geological investigations to the Washington public.

When giving consideration to these three recommendations it should particularly be noted that the requests are not for expansion of the work of the Division of Geology in new and untried lines, but instead are wholly planned to provide the citizens of the State with the benefit of work already completed or in progress.

DIVISION OF MINES AND MINING

SHELDON L. GLOVER
Supervisor

INTRODUCTION

During the past biennium, October 1, 1942 to September 30, 1944, the Division of Mines and Mining has continued to add to its fund of available information on Washington mineral deposits of present and future economic value, to aid in the development of our mineral resources, and to supply industry with information on sources of raw materials. Many of the activities had a more-or-less direct bearing on war needs, as, for example, certain limestone investigations, made when reports were requested on a special low-phosphorous stone; studies initiated on nickel occurrences; and evaluation of iron ores for ship ballasting. Various war-related investigations have continued, but a shift from war needs to plans for postwar development became a marked feature of the requests and inquiries from industrial organizations as the biennium advanced. This has had a direct influence on the activities of the Division, and has indicated the direction that future investigations must take if maximum value is to be obtained from the work carried on.

ECONOMIC IMPORTANCE OF THE MINERAL INDUSTRY

The **direct** money value of the State's mineral industry is indicated by the following table of 1942 production, the most recent year for which statistics are reasonably complete. It should be realized that this is **new** wealth; also that the **indirect** value to the State is in far greater amount than indicated, owing to the economic importance of industries that are dependent on or subsidiary to basic mining.

STATE OF WASHINGTON MINERAL PRODUCTION FOR THE YEAR 1942①

PRODUCT	Quantity	Value
Clay and clay products		$1,500,000②
Coal ..... short tons	1,971,185	7,536,588
Copper ..... pounds	16,060,000	1,943,260
Gold ..... troy ounces	75,396	2,638,860
Lead ..... short tons	4,851	650,034
Lime ..... short tons	55,864	623,766
Sand and gravel ..... short tons	5,634,676	4,094,900
Silver ..... troy ounces	369,038	262,427
Stone ..... short tons	1,965,700	1,809,757
Zinc ..... short tons	14,398	2,678,028
Miscellaneous③		12,000,000②
Total		$35,737,620

① Statistics in part from published information of the U. S. Bureau of Mines, and Chief Mine Inspector.
② Estimated from information in files of the Division of Mines and Mining.
③ Includes portland cement, fluorspar, diatomite, iron ore, magnesite, manganese ore, mercury, strontium minerals, and tungsten ore.

INFORMATION ON MINERALS AND MINING

The Division is called on to provide information on an endless variety of matters pertaining to mining and the mineral industry. Some inquiries may appear trivial, but they are important to the inquirer, as, for instance, questions regarding mineral rights on farm land or what to do when well water

discolors fabrics. Or an inquiry may be of such importance as to justify dropping all other activities and concentrating every facility on providing an answer, as when one phase of the war's aviation program depended on the availability of a few pounds of a vital mineral. The Division's part in this last is indicated in "The Metal that Couldn't be Found," under Report to the Editor, Saturday Evening Post, p. 6, September 2, 1944.

Providing authentic and immediate answers to these voluminous inquiries is one of the most valuable functions of the Division and one that is appreciated by the greatest number of persons. It is partly handled by correspondence, partly in office conferences, and, occasionally in "field" or out-of-office conferences. During the past biennium more than 2,000 items were handled by correspondence. These varied from 52 to 119 and averaged 84 letters per month. Office conferences, generally of greater importance and permitting of more adequate treatment than is possible by correspondence, numbered nearly 1,000; they varied from 18 to 65 and averaged 41 conferences per month.

EXAMINATION OF MINING PROPERTIES AND MINERAL DEPOSITS

A basic activity of the Division is the examination of mineralized areas and of specific mining properties. This is a source of firsthand information on the occurrence of minerals of economic value—information that may have an immediate industrial application or that, on the other hand, may be added to the continually expanding file of similar data for future industrial needs. It enables the Division to keep in touch with the progress of mining development and forms the basis for reports on mining operations and on mineral resources. It also makes possible a personal acquaintance with prospectors and operators whereby their problems can be discussed and, if desired, advice can be given at the property regarding the geology of the ore occurrence and feasible procedures of development and exploitation.

During the past biennium more than 600 field conferences were held, and 456 properties or mineral occurrences were examined in more-or-less detail, depending on the information desired and the amount of time that the investigation warranted.

COAL STUDIES

Coal is one of the State's most valuable mineral resources. Since the first mine was opened some 90 years ago, approximately 140 million tons has been produced, adding close to one-half billion dollars in new wealth to the State. In 1918, 4,128,424 tons, valued at $14,564,445, was produced; in 1942, another war year, only 1,971,185 tons, valued at $7,529,926, was produced despite the availability of great coal reserves and a strong market demand.

In an effort to aid the coal-mining industry in every possible way, a mining engineer of long experience in coal-mine operation, both here and in other states, was added to the staff of the Division. All coal operations are visited as occasion arises, and the problems of production and marketing are considered. Meetings are arranged, as in cooperation with the Seattle Chamber of Commerce in June 1944, where conditions adversely affecting the industry are discussed and remedial action planned. Tangible benefits from this work are already being obtained.

COOPERATION WITH OTHER AGENCIES

As in the previous biennium, active cooperation with Federal agencies and with other State agencies was maintained. The Division cooperates with the U. S. Bureau of Mines in the collection of statistics of mineral production; this does not require much time but does involve an annual trip throughout the State in order to prevail on operators who may be delinquent in making returns to supply the data upon which the Minerals Yearbook is based, and also to acquire the names of new producers. The Division has been able to supply the U. S. Geological Survey and Bureau of Mines with information on the location of certain resources—as high-alumina clays—and, on request, has accompanied their representatives on field trips. It is hoped that this has been of service to the Federal agencies in their succeeding detailed studies and exploration programs. In return, the Division has been generously supplied with data obtained by both the U. S. Geological Survey and Bureau of Mines.

It has been possible to supply other Governmental agencies with requested information. Conferences and correspondence of mutual benefit have been held with representatives of the War Production Board, Petroleum Administration for War, Smaller War Plants Corporation, and with Senate Investigative Committees. Also, aid was given the Army in the matter of establishing training camps for personnel engaged in the production of road metal and dimensional stone—this last, incidentally, involving lectures by members of the staff to the trainees.

The Division has the equipment and trained personnel to be of service to State departments who occasionally may deal with matters of geology, mineralogy, or mining. This cooperation is freely offered in the belief that it is more economical and generally advantageous to the State for such matters to be referred to full-time specialists trained in such work than that it be handled by inadequately trained men, or as merely incidental to other activities, or that technical assistance be disregarded or be nonavailable. In line with this policy, aid, on request, has been given to the Highway Department and License Department, and is available to other State agencies.

MINERAL EXHIBIT

A permanent display of commercial minerals is maintained for the benefit of prospectors and to acquaint industrialists with the raw materials that are available in the State. It is not designed as a museum collection, but rather to be a working exhibit of economically valuable materials whose appearance and physical properties are best learned through the actual handling of typical samples. The 200 or so specimens cover the whole field of industrial minerals occurring here. Aside from its general educational value, the collection has proved to be indispensable as a source of illustrative material to be used in conferences regarding the State's resources, particularly in the field of nonmetallics.

LABORATORY RESEARCH

The Division is fortunate in having available most of the scientific equipment that is needed to properly carry on the continuing research that necessarily accompanies the field examination of mines, prospects, and newly discovered mineral occurrences. Such work may be minor in amount or it may involve long and painstaking study; it is an integral part of activities and cannot be slighted if useful results are to be obtained.

The facilities were fairly complete, chiefly necessitating the purchase of

reagents and other expendable supplies during the past biennium and the improvising of equipment for the study of ores in polished section. The War Production Board advanced the laboratory's priority rating to AA-1, thus providing for the acquisition of essential materials, but the purchase of a few instruments that are still needed must be postponed until after the war.

MINERAL IDENTIFICATION SERVICE

It is possible to examine, identify, and evaluate minerals and rocks from the State, submitted by prospectors or anyone else who may have need for such service. No laboratory facilities are required that are not already available and in use for regular Divisional activities. This provides valuable information without cost to those who submit the samples, and the Division commonly benefits through the opportunity to learn of new occurrences of mineral substances. In this way, more than 400 samples were examined during the past biennium, and information was supplied on the value and possible utilization of the materials.

PUBLICATIONS

Reports of general interest to the mining industry are published as expeditiously as possible. However, much of the work of the Division is of such nature that publication of the results obtained is not feasible or desirable. For example, the activities coming under the head of individual aid to prospectors and small-mine operators and the work necessitated by increasingly numerous inquiries covering the whole field of mineral occurrences, development, and utilization are originally of limited interest. These activities are handled through personal correspondence and conferences, commonly of confidential nature. They are of basic value to mining and to the general industrial development of the State, but they do not result in specific reports for regular distribution. Other activities are of broader interest and are primarily designed to supply information that can be published. The following reports were distributed during the biennium just past or were prepared and are nearly ready for distribution:

REPORTS OF INVESTIGATIONS

4. Coal and Coal Mining in Washington, by Stephen H. Green.
5. Memorandum Report on Iron Ores of the Cle Elum District, Washington, by Carl Zapffe.
6. Relation of Geology to Mineralization in the Morton Cinnabar District, Lewis County, Washington, by J. H. Mackin.

(Nos. 5 and 6 give the result of investigations made by the Northern Pacific Railway Co., and were made available to the Division of Mines and Mining through the courtesy of that organization and the authors.)

7. Manganese Deposits of the Olympic Peninsula, Washington, by Stephen H. Green. (In preparation.)
8. Geology and Ore Deposits of the Sultan Basin, Washington, by Ward Carithers and A. K. Guard. (In preparation.)

INFORMATION CIRCULARS

8. Directory of Washington Mining Operations, by Ward Carithers.
9. 1944 Directory of Washington Mining Operations, by Stephen H. Green.
10. Geologic factors of quarrying, by Sheldon L. Glover and W. A. G. Bennett.

MINE-TO-MARKET ROAD COMMISSION

Ed Davis, Director, Dept. of Conservation and Development, **Chairman**
P. Hetherton, Executive Officer, State Planning Council, **Secretary**
Burwell Bantz, Director, Department of Highways, **Member**

In the biennium ending September 30, 1944, the Mine-to-Market Road Commission received 21 petitions for roads to serve mineralized areas. As soon as possible after the receipt of petitions, steps were taken to ascertain the nature and extent of mineralization, the most feasible route for the proposed road, and the cost of construction. Every effort was made to clear approved projects as expeditiously as possible, so that construction could begin. In some instances, however, it was necessary to have the approval of the War Production Board, in order that priority for construction could be obtained; a denial of priority, of course, resulted in the suspension of any work on a given project.

Agencies of the Federal Government evinced interest in several projected roads that might aid in the production of critical minerals and made preliminary offers of assistance in such construction; these offers were accepted by the Commission and complete cooperation assured the Federal agencies, but the offers were withdrawn, preventing cooperative construction.

Sixteen petitions were received and acted upon for new roads not previously considered under the mine-to-market road law. Also, four new petitions were received for roads previously under consideration and one for added construction on a road nearly completed at the end of the preceding biennium. The aggregate length of all roads considered was 73¼ miles.

Following is the record for the biennium:

Chelan County—The construction of the extension of the Stehekin River road, begun in the previous biennium, was completed. The amount expended in the biennium ending September 30, 1944, was $10,581.72.

A petition was received in July 1944 for a road less than one mile in length in Winesap Canyon. This road was authorized, and constructed at a cost of $991.90.

Clallam County—In December 1943 a petition was submitted for a road 6½ miles in length up Little River. The necessary investigations were made, $395.25 being expended on the survey. No construction was authorized, as the proposed road is partly within the Olympic National Park, and right-of-way from the Park Service has not yet been obtained.

Jefferson County—A petition was submitted in August 1944 for a road about one mile in length in T. 26 N., R. 4 W. Investigations were authorized.

King County—In February 1944 a petition under the 1943 mine-to-market road law was submitted, superseding a petition filed in January 1942, for a road about 2 miles in length into Coney Basin. A contract in the amount of $22,125 was let for this construction. On September 30, 1944, the amount of $7,850.64 had been expended.

A petition was submitted in September 1943 for a road 3 miles in length to some limestone properties in T. 26 N., R. 10 E. Before action could be taken the petitioners advised the Commission that they were applying for Federal access-road funds, making unnecessary any further attention from the State.

Lewis County—In September 1943 a petition was submitted for a road about one mile in length to serve a coal area. The road was authorized, and constructed at a cost of $2,314.36.

In January 1944 a petition was submitted for a road less than a mile in length to coal properties in Hanaford Valley. A subsequent change in the petitioner's plans rendered action by the Commission unnecessary.

Lewis-Thurston Counties—Identical petitions were received in August 1944 from each county for a road about one mile in length in T. 15 N., R. 2 W. Construction was authorized, but by the close of the biennium only one county had submitted a resolution to bear its part of cost.

Okanogan County—In October 1943 a petition was submitted for a road up Goat Creek, requiring about 2 miles of new construction. Necessary investigations were made and the cost of construction ($7,700) was ascertained and reported.

In March 1942 a petition was submitted for a road about 4 miles in length to an area east of Monse. This road was established and partially constructed, but right-of-way difficulties caused suspension of work. The sum of $1,202.55 was expended in this biennium.

Pend Oreille County—A petition was received for a road, designated as the Coffin road, 2½ miles in length, to a mineralized area in sec. 16, T. 38 N., R. 42 E. Construction was authorized and work commenced, $1,004.79 being expended to the end of the biennium.

In August 1943 a petition was submitted for a road less than a mile in length in the vicinity of Leadbetter Lake. This road was established and constructed at a cost of $3,023.17.

In November 1943 a petition was submitted for a road less than a mile in length up Noisy Creek. The road was authorized, and constructed at a cost of $1,369.68.

A petition was submitted in June 1944 for a road 2½ miles in length in T. 37 N., R. 41 E. Investigations were authorized.

Skagit County—A petition was received for a road up the Cascade River from the end of the present road to Gilbert cabin, a distance of about 9 miles. Reports on mineralization and feasibility were favorable and the cost was estimated at $96,460. Later the petitioners applied for Federal access-road money, and although the Commission was informed that this request was denied, no further steps were taken to obtain State aid.

Skagit and Whatcom Counties—A new petition was received, superseding several that had been submitted under the old law. This was for a road, 12 miles in length, in Skagit and Whatcom counties to serve part of the chromite-ore area of the Twin Sisters Mountains. The Public Roads Administration advised the Commission that Federal access-road money would be available, in the amount of $70,000, for this construction. The total cost was estimated at $118,450. The Mine-to-Market Road Commission authorized construction, but later the Public Roads Administration notified the Commission that the War Production Board had finally decided the project was not justified.

Snohomish County—In July 1943 a petition under the 1943 law, superseding a former petition, was submitted for a road 6 miles in length up Williamson Creek. This road was authorized and $341.81 expended on the survey.

Despite repeated efforts to get clearance from the War Production Board, no priority could be obtained, so construction is indefinitely delayed.

In December 1943 a petition was submitted for a road 4½ miles in length in Sultan Basin, it being understood that the Federal Government would contribute $16,000 toward the cost. In March 1944 the Commission was advised that Federal funds would not be available.

A petition was submitted in July 1944 for a road 9½ miles in length in Sultan Basin, and investigations were authorized.

Whatcom County—A petition was submitted in June 1943 for a road less than a mile in length at the head of Slate Creek. In September, petitioners requested that investigations be postponed until later.

The following roads, previously authorized and begun, were completed and balance of costs paid in the current biennium:

Grays Harbor County: Cook Creek road, $8,572.92.

Snohomish County: Barlow Pass-Monte Cristo road, $3,709.81.

Okanogan County: Squaw Creek road, $1,958.76.

Chelan County: Merritt-Chelan road, $40.51.

COLUMBIA BASIN COMMISSION

ED DAVIS
Chairman

The present Columbia Basin Commission was authorized by Chapter 283, Laws of 1943, for the purposes of furthering the authorization, planning, construction and development of the Columbia Basin irrigation project; the development of the hydroelectric resources of the Columbia River and the discovery and uses of mineral, agricultural and industrial resources of the adjacent area. The commission has seven members including the State Director of Conservation and Development, as its chairman. It is divided into two sections, the Reclamation Section with three members selected by and from among each of the boards of directors of the three Columbia Basin irrigation districts, and the Resources Section with three members appointed by the Governor. The State director is the fourth member and chairman of each section.

The commissioners thus selected, who have served during the past report-biennium, are as follows:

Ed Davis, Director, Department of Conservation and Development, Chairman. Reclamation Section: Don Damon, Cunningham; W. O. Marshall, Connell; J. A. Weber, Quincy (representing the three irrigation districts). Resources Section: Fred J. Cunningham, Spokane; Rufus Woods, Wenatchee; Thomas D. Welborn, Brewster.

Early in its deliberations, the commission concluded that its primary task was to exercise its influence toward the allocation of Coulee Dam costs to the various uses which the project is capable of serving, and the early preparation of repayment contracts in order that they might be negotiated and executed as early as possible. To these ends the commission engaged the services of James O'Sullivan, who has been intimately connected with the power and irrigation ends of the project since its inception. He was sent to Washington, D. C., where a major part of his time has been spent since, and where he has put forth every effort in the interest of the commission's two primary objectives.

In the meantime, the commission devoted its efforts and meetings primarily toward informing our own people and others of the importance and value of the Columbia Basin project to the State and Nation. Frequent meetings of the commission were held at various population centers of the State on both sides of the Cascades. By arrangement, they met in a body or as individuals with various organizations interested in the development of our State. During the early summer of 1943, members of the commission attended public hearings held by the Army Engineers in Montana and Idaho in regard to storage of waters in those two states for the benefit of local and down-stream power development on the Columbia River. Members also appeared before the Sub-committee of the House Interior Appropriations Committee, which was touring the Northwest and holding public hearings at various points for the purpose of obtaining information and local points of view regarding reclamation and other water utilization projects in this region. Friendly contacts were established with various parties interested in the British Columbia section of the Columbia River Basin with the view to conservation of water on the Canadian side of the boundary in the interest of

mutually beneficial and over-all Columbia River development. As a result of all these meetings and contacts it is believed that the commission has, in a material degree, met the educational responsibilities placed upon it by law.

The commission has also given considerable attention to the studies imposed upon its Resources Section. It has arranged with the Department of Conservation and Development for the compilation, by its Division of Geology and Mines and Mining, of a folio of maps showing the known occurrences of metallic and non-metallic minerals in the Columbia River Basin and the status of their development and utilization. This work is now well under way and the results will be available soon. The commission has likewise arranged for a thorough survey and evaluation of deposits of mineral salts in the Columbia Basin region. Work on this project will be undertaken early this fall. Results of sundry mineral investigations in the basin have also been made available for study by the commission.

Shortly before the close of the report period the commission engaged the services of Charles E. Cone of Chelan as research assistant to the Resources Section.

Sufficient agreement on allocation of Coulee Dam costs was reached during the summer of 1944 to permit a preliminary draft of the repayment contract between the three Columbia Basin irrigation districts and the Bureau of Reclamation to be prepared and submitted for the consideration of the districts and the commission during the latter days of September of this year.

The primary task of the commission for the immediate future will be the cooperation with the Columbia Basin irrigation districts in their study of the provisions of the repayment contract as well as of the recordable contract, as and when a draft becomes available, and an effort to obtain such changes as may be indicated as desirable in the interest of the districts and the State. It is anticipated that this will involve considerable effort and expense on the part of the commission. After the contract with the districts has been executed the commission's efforts will be directed toward securing such authorizations and appropriations as may appear desirable and necessary for the inauguration of construction of the irrigation system as soon as the war situation permits men and material to become available.