STATE OF WASHINGTON

Department of Conservation and Development

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DIVISION OF NATURAL RESOURCES

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Report of Natural Resources Survey

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LETTER OF TRANSMITTAL

February 28, 1935.

Mr. E. F. Banker, Director,
Department of Conservation and Development,
Olympia, Washington.

Dear Sir:

Herewith is submitted report of activities carried on under grant of $80,000 from the Washington Emergency Relief Commission, for a Natural Resources Survey, with particular reference to stream measurements, river surveys, topographic mapping, and geological and mineral investigations. Report is also made of expenditures from the $20,000 allocated to your Department by the Columbia Basin Commission, for equipment of a laboratory at the State College of Washington, and for a study of power markets that may become available through development of mineral resources.

A financial statement is attached.

Respectfully,

THOMAS B. HILL, Assistant,
Division of Natural Resources.

FOREWORD

A systematic survey of the natural resources of the state was undertaken in the summer of 1933 by the Department of Conservation and Development. For the purpose of carrying it out more efficiently, and to provide employment to unemployed engineers, technical men and laborers, both in making the survey and through opportunities that might be developed by the survey, the Washington State Emergency Relief Commission granted the sum of $80,000 to the Department of Conservation and Development, making particular reference to stream gauging, river surveys, topographic mapping and geological and mineral investigations.

On September 1, 1934, there was made available to the Department by the Columbia Basin Commission, from its allocation of the Emergency Relief Fund, the sum of $20,000, approximately one-half of which was to be used in the investigation of a power market in connection with the development of the mineral resources, and the other half for special equipment for the laboratory of the Department of Mines and Metallurgy at the State College of Washington to work on the electro-metallurgical and electro-chemical problems of the mineral resources, in the interest of industrial development in connection with power production at the Coulee dam on the Columbia river.

In undertaking this survey it was recognized that much work already had been done by this department and by various other departments and institutions of the state, in many instances with the cooperation of the Federal Government, and that the particular task was to proceed toward the completion of the various programs. It was also recognized that the natural resources are closely interrelated and therefore the survey of any resource would naturally involve consideration of other resources. To establish harmonious relationships and lay the foundation for efficient co-operation and co-ordination several conferences were held, which were attended by representatives of the various state and federal departments and institutions most directly concerned with the subjects under consideration.

The following report deals primarily with the activities for which the sum of $100,000 of Emergency Relief Funds was allocated; namely, stream measurements, river surveys, topographic mapping, and geological and mineral investigations. Account is also made of money received under C. W. A. and W. E. R. A. projects, for mineral investigations and topographic mapping. Report is made on a Coast and Geodetic Survey project, sponsored by this department, and on flood rehabilitation and control. Because of their close relationship to the survey of natural resources, brief reference is also made to certain work of the Divisions of Reclamation, Hydraulics and Forestry, and some statistics on hydro-electric resources are included.

GEOLOGICAL INVESTIGATIONS

The special activity of the Division of Geology in the survey of natural resources has been with respect to areas of the state not heretofore covered. The purpose of the Division of Geology is to tie its present work in with that already accomplished, to compile all of this data, and prepare a geologic map of the entire state. In connection with this, much original and research work is being done by the Division in developing material for a bulletin to

then operated until February 7, but on a very limited scale after November 30. In the meantime a grant of $20,000 was made available by the Columbia Basin Commission from its W. E. R. A. allotment, for the purpose of equippng a laboratory at the State College of Washington for electro-metallurgical and electro-chemical work, and also for special investigations as to markets for power.

In conducting these mineral investigations every effort has been made to avoid duplicating work that had previously been accomplished and to co-operate with the University of Washington, Washington State College, United States Bureau of Mines and other agencies interested and active in the development of the mineral resources. Laboratory facilities of the state institutions and of private industrial firms have been offered and used with good results.

Mineral Inventory

An inventory of occurrences of minerals and mineral products of the state include the following:

Non-Metallic Resources

Asbestos	5	Mineral pigments	10+
Barium	3	Mineral waters	20+
Beryl	1	Natural alum—some reported	
Brucite	1	Natural gas—abundant	
Chalk	2	Oil, seeps and tests	8
Diatomite	41	Phosphate rock	1
Dolomite—1 operated; many others		Potash (reported)	1
Feldspar	2	Sand, foundry	2
Fluorite	2	Sand, glass	2
Fuller's earth—some reported		Semi-precious stones	
Garnet	3	Serpentine	6
Graphite	6	Silica (quartz)	5
Gypsum	1	Sillimanite	1
Kaolin—with Spokane clays		Slate	3
Limestone { Eastern Washington	101	Soapstone	9
Limestone { Western Washington	38	Sodium carbonate	1
Lithium	2	Sodium sulphate	2
Magnesite	11	Sulphur	2
Magnesium sulphate (epsomite)	2	Talc	9
Marble—see Limestone		Travertine	7
Marl	4	Vesuvianite	4
Mica	4	Vivianite	2
		Volcanic ash—abundant	

Metallic Resources

Aluminum—from Spokane clays		Mercury	10
Antimony	13	Molybdenum	23
Arsenic	14	Nickel	6
Bentonite	1	Platinum	18
Bismuth	4	Pyrite	19
Chromite	5	Pyrrhotite	15
Cerium	2	Solenium	2
Cobalt	2	Silver	53
Copper	67	Strontium	2
Gold (lode)	95	Tin	7
Gold (placer)	55	Tungsten	19
Iridium	1	Uranium	2
Iron	23	Vanadium	1
Lead	60	Zinc	16
Manganese	24		

These minerals are widely distributed throughout the state, nearly every section having some deposit of possible commercial importance. Many of these deposits of various kinds have been visited during these investigations, and all stages of development, ranging from a bare prospect to producing mines have been found. Many mineral areas have been found to be larger and much more important than was previously known.

Mine-to-Market Roads

One of the important results of the investigations has been the disclosure that there are important mineral areas that have remained undeveloped because of lack of transportation facilities. The construction of mine-to-market roads, in many instances should result in immediate and profitable operations. In most instances, too, such roads would serve for forest protection and development, and for recreational purposes. Many mineral deposits are on state lands, and their development would result in substantial accretions to the school funds of the state.

Practical Results

Because of information developed and assistance rendered by these investigations, several deposits are being worked, producing new wealth, providing revenues to the state in royalties, and giving employment to a large number of men. Material assistance has also been given to existing operations.

Markets for Power

One of the important purposes of these investigations has been to study potential power utilization in connection with the mineral industry. The results disclose that there are a large number of mineral deposits that will require electric power; and in fact their development is dependent upon an abundant supply of cheap power. There is a very definite opportunity for the production of ferrous alloys from deposits within the state. Ferromanganese, ferrochrome, ferrosilicon, ferrovanadium and others are dependent upon large quantities of cheap electric power for their economic production. The ores carrying these various materials are known to exist in quantities in this state. Up to the present time they are practically undeveloped, but sufficient work has been done to demonstrate their importance. Further field work and metallurgical research will materially aid in the establishment of the ferro-alloy industry in this state in connection with the extensive power development now under way.

The extensive copper deposits known to occur in various sections of the Cascade Mountains, and the zinc deposits in the northeastern parts of the state, offer an opportunity for large consumption of electric power in the recovery of copper and zinc by electro-metallurgical processes.

There are a number of large properties reported to carry gold, silver and some of the base metals, commonly referred to as large low-grade properties, which, if worked on a large scale, and provided with cheap power, offer opportunities for profitable production. These would be large consumers of power. There are also possibilities for the establishment of a carbide industry, which is dependent upon cheap and abundant supplies of limestone, coal and electric power.

The commercial production of aluminum and magnesium for raw materials known to occur in this state by electro-metallurgical processes is being carefully investigated by the Department of Mining and Metallurgy of the State College of Washington. The establishment of the iron and steel industry based on using the iron ores of the state in the electric furnace process of the reduction is another possibility.

The mineral resources of the state offer large opportunities for utilization of power, and conversely cheap electric power will aid materially in the development of the mineral resources.

Market Research

A market research was conducted for a brief period to ascertain what mineral products are used in Washington industries, their source of origin, current market price and general specifications. It was desired to determine to what extent Washington minerals may find a market in this state. It was also desired to determine what market might be developed for Washington minerals in other parts of the United States. While only a beginning of this work could be made, some valuable information was disclosed. For instance, it was found that the pulp and paper industry of Washington requires approximately $3,000,000 worth of mineral products. While the state is now supplying only about ten per cent of this, the investigations indicated deposits from which a considerable portion could be furnished. Among the products used in the pulp and paper industry are limestone, burnt lime, slaked lime, sulphur, soapstone, talc, sodium sulphate, sodium carbonate, and china clay.

The United States is largely dependent upon foreign importations for its supply of manganese, chromium and tungsten, used in the manufacture of ferrous alloys, and essential to the manufacture of iron and steel. As the State of Washington has supplies of these minerals, a special investigation was made on the occurrence and nature of the deposits, and on methods of preparing for commercial use.

Some chemical research was undertaken to determine the economical treatment of the saline deposits of magnesium sulphate, sodium sulphate and sodium carbonate, and to investigate the possibilities of producing either elemental sulphur or sulphur dioxide from the pyrite deposits of the state. While there was no opportunity for extended research, it was revealed that economic methods could be developed for the recovery of sodium sulphate, sodium carbonate and magnesium sulphate. The experiments encouraged the belief that with special laboratory facilities a process may be developed for the production of sulphur. No doubt this work can be advantageously done by the chemical engineering departments of the state institutions.

Assaying

Some assaying and listing of samples was done in private commercial laboratories, but most of it was done by employing assayers and using the facilities of the mines departments of the University and the State College. A total of 937 samples were obtained from 267 different properties, from which 2058 determinations were made.

Metallurgical Tests on Gold Ores

A large number of metallurgical tests were made on the gold ores of the Republic district and considerable progress was made in solving a difficult problem. It is believed that a large tonnage of ores from a number of well developed properties of the district could be mined profitably if treated by a centrally located custom plant. The success of this program would probably create employment for several hundred men and utilize much power.

Manganese Metallurgy

Very important metallurgical work was carried on in connection with manganese ores from the Olympic Peninsula. Reports of field engineers, supplementing work previously done by United States and Washington Geological Surveys, indicated that there are extensive bodies of ore in commercial quantities. Many samples of outcroppings and developed areas have been taken, with indications that there are many million tons, largely as manganese silicate, with moderate tonnage of manganese oxide. Extensive metallurgical research was conducted, and special furnaces were constructed, with highly satisfactory results. A commercial grade of ferromanganese was produced from the manganese-silicate ores tested. The manganese deposits of the Olympic Peninsula offer an opportunity for the establishment of a new industry that would give employment to a large number of men, consume a large quantity of electric power and supply a product of national economic importance.

Chrome

Chrome deposits are reported in different parts of the state, principally on Twin Sisters Mountains, in Whatcom County, Cypress Island in Skagit County, Mt. Chopaka in Okanogan County, and Mt. Hawkins in Kittitas County. The investigations indicate substantial amounts of ore on Twin Sisters Mountain, which is of high grade quality which requires no special metallurgical research for its conversion into ferrochrome. Further investigation may show that the other occurrences are of importance.

Tungsten

Tungsten has been produced in this state in Stevens County, by German interests. Conditions of its production and transportation indicate that the ore was of very high grade. This mine is now being worked to a limited extent. There is a deposit near Bumping Lake in Yakima County, another in Okanogan County. These have important possibilities. Other occurrences have been reported, one that may have real possibilities in Skamania County.

Molybdenum

A number of deposits of molybdenum are reported from different parts of the state. There is one near Omak, and another near Tonasket. The latter may have commercial importance. Commercial grades of molybdenum are reported on the North Fork of the Skykomish River, another on Railroad Creek in Chelan County, and a large deposit near the Diablo dam site on the Skagit River. There is a deposit on Sheep Mountain in Okanogan County, and on the Naches Pass highway near the summit of the Cascades.

Vanadium

Vanadium is reported to occur in Snohomish County, in Skamania County and in other sections of the state, but have not been investigated.

Iron

Investigations of iron ore deposits confirmed previous investigations and reports as to extensive deposits of commercal importance, when conditions are favorable for marketing.

Conclusions

The following conclusions were reached from the investigation of the ferrous groups: (a) All the raw materials (including coal and limestone and other fluxes) are available in quantity; (b) there will be an adequate supply of cheap electric power; (c) a production plant can be erected on Puget Sound offering world-wide distribution facilities.

Light Metals

In light metals investigations were confined to a search for raw materials as the metallurgical work is being done by the Department of Mines and Metallurgy at the State College. Reported occurrences of bauxite, the principal source of aluminum, in various sections of the state were investigated but none was found of commercial importance. Many samples of alumina clay were submitted to the Ceramics Department of the University, and some were found to offer possibilities.

Raw materials for the production of metallic magnesium were investigated. The most important at present are the magnisite deposits of Stevens County. Other deposits were reported from Snohomish and Chelan counties, but further investigation is required to reach a conclusion as to their importance.

Investigations on reported deposits of beryllium in the Nespelem district, and in other sections, did not show commercial quantities. However, these investigations were only preliminary, and more extensive studies might show encouraging results.

Placer Investigations

Exclusive placer investigations were made on the Columbia River, over that area that will be flooded by the Coulee Dam. Pay values were found in many instances. As a result about a dozen mechanical plants have been installed, and many small hand operations were under way. On December 1st it was estimated that 2500 yards of gravel were being handled, with a recovery in excess of $450 per day. The total number of men working at that time was estimated at over 200. It is believed this number will be greatly increased at the close of the winter season. Some surface testing has been done on the Yakima River above Ellensburg, on the South Fork of the Nooksack, and on the beach sands near Long Branch on Puget Sound, with encouraging indications.

Gold-Lode Deposits

A large number of gold-bearing lode deposits have been investigated. These may be divided into three classes, as follows:

1. Where gold is the principal value, the ores carrying sufficient values to work on a small scale.

2. Dikes and large deposits where gold content is relatively low, and can only be worked profitably by large scale operations.

3. Where gold is associated with silver, copper, lead, zinc or other base metals, and where it is not necessarily the principal value of the ore.

Deposits that would fall under the first group have been examined in Stevens, Okanogan, Chelan, Whatcom, Kittitas and Skamania counties. Many properties in these counties may probably be developed into profitable producers.

In the second group areas have been investigated in Yakima, Okanogan, Pierce and Whatcom counties.

Under the third group many properties have been examined in Ferry, Stevens, Okanogan, Snohomish, King, Yakima and Skamania counties.

In many of these indications point to opportunity for profitable operations, but detailed examinations are necessary before definite conclusions may be reached.

Silver and Base Metals

A number of deposits have been investigated and reported upon where the principal values are either in silver or a combination of silver with other metals. Among these are deposits in Stevens, Ferry, Okanogan, Snohomish and Clark counties. There are a number of other known deposits in various parts of the state.

Copper, Zinc, etc.

There are many extensive deposits of copper in the Cascade Mountains. Some of these were examined, while information previously prepared by engineers was examined, leading to the conclusion that the copper deposits of the state offer opportunity for extensive operation. With cheap power available, and transportation facilities provided, the development and operation of these deposits should give employment to many men, and use great quantities of electric power.

The zinc deposits of Pend Oreille County were examined in some detail, and the conclusion reached that extensive operations on large low-grade ore bodies are possible with a plant using electro-metallurgical processes for zinc recovery, and the possibility of combining this treatment with one for manufacture of super-phosphate.

Arsenic, bismuth, cadmium, etc., occur in varying quantities with silver, copper and others listed. These were found in connection with the general investigations, but no special investigations were made with regard to them.

Antimony is reported in different parts of the state, the principal deposits being in Ferry, Kittitas, Chelan and Okanogan counties. They may have considerable future importance but present market conditions are not encouraging.

Nickel and cobalt are reported to occur in different parts of the state, but no special investigations of these were made.

Clays, Etc.

Various samples of clays were submitted to the Ceramics Department of the University, which is making extensive studies of the clays of Washington.

Silica deposits suitable for the production of ferrosilicon were reported. These would be of particular value in the event of the establishment of the ferro-alloy industry. Silica sands suitable for glass were reported, and several deposits of molding sand were reported, and some found to be of good grade.

Deposits of limestone are widely distributed over the state on which there had previously been developed much information. A limited investigation was made for the purpose of finding deposits suitable by reason of quality and proximity for use in the pulp plants.

Saline Deposits

Sodium sulphate, sodium carbonate and magnesium sulphate are known to occur in considerable quantities in different parts of the state. No field work was done because of general information available, but an investigation of the recovery problem was instituted under the direction of a chemical engineer, and encouraging results were obtained. Sodium sulphate is important because Washington pulp mills use over 35,000 tons annually, practically all of which is imported. Sodium carbonate and magnesium sulphate have a market for various purposes. The development of these saline deposits would be important, and would add materially to the industrial pay rolls.

Sulphur

The matter of sulphur was given particular attention in the investigations, both in the matter of deposits, and of metallurgical recovery. One large pyrite deposit in Snohomish County was investigated with encouraging results. Other pyrite deposits were reported, as also were deposits in the form of brimstone. From the pyrites it is believed that either elemental sulphur or liquid sulphur dioxide can be economically produced. The production of sulphur in this state is important because market investigations reveal that at least two million dollars worth of sulphur are used in this state, in the pulp mills and for agricultural purposes.

Soapstone and Talc

There are extensive deposits of soapstone in Skagit, Chelan, Stevens and Okanogan counties. As a result of investigations there has been a material increase in the production of soapstone. Tests have been made on the talc that can be produced from these deposits and show that talc suitable for a paper filler can be made.

Diatomite

There are extensive deposits of diatomite in this state, both in central Washington and west of the Cascades. Material from sixteen of these deposits was tested and analyzed and it was found that a product equal to that which is imported can be obtained for nearly every requirement, either from some one or a combination of different deposits.

Peat

There are many deposits of peat in this state, which if properly and economically dried may compete with the several thousand tons that are imported.

Asbestos

Two deposits of asbestos, one long-fibre and the other short-fibre, were investigated; other deposits were reported. It is believed that there may be successful development, depending on market demand.

Graphite, Etc.

Several graphite deposits were reported, but no detailed investigations were made.

Samples of whiting were submitted to the Ceramics Department of the University for analysis and determination.

Assays of barite deposits in Ferry County indicate it of satisfactory quality for oil well drilling. Should an oil or gas field be developed in this state there should be considerable demand for this material.

A deposit of strontium in Skagit County was investigated, and found to contain high quality that could be cheaply produced.

Mercury has been produced from cinnebar deposits in Lewis County. Other cinnebar deposits have been reported from Chelan, Kittitas, Skamania and Clallam counties, but only a preliminary investigation was made.

Coal Markets

The only investigations made in the matter of coal was to find increased markets and new uses. Among definite findings made was on the opportunities for increasing the use of hand fired stokers for domestic use. It is interesting to note that recently coal companies report a substantial increase in the use of stokers and the sale of coal for this purpose. It was also found that there are distinct possibilities of increased use of powdered coal as an industrial fuel. The use of domestic coal would be greatly increased if public institutions would use Washington coal in place of imported fuel oil.

Miscellaneous

Many other minerals and mineral products were reported, during the investigations, but no detailed work was done on them. It is known that there are great quantities of building and ornamental stone and building materials.

In addition to the actual investigations and tests, information has been furnished to many people, some seeking investment, and others desiring information on the mineral resources for various purposes.

In all of the work of investigating the mineral resources every effort was made to avoid duplicating work that has been done or is being done by state institutions, departments or other agencies, and to co-operate to the fullest extent wherever possible.

Public Interest

A most encouraging feature of the investigations was the public interest that was manifested and co-operation extended by individuals, communities, industrial concerns, etc. Many communities, through their chambers of commerce and otherwise, rendered noteworthy service, both independently and co-operatively.

Inventory of Mines

In addition to work on a mineral inventory, a beginning has been made on a directory of mining properties in co-operation with the Division of Geology. Over seven hundred properties have been listed. The completion of this work is of first importance. It involves the collection of detailed information with respect to each property. The completion of this information is essential to the consistent and intelligent promotion of the mining industry of the state.

LABORATORY EQUIPMENT AND POWER MARKET INVESTIGATION

The sum of $20,000 of Emergency Relief funds was made available to the Department of Conservation and Development by the Columbia Basin Commission, $10,000 of which was for the purchase of laboratory equipment and supplies for the Department of Mines and Metallurgy at the State College of Washington, and $10,000 for further research and investigation of mineral resources and their possible use in the consumption of power.

The purpose of the laboratory equipment is to provide facilities at the State College for special research and experimentation in electro-metallurgy and electro-chemistry for the production of aluminum, magnesium and other light metals from Washington minerals. The equipment and supplies have been ordered and are being installed.

The research and investigations with respect to power markets have been conducted in connection with the geological and mineral investigations and are included in that report.

TOPOGRAPHIC MAPPING

As topographic mapping is of primary importance in the development and economic utilization of natural resources, such as highways, land use, forestry, flood control, reclamation, irrigation, power development, etc., it was felt that this program should be furthered to the fullest extent possible.

This work has been carried on for many years under a co-operative arrangement between the state and the United States Geological Survey. About one-half of the state had been mapped up to the beginning of the year 1934. This department set up a C. W. A. project for mapping under a supervisor provided by the United States Geological Survey.

About thirty engineers, topographers, levelmen, rodmen, chainmen, etc., have been employed, the cost being paid from Grant 14 when the C. W. A. and W. E. R. A. project was discontinued. Under the project the Olympia 15 minute quadrangle was mapped. The Troutdale 15 minute quadrangle on the Columbia River near Vancouver has also been completed. The maps of these two quadrangles have been forwarded to the U. S. Geological Survey at Washington, D. C., and will be published in the regular order.

In addition to the above, the topographic branch of the U. S. Geological

Survey completed the Mount Constance quadrangle in the Olympic Peninsula, an area of special importance on account of the manganese deposits, and also because of recreational and other features. The Survey has also mapped the Eatonville quadrangle southeast of Tacoma, the Metaline quadrangle in Pend Oreille County and the Ft. Simcoe quadrangle in Yakima County. Primary control was completed on the Marcus quadrangle in Stevens and Ferry counties.

In the northwestern part of the Olympic Peninsula the U. S. Army Corps of Engineers completed an area of considerably more than one 30 minute quadrangle. This was part of an aerial mapping program, on which the flight work was practically completed in 1933, and the ground work in 1934.

The total topographic mapping program for 1934 amounted to an area of about one-seventh of all that had previously been mapped.

U. S. COAST AND GEODETIC SURVEY

A project for coast and geodetic survey work was carried out with C. W. A. funds under the direction of this Department, with Dean C. E. Magnusson of the University of Washington as supervisor. The surveys made by the U. S. Coast and Geodetic Survey were basic for all surveys in the United States.

The U. S. Coast and Geodetic Survey has established over many years a series of points at various distances of twenty-five or more miles apart. These triangulation stations cover the greater part of this state. Primary level lines have also been established mainly in the areas having triangulation stations. In order to make this data readily available as reference points for ordinary surveys it is necessary to supplement the primary triangulation work by a network of local control surveys. The C. W. A. project referred to was for the purpose of making these surveys.

For local control survey course starts at a point definitely located by primary surveys and continues along a desirable route to another established primary point. Along the local control survey a succesSon of concrete monuments are erected. Successive monuments are inter-visible and located such distance apart, up to a few miles, as may be determined by the nature of the terrain. On top of each monument is a brass cap, the central point of which is located definitely in latitude, longitude and elevation. The direction of lines connecting successive monuments is also definitely determined and recorded.

From these monuments surveys already made in the region can be definitely traced in and corrected so as to correspond to the basic North American datum of 1927. All future surveys can readily be made accurate by using any one of the Coast and Geodetic control survey monuments for basic datum.

As the need for control surveys is greatest in the more populous sections, this project was carried on in the vicinity of Seattle, Tacoma and Everett. Other sections had been selected for the work in both Western and Eastern Washington, but C. W. A. funds were discontinued before they could be reached.

The following is a summary of the work accomplished, all of which was

caused the setting up of many C. W. A. projects to cope with the situation. The greatest damage was in the area of western Washington from the Columbia River to Skagit County, although the damage was also severe and widespread in Skagit and Whatcom Counties. There was also severe damage in eastern Washington, particularly in the Yakima and Wenatchee valleys. The major work of rehabilitation and repair was ultimately under the direction of the U. S. Army Engineers, although counties and other municipal divisions contributed substantially. The funds were largely provided by C. W. A. and W. E. R. A. It is not practicable or necessary here to outline in detail the work that was done. All badly flooded areas, where damage was widespread, were given attention and work was done costing probably well in excess of $2,000,000. The expenditures through projects were as follows:

Under C. W. A.	$1,288,262.96
Under W. E. R. A.	502,294.37
Total C. W. A. and W. E. R. A.	$1,790,557.33

Much additional work was done by the State Highway Department, various counties, private interests, etc.

This department co-operated in all this work, and is using its facilities, the data it has developed, and the information gained through this emergency experience to formulate a permanent flood control program. The development of facts with regard to all flood areas and all the streams of the state is of first importance.

FORESTRY

The Department of Conservation and Development through its Division of Forestry is responsible for the protection of some twelve million acres of state and privately owned forest lands, and employs during the summer about 400 fire wardens, rangers, patrolmen and lookouts.

Co-operation in the work of forest promotion and protection is had from the federal government and larger timber owners who maintain the Washington Forest Fire Association. Approximately $300,000 a year is expended under this co-operation. This is exclusive of expenditures made by the federal government on National Forests and by logging companies. There is now organized fire protection in 31 of the 39 counties of the state.

In addition to the regular work in forest promotion and protection, there has been added in the last year the Emergency Conservation work of the CCC. The Division of Forestry has had from 5 to 16 CCC camps under its direct supervision. A consolidated progress report of work accomplished to July 1 by the camps under supervision of this department follows:

New road construction	805.3 miles
Conversion abandoned logging railroad grades into truck trail	622 miles
Horse trail	164.9 miles
Telephone line	238.5 miles
Fire trail	535.9 miles
Roadside clearing	333.9 miles
Bridges constructed	234
Fire fighting	21,355 man days
Snags felled	75,474
Hazard reduction	5,732 acres
Lookout towers constructed	5
Ranger stations constructed	4

Because of the increasing forest protection by this department the average area burned per fire was reduced from 208 acres for the 1917-1924 period to 128 acres for the 1925-1932 period, and to 48 acres for 1933. Marked reduction in damage and loss of property was a feature of 1934.

As fire protection is the determining factor in natural reforestation, this has been measureably improved each year. Cut-over and burned areas, when properly protected from fires reforest rapidly as is plainly demonstrated by the thousands of acres now bearing a fine crop of reproduction.

Under the State Forest Land Policy inaugurated by the legislature of 1929, the Division of Forestry has examined and classified some three hundred thousand acres and has received applications for examination of an additional half million acres. These lands must be found more suitable for growing timber than for other purposes and the land owner must agree to use this land for the sole purpose of producing timber. The lands are valued at $1 an acre in Western Washington and 50c an acre in Eastern Washington. Under this policy an increasing amount of reforestation will be carried out on privately owned lands.

A State Forest Board was created by the legislature in 1923. This board has acquired by gift or purchase about 100,000 acres of cut-over land for reforestation. These lands are reforesting in a very satisfactory manner. In this manner large areas may be developed as state forests. Proceeds from the sale of dead cedar, Christmas trees and stumpage may make these forests self supporting and cost the State no direct out-lay of capital.

Under the forestry laws, forest lands may be acquired from counties and at present the department has a crew in the field examining some 300,000 acres of county owned forest lands which probably will be added to the state forests.

Through all these methods the state is thus rapidly developing forest lands.

The Department has compiled an inventory of the forest resources of Washington showing a total timber stand of 276,271,000,000 B. M. This total is composed of species in the following order: Douglas Fir, Western Hemlock, Western Red Cedar, Western Yellow Pine, Noble Fir, Sitka Spruce, Western Larch, Western White Pine, and miscellaneous.

The area covered by this timber amounts to 11,541,000 acres, or more than one-fourth of the area of the state. The ownership is divided as follows:

Federal	88,927,000,000 B. M.	on 6,148,360 acres;
State	22,027,000,000 B. M.	on 1,000,000 acres;
Private	145,691,481,000 B. M.	on 4,392,640 acres.

The rate of depletion has been as follows in a normal year:

Logged	171,050 acres
Burned	12,242 acres
Total	183,292 acres

The value of the forest industry of Washington has been about $200,000,000 a year, employing about 86,000 men in logging camps and lumber mills.

The federal forest service is making a detailed inventory and economic survey of counties.

GRANT 14 EMERGENCY RELIEF FUND

March 31, 1935

Total Grant to Department of Conservation and Development			$80,000.00
Allocated for Stream Gauging on a cooperative basis with the Water Resources Branch of the U. S. Geological Survey		$20,000.00	
Allocated for River Surveys on a cooperative basis with the Conservation Branch of the U. S. Geological Survey		10,000.00	
			30,000.00
			$50,000.00
Expended as follows:			
Geology			
Salaries	$13,776.79		
Expenses	4,957.29		
Supplies	647.06		
		$19,381.14	
Oil Investigations			
Salaries	$1,162.00		
Expenses	371.83		
Supplies	.....		
		1,533.83	
Research Mineral and Geology (Spokane)			
Salaries	$2,356.14		
Expenses	691.14		
Supplies	65.68		
		3,112.96	
Mineral Investigations			
Salaries	$3,766.17		
Expenses	287.85		
Supplies	61.33		
		4,115.35	
Topographic Mapping			
Salaries	$13,130.48		
Expenses	1,201.18		
Supplies	369.40		
		14,701.06	
Administration			
Salaries	$4,702.16		
Expenses	446.83		
Supplies	24.92		
		5,173.91	
			48,018.25
Balance available for all purposes except Stream Gauging and River Surveys March 31, 1935			$1,981.75

GRANT 46 COLUMBIA BASIN COMMISSION

Mineral Research

March 31, 1935

Total Grant to Department of Conservation and Development for Mineral Research—September 1, 1934			$20,000.00
To be expended for Mineral Research.....	$10,000.00		
Expended as follows:			
Salaries	$6,353.83		
Expenses	1,594.13		
		7,947.96	
Balance for Mineral Research.....		$2,052.04	
To be expended for equipment and supplies for laboratory in College of Mines, State College of Washington.....	$10,000.00		
Expended	8,354.68		
Balance for laboratory equipment.....		1,645.32	
Balance of Grant 46—March 31, 1935.....			$3,697.36

MINERAL INVESTIGATIONS

March 31, 1935

Expended as follows:

	Salaries	Expenses	Total	
C. W. A. Funds	$17,017.90	$397.73	$17,415.63	
W. E. R. A. Funds.....	13,208.95	1,301.68	14,510.63	
				$31,926.26
Grant 14				
Research Mineral and Geology (Spokane)	2,356.14	756.82	3,112.96	
Mineral Investigations.....	3,766.17	349.18	4,115.35	
Oil Investigations	1,162.00	371.83	1,533.83	
Geology	13,776.79	5,604.35	19,381.14	
				28,143.28
Grant 46				
*Mineral Survey	6,353.83	9,948.81	16,302.64	
				16,302.64
Total expended for Mineral Investigations March 31, 1935.....				$76,372.18

*$8,354.68 expended for equipment and supplies for laboratory in College of Mines, State College of Washington.

FARM CROP 1934

In 1934 the apple crop was 32,300,000 bushels, estimated to be worth $22,610,000. Wheat, $27,000,000.

Truck crops for market, canning and manufacture valued together was set at $4,007,000.

Farm Value Truck Crops—Farm values of 1934 amounted to $7,177,000 compared with 1933 of $6,812,000, an increase of 5% and 32% over 1932 value of $4,650,000.

Fruit and Nut Crop—Farm value of the 1934 fruit and nut crop was $29,376,000, against $23,409,000, a gain of 20% over 1933 and more than 54% over 1932.

Field Crops—Total value for 1934 is estimated at $56,337,000, an increase of 7% over 1933 yield of $52,150,000 and 38% over the 1932 output of $31,717,000.

TOTAL FARM VALUE—ALL CROPS

1932 Total value $66,542,000. 1934 Total value $92,890,000, increase of 31%
1933 Total value $90,372,000. 1934 Total value $92,890,000, increase of 8%

LIVESTOCK

The total value of all cattle in the state, 659,000 head, including 70,000 milk heifers and 318,000 dairy cows, valued together at approximately $18,000,000.

CANNED FRUIT, 1933 (cases)

Apples, 740,827; pears, 1,227,923; blackberries, 288,200; cherries, 206,460; miscellaneous, 331,180; total, 2,794,590; value, $7,220,892.

CANNED VEGETABLES, 1933 (cases)

Peas, 474,012; green beans, 47,024; miscellaneous, 323,006; total, 844,042; value, $2,159,573. In 1934—peas canned, 839,797; green beans, 137,002.

FISHERIES AND MARINE PRODUCTS

Of the 300 vessels comprising the North Pacific halibut fleet more than one-half is owned and operated by Washington firms plying from Puget Sound areas.

The annual halibut catch landing at Seattle averages more than 22,718,000 pounds with an approximate value of over $1,500,000 at the docks. In 1934 the North Pacific halibut fisheries procured 47,462,722 pounds, an increase of 15% over the 1933 catch.

Total landings of fresh fish at Seattle docks alone in 1934 (all kinds) amounted to 44,253,960 pounds valued at $2,755,000.

Salmon—Salmon pack for state for 1934, 586,863 cases; value, $4,572,000.

More than 20,612,000 pounds of frozen fish of which 9,819,250 pounds were salmon; 8,276,000 pounds of halibut; 1,381,000 pounds of staple, and 1,362,000 pounds of miscellaneous varieties; together valued at $2,275,000.

In addition to the fresh, frozen and canned fish more than 3,405,000 pounds of mild cured salmon and 3,000,000 pounds of salt cod were manufactured, valued at $371,000.

The annual average production of the oyster industry, fresh and canned, is estimated at 67,261 cases canned, valued at $538,000, and 295,000 gallons fresh, valued together at $1,195,558.

Clams canned, 44,111 cases; value, $264,000; clams fresh, value, $500,000.

Fish by-products—fish meal, fish oils, $57,000.

Total value, fish and marine products, $13,489,588.

STAND OF SAW-TIMBER IN WASHINGTON BY REGIONS, OWNERSHIPS, CLASSES AND PRINCIPAL SPECIES
(Compiled by Pacific Northwest Forest and Range Experiment Station)

SPECIES	EASTERN WASHINGTON				WESTERN WASHINGTON				TOTAL WASHINGTON			
	Private	Federal	Other Public	Total	Private	Federal	Other Public	Total	Private	Federal	Other Public	Total
				MILLIONS OF FEET BOARD MEASURE, LOG SCALE								
Douglas Fir	2,169	5,012	497	7,678	60,146	30,634	8,623	99,403	62,315	35,646	9,120	107,081
Sitka Spruce	.....	.....	.....	.....	4,257	1,663	809	6,729	4,257	1,663	809	6,729
Engelmann Spruce	95	788	18	901	.....	34	.....	34	95	822	18	935
Western Hemlock	348	509	44	901	38,264	32,372	9,337	79,973	38,612	32,971	9,381	80,964
Mountain Hemlock	.....	69	.....	69	183	1,189	21	1,393	183	1,258	21	1,462
Western Red Cedar	261	275	35	571	10,820	7,579	2,662	21,061	11,081	7,854	2,697	21,632
Alaska Cedar	.....	1	.....	1	89	441	5	535	89	442	5	536
Ponderosa Pine	3,935	7,545	2,984	14,464	.....	101	.....	101	3,935	7,646	2,984	14,565
Western White Pine	437	254	167	858	239	1,143	116	1,498	676	1,397	283	2,356
Lodgepole Pine	64	18	9	91	1	5	.....	6	65	23	9	97
Balsam Firs	377	1,629	295	2,301	8,940	20,768	3,833	33,541	9,317	22,397	4,128	35,842
Western Larch	929	1,779	167	2,875	.....	26	.....	26	929	1,805	167	2,901
Other Softwoods	105	85	26	216	.....	.....	.....	.....	105	85	26	216
Total Softwoods	8,720	18,054	4,242	31,016	122,939	95,955	25,406	244,300	131,659	114,009	29,648	275,316
Hardwoods	.....	.....	.....	.....	740	132	83	955	740	132	83	955
Grand Total	8,720	18,054	4,242	31,016	123,679	96,087	25,489	245,255	132,399	114,141	29,731	276,271

Figures for Eastern Washington are from data compiled by U. S. Forest Service in 1931 for use in Senate Document No. 12, reduced to log scale by multiplying lumber tally figures by 0.88. Data for Western Washington are from the Forest Survey of the Douglas Fir Region, Research Notes No. 13, rounded to millions of board feet. "'Federal" includes National Forest, Revested Land Grants, Indian Lands, Public Domain and all other lands in federal ownerships.

FOREST INVENTORY

Rate of Depletion (Normal Year):

Area logged, 171,060 acres; area burned, 12,242 acres
Total ..... 183,292 acres
Amount logged, 6,927,683,000 B. M.; amount burned, 95,284,000 B. M.
Total ..... 7,022,967,000 B. M.
Annual lumber production, 6,927,683,000 B. M.; value $200,000,000
Number of men employed in woods (normal times) 30,507
Number of men employed in manufacturing (normal times) 55,938
Percentage of industrial employment ..... 43.9 per cent

State Forestation:

Already classified for reforestation	183,820 acres
Examined and ready for classification	143,691 acres
Already acquired for state forests	86,000 acres
Examined for purchase for state forests	300,000 acres
Total	713,491 acres

MINERALS

The value of gold, silver, copper, lead and zinc produced from mines in Washington in 1934 was about $454,180.

The production of gold increased from 4,562.68 ounces in 1933 to about 6,900 ounces in 1934. About one-half of the gold produced in 1934 came from 14 mines in the Republic District, in Ferry County, and the First Thought Mine in Stevens County. Considerable gold was also produced from placer operators on the upper Columbia River.

The output of silver in the state increased from 18,520 ounces in 1933 to about 40,000 ounces in 1934, and the value from $6,482 to $25,840, as the average price increased from 35 cents an ounce to 64.6 cents an ounce. About one-half of the silver produced in 1934 came from gold ore mined at Republic, most of the remainder from silver ore in Stevens County.

The average annual value of mercury production in the state is about $1,500,000, mostly from the vicinity of Morton in Lewis County.

In 1928 the magnesite beds near Chewelah in Stevens County estimated as the largest known deposits in the Western Hemisphere produced 85,900 short tons of magnesite or more than 67% of the total yearly output in the United States.

The production of coal in the state in 1933 amounted to 1,460,000 net tons, valued at $5,402,000. The reserve supply of bituminous coal in the state of Washington is set at 64,000,000,000 tons.

The average annual value from mineral resources in the state, including metallic, non-metallic and metallurgical industries amounts to more than $21,000,000.

With the present known deposits scarcely disturbed and further surveys in progress the future of the mining industry in the state looks very promising and should within the next few years of development make Washington one of the leading, if not the most important, mineral producing state in the Union.