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RECLAMATION AND CONSERVATION

Senior Thesis Spring 1937

Howard E. Conkle

FORWORD

This does not attempt to be a complete technical description of the Reclamation and Erosion Works Program, but rather it is an explanation of the Reclamation Act and its workings, and an explanation of the Soil Conservation Service, and the things these two agencies are doing to reclaim agriculture land and prevent further wasting of erodeable land.

All of the material is taken from current literature and is up to the minute material and data with illustrations of the program being carried out.

Reclamation and Conservation

Reference list

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The Land Official Bulletin Soil Erosion Service
USDI Vol. 1 No. 2

The Land Official Bulletin Soil Erosion Service
USDI Vol. 2 No. 1

Soil Conservation
Official Organ of the Soil Conservation Service
USDA

January	1937	November	1936
July	1936	December	1936
August	1936	February	1937
September	1936	April	1937
October	1936		

Federal Reclamation Projects USDI
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In the Future

RECLAMATION AND CONSERVATION

In the early days of North America the towering forests, the mild climate, the rich soiled valleys, and the animal life of the Northwest attracted many. To be more explicit, our forests, our fish and game, and the rich soil, are the attractions we have to offer. The Americas and the United States in particular have been on the receiving end of untold wealth in natural resources, resources which under the pressure of public opinion have been wantonly destroyed.[1]

We are familiar ith the land grabbing, the scheming and the speculating of our early forefathers. George Washington, Benjamin Franklin, Patrick Henry, to name a few of our foremost early citizens, were all a part of the great turmoil over our forests and lands which is with us to the present.[2]

A record of land misuse which is almost unparalleled is a heritage which we of the present are facing. For a century these forest lands were forced from public to private ownership, then a reversal of public opinion; congress and the state legislatures began a new era of returning land to the ward of the public. So sure has been that return that private interest became alarmed at the loss of possible timber land to private use, until now, the Society of American Foresters un-[3]

1. North American Fauna # 55 U. S. D. A
2. The Great American Land Bubble Sakalski
3. Forest and Permanent Prosperity USDA Misc. # 247

officially advocates the discontinuance of Federal acquisition of forest land. Such is the history of Forest mismanagement in these United States.

Steps Toward Better Use

In this year of 1937, 445 years after Columbus discovered America, we have in the United States, only one government laboratory set up and equipped to study and experiment with wood products. Such lack of interest in something which effects each and every person on this continent of North America is hard to realize. Perhaps it is because we are in truth acting out, "Familiarity Breeds Contempt".

Established in 1910, the Forest Products Laboratory at Madison Wisconsin, is a scientific and technical research institution whose business it is to aid in protecting and enhancing the value and utility of forest products. Acting on the Forest Service policy of use for the greatest good to the greatest number of people, and that forestry is the preservation of forests by wise use, the laboratory has constantly directed its research toward insuring the American people the maximum of values and services from the unnumerable products which the forest can supply. Savings of $10,000,000, in finished lumber, $37,000,000 in railroad damage claims and untold hundreds of millions in finding new uses for wood products, can be traced directly to the Forest Laboratory. It is true that each forest region has [1]

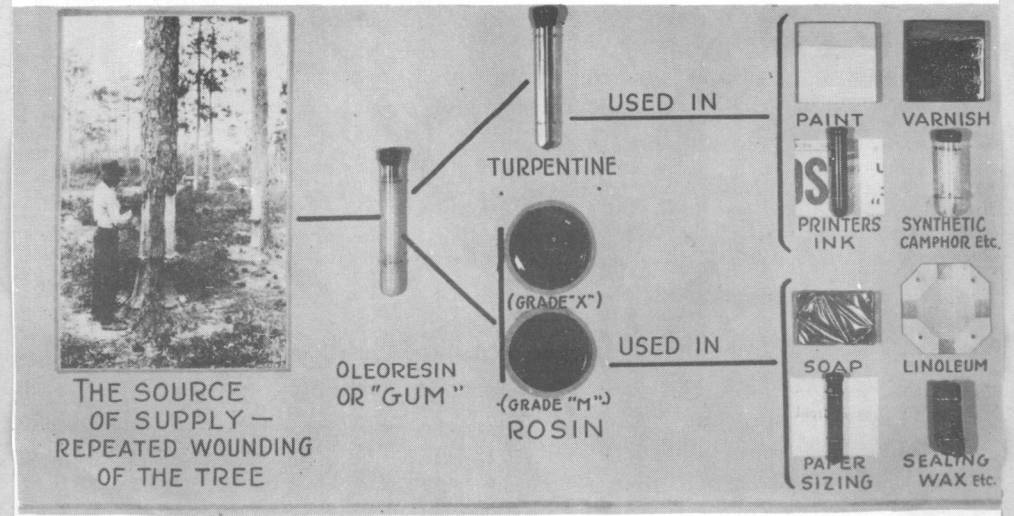
1. USDA Forest Service unnumbered pub. Forest Lab.

QUALITY OF WOOD AND WOOD PRODUCTS LINKED TO FOREST GROWTH AND MANAGEMENT ° ° °

IT is one of the functions of the Laboratory to find out what influence various environmental conditions have on the quality of wood and consequently on its usefulness and value. Research along these lines is of importance in growing timber so that wood of desired properties can be produced in the shortest possible time.

A major forest industry of the United States is the production of gum resin and turpentine, the "naval stores" of commerce, from longleaf and slash pines of the South. The Laboratory, collaborating with other Forest Service units, has shown the practicability of maintaining the flow of oleoresin by light, narrow chipping at as high a yield as by heavier chipping.

TOP picture shows a portable pruning saw developed by the Laboratory. Pruning enables the tree to grow wood free of knots, so that marketable lumber is produced at an early age. BELOW is an illustration showing the source of supply of gum resin and turpentine and some of the products depending upon them.



its labor tory and experiment station, but these are primarily for the purpose of study of tree growth and other silvicultural projects.

Wild Life History

Land history has its parallel in the history of our fish and game, and as the importance of this item of our national welfare has been realized, organizations such as, the Oregon State Game Commission, Oregon State Fish Commission, and the State Planning Board, have been set up to work out a plan of systematized developement of Fish and Game in the stae, in cooperation with the U. S. Biological Survey.

This problem is not only urs, but it is one which effects the whole country. The value of wild game, birds, and fish, is difficult to accurately determine: we can say however, that the public welfare of the country is of even more importance than the economic return of dollar and cents which runs up into the millions each year.[1]

The need of conservation of our wild life is very apparent. Only a pitiful remnant of fur bearing animals remain today from former large numbers. Migratory water fowl are increasing slightly from the lowest point ever known, upland game birds are diminishing and fish resources have been seriously depleted.

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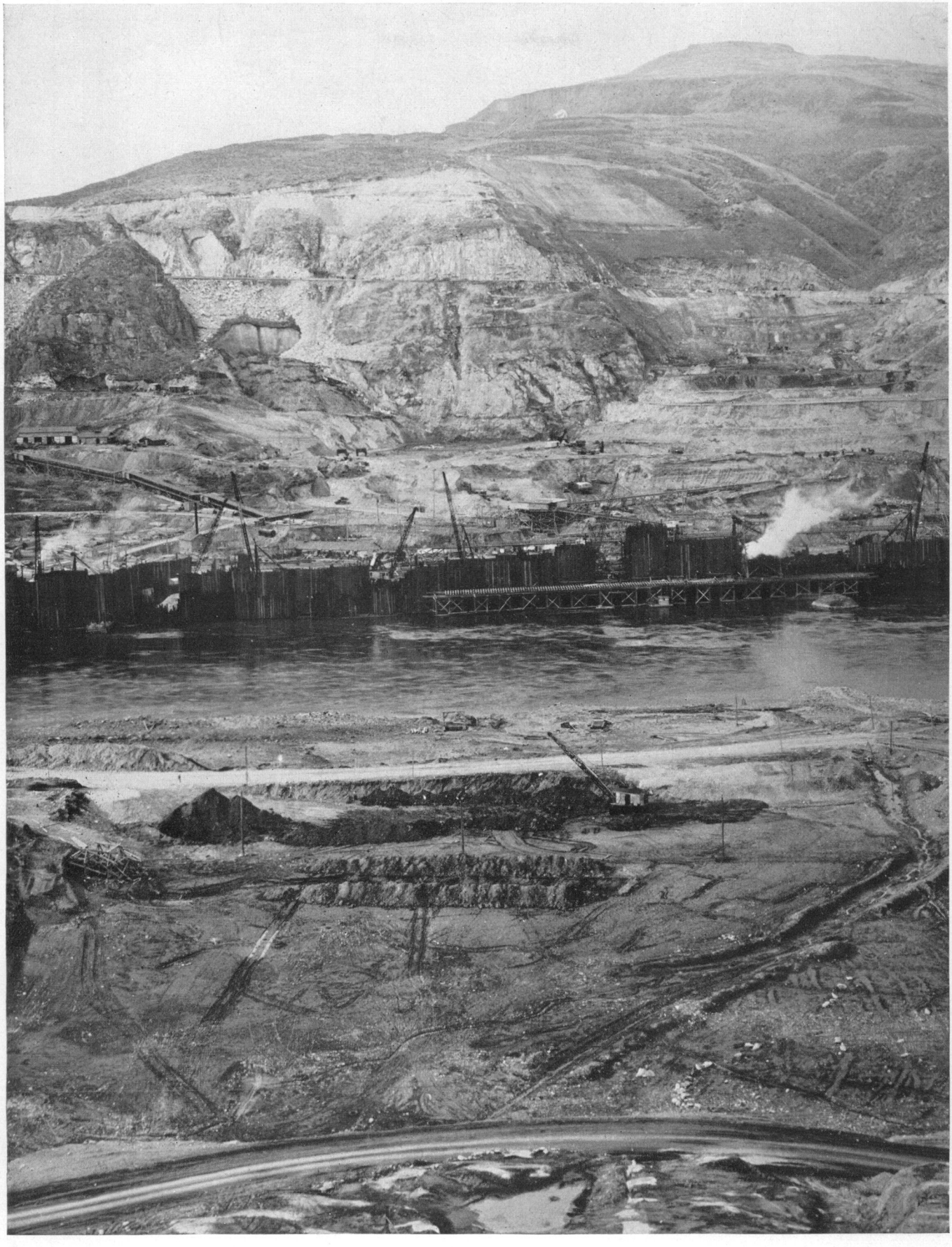
1. Oregon's Wild Life Resources-Oregon State Planning.



First cofferdam, on west bank of the Columbia, built of 13,000 tons of 80 ft. steel sheetpiles and 400,000 cu.yd. of fill and backing material

The Senate committee on Conservation of Wild Life Resources disclosed that during the decade ending in 1930, a 400 percent increase nationally in the number of persons purchasing licenses was noted.

Soil History

From this short history of forested land, and of animal and fish, we can go to one of our soil. The need for prompt action insofar as our eroded hillsides and dust blown country is concerned is not as apparent, but is just as necessary as action on forest and game. Conservation and reclamation go hand in hand, and since at present our attention is being directed towards reclamation this report is an attmept to show what is being done in that field and some of the steps in the field of soil conservation.

THE FIELD OF RECLAMATION

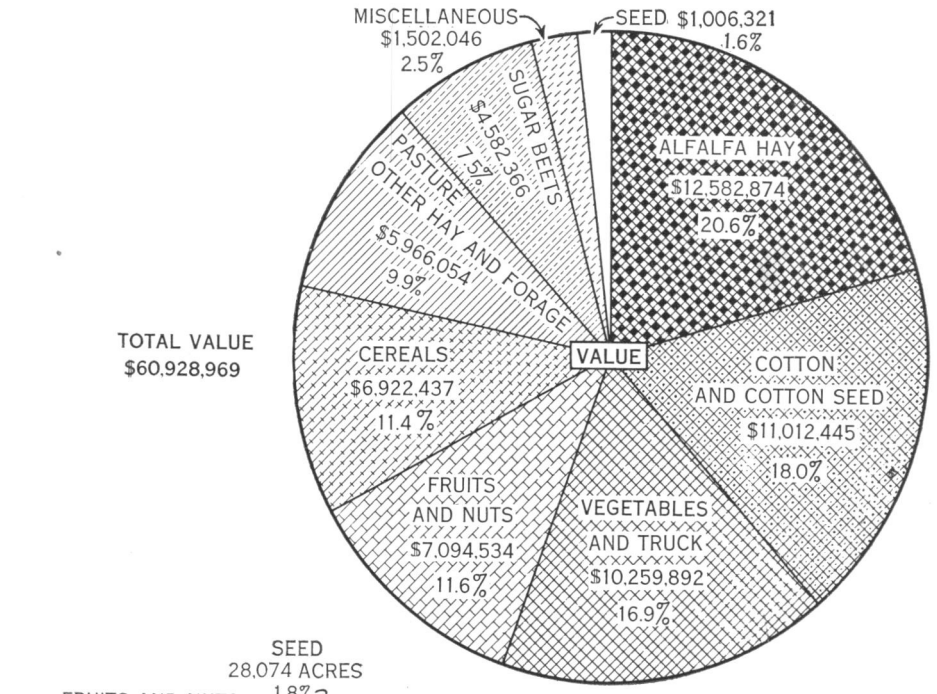
The Reclamation Act was approved in June 17, 1902, and since that time, 38 projects have been or are in the process of being completed in the 16 states named in the original act. During the existence of the Bureau of Reclamation $1,970,000,000 worth of crops has been produced on land previously without a sufficient water supply.

At the close of 1934, the Bureau had constructed 58 storage dams and had 5 under construction. It had built 51 diversion dams, 19,900 miles of canals, ditches, and drains, 170,700 canal structures, 15,530 bridges,

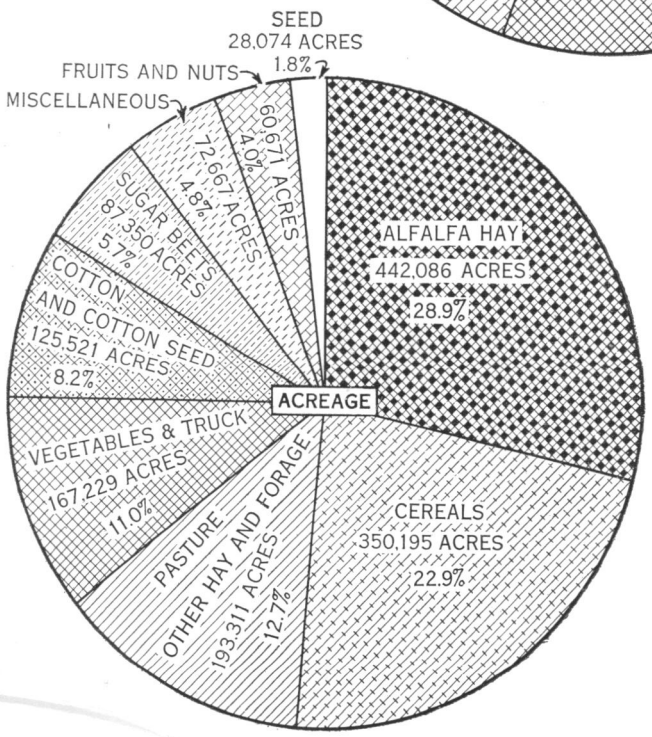
FEDERAL IRRIGATION PROJECTS

VALUE AND ACREAGE OF IRRIGATED CROPS

1934



TOTAL VALUE
$60,928,969



TOTAL ACREAGE
1,527,104 ACRES

ADDITIONAL LAND, 1,229,594 ACRES, RECEIVING PROJECT WATER UNDER WARREN ACT CONTRACTS,
PRODUCED CROPS VALUED AT $40,014,745 OR A GRAND TOTAL OF $100,943,714.

FCS

No. 29995

16,740 culverts, 5,680 flumes, 1,510 miles of roads, besides telephone lines and transmission lines.

Confusion should not arise when it is learned that Bonneyville and other projects are not listed as reclamation projects. Bonneyville is essentially a power and navigation development work, as are many other ones built by the PWA. Up to January 1, 1931, 175,000,000 had been alloted out of an original grant of $300,000,000 to finance the work of reclamation under PWA.

Among the works in the Bureau, the Boulder Canyon Project is one of the largest. Built for the following purposes,

Flood Control
General river regulation
Irrigation
Silt control
Power development
Domestic water supply

the Boulder Canyon Project act authorizes appropriations not to exceed $165,000,000. The dam, a concrete arch-gravity type one is 727 feet high from foundation rock to roadway ontop of the dam. 4,400,000 cu. yards of masonry were used, enough to build a 100 x 100 foot block 2 1/2 miles high when finsihed, 1,835,000 potential horsepower will be developed to be distributed between Arizona, Nevada, Los Angeles, Southern Calif., Edison Co., and the Metropolitan water district. 1

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1 Federal Reclamation Projects USDI unnumbered pub.

The Reclamation Act provided that the funds obtained from the sale of public lands in 16 of the arid Western States should be used by the Secretary of the Interior for the examination and survey for and construction and maintenance of Federal Reclamation projects. Soon after the act became operative, projects were selected and construction began. The construction program adopted soon required all the funds made available by the act and an additional sum of $20000,000 was needed, which was provided for by a loan from the United States Treasury.

It was the intent of the original reclamation act that the irrigation system should be constructed by the Government and turned over to the water users to be maintained at their expense. Inability to collect charges caused irrigation districts to be sent up and organized under the provision of State Law.

The act of May 25, 1926, authorizes the Secretary of the Interior to extend the time of payment of construction charges on existing projects, but not to exceed 40 years from the date the first payment matured under the original contract, with the provision that a joint liability contract shall be executed with a water users association or irrigation district providing for the payment to the United States of all charges becoming due on the productive irrigable land.

The Act of June 17, 1902, provided that upon determination by the Secretary of the Interior that a project was practicable he could cause it to be constructed and then by public notice give the terms and conditions under which public lands might be entered or water-rights application accepted for lands in private ownership and the number of annual installments, not exceeding 10, in which the construction charges were to be paid and the time when such payments should commence.

CONSTRUCTION COST PAYMENT

The Reclamation Act and amendments thereto provide that those who settle upon the reclaimed lands shall be required to repay in installments and without interest the money which has been expended in the construction, of the works necessary to make water available to the farmer.

At present, construction charges must be paid in 20 years, but provision has been made that will allow payment in 40 years.

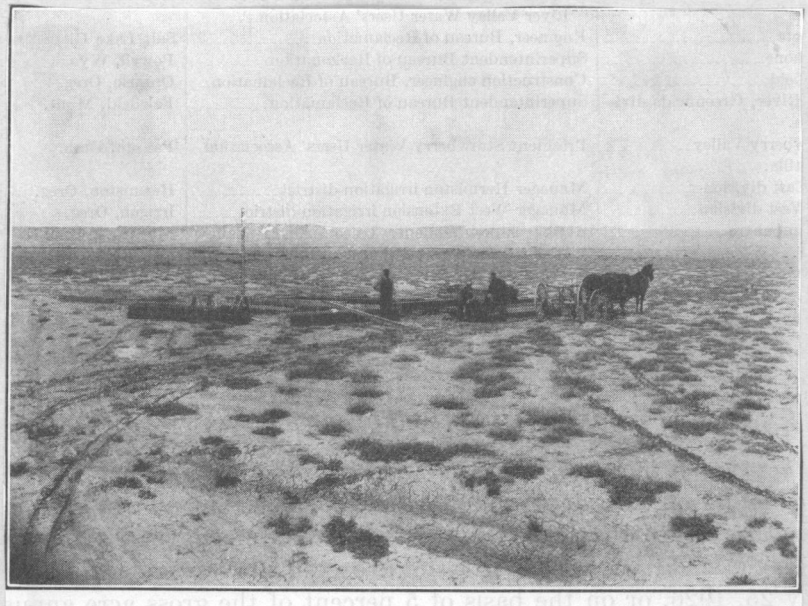
The other method of payment is on a crop-production basis. The act of December 5, 1924, provided for payment of the construction charge at the rate of 5 percent of the average gross annual acre income for the 10 calendar years first preceding, or for all years of record if fewer than 10 years are available, of the area in cultivation in the project, or a division thereof, in which the land is located, as found annually by the Secretary of Interior.

Oregon Projects

05-17 Burnt River Storage dam at Unity
PWA 2
05-29 Deschutes Water supply, reservoir sites
PWA 36 Grande Ronde Investigation of water sites
PWA 23 Stanfield Construction of canals and structures in Stanfield irrigation district.
PWA 6
05-9 Vale Agency Valley Storage dam and reservoir.
PWA 38 Klamath Extensive drains and reconstruction and completion of dikes for flood protection
PWA 5 Canals, laterals, tunnels, siphons and canal

Where the Money comes from

Not only are the reclamation projects financed by the west, but in the course of time the whole cost of construction and maintenance returns to the federal treasury. It goes into a revolving fund through payment by inhabitants of the reclaimed areas.



Laying the foundations of a project home.

As a general rule, new reclamation projects have not been financed with PWA funds. There have been a few exceptions which are discussed in the following.

Funds for the completion of the Owyhee and Vale projects in Oregon and for the Sun River Projects in Montana.

Many misinformed people in the industrial East complain bitterly that a large part of their taxes are diverted to pay for reclamation benefits in the West. As told above, such is not the case as the projects are entirely liquating and the cost is paid for by the owners of the reclaimed land.

The rest of the country receives direct benefits from the rich markets which these areas create for manufacturers, merchants and carriers. A recent survey revealed that in one year 95,000 carloads of manufactured goods valued at $120,000,000 were shipped to points in seventeen of these reclaimed places.[1]

Although Boulder Dam lies in the basin of the Colorado River between Nevada and Arizona, many of the millions of dollars spent there have gone into the tills of manufacturers at Schenectady, Pittsburgh, Youngstown and other eastern industrial centers.

Problems of Reclamation

In designing the penstock tunnels, which cary

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[1] Thought for the Morrow---Harold L. Ickes
Colliers December 8, 1934

water under terrific pressure to the turbines at the foot of the dam, it was necessary to assume the walls of the canyon would be strong enough to withstand the pressur of this water from within. The strength of the ten or fifteen-foot slab of solid rock outside the tunnel, as it plunged down into the canyon to the powerhouse of BOULDER DAM, could not be measured. But no chances were taken. The tunnels were enlarged, and gigantic steel pipes the strength of which was known to the last pound, were inserted within the rock walls to carry the water to the powerhouse.

In pouring the concrete a problem also arose. When concrete is hardening, heat is generated within it. Because heating and, subsequently, cooling would cause changes in its volume which might be sufficient to crack it, these processes had to be controlled. To do this cooling it was estimated would require 200 years so it was decided to refrigerate the concrete by placing within the concrete a network of pipes whrough which iced water could be circulated. Doing this removed the heat from the concrete in six weeks, and expansion and contraction processe took place immediately.[1]

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1. The Nations Agriculture April 1936
William E. Warne

SOIL EROSION

Hand in hand with reclaiming of the land for farm and agricultural use is the protecting of that land from wind and rain erosion. During the past few years the attnetion of the public has been forcibly drawn to the dust stroms in the east and middle west, while last year for the first time, basic pattern for permanent cooperative effort in the field of soil conservation took form as Federal, State, and private agnecies began to move in unison through several avenues of action toward wiser use of the land.[1]

In carrying out this Federal program, the Soil Conservation Service exerted an important influence in stimulating soil conservation effort by the states, private organizations devoted to land welfare, and individual farmers and landowners throughout the country.

Erosion in Foreign Lands

The work of stabilizing the soil is not new of course just to the American continent. The other countries of the world have had the problem and have met it.

France

For the entire French territory between 1861 and 1935 the French Administration of Waters and Forests has reforested approximately 1,190,000 acres at a

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1. Soil Conservation Service 1936 report

cost of 317 million francs, of which 57 million francs have been spent for corrective works. The social importance of works of correction and reforestation executed in the Alps is considerable. It was not only necessary to protect roads cut from mud flows, but it was particularly important not to allow streams to carry away top soil from a village or the smallest hamlet. Works of correction of torrents and the regulation of pastures cannot be done without injuring certain private interests.

In France, a number of laws permit the Forestry Administration to overcome resistance which might occur. The first was the law of July 28, 1860, on the reforestation of mountains; the second of June 8, 1864, on the replanting of grazing lands; and finally the law of April 4, 1862, which abrogated and replaced the two preceding laws.[1]

As early as January 1518 an ordinance was passed and from that time until the law of June 18, 1859, which is still in force, cutting of trees on erodeable land has been guarded against. This law of 1859, provides for the prohibition of clearing land whenever the forests are necessary to protect mountain soil and slopes; for the protection of the soil from the sea and the movement of sand; for the protection of land in border zones; and, for the benefit of the public

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1. Soil Conservation USDA Dec. 1936

health. The scope of the law is wide and it is frequently possible to oppose the destruction of a forest by its owner.

Italy

From transalations of Italian works by Albert Chiera the following laws of soil conservation were taken

1. By land conservation is ment the prevention of land destruction by carelessness on the part of land-owners, or by improper methods of land exploitation, which, under penalty of law, the State will not tolerate.

2. By land reclamation is meant those supplementary works required for restorative vegetation to become reestablished over denuded areas, particularly mountain slopes.

In Italy, conservation works required to preserve the land are carried out by landowners at their own expense;reclamation workd, being more costly, are subsidized by the State, in some cases to the extent of 90 percent of the cost

Methods Used

Italy is a mountainous country, runoff waters mounting into torrents from the melting of snow and ice in the Alps and Apennines must be first be checked before any work of reforestation is attempted. Unfortunately, vegetation can only grow up to a certain altitude, and mountain torrents must first be controlled by large dams, which decrease in size as vegetation takes up its task of binding soil and restraining runoff waters.[1]

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1. Soil Conservation July 1936

Italian methods emphasize the necessity of growing plants in a nursery on a mountain resembling the climatic conditions of the place to which they are later to be transported.

Erosion work is first tried and the point is made that reclamation is necessary only when soil erosion work has not been used. How simpler it is when possible to prevent silting of a watercourse by binding the soil particles with begetation than to sieve the water to remove them by all sorts of man-made contraptions.[1]

Program of the SC Service

To accomplish its work the Consevation Service has a definite program of accomplishments to undertake.

1. One of the first functions of the Service is to prepare and interpret maps showing the four major physical factors which affect the use of land, namely

The degree of Erosion
The soil type
The slope
Present land use

2. Next in line of surveys and out side of the regular demonstration-project areas were detailed surveys of 15 watersheds above reservoirs, where measurements of the amount and rate of silting has begun. Aerial surveys were made in some cases to provide base maps for more of the detailed soil conservation work.

3. Next in group of activities is the report unit, which last year c mpleted tabulation and analysis of erosion-survey data from the survey of 20 counties in

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in the Great Plains and began work on data from 7 demonstration-project surveys.

4. The function of the photography unit is to produce planimetric maps from aerial photographs on a final scale of 4 inches equals 1 mile.

5. Drafting unit completed

22 state reconnaissance erosion maps
Prepared detailed erosion-survey maps of 20 counties.
Completed work on Puerto Rico
Performed drafting work for all branches of the service.

6. The Agronomy section coordinated the erosion control on farm fields and pastures.

Administration

In an effort to decentralize administration and technical supervision, the field organization therefore operated on a project basis, was divided into 11 administrative regions each of which conforms as closely as possible with regional problems of soil conservation and land use

1.	Northeast	Pa.
2.	Southeast	South Carolina
3.	Ohio Valley	Ohio
4.	Midsouth	Texas
5.	Upper Mississippi	Iowa
6.	Southern Great Plains	Texas
7.	Central Great Plains	Kansas
8.	Southwest	New Mexico
9.	Northwest	S. Dakato
10.	Pacific Southwest	California
11.	Pacific Northwest	Washington

Each of the 11 regions is under thejurisdiction of a regional conservator with headquarters at a point most convenient from the standpoint of transportation, 1

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1. Annual Report of the Chief of the Soil Conservation Service 1936

communication, and accessibility to projects within the region.

Table

Private land-use and treatment program, year ending June, 1936

Oregon		
Number of projects	2	
Gross area	92,000	
Area under coop. agreement		24,666
Area for which erosion control plans are made		40,466

Types of Erosion

Most of us are familiar with the gully type of erosion whch is widely recognized and usually understood. The other type of erosion, not so easily recognized or understood is sheet erosion, erosion of clean-tilled fields.

Soil Defense Measures

We are interested not so much in the king of erosion, but in the methods we can use to prevent a continuation of the land trouble.

To date, the following are the prescribed measures used by the Soil Conservation Service.

Terracing
Contour Tillage
Strip Cropping
Close-growing crops in rotation
Contour furrowing in pastures

1. Terracing

Priestly Mangum, a farmer at Wake Forest, N. C. made the first great contribution to modern terrace*

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* Soil Defense in the Piedmont
USDA Farmers Bulletin 1767

design, creating the terrace which bears his name. In constructing this terrace, approximately one-third of the soil is moved uphill and two thirds downhill. The mangum terrace may be roughly described an interception and absorption structure while other terraces built on the same principle are of the same type, but also drain the water away.

About 1924 M. L. Nichols, head of the department of agricultural engineering at the Alabama Polytechinc Institute, disigned a broad-base terrace superior in some respects to the Mangum terrace for certain soils. The Nichols design has since become popular in the southern Piedmont area, notable in South Carolina, Georgia, and Alabama. It is the type now being built generally on the Service's demonstration areas in the States. The Nichols terrace is, essentially, a broad, shallow ditch butressed on the lower side by an embankment of earth. It is built entirely from the upper side by moving the soil down from the earth above. Most of the water behind the terrace flows in a channel below the original surface of the ground, and complete terrace failures therefore seldom occur. The Mangum terrace differs in that it relies more upon a broad embankment of earth to hold the water. In constructing the Mangum terrace approximately one third of the soil is moved uphill and two-thirds downhill.

FIGURE 11.—*The modern broad-base terrace is a stronger sort, 18 to 24 feet broad and 12 to 15 inches high. It intercepts water and directs it safely from the field.*

Terracing is based on the principle of slowing the speed of the flow of water so as to cause it to loose most of its power to carry a soil load. The terrace is from 12 to 15 inches high and 18 to 24 feet broad.

TABLE 1.—*Spacing recommended in the construction of terraces*

Slope of land in feet per 100 feet (feet)	Vertical distance or the drop between terraces	Horizontal distance between terraces	Slope of land in feet per 100 feet (feet)	Vertical distance or the drop between terraces	Horizontal distance between terraces
	Feet Inches	*Feet*		*Feet Inches*	*Feet*
1	2 6	180	7	4 0	57
2	2 9	140	8	4 3	53
3	3 0	100	9	4 6	50
4	3 3	80	10	4 9	48
5	3 6	75	12½	5 4	43
6	3 9	63			

2. Contour Tillage

Although contour tillage probably owes its origin in this country to Thomas Jefferson and was first practiced in Virginia, it is used throughout the world in combating soil erosion.

Most farmers prefer stright rows and point them up and down a slope, thus creating a condition under which a field is least able to hold its soil. Instead of laying out these rows up the slope, an effort is made to till the land with the contour of the topgraphy. Real contour tillage is contour elevation, for when practiced, the soil is tilled up above the level of the surrounding land so as to form an impediment to the run-off of water.

3. Strip Cropping

FIGURE 21.—*When a field is strip cropped, water, as it flows down a slope freshly plowed for cotton or corn, encounters a strip of grain or hay crop which, owing to its close-growing nature, checks the flow of water, spreads it, and filters from it its load of soil.*

One of the newer methods of checking the flow of water, strip cropping is often used in conjunction with contour and terrace control work. It consists in seeding the usual farm crops adapted to a locality in long bands, or strips, laid out as nearly as possible on the contour and arranged so that adjacent strips, or or ones for cultivated crops, are not plowed at the same time. Under this arrangement, water, as it flows down the slope encounters water and filters the soil from it.

4. Close Growing crops in the Rotation

FIGURE 22.—*Close-growing and green-manuring crops in the rotation add organic matter to the soil, which increases its power to retain moisture and decreases soil losses.*

Natures way of controling erosion is by the use of close grown crops. Using corn one year, and close grown broadcast crops the other two years reduces to a great degree the amount of erosion.

5. Contour Furrowing

Contour Furrowing in pastures is one of the new erosion control measures. At present it is being used in Virginia, South Carolina and Georgia.

FIGURE 23.—*Contour furrows in pastures hold rain water until it percolates into the ground. A system of contour furrows conserves moisture and curbs erosion.*

Contour furrows are made by an ordinary two-horse turning plow, and they are turned on the exact contour of the land, as near to dead level as it is possible to run them. Such a system of contour furrows catches the rain and directs it into the grass roots. L

In region, the average farm pasture has too little cover to hold the torrential summer rains, with the result that there is frequently a shortage of moisture during midsummer. Contour furrows have considerable

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L Soil Conservation January 1937

value as a means of holding the rainfall until it can be absorbed by the soil. It has been observed that rainfall penetrates 6 to 18 inches deeper on land that is furrowed. By using equipment which the farmers have, and by plowing small furrows close together, the work can be done very cheaply and as much as 80 percent of heavy rains can be held.

In making the furrows, the plowis jumped out of the ground at distances of 15 to 50 feet, leaving blocks 3 to 6 feet long to stop the drainage if the grooves are not exactly on the contour. With a little planning, it is believed that most farmers will be able to put in such furrows without an instrument to establish contour lines.*

6. Further Erosion controls

Just as sheet erosion is the hardest to notice and very difficult to remedy even using the above controling methods, gullying is also very important.

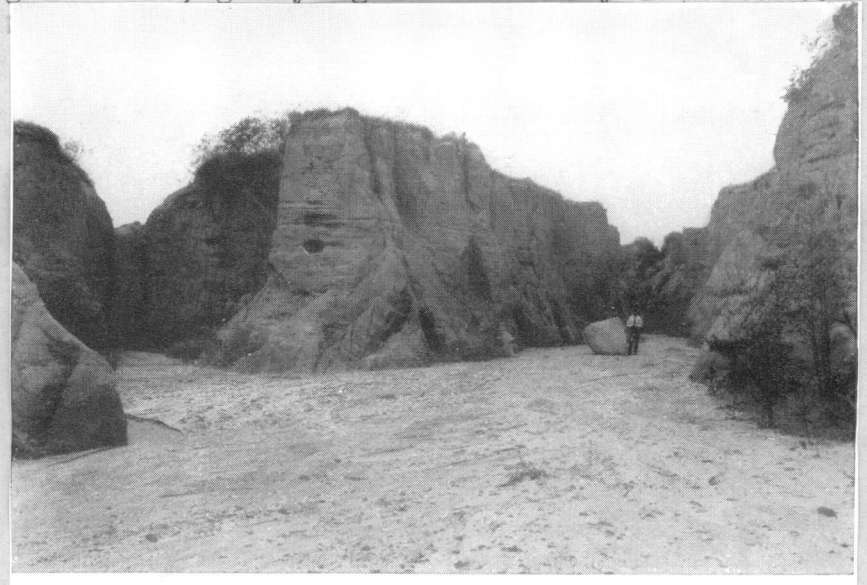

FIGURE 24.—*Gullies grow, gnawing their way farther and farther into cultivated fields, sending out fingers and laying waste huge areas of land.*

* Following Contour Furrows across the United States
A. T. Semple- Senior agronomist, Soil Conservation Service

Once a field is gutted and gashed by gullies and abandoned, nature takes its own way of correcting the evil. First briers and weeds come in, which is succeeded by, in Virginia, with sassafras, persimmon, sumac, and pine. After the pines are established, the eroded area is protected from further washing and starts to build up the soil at a rate which has been estimated to be 1 inch in 600 years. To speed up the work of nature, the gullies are first graded by a bulldozer or by blasting, and the necessary ditches or embankments are made. Temporary dams are sometimes constructed to serve a double purpose; to collect the soil in which vegetation can gain a foothold and to prevent further washing. After the gullies are smoothed and the above measures taken, vegetative cover is started on the eroded land. In the east such grasses as Bermuda, bluegrass, Kudzu, honeysuckle, and trees such as the black locust and pine have been used by the erosion service.

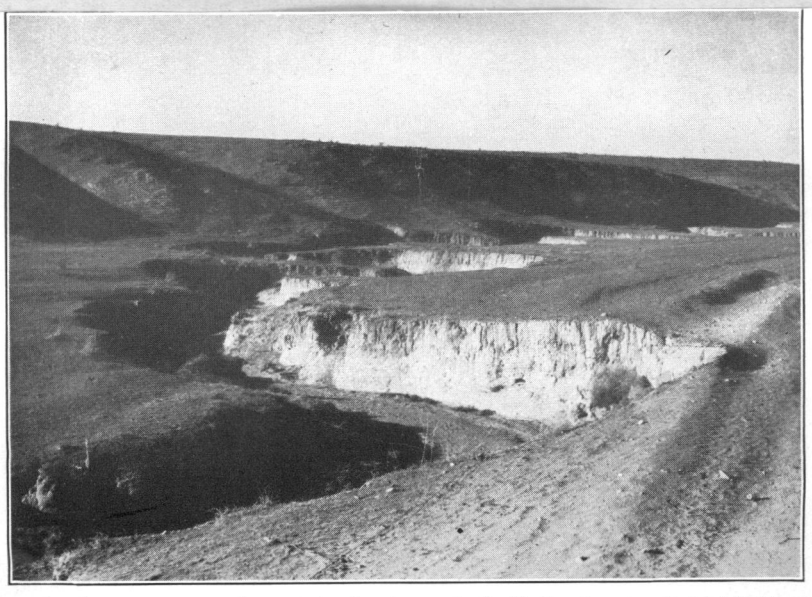

Figure 3.—Severe overgrazing characteristic of vast areas in the Northwest renders the land highly susceptible to floods, sheet erosion, and gullying. Only immediate regulation of grazing will save such lands from total destruction.

FIGURE 9.—*Reservoirs filled quickly with silt and lost much of their storage capacity. Many Piedmont reservoirs filled in less than 30 years*

A problem all its own is the silting of reservoirs. The relation of silting of reservoirs to problems of erosion control led the Soil Conservation Service to institute in July 1934 the first attempt at a general survey of the condition of reservoirs with respect to reduction of storage by silting.

The rate of sediment accumulation and forms of its distribution in a reservoir are determined by the volume and character of load carried below flow line by contributing streams. The transporting power of streams

and the load they carry are, in turn, determined by the extent of the drainage area and erosional factors of climate, topographic relief, soils, vegetative cover, and land use over water-shed areas. The total stream load derived from headwater sources is subject to variation, from time to time, by changes in factors controlling erosion, particularly through changes in extent and effectiveness of cover.

Erosion in the Northwest

Erosion in the west is more recent than erosion in other parts of the country, and so because of this it is natural that more methods for combating soil wastage will have been developed in other parts of the country. One contribution that the Northwest and the state of Oregon has made, is the Whisker Dam, reported by C. Edwing Hill, Oregon State Coo rdinator of the Soil Conservation Service.

The construction of a whisker dam is simple. An old fashioned, square-nosed spade is used. It is first pushed into the ground up to the handle and then moved back and forth until a little V-shaped trench is formed. This is done until there is a trench across the gully. Next, the trench is covered with straw, and the square-nosed spade is used to press the straw down into the trench and to close the trench and pack the dirt in it by shuffling along with the upright whisker dam between your feet.1

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1. Soil Conservation Service
February 1937

Anchoring the Dunes

One of the erosion measures being done in Oregon is an attempt to anchor the Clatsop Sand dunes with vegetation. With this end in view, the Service established a project at Warrenton, Oregon a year ago. The service discovered that the blame for the enchroaching dunes was laid to the misuse of the land by man, but in this case was of a recent nature.

In the late 1860's, measures were passed by incorporated Clatsop County to the effect that certain areas were to be prohibited to grazing. The presemt members of the country obeyed the laws, but as time went on, the new comers didn't.

According to the Erosion Service, one of the first steps in stopping a dune is to build another one. To do this, a double line picket fence is driven into the sand in the position desired for the dune. The incoming sands pile over the fence. Each time the stakes are covered they are pulled half their length. This is repeated until the dune attains a height of 8 or 10 feet. The dune is then planted to sand-stilling and sand-catching grasses, such as Holland and American dune grasses. The vegetation collect more sand and the dune gradually rises to its ultimate height of 20 or 30 feet. The next step which has been used on the Clatsop dunes, is the pplanting of dune grass species at 18 inch intervals over the blowing areas to the windward side

of the "fore" dune. Later, as a third step, sod-forming and soil building vegetation is established; and finally those areas that will support such vegetation, trees and shrubs are planted for further protection.

SOIL CONSERVATION NURSERIES

One of the major works of the Service is the propagation and growth of grasses and trees used in erosion work. To-date the following grasses and trees have been used by the Erosion Service.

Black Walnut
Oak
Black Locust
Tulip tree
Hickory
Wild Plum
Russian Olive
White ash
Butternut
Loblolly pine
Hazelnut
Green Ash
Hackberry
Sugar Maple

Wheatgrass
Blue grama
Bluestem
Dropseed
Needlegrass
Indian rice
Indian grass
Wild rye
Sand reed
Slough grass
June grass
Slash pine
Western yellow pine

The locating, harvesting, storing, and distributing of native seed was a major problem, the first few years of extensive soil erosion work.

Such other problems as engineering, the gathering of cost data and technical information, the development of equipment and its purchase were worked out and correlated with the other departments of the Service.

IN THE FUTURE

As work in this country progresses in the field of reclamation and conservation, we will not be focusing

our attnetion on bringing back land already destroyed, by we wil have devised ways and means to prevent further destruction of our natural gifts from nature.

Such projects as the one sponsered by TVA and the soil erosion service to combat silting on the Norris Dam project will be used to presere what we already have instead of spending millions to restore that which is lost.