Report Of
The
STATE OF OREGON

To
UNITED STATES SENATE
SELECT COMMITTEE
ON
NATIONAL WATER RESOURCES

Issued by Committee on Natural Resources

November 1959
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>General Statement on Water Supply</td>
<td>3</td>
</tr>
<tr>
<td>Climate and Other Factors</td>
<td>3</td>
</tr>
<tr>
<td>Surface Water</td>
<td>3</td>
</tr>
<tr>
<td>Occurrence of Ground Water</td>
<td>5</td>
</tr>
<tr>
<td>Withdrawals, Reservation and Use of Water</td>
<td>6</td>
</tr>
<tr>
<td>State Withdrawals</td>
<td>6</td>
</tr>
<tr>
<td>Federal Withdrawals</td>
<td>6</td>
</tr>
<tr>
<td>Fundamental Surface Water Problems</td>
<td>8</td>
</tr>
<tr>
<td>Fundamental Ground Water Problems</td>
<td>10</td>
</tr>
<tr>
<td>Analysis of Present and Probable Future Water Problems</td>
<td>11</td>
</tr>
<tr>
<td>Population Projections</td>
<td>11</td>
</tr>
<tr>
<td>Municipal Water Use</td>
<td>12</td>
</tr>
<tr>
<td>Agricultural Use of Water</td>
<td>12</td>
</tr>
<tr>
<td>Water Needs of Industries</td>
<td>12</td>
</tr>
<tr>
<td>Flood Control</td>
<td>13</td>
</tr>
<tr>
<td>Electrical Energy</td>
<td>13</td>
</tr>
<tr>
<td>Navigation</td>
<td>15</td>
</tr>
<tr>
<td>Pollution Abatement</td>
<td>15</td>
</tr>
<tr>
<td>Fish and Wildlife</td>
<td>18</td>
</tr>
<tr>
<td>Recreation</td>
<td>24</td>
</tr>
<tr>
<td>Waste Disposal</td>
<td>26</td>
</tr>
<tr>
<td>Some Means of Meeting Future Demands</td>
<td>27</td>
</tr>
</tbody>
</table>
Introduction

This report has been prepared for the United States Senate Select Committee on National Water Resources, pursuant to a request from the Honorable Robert S. Kerr, Chairman of the Committee.

Under the provisions of Senate Resolution 48, adopted April 20, 1959, the Select Committee is assembling and analyzing all information on the Nation's water problems.

Information included herein has been compiled from material submitted by the Oregon Water Resources Board, Oregon State Engineer, Oregon State Game Commission, Oregon State Fish Commission, and the Oregon State Sanitary Authority.

In 1955, the Oregon Legislature created a comprehensive water policy and established the Oregon Water Resources Board to carry out this policy. The Board was instructed by the Legislature to proceed as rapidly as possible to study existing water resources of the State; means and methods of conserving and augmenting such water resources; the existing and contemplated needs and uses of water for domestic, municipal, irrigation, power development, industrial, mining, recreation, wildlife and fish life uses, and for pollution abatement, all of which were declared beneficial uses by the Legislature. The Board was further instructed to consider all other related water-use subjects, including reclamation and drainage.

It has been generally acknowledged that Oregon's is a model water law, particularly among Western states. For the first time, all beneficial uses of water are given equal status in determining priorities of use, with only human consumption and livestock use as dominant in the event of irreconcilable conflicts.
It is hoped that this report may prove of assistance to the members of the Select Committee in their important deliberations. Obviously, in many instances, Federal-State cooperation is of vital importance is the solution of water problems, both in Oregon and elsewhere in the United States. It is in such a cooperative spirit that Oregon submits this report.
General Statement on Water Supply

Climate and Other Factors

Perhaps no region of similar size has so wide a variety of climate as does Oregon. The marine influence on one side and the continental influence on the other results in striking contrast. The mountain barriers running north and south prevent free interchange of air. These barriers also greatly affect the temperature and moisture content of the air masses that surround them.

The variation in precipitation in different parts of the state is quite pronounced. The geographic distribution of precipitation is profoundly affected by topography; the heaviest rains being on the slopes exposed to the ocean.

There are some locations on the west slope of the Coast Range that have heavier precipitation than has been recorded in any other state, while east of the Cascade Mountains there are areas having less than any part of the United States east of the Continental Divide. Only 12 to 20 percent of the state's annual precipitation occurs during May through September. Some areas have a minimum annual precipitation of 50 or more inches, but they receive an average of only one-half inch during July and August.

Surface Water

Oregon's rivers carry about 88 million acre-feet of water to the ocean in an average year, and some 49 million acre-feet of water evaporates from the land surface, is transpired by trees and plants, or used consumptively by man.

The Columbia River forms most of Oregon's northern boundary. The average annual discharge of the Columbia River at its mouth is approximately 180 million acre-feet. Oregon's average annual contribution to the Columbia
River is approximately 35 million acre-feet of discharge directly into the Columbia River, while some 3,800,000 acre-feet reaches the Columbia River through the Snake River drainage.

Oregon's coastal streams discharge about 48 million acre-feet into the Pacific Ocean annually. The Umpqua and Rogue are Oregon's largest coastal rivers, with average annual discharges of 6,700,000 and 5,660,000 acre-feet, respectively. Most of Oregon's streams are characterized by low discharge during summer months, the period of greatest water need. Low elevation watersheds produce peak discharge during the winter months. High elevation watersheds store winter precipitation through snow accumulation which delays runoff until spring or early summer months. The average annual consumptive use of water in Oregon for irrigated agricultural lands probably exceeds two million acre-feet. The amount of water evaporated on bodies of water in an average year has been computed as two million acre-feet. Of this amount, about 750,000 acre-feet evaporates from basins that have no outlet to the sea.

Releases of water from storage reservoirs has increased summer stream discharge in many of the state's streams. This stored water is committed to consumptive use except for releases from storage of Corps of Engineers, U. S. Army, reservoirs in the Willamette River Basin.

The total known capacity of Oregon's 1,290 reservoirs is 5,399,820 acre-feet in August, 1959. Of this total, 4,615,800 acre-feet is useful or effective storage. Most of the remaining or "dead" storage is used for recreation, conserving fish life, wildlife or creating a head for power plants. Non-federal (private) interests have constructed 2,414,320 acre-feet or 52 percent of the total known effective storage in Oregon. Federal interests have constructed 2,201,480 acre-feet or 48 percent of our effective storage.
Occurrence of Ground Water in Oregon

Important ground water supplies occur in the Willamette Basin, the Cascade Mountains and several intramountain basins such as Walla Walla, Umatilla, Fort Rock, and Harney Basins. Few basins contain all of the three basic considerations for good ground water potential, according to the U. S. Geological Survey.
Withdrawals, Reservation and Use of Water

Federal Withdrawals

Federal withdrawals and reservations constitute a serious legal problem confronting the state in the planning and administration of its water resources. Recent U. S. Supreme Court decisions have cast a cloud on the validity of water rights acquired under state law in those areas where the water originates from or flows through reserved or withdrawn lands. Fifty-two percent of the land area of the State of Oregon is owned by the federal government. The federal ownership represents the major mountain areas which produce the major quantity of the water resources of the state. A major portion of the federal ownership is in U. S. Forest Service or other reserved lands. There is an urgent need to clarify the status of federal-state jurisdiction over water.

State Withdrawals

Oregon's State Engineers have made withdrawals of water in the amount of 3,649,000 acre-feet and 2,600 cubic feet per second for storage or use, under the authority of Chapter 87, Laws of Oregon, dated 1913. Most of the state's large irrigation reservoirs have been built under authority of these withdrawals. The status of some of these withdrawals has not been fully determined.

Oregon's legislature has made withdrawals on restricted use of water on many streams through the years to protect scenic attractions, recreation areas, and fishery uses.

In 1955 the Oregon Legislature enacted into law a comprehensive state water policy and established the State Water Resources Board to carry out this policy. In progressively formulating this integrated, coordinated program of water use and control, this Board is classifying
waters for greatest beneficial use; and, when based on need, is establishing base perennial flows which shall be preserved against future appropriation. This is, in effect, making a withdrawal of water.

Rights to use 65,983.89 cubic feet of water per second were issued to water users by the state between 1909 and 1953. Of this total, 35,134.46 cubic feet per second were for power uses. The state had issued rights to irrigate 2,663,910 acres of land by 1953.

Surface water appropriations for consumptive use increased about 7,300 cubic feet per second from 1945 through 1957.
Fundamental Surface Water Problems

Oregon's seasonal maldistribution of precipitation and resultant stream discharge often creates damaging floods, followed by critical water shortages during the summer months.

The Corps of Engineers, U. S. Army, estimates the average annual flood damage at $19,552,400 in areas they have studied in Oregon, based on 1952 to 1954 price levels and 1939 to 1952 developmental levels. Estimated average annual flood damages in the Wallowa, Goose Lake, Klamath, most of the Deschutes, and many coastal basins is not available.

Most Oregon streams have a critical period during the late summer when the flow available at that time is not sufficient to meet the present demand. In some streams in eastern Oregon the water demand, over the entire water period, is quantitatively in excess of the yield that can be normally expected.

This seasonal maldistribution of water creates hardships for all water uses. Mining is usually restricted to winter operations. Irrigators with late priority water rights attempt to store maximum amounts of water in the soil early in the growing season. This often results in the leaching of plant nutrients. Municipal uses are sometimes curtailed. The state's fishery resource is difficult to maintain and sometimes impossible to improve when floods scour spawning beds and low flows restrict habitat and create critical temperatures. Water quality, particularly temperature, is becoming an increasing problem in the state. Temperatures on major streams have been recorded higher than those compatible for habitat or passageway for food or game fish.
Conflicts arise between water users for the right to use the remaining unappropriated waters. Fishery interests want continuous stream-flows unimpeded by dams that will block spawning areas for anadromous fish. Consumptive users of water wish to take water from the streams, particularly during hot, dry summers when streams have their lowest discharge. Recreation interests want full reservoirs during the summer, at the same time when irrigationists must effect drawdowns.
Fundamental Ground Water Problems

A deficiency in basic data is Oregon's primary ground water problem. Determining safe and economical yields of ground water is impossible without additional research in most of Oregon. Areas where economical artificial recharge may be effected are largely unknown.

Ground water supplies have been inadequate to satisfy present ground water uses in the Milton-Freewater area, The Dalles area, and part of the Willamette Basin.

Salt water is occasionally found in marine sedimentary rocks beneath the Willamette Valley, the Coast Range, and the Klamath Mountains. Highly mineralized water is often found along fault lines in the south-eastern plateau.

Few basins contain all of the three basic considerations for good ground water potential, according to the U. S. Geological Survey.

<table>
<thead>
<tr>
<th>Division</th>
<th>Precipitation</th>
<th>Porous Rocks</th>
<th>Topography</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southeastern plateaus</td>
<td>Poor</td>
<td>Good</td>
<td>Fair</td>
</tr>
<tr>
<td>Columbia plateau slope</td>
<td>Fair</td>
<td>Fair</td>
<td>Fair to poor</td>
</tr>
<tr>
<td>Central and central-eastern mountains,</td>
<td>Fair</td>
<td>Fair</td>
<td>Poor to fair</td>
</tr>
<tr>
<td>Cascade Range</td>
<td>Good</td>
<td>Good to fair</td>
<td>Poor</td>
</tr>
<tr>
<td>Klamath Mountains</td>
<td>Good</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Willamette Valley</td>
<td>Good</td>
<td>Good to poor</td>
<td>Good</td>
</tr>
<tr>
<td>Coast Range</td>
<td>Good</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Coastal belt</td>
<td>Good</td>
<td>Poor to fair</td>
<td>Fair</td>
</tr>
</tbody>
</table>
Analysis of Present and Probable Future Problems

Population Projections

The growth of Oregon's population is shown in the following table:

*OREGON POPULATION

<table>
<thead>
<tr>
<th>Census Date</th>
<th>Population</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1850 (June 1)</td>
<td>12,093</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>1860 (June 1)</td>
<td>52,465</td>
<td>40,372</td>
<td>333.8</td>
</tr>
<tr>
<td>1870 (June 1)</td>
<td>90,923</td>
<td>38,458</td>
<td>73.3</td>
</tr>
<tr>
<td>1880 (June 1)</td>
<td>174,768</td>
<td>83,845</td>
<td>92.2</td>
</tr>
<tr>
<td>1890 (June 1)</td>
<td>317,704</td>
<td>142,936</td>
<td>81.8</td>
</tr>
<tr>
<td>1900 (June 1)</td>
<td>413,536</td>
<td>95,832</td>
<td>30.2</td>
</tr>
<tr>
<td>1910 (Apr. 15)</td>
<td>672,765</td>
<td>259,229</td>
<td>62.7</td>
</tr>
<tr>
<td>1920 (June 1)</td>
<td>783,389</td>
<td>110,624</td>
<td>16.4</td>
</tr>
<tr>
<td>1930 (Apr. 1)</td>
<td>953,786</td>
<td>170,397</td>
<td>21.8</td>
</tr>
<tr>
<td>1940 (Apr. 1)</td>
<td>1,089,684</td>
<td>135,898</td>
<td>14.2</td>
</tr>
<tr>
<td>1950 (Apr. 1)</td>
<td>1,521,341</td>
<td>431,657</td>
<td>39.6</td>
</tr>
</tbody>
</table>

*Estimated present and future population is as follows:

<table>
<thead>
<tr>
<th>Census Date</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958 (July 1)</td>
<td>1,728,550</td>
</tr>
<tr>
<td>1970</td>
<td>2,132,363</td>
</tr>
</tbody>
</table>

It is assumed that this population increase will be distributed geographically about as it is now with the major increases occurring in the Willamette Valley, southern Oregon, and along the Columbia River.

* Source: U. S. Department of Commerce and Oregon State Board of Health
Municipal Water Use

Oregon's incorporated city water systems used an estimated 65,909 million gallons of water during fiscal year 1951-52. These cities served approximately 1,300,000 persons or 86 percent of Oregon's population. It was estimated that 8,488 million gallons were used during the maximum demand month. Suburban living has increased the per capita water requirements. Residents of Oregon's eleven largest cities used nearly 340 gallons per capita daily during the maximum demand month. Acute water shortages have been reported in cities near Portland as well as other Willamette Valley towns and cities.

Water Needs of Industries

Processing forest and agricultural products constitutes Oregon's largest industrial uses of water. Other uses include cooling, other processing, fire protection, and storage (log ponds). In 1954, the Bureau of Census reported that Oregon had 37 pulp or paper plants and 198 plants manufacturing food and kindred products, all with 20 or more employees. By 1957, $72,891,227 was paid for covered employment in food and kindred products industries and $337,618,583 was paid for covered employment in lumber and wood products industries.

Oregon ranks first among the states in timber production but only seventh in pulp and paper production. Oregon's economy could be broadened and her seasonal employment stabilized by greater utilization of the estimated 40 percent timber waste.

Agriculture Use of Water

Irrigation is the largest consumptive use of water in Oregon. According to the U. S. Census of Agriculture, the increase in irrigated acres has been as follows:

1940 - 1,050,000
1944 - 1,129,059
1949 - 1,306,810
1954 - 1,490,366

-12-
By 1954 nearly 2,690,000 acres of land in Oregon held irrigation rights. Rights initiated between 1909 and 1954 totaled 30,930 cubic feet per second to irrigate 1,475,355 acres. Much of Oregon's farm lands receive enough precipitation to grow crops with small summer water requirements, such as cereal grains. For this reason there is little relationship between the acreage of lands holding water rights and land actually irrigated.

The Water Resources Committee of the School of Agriculture at Oregon State College estimated in 1954 that during the next 25 to 50 years, an additional 1,364,000 acres of land will be irrigated in Oregon. This will require in excess of 3,500,000 additional acre-feet of water. Supplemental water is needed to stabilize production on over 1,000,000 acres presently irrigated in the state.

**Flood Control**

Floods are and will continue to be a serious problem in Oregon. Since the beginning of civilization, people have encroached upon the flood plains because of the availability of water, fertile soils, and other conveniences. Transportation arteries follow our narrow valleys adding to the value of development in the flood plain.

An implemented flood control construction program is needed to maintain our present situation in view of the expected development in flood problem areas.

**Electrical Energy**

More than 98 percent of the kilowatt hours of electricity produced in the Pacific Northwest in 1950 was developed from falling water. Hydro provided about 30 percent of the total energy for the region, far above the national average. Oregon must rely on hydro power due to the shortage of fossil fuels in the state.
At the end of 1957, Oregon's consumers were served by the following types of electric utilities:

<table>
<thead>
<tr>
<th>Type of Utility</th>
<th>Number of Utilities</th>
<th>Percent of Customers In State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Privately Owned</td>
<td>5</td>
<td>84 percent</td>
</tr>
<tr>
<td>Municipally Owned</td>
<td>10</td>
<td>7 percent</td>
</tr>
<tr>
<td>Cooperatives</td>
<td>18</td>
<td>6 percent</td>
</tr>
<tr>
<td>People's Utility Districts</td>
<td>4</td>
<td>3 percent</td>
</tr>
</tbody>
</table>

Average consumption for residential and rural customers for Oregon operations of privately-owned utilities, as well as the total United States, in kilowatt hours, is as follows:

<table>
<thead>
<tr>
<th></th>
<th>1957</th>
<th>1956</th>
<th>1955</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oregon</td>
<td>8,139</td>
<td>7,792</td>
<td>7,324</td>
</tr>
<tr>
<td>Total United States</td>
<td>3,174</td>
<td>2,969</td>
<td>2,751</td>
</tr>
</tbody>
</table>

If the present per capita consumption rate of increase continues, Oregon's residents will use an additional 5,304 kilowatt hours or 13,443 KWH by 1970. The Oregon State Board of Census population estimate for 1970 is 2,132,363 for Oregon. Using these estimates and trends, Oregon electric consumers will use approximately 28,665,355,809 kilowatt hours by 1970.

The average annual generation of Oregon's hydroelectric projects by January 1, 1953 was 6,055,880,000 according to the Federal Power Commission. Bonneville Dam Generation was included in this total (1,400,000,000 KWH). Installed capacity was listed at 820,349 KW.

By August, 1959 there was 998,030 KW installed capacity in electric power plants of over 1,000 KW within Oregon. Of this total, 254,500 KW was federal and 743,530 was non-federally-constructed. In addition there was 2,626,200 KW installed capacity (nameplate rating) on Oregon's border streams.

* The Dalles Dam installed capacity was 729,000 KW. An additional generator of 78,000 KW is scheduled to be brought on the line every three months to a maximum installed capacity of 1,119,000 KW.
the Columbia and Snake Rivers. Of this total, 398,800 KW was non-federal generation and 2,227,400 KW was federal.

Oregon has an undeveloped hydroelectric capacity of about 5,000,000 KW. Most of this potential power will be developed only when fish passage facilities problems are solved and the demand for power economically justifies construction of these projects.

Navigation

Navigation is not a prime factor as far as quantitative use of water is concerned in Oregon. The release of multiple purpose storage during low flow periods has aided navigation in the Columbia and Willamette Rivers.

Early completion of the John Day Dam and Reservoir and the 27-foot deep and 300-foot wide channel to The Dalles will be of great benefit to Columbia River navigation. The need for this work is evidenced by the fact that 1,750,520 tons of cargo passed Bonneville Locks during 1958. New tonnage records were set in 1958 at both Bonneville Locks and The Dalles Dam.

Pollution Abatement

The Oregon State Water Resources Board has not assigned water for pollution abatement without proper treatment facilities sufficient to insure that the quality of the water will not be lowered.

In 1939, only 93,000 Oregonians were living in dwellings being served by sewage treatment plants. At the end of 1958 there were 168 public and semi-public sewage treatment plants in operation serving an estimated 810,000 persons or 90 percent of the total served population of the state. At the same time, there were more than 100 communities in Oregon that needed new or improved sewage collection and disposal facilities, according to the Oregon State Sanitary Authority. Construction of these needed projects will cost from 30 to 50 million dollars. By the end of 1958, $1,956,000 had been granted.
to assist 23 Oregon communities, under the federal program authorized in Congress in 1956. In 1958 the Oregon Sanitary Authority received three times as many applications for federal grants as there were funds available.

The pulp and paper plants expected to locate in Oregon, pose a problem of locating water for processing and diluting the effluent.

Flows in most streams west of the Cascade mountains are insufficient during the summer months to assimilate residual pollution loads.

Bacterial pollution and industrial waste discharges have prevented the use of portions of some streams for recreational purposes.

Oxygen conditions in lower Portland harbor are not always high enough to support runs of salmonoid fish in the late summer and early fall.

The addition of domestic sewage effluents and industrial wastes to streams has impaired their usefulness as sources of domestic, industrial and agricultural water supplies.

Logging operations and road construction on various basin watersheds cause serious problems of color and turbidity in streams. These interfere with use of waters for recreation, for water supply and for fish propagation.

Increased population and industrial expansion and development cause pollution loads on streams to increase faster than remedial works have been constructed for correction.

Increased industrial production will create problems of pollution control in certain areas.

Domestic sewage effluent loadings on streams will increase about 50%. Extremely high degrees of sewage treatment will be required on both tributary streams and main water courses.

Recreational pressure on all surface waters can be expected to increase proportionally to population increases. This will require that:
1. Water quality be restored and maintained at a high level to protect the public health.

2. Stream flows must be adequate to protect aquatic life and permit water-associated recreation activities.

More industries and more people will use more water and stream flows must be maintained to meet these demands.

Non-biological contaminants must be controlled to provide safe water for drinking purposes.

Continuation and acceleration of the present joint federal-community program of state-approved sewage treatment works construction is vital in order to bring about higher degrees of sewage and industrial waste treatment; and additional upstream impoundments having sufficient storage to sustain required flows in all major waterways should be considered.
Fish and Wildlife

The total average annual commercial catch of anadromous and fresh water fish in Oregon is worth about $13,600,000. In addition, about one in every four Oregon adults purchases a sports fishing license. In 1957, 529,061 sports fishing licenses were issued in the state. The average annual expenditure for sports fishing in Oregon has been estimated at a minimum of $100,000,000. In 1957, 798,805 licenses were issued in the state for hunting. The total deer kill was reported to be 115,364 and the reported elk kill was 5,761. More than 890,500 ducks and geese were taken by over 67,900 waterfowl hunters during the 1958 season.

In considering how to provide hunting and fishing for the expanded population by 1970 and with the other increased pressures for use of water, the following information is pertinent:

Fish management problems

1. Base stream flows

One of the problems upon which attention has become focused in the last ten years and which will continue to become more acute is the maintenance of adequate stream flows through the natural low water seasons.

One common misconception concerning the establishment of minimum stream flow figures is that the aquatic environment can be maintained if the flow is leveled off at that quantity throughout the year. Minimum stream flow figures are the smallest volumes that can be tolerated in the natural low flow season. The biology of anadromous fish is geared to the natural variation of stream flows at different seasons of the year. A minimum flow that would be satisfactory through the late summer months might be completely inadequate throughout the winter and spring months.
Some scarcities could be overcome if a method of control was established which would insure the proper use of all diverted water and permit none to be wasted. Elsewhere headwater storage of the seasonal surplus could be developed to augment the low flow as well as provide additional water for other beneficial uses.

2. Water temperatures

High summer water temperature is a companion problem to inadequate water flow. In some areas it has become a serious threat to the management of the native cold water species.

Perhaps some of the high temperature problems can be remedied through the storage of the seasonal surplus for release during the critical periods. Before any such project is initiated, it must be predetermined that the stored water will be in adequate supply and of proper quality. Releases of water of undesirable quality could be disastrous. Thorough studies of the probable effects of supplemental releases should be made in conjunction with the other planning if the developments are to enhance the fishery resource rather than destroy it.

3. Passage facilities at barriers

Much thought and effort is being given to the problems surrounding passage of young and adult migratory fish at man-made barriers. Substantial successes have been achieved at many dams as well as at natural waterfalls, but as basin development projects become more complex, greater fish passage problems are created. All of the public fishery management agencies, as well as some of the construction agencies, are giving their combined talents to the search for adequate solutions to the passage problems. Given sufficient time and resources, there is reason to believe they will be successful.
4. Protection at diversions

Closely associated with the problem of safely passing young anadromous fish downstream around barriers is the matter of protecting them from diversions for industrial and agricultural uses. Frequently most, if not all, of the natural stream flow is diverted for such purposes. When the amount of diverted water is small, relatively simple screens can be installed to protect the fish. When vast quantities are removed from the river or passed through hydro-turbines, the solution becomes difficult.

Small rotary screens have been very successful in keeping fish out of the small irrigation ditches. Most of the diversions that can be protected in that manner have facilities installed, but new ditches are being constructed constantly. Large mechanical screens have been placed in some of the major diversions and negotiations are under way with owners of others for similar installations. A rather recently developed stationary louver type screen appears to have considerable promise for fish protection in certain types of large ditches. One installation has been completed and efficiency testing is under way.

5. Pollution abatement

Water pollution has become a serious fishery management problem in some streams. The most infamous example is the Willamette River. Industrial and municipal pollution has completely eliminated some races of fish from the basin.

Much progress in abatement of existing pollution has been made, but population growths and industrial developments have created new problems faster than the old ones can be eliminated. Continued growth of the region will require ever increasing efforts to control the problems.
6. Trash fish control

The construction of basin development projects frequently has changed the habitat so that indigenous species of coarse fish become a nuisance. Populations of squawfish and suckers have mushroomed in the flood control reservoirs of the Willamette Valley and irrigation impoundments of eastern Oregon to the extent that salmonoids cannot compete for food or living space.

The only effective means known to control the problem is to chemically treat the water to remove all fish life, and then restock with desirable species. That usually is a costly endeavor and unless the watershed above the impoundment can be treated effectively, is only a temporary measure.

7. Streambed gravel removal

The indiscriminate removal of gravel from stream beds has at times caused localized fishery management problems. Sometimes the removal is made while eggs or fry are in the gravel, consequently that part of the production is destroyed.

The natural productivity of some streams has been reduced by gravel removal. A shortage of suitable spawning areas is sometimes a factor limiting fish production. When shortages exist, the removal of gravel further reduces the production potential of the area.

Game management problems

1. Water distribution

The distribution of adequate water supplies has an affect on the distribution of game animals and birds in the more arid parts of the state. Under normal conditions sufficient water occurs throughout most of Oregon to provide for the species occurring in the various areas, but in adverse years some acute shortages are experienced.
Under some agricultural practices water supplies are either eliminated or their use withheld from game species. As the human population grows, greater conflicts will develop resulting in greater restrictions.

Planning to accomplish the utilization of surplus and waste water from some of the reclamation projects for game and waterfowl enhancement would be very beneficial in several areas. Rather than wasting the excess back to the stream, which frequently creates fishery problems, it could be picked up and transmitted to suitable areas for game use or wet land development.

2. Protection along diversion canals

With the increased development of hydroelectric and reclamation water supplies in the back country, big game populations are exposed to new hazards. Open canals, winding for many miles through the mountains, make effective barriers across deer and elk migration routes.

Waterfowl and fur bearer management problems

1. Marsh and pond drainage

The most serious limiting factor affecting waterfowl has been the indiscriminate destruction of wet land areas. It is fundamental that waterfowl need water, and their numbers decline as their habitat is reduced.

Reclamation of many marshlands for agricultural development has proved to be ill-advised as the resulting lands were not desirable for farming purposes. Most careful consideration should be given to all factors before further drainage is accomplished, and the rewatering of some areas might be desirable.

2. Providing adequate water supplies

Diversion of water supplies and drainage at adjacent areas have seriously reduced the available water at some of the existing marshes and other waterfowl areas. Management agencies have alleviated some of the distress by acquiring
water rights to restore the potential, but the problem remains serious in several areas.

It behooves all public water planning and control agencies to give careful consideration to the needs of waterfowl and fur bearers, as well as all other wildlife, when studying or authorizing future developments.

3. Stream channellization and cover removal

A number of small, localized flood control or drainage projects have been accomplished by removing the bank cover and rechannelling the stream. Most of these waterways, especially those on the floor of the Willamette Valley, provide excellent habitat for ducks, beavers, and muskrats. Frequently the surplus water problems could have been solved by removal of the accumulated drift and debris from the natural stream channel and widening it only at the constricted points.
The Importance of Water As a Recreational Feature in Oregon State Parks

The use of water for outdoor recreation is becoming of increasing importance in nationwide leisure time activities. Pleasure boating, swimming, fishing, water skiing, and skin diving are the main uses, most of which have shown large participation increases within the last 10 years. According to the Outboard Boating Club of America, pleasure boating is now termed the nation's number one family outdoor sport, with 37,000,000 persons participating in 1958 and spending $2,000,000,000. Seven million three hundred thirty thousand boats were in use as compared to 2,440,000 in 1947. Among other factors, the mobility of pleasure craft and increase in the number of water impoundments throughout the county are contributing factors to greater use. Published reports indicate last year 5,000,000 skin divers spent $30,000,000 on equipment, representing perhaps a 1,000 percent increase in use over ten years ago. Water skiing, almost unknown a decade ago, has grown along with the boating trend. Such established water use activities as angling and swimming are also increasing.

On the state level, the public's preferences in recreation are reflected in the establishment and development of Oregon State Parks. These trends are considered in the selection and planning of state parks, and the use made of the park areas is the measure of their public worth. For example, 19 new state parks have been acquired since 1954 and 17 of these have water interest as their main feature. During the same period the Parks Division developed another seven areas already in the park system, all of which featured lakes, streams, rivers, or ocean frontage.

State Park attendance figures are ample evidence of public interest and use, as illustrated by several of the following examples: Rooster Rock State Park, developed in 1956 featuring boating and swimming, had a 1958 attendance
of 417,681; Hat Rock State Park developed in 1955 for swimming had a 1958 attendance of 124,599; Detroit Lake improved in the same year for boating and camping had 148,425; and Ochoco Lake developed in much the same manner had 116,226.

In summary it may be noted that of Oregon's 170 state parks, 90 have some form of water interest for the basis of their attraction. Inasmuch as predictions based on past and present use indicate a substantial increase by 1968, and parks featuring water associated activities and attractions account for approximately 82 percent of total park usage, it is evident that water will continue to play a very important role in providing recreation opportunities for many years to come.
Trends in the Consumptive Use of Water for Waste Disposal

Consumptive use of water for waste disposal may be expected to increase with the proposed construction of evaporation lagoons by both industry and municipalities. If Oregon makes full use of her timber resources by utilizing waste forest products and tree thinning, the increase in use of water for disposal of effluent may increase manyfold by 1970. The availability of water and markets will determine the rate of increase.
Some Means of Meeting Future Demands (New Techniques)

A. Conventional methods of adding new supplies and costs thereof:

Programs designed to facilitate reservoir construction of all sizes must be implemented. Reregulating reservoirs have recently proven their value in reducing operational wastes.

Storage projects proposed by federal construction agencies are available through these agencies. Cost estimates per acre-foot of proposed storage varies from about $20 per acre-foot (Silvies River and Duncan Ferry Projects) to well over $200 per acre-foot (Thorn Hollow Dam). As development continues within our proposed reservoir sites, we can expect greater cost of storage in the future as a result of expensive relocations and land acquisition.

Ground water studies may discover new water sources and areas where economical recharge is feasible. The practice of range pitting, spreader ditches, and other means of recharging ground water is expected to increase.

B. Vegetative Management (Reduction of Evapo-Transpiration)

Research is needed in vegetative manipulation on watersheds. Strip or patch cutting practices show promise as a tool in water management in high elevation watershed.

Practically all of Oregon's greatest water producing areas are forested. More than 30,260,000 of the state's 61,641,000 acres or 49 percent is forested. About 25,875,000 acres or 42 percent of the state's area is in commercial timber production and 4,396,000 or seven percent is forested with non-commercial timber or the land use is restricted by parks, etc.
Additional research is needed to determine the amount of water consumed by "weed" trees and other woody plants and their effect on the watershed. When adequate basic watershed information is acquired, federal agencies that now administer over one-half of Oregon, should be given funds and authority to implement justified watershed programs. Continued development and use of safe, efficient and economical chemicals for weed and moss control in and along irrigation canals should be encouraged.

C. Weather modification (induced precipitation)

Additional research is needed for weather modification to induce precipitation or reduce storm damage.

Regional policies should be developed and promulgated regarding the right and extent to induce precipitation if results of research in this field are productive.

D. Evaporation Reduction and Seepage Control

Continued research is needed to provide economical reduction of evaporation on Oregon's 1,290 reservoirs. The use of products presently developed have been restricted due to their cost and a lack of knowledge of their capabilities.

Seepage control has not been a serious factor in Oregon storage projects except in the Upper Deschutes Basin. Tumalo Reservoir failed to hold water and the seepage loss at Crane Prairie Reservoir, when full, is estimated to be about 270 cubic feet per second. The development of economical means of reducing or eliminating these losses, would be highly desirable.
Transmission and distribution losses constitute a serious loss of water. Present canal sealing techniques are effective but too expensive in areas where low income per acre crops are grown.

E. Desalinization

The desalinization of ocean or brackish water has not been seriously considered in Oregon. Other sources of water appear to be less expensive and more favorably located for use.

F. New Techniques in Multiple River Management

In 1955, the Oregon Legislature created a comprehensive water policy and created the State Water Resources Board to carry out this policy. The Board was instructed by the Legislature to proceed as rapidly as possible to study: existing water resources of this state; means and methods of conserving and augmenting such water resources; existing and contemplated needs and uses of water for domestic, municipal, irrigation, power development, industrial, mining, recreation, wildlife and fish life uses, and for pollution abatement, all of which are declared to be beneficial uses, and all other related subjects including reclamation and drainage.

After making river basin studies, the Board progressively formulates an integrated, coordinated program for the use and control of the water resources and prepares reports and programs thereof.

By 1959 the Board has investigated the Rogue, Umpqua, Grand Ronde, and Upper McKenzie Basins. The Deschutes, Upper Willamette, John Day, and North Coast Basins are scheduled for study within the next two years.
G. Effects of Nuclear Energy

Nuclear energy production presents new problems to water users. The effect and extent of water contamination from radioactive waste disposal and the effect on water temperatures after the water is used for cooling processes, needs careful study.


Research is needed for the following:

1. Determining the proper duty of water for agriculture, both in quantity and during critical periods.
2. Reclaiming water from industry, particularly food and wood fiber processing plants.
3. Locating and developing underground storage of water.
4. Long-range weather and streamflow forecasting.
5. Controlling or eradicating undesirable vegetation.
6. Developing food and fiber plants that use water more efficiently.

A program of continued research and the development of basic data that will provide an inventory of knowledge and efficient techniques for utilizing our valuable water resources, is of paramount importance.

Multiple-use water resource planning must be continued at an implemented rate to facilitate the productive harvest of Oregon's water crop.