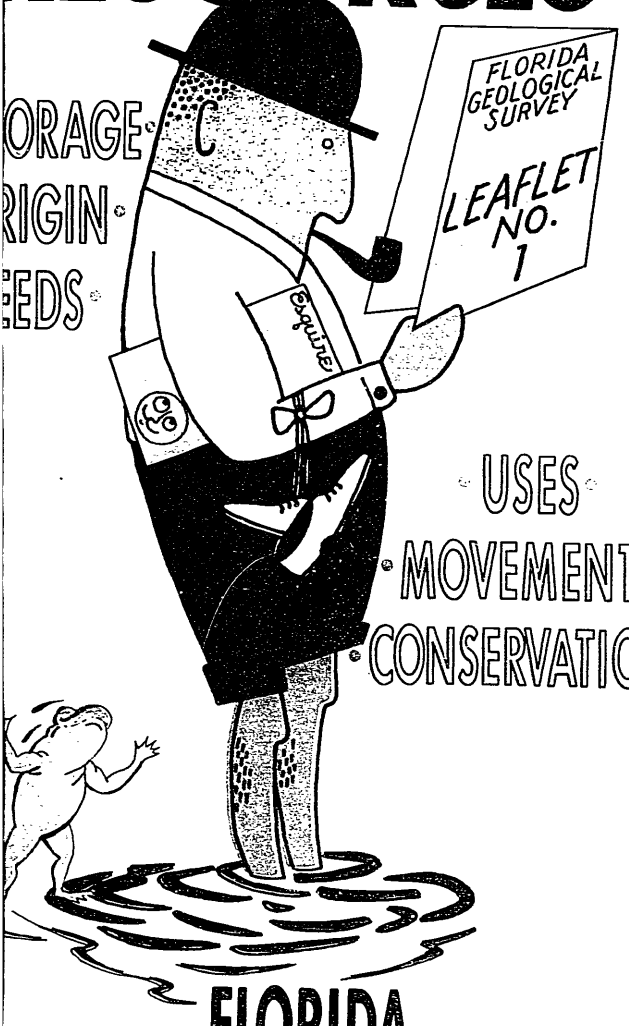
YOUR WATER RESOURCES



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INTRODUCTION

Florida has a high annual rainfall; more than 30,000 named lakes; one of the largest, most prolific ground-water reservoirs in the world; and numerous springs, of which 66 each discharge in excess of six million gallons of water per day. Seventeen of these springs produce at rates that exceed 65 million gallons of water per day. The runoff from this wealth of water has established itself into 12 large stream basins and many other smaller ones.

Water is the State's most important natural resource, and since there appears to be such an abundance of this resource, what are the problems? Why the growing concern over it? Do we have less than we enjoyed in the past—and sometimes more?

Problems of supply and demand arise out of the irregular distribution and movement of water. The values for rainfall, stream flow, spring discharge, lake levels, and water levels in wells reflect periods of great drought and excess of water. It is this irregularity and variability of occurrence that creates problems. Problems in Florida, for the most part, arise out of not having the water arrive at the place at the time it is needed; although flooding, pollution, contamination, and heavy mineralization are locally troublesome.

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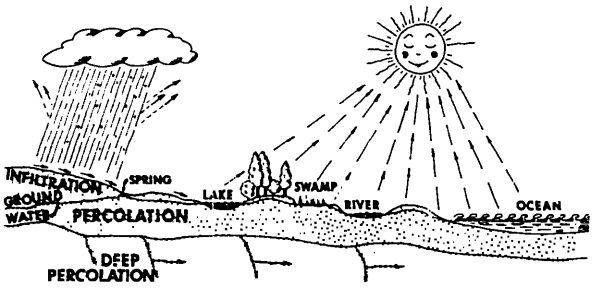
WHERE DOES OUR WATER ORIGINATE?



Contrary to some popular opinions, our water resources come entirely from precipitation (rain, snow, hail, and sleet), that falls on Florida, southern Georgia, and southern Alabama. The water cycle, from atmosphere to land and water and back to the atmosphere, constantly renews and revitalizes the supply.

Water goes into the atmospheric cycle by evaporation from open bodies of water and from land surfaces. Vegetation helps this process. Once into the air as vapor, water collects into clouds to be transported and condensed into precipitation to return to the earth. That which falls on the land surface is the potential for our drinkable water supply. Most of this water runs off to the sea or goes back into the air by evaporation. Some of it goes into ponds and lakes to form a reserve supply for ground and surface water. A part of that which goes into the ground forms a near-surface groundwater supply which can be tapped by shallow wells. The rest goes into deeper porous rocks, through which the water travels under pressure from the point of entry or recharge to remote regions of the State. This is the principal source of ground water.

About 73 percent of the water falling as rain is used by vegetation or evaporates from exposed water and land surfaces.

Both surface and ground waters are used in the needs of industry, municipalities, domestic and farm areas, recreation, power, and irrigation—but ground water supplies about 59 percent of the consumptive needs of the State.

HOW IS ONE WATERSHED SEPARATED FROM ANOTHER?

Because of climatic controls, rainfall is not uniform throughout the State and varies from an annual average of 38 inches at Key West to 64 inches at DeFuniak Springs. Each city in Florida receives varying amounts of rainfall.

Water that has fallen upon the State is separated into watersheds, composed of all the land that directs water into a common stream or body of water. There are approximately 50 clearly defined watersheds in Florida.

However, where water enters the ground in high areas of a watershed it moves toward and discharges into streams, lakes, and the ocean. The direction of flow may cause the ground water to cross beneath watershed boundaries established for surface water. The slope of the ground surface, size of channel and the volume of water, control the rate of flow in surface streams, but the amount of voids or space in the rock (porosity), the degree of connections of the voids (permeability), and the slope of the surface of the ground water (gradient) controls rate of flow in ground water.

Once surface water enters a watershed it can not cross watershed boundaries (divides), but ground water can pass beneath these watershed boundaries moving downgradient from high areas where it emerges in low areas as surface water. Surface-water problems, therefore, are local ones caused by floods and droughts, whereas ground-water problems may affect broader areas.

Water can only be taken from one watershed and diverted for use in another with the permission of the State Board of Conservation. Problems of flood, erosion, drought, contamination, and sedimentation must usually be met within the boundaries of each watershed.

Most streams originate in the highlands of Florida and adjoining states and are separated by rolling hills or stream divides which are composed of several kinds of sediment and rock.

There are some rivers and streams that originate in the coastal lowlands and the divides are flat marshy areas with very little relief.

Elevations of the ground surface in Florida range from sea level to a little above 350 feet. This low relief generally does not allow the development of deep ravines in the divides, nor does it create steep slopes.

HOW DOES THE LAND INFLUENCE THE SUPPLY?

Because Florida has a very sandy soil and a flat terrain broken by numerous sinkholes, lakes, and swamps, much of the water falling on the land is retained at the surface or enters the ground. Because of this, the percentage of water that runs off is moderate.

The amount that enters the ground or runs off depends in part upon the slope of the land, the vegetative cover, type of soil, condition of the soil by mulching and tilling, and by terracing of slopes.

Loose, mulched soil can retain large quantities of soil moisture for plant use. Soil management by the farmers, growers, and ranchers is the first step in water control and management.

Land regulates the amount of water that enters the basins. Sloping surfaces are drained faster than flatlands. Sandy land absorbs water more readily than clayey lands. In some areas of Florida there is a layer of dense, organic sand, called hardpan, just under the surface, which may retard the movement of water into the ground.

Sandy soils allow water to enter the ground rapidly and permit its storage as ground water for dry times. Clayey soil will absorb and store less water.

The lakes and sinkholes of Florida are storage basins through which the ground water is being continuously replenished.

HOW MUCH WATER DO WE HAVE?

The State of Florida has an average annual rainfall of 53 inches. This amounts to an average of 148 billion gallons of water falling upon Florida in a day. This is the principal source for our streams and thousands of lakes as well as the water in the ground. Beneath Florida lies one of the most extensive and productive ground-water reservoirs in the Nation. The volume of water in this reservoir has been estimated to be several times that impounded behind Hoover Dam, the Nation's largest man-made lake. There also are several less extensive water-bearing rocks that supply areas such as Miami and Pensacola. Certainly Florida has more fresh, drinkable water available than is now used or will be used for some time to come, but this condition may prevail only if this resource is wisely managed.

For all purposes of planning, the daily discharge of streams, estimated at 40 billion gallons of water per day, is the amount available for future use. This is about 17 times the State's requirements today for consumptive uses.

SURFACE WATER RESOURCES

Surface water occupies defined channels upon the ground surface to form rivers, brooks, creeks, lakes, ponds, swamps, marshes, and variations and combinations of these. Man-made dams may create additional reservoirs in these surface channels to increase the water storage, or ditches and canals may be constructed to increase the discharge.

Surface water supplies the primary needs of irrigation for citrus growers and farmers. Only four

hydroelectric power dams are operated in Florida: Jim Woodruff Dam on the Apalachicola River at Chattahoochee, Inglis Dam at Inglis on the Withlacoochee River, Talquin Dam on the Ochlockonee River at Bloxham, and a small dam at Moss Bluff on the Oklawaha River. These dams store in excess of 575,000 acre-feet of water for use in power generation, navigation, recreation, and conservation. It requires 325,850 gallons of water to cover an acre to a depth of one foot.

With the completion of the large water-management project, now under development by the Central and Southern Florida Flood Control District, 4½ million acre-feet of water can be stored during periods of abundant rainfall in three conservation districts for release during droughts.

In addition, under the U. S. Soil Conservation Service, more than 3,350 small ponds in Florida have been constructed on farms and store about 28,764 acre-feet of water in areas where irregular patterns of rainfall make these most useful.

The use of land in Florida changes from year to year, and roads, building, poor mulching, and soil conditioning, lack of terracing in high lands, and destruction of forests may increase the amount of water that runs off. Any changes in land use may also alter the timing and peak flow of streams, the levels of lakes, amount of recharge to ground water, and quality.

Florida streams generally have moderate to slow rates of flow because of the flat terrain and low slopes. Much of the rainfall is trapped in basins or by the sandy soil and enters the ground as ground water. About 50 stream basins drain the State, but south of Lake Okeechobee the water stood in shallow sheets or moved as sheet flow slowly through the Everglades until controlled by man. Drainage canals and conservation districts now concentrate this water and make the peaty soils available for cultivation.

Because of differences in the soils, rocks, climate, terrain, vegetation, and evaporation, twice as much water runs off the land into streams in Panhandle Florida as in the peninsula. Springs add to the amount of water in streams. Silver Springs, at more than 500 million gallons per day, and Rainbow Springs, at about 450 million gallons per day, are among the larger springs in the world. Of the 53 inches of annual rainfall, 39 inches are lost to evaporation and used by vegetation, and 14 inches enters the ground or runs off of Florida in streams that empty into salt water. This measurement of runoff does not include water entering the State from Georgia or Alabama and water emerging as springs under salt water.

GROUND WATER RESOURCES

The State is blessed in having some of the best and most productive ground-water reservoirs in the world. Several thousand feet of porous

limestones, that make up the principal ground-water reservoir, contain an estimated 1,600 cubic miles of fresh water, better than 44,000 times the average daily stream discharge of 40 billion gallons.

At least 100 named springs are known, most of which are fed by water rising from the porous limestones under pressure. Florida has more large springs than any other state, and Silver Springs alone discharges enough water to satisfy all of Florida's municipal and rural domestic needs, if it could be distributed to the place of need.

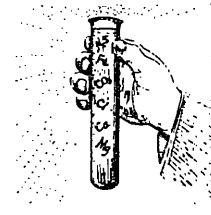
In areas along some of the coastal margins and where the deep ground water is heavily mineralized, shallow porous sand, shell, and limestone contain sufficient amounts of water to supply the needs of these areas. Miami, in particular, relies upon highly permeable sediments that lie at or near the ground surface of the area.

About 1.5 billion gallons of water per day are drawn from ground water by domestic, municipal, industrial, and agricultural users.

WHAT DOES THE WATER CONTAIN?

Rain falling on the earth is practically pure, containing only a small amount of carbon dioxide and oxygen dissolved from the atmosphere. As the water soaks into the soil and becomes part of the ground water, it begins to dissolve mineral matter from the materials through which it passes.

The substances most commonly found dissolved in Florida waters are hydrogen sulfide, calcium and magnesium sulfates and bicarbonates, and sodium chloride. Iron and organic materials are also present, more commonly in water at the surface and in shallow wells. Sodium is usually restricted to highly mineralized



waters, or in waters affected by salt-water intrusion. Strontium and fluorine are also present in some Florida waters although usually in very small quantities.

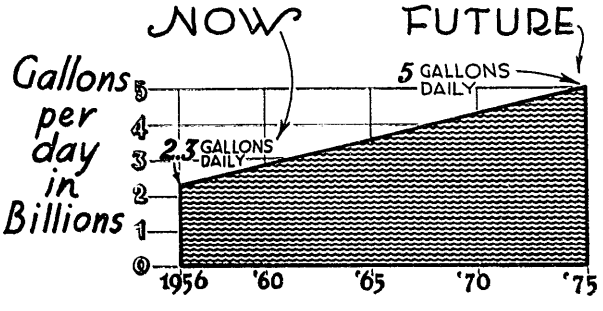
CHEMICAL CONSTITUENTS AND WATER USE	
Constituent	Effect on Water Quality
IRON	More than 0.3 ppm (parts per million) of dissolved iron will cause staining, discoloration (''red water''), and an unpleasant taste.
HYDROGEN SULFIDE	Gives the water an unpleasant odor, but is harmless and easily removed by aeration.
(Calcium, Magnesium) SULFATE	Gives water a bitter taste if concentration is greater than 500 ppm.
CALCIUM	Main cause of hardness in water.
MAGNESIUM	Second most important cause of hardness.
SODIUM CHLORIDE	Public supplies must contain less than 250 ppm. Larger amounts give a saline taste and increases the corrosion.
SODIUM AND POTASSIUM	The amount normally found in drinkable water is of little significance. High concentrations sometimes found in very deep wells may be harmful when used directly for irrigation.
(Fluorine in the form of) FLUORIDE	Concentrations of 0.7 to 1.5 ppm are helpful in preventing dental caries. Large concentration may cause mottling of teeth. Concentrations of this element in Florida ranges from a trace to 2.5 ppm.
(Calcium, Magnesium) BICARBONATE	Contributes to hardness of water.

IS IT GOOD WATER?

Water which is considered good for one purpose may be unsuitable for another. Water from wells which penetrate covered limestone rocks containing water under some pressure is less subject to contamination from surface sources and is low in iron. It is, however, usually hard and, in some places, salty enough to be unpleasant tasting and corrosive to plumbing. Surface water and water from shallow wells often contains enough iron to cause staining and give the water an unpleasant taste.

For the most part drinkable water of high purity is available over most of the State from streams, lakes, ponds, deep wells, and from shallow wells in areas where the deeper well water is highly mineralized.

HOW MUCH WATER WILL WE USE IN THE FUTURE?



It has been estimated that in 1975 the Nation as a whole will be using twice the amount of water that was used in 1956. As the rate of growth of Florida is much greater than that of the Nation we can expect a greater proportional increase in water use. The estimated 1956 consumptive use in the State was about 2.3 billion gallons per day. The 1975 consumptive use will probably amount to about 5 billion gallons per day.

WHAT ARE THE CURRENT USES?

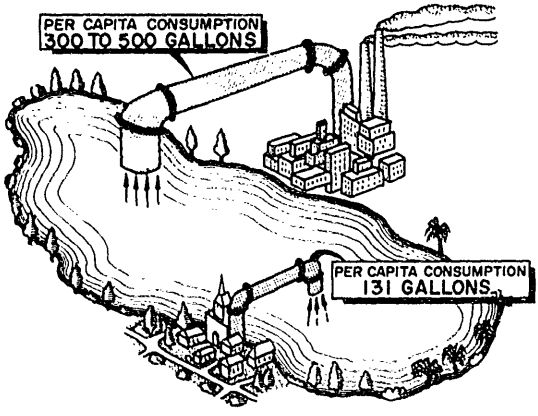
The uses of Florida's water are as diverse as the many activities in the State. The major uses range through agricultural, municipal, rural, domestic and livestock, industrial, power, and recreational. The last two uses cannot be evaluated quantitatively in a manner similar to that of the other principal uses. A summary of consumptive-water use in Florida in million gallons per day (mgd) for 1956 and projected to 1975 is as follows:

	1956	1975	% Increase
Agricultural	1,182	2,500	111
Industrial	639	1,550	142
Municipal	390	750	92
Rural	104	200	92
Total (mgd)	2,315	5,000	111

HOW MUCH WATER FOR CITIES AND TOWNS?

The foremost priority for an area's water resources is a safe and drinkable supply. In general, the requirements for water are based upon the number of people served, with proper allowance for the standard of living of the population. The present daily per capita consumption, of persons served by public systems in Florida, is 131 gallons with the

national daily average of 153 gallons. The urbanizational trend and rapid population growth indicates that by 1975 the average water demand in Florida should exceed 150 gallons daily per person. Better than 90 percent of municipal requirements for water comes from ground water.



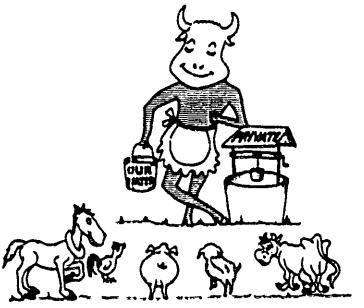
Cities and areas of industrial development use from 300 to 500 gallons per person per day. As Florida develops industrially it can be anticipated that its per capita use of water will accelerate.

FROM WHERE WILL THE WATER FOR LIVESTOCK AND FARM HOMES COME?

Practically all farm water supplies are obtained from privately developed wells which furnish water at a fairly constant temperature and quality throughout the year. In some areas wells flow naturally making pumping unnecessary. In most areas, however, a pump is needed to furnish an adequate supply.

Daily requirements for farm use are estimated at 35 gallons for each person, 12 gallons each for

horses and beef cattle, 25-30 gallons each day for dairy cattle, and about 2 gallons each for small stock.



The use of wells for watering livestock has greatly increased because wells are more dependable as a supply than surface sources.

HOW ABOUT IRRIGATION?

In Florida more water is used for irrigation than for any other consumptive purpose. A large amount of water is supplied for crops and groves by rain falling on the area where it is to be used, or by surface water stored in adjacent areas. Due to the seasonal nature of rainfall in Florida, it is sometimes necessary to supply additional water to growing crops, especially when the rainy season does not correspond with the growing season. A large number of wells are now in use for this pur-

pose, many flowing naturally and others being pumped. Use of water for irrigation can be expected to increase as more land is put into cultivation.

Surface water supplies about 70 percent of the requirements for agriculture, this being the largest consumptive use of water in Florida. When spread out on cultivated land, large amounts of water are utilized by vegetation, but the greatest loss is through evaporation.

WILL INDUSTRY HAVE ALL THE WATER IT NEEDS?

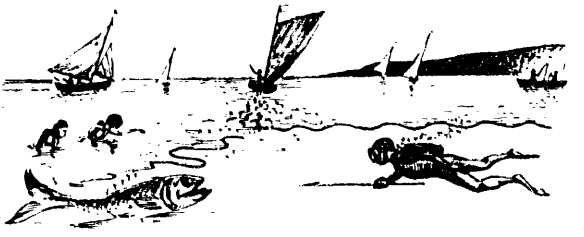
The water requirements for industry are more diverse than those for other uses. Some industries use very large volumes of water while others use practically none. The quality requirements also vary greatly depending upon the type of industry — some requiring water of the highest purity while others can use water of almost any quality.

In all uses conservation should be undertaken by reusing water whenever possible, and by reclaiming it where desirable and necessary. However, it is not expected that there will be a shortage of water for industrial use in the foreseeable future, provided that intelligent plans for water supply are made prior to the location of new industrial sites, or expansion of present plants.

There are four major industrial users of water in Florida: (1) Electric power installations – 1,590 million gallons per day, of this only about 4 percent was actually consumed, the remainder was returned to the reservoirs; (2) pulp and paper and chemical industries – 354 million gallons per day; (3) citrus processing industry – 94 million gallons per day; and (4) the mining industry – 191 million gallons per day.

OTHER IMPORTANT USES

The use of water resources may be divided into consumptive and nonconsumptive uses. Irrigation, domestic and municipal, are examples of consumptive uses, whereas, recreational, power and transportation uses are nonconsumptive. In dollars and cents value to the State probably the most important use is that of recreation. The money spent in boating, swimming, fishing, skiing, and other recreational activities utilizing water cannot be accurately given, but because of the unique appeal of Florida and its great attraction to tourists, estimates of the recreational value of water run to several hundred million dollars, including more than 300 million dollars spent annually on the purchase of boats, their upkeep, and operation.

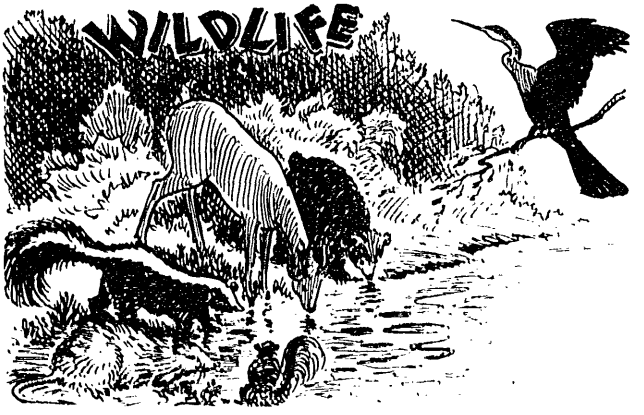


Florida has a coastline of about 8,500 miles measured to tidal water limits, or upstream to a width of 100 feet. The total water area, including lakes and streams, exceeds 3,800 square miles.

Few states have as many natural waterways and improved harbors. Eight seaports, having a depth of 30 or more feet, and eight having 21-28 feet, handle millions of tons of commerce. Tampa, Jacksonville, and Miami are the largest. Petroleum, chemicals, paper and its products, phosphate, oyster shell and limestone, are the principal commodities transported.

Because of the unique appeal of the State's climate and recreational possibilities, the many miles of navigable waterways are extremely important in the economy of the State. A coordinated waterway program is underway and will be developed.

HOW ABOUT THE NEEDS FOR RECREATION AND WILDLIFE?



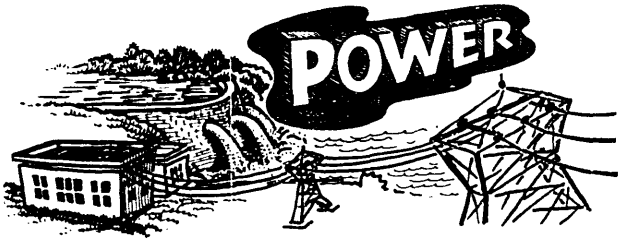
In any local or statewide long-range planning for the use of our water resources, the preservation of uncontaminated surface waters for recreation and wildlife must be considered. In 1955 it was estimated that $381 million was spent by the public in the use of our fresh-water resources for recreation. The chief threats to our recreational use of water are pollution and restriction of public access.

Water used for recreation, boating, and wildlife is not consumed or changed by that use, but consumptive uses may reduce the amount available for game and fish and other recreation management.

With a tidal coastline of about 8,500 miles, along with numerous streams, springs, and lakes, the State is adequately endowed for recreational purposes and wildlife management.

WHAT ARE THE PROSPECTS OF USING WATER FOR POWER?

Because of the low relief and terrain natural to Florida, and the resulting sluggish streams, there are very few sites available for the development of dams suitable for power production. At the present time, small plants are operated at Inglis, Bloxham, and Chattahoochee. The Jim Woodruff Dam at Chattahoochee is the largest of the three, and it is designed to produce an average of 212 million kilowatt hours of electricity, but that only during times when the head pool is higher than the tail pool. Almost any quality of water can be used for power production.



Steam-generation installations used in excess of 1,600 million gallons of water per day during 1956, of which only 2 to 3 percent was obtained from ground water.

HOW DO WE LOSE WATER?

Much of the fresh water of the State runs rapidly off to the ocean. This loss could be reduced greatly by more adequate storage facilities, but when developing and improving water-storage facilities we should consider the increased loss of water by evaporation. Any method whereby the water can be retained upon the land for a longer period of time will reduce the loss from runoff. Mulching and tilling of the soil, terracing, farm pond construction, and winter crops help in this conservation.

Great quantities of municipal and industrial wastes find their way into streams, lakes, and ground water. Contaminated and polluted water is not suitable for most uses. Some of our streams are being contaminated to a degree that they can be used only as running cesspools for disposal of industrial wastes.

The former reckless drainage of the Everglades, coastal marshes, and other storage basins has not only wasted the State's water but allowed the very rapid oxidation of organic soils.

In areas of artesian flow, water is lost through leaking valves, open casings, valves deliberately or carelessly left open, abandoned and rotted casings, and wasteful irrigation practices.

Contamination of ground water is another cause for water loss. Disposal of industrial and city wastes into the ground can cause the water supply to be unfit for many purposes. In some areas the absence of streams make it necessary to dispose of surface water through wells. In this manner lake levels can be controlled and street drainage carried underground. Some industrial wastes have also been placed in these wells, and their disintegration has produced inflammable gas which has accumulated in the porous limestones that underlie the area.

Overpumping of a ground-water source may draw salt water into the aquifer from the sea, or from below, and will increase the mineral content of water in wells of the area. A number of our communities have experienced this problem and have had to relocate their well fields.

CAN WE HAVE TOO MUCH WATER?

Much of the recent damage and difficulty occurring from too much water has stemmed from Florida's rapid population growth, and the ensuing encroachment into the lakes and river basins in the never-ending search for water-front property. Since most of Florida is within 60 miles of the sea, and less than 350 feet above sea level, drainage is often inadequate during heavy seasonal rains. Not only do some sections of the State suffer from seasonal stream flooding, but also from a high water table and raised lake levels accompanied by waterlogged soils and temporary ponds. The problem of too much water is being studied and attacked not only from the standpoint of single watershed areas, but also within much larger areas involving several counties.

Flooding in Florida is frequent because of the flatlands, the concentration of much of the annual rainfall over short periods, and absence of protective water-control facilities.

HOW CAN WE PROTECT AND CONSERVE OUR WATER RESOURCES?

We can best protect and conserve our water resources by developing a comprehensive statewide

long-range water plan. This plan should be based on a complete understanding of the natural and man-made controls that regulate the storage, movement and quality of water conditional to the availability and need for water, fairly apportioned among the users.

Ground-water management must be statewide but surface-water management is a watershed problem and must be approached within each watershed. A coordinated district action is required and usually a soil conservation program is included. The construction of terraces to reduce slope wash, the encouragement of good soil tilling and mulching practices, the planting of protective vegetative cover, all work toward soil and water conservation.

C O N S E R V A T I O N

The Watershed Protection and Flood Prevention Act (U. S. Public Laws 566 and 1018) provides for management and use of water by upper watershed control structures. Flood control and agricultural benefits can be combined with improvements for industrial and municipal supplies, wildlife management, and recreational facilities with these sharing in the costs of construction according to the value and degree of the benefits.

WHO OWNS THE WATER IN FLORIDA?

Florida follows the general rule of riparian rights, which essentially guarantees that each ri-

parian proprietor is entitled to make use of any water resources on his land, provided his use does not unreasonably affect the rights of adjacent riparian owners. This right implies "reasonable use," but this term has never been clearly defined by legislative or judicial authority in Florida.

In 1955 the Legislature of the State of Florida declared that the, "Waters in the state are a natural resource," and that, "The ownership, control of development and use of waters for all beneficial purposes is within the jurisdiction of the state which in the exercise of its powers may establish measures to effectuate the proper and comprehensive utilization and protection of the waters."

Such implementation of this policy must be within the framework of judicial opinion relative to the riparian doctrine. Irrigation is necessary in Florida. The construction of surface reservoirs and the use of waste waters for this purpose should be encouraged. But irrigation is not possible without the loss of water through evaporation, and large losses might exceed the "reasonable use" provision of the riparian doctrine.

The laws of Florida should anticipate the relative rights of human needs, stock requirements, irrigation, industrial, and recreational uses, and should adopt means to fairly apportion such rights to the extent to which they are most reasonably capable. In this way, waste and unreasonable use of water should be prevented.

The Department of water Resources was created in 1957 for the purpose of implementing the water policy of Florida. This department primarily exercises control over and manages our water resources, formulating reasonable rules and regulations to implement the policy. The Florida Geological Survey is designated by the Legislature as the primary state agency for the collection of data on water resources, and joins the U. S. Geological Survey, State universities, Salt Water Fish Commission, and the State Game and Fresh Water Fish Commission to provide specialized data on water resources relating to specialized fields of responsibility.

SUMMARY AND CONCLUSIONS

Florida's water supply is adequate to meet all present needs for many years to come, with a surplus of water for future development. This surplus is sufficient for the expected increases in water use for all purposes. Industry has been, and will be, attracted by large volumes of good water combined with extensive tracts of available land, good research facilities, and an unexcelled climate, beaches and recreational facilities. While the State has large quantities of available water resources now, responsible public officials must take a long-range planning view of the total quantity and quality of available water. Excluding storage, it has been estimated that we have a surplus runoff of about 17 times the amount of water used in Florida at the present time. This water is available for additional and increased uses. The limited problems that have arisen in the use of the State's water resources can be eliminated for the most part by wise management and control.

How we use our water resources, whether wisely or unwisely, will rest upon each citizen of Florida. Floridians can look to the future with optimism.

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