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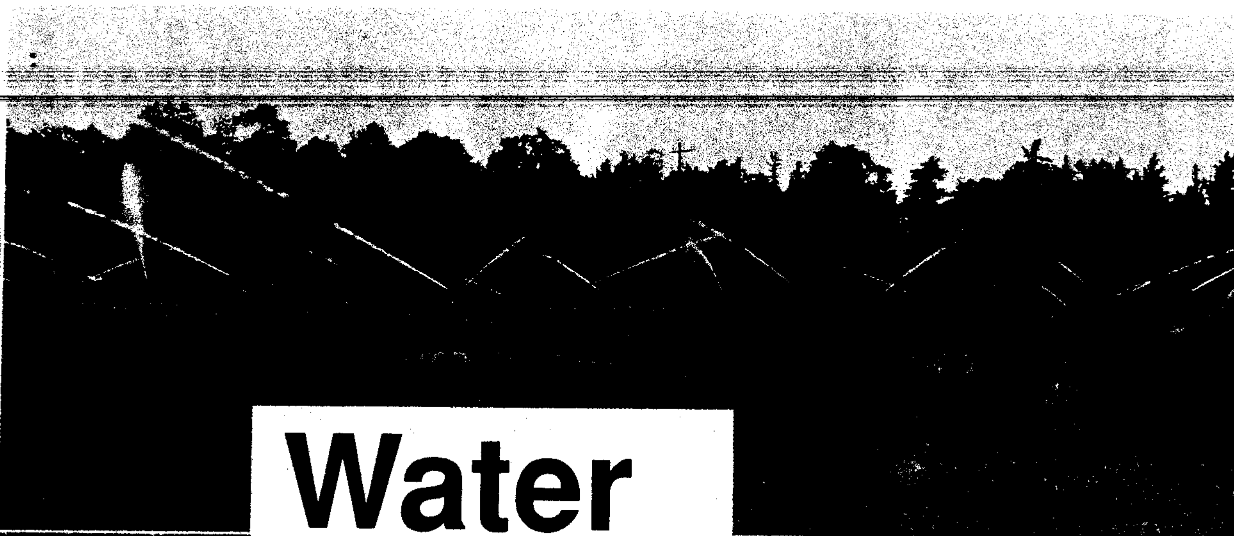
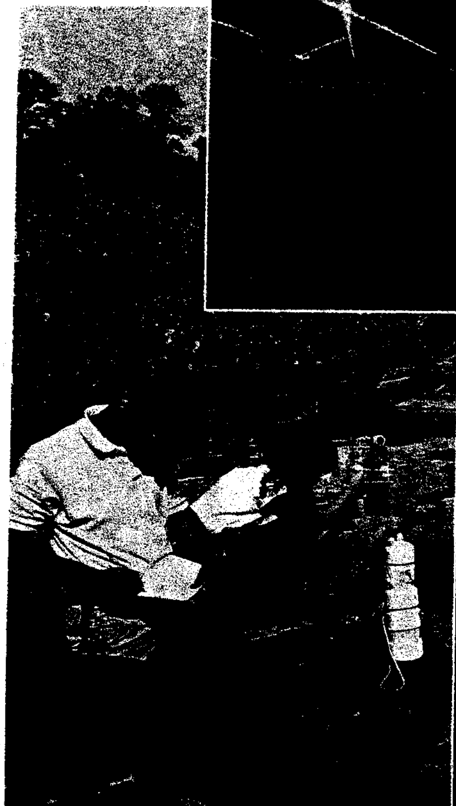
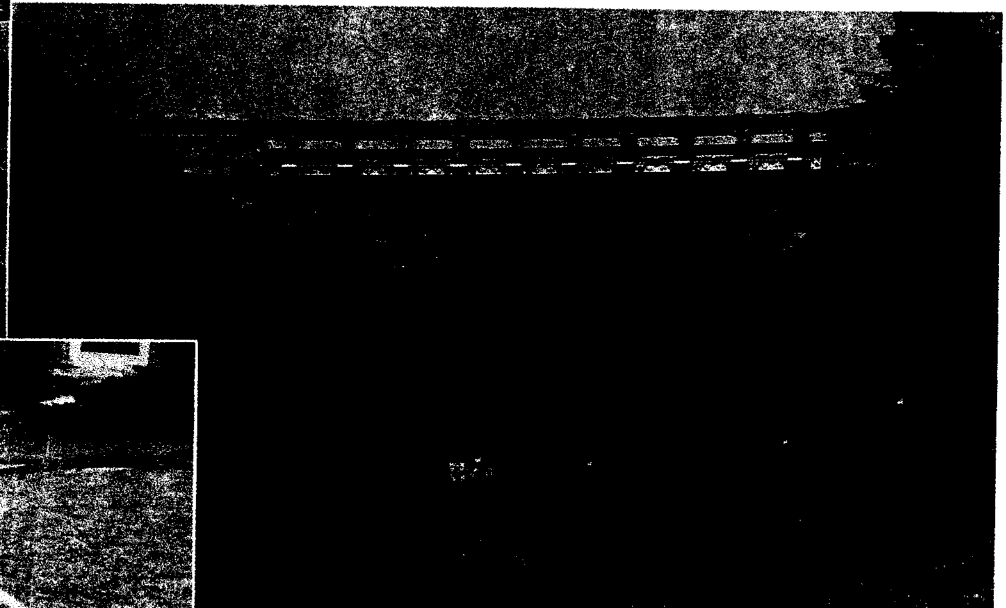


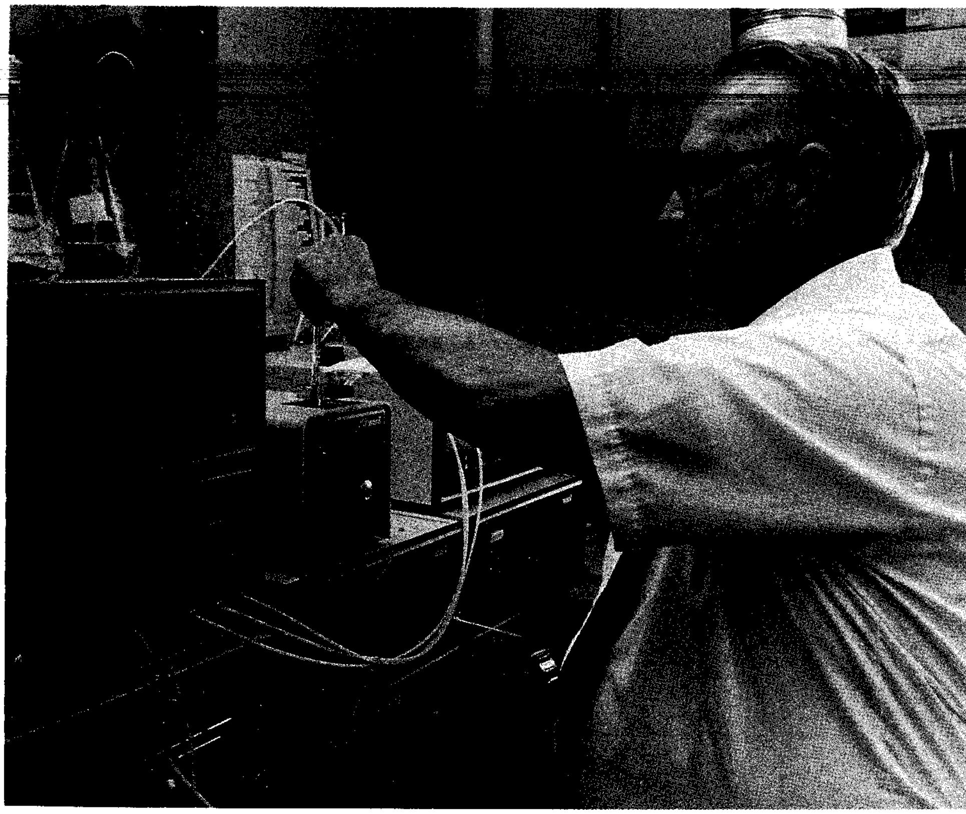


Water Conservation



A Guide for Georgia

Georgia has abundant surface waters — over 20,000 miles of lakes, rivers and streams, replenished by an average of 50 inches of rainfall yearly — as well as one of the world's largest and highest quality aquifer, or underground water, systems. Conservation is now vital for protecting these lifegiving resources.

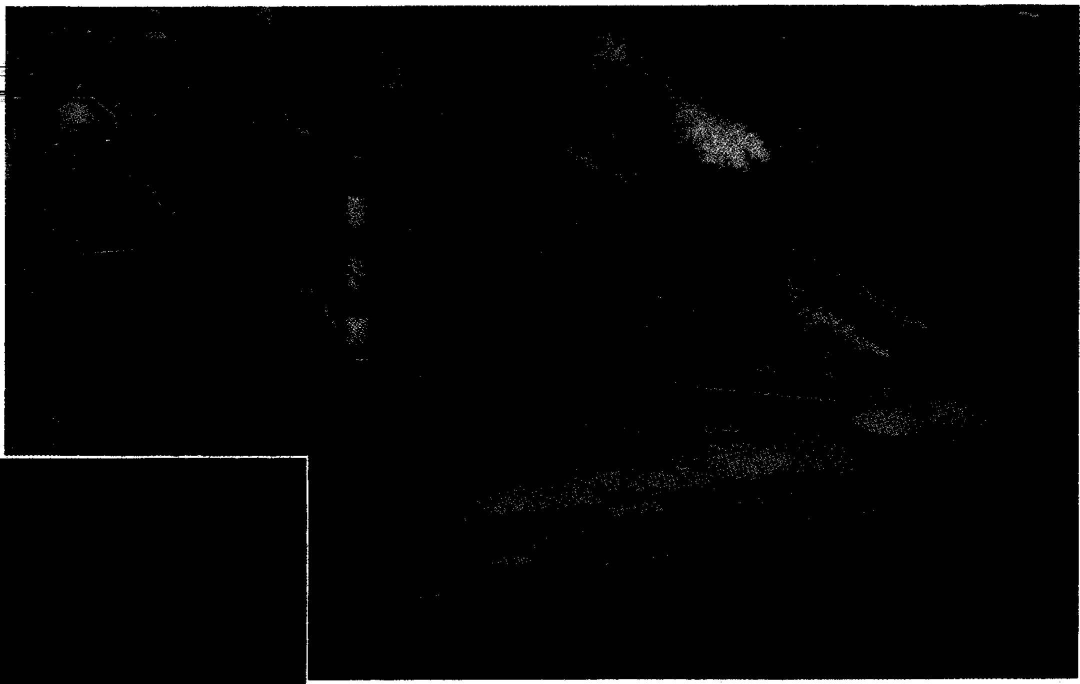


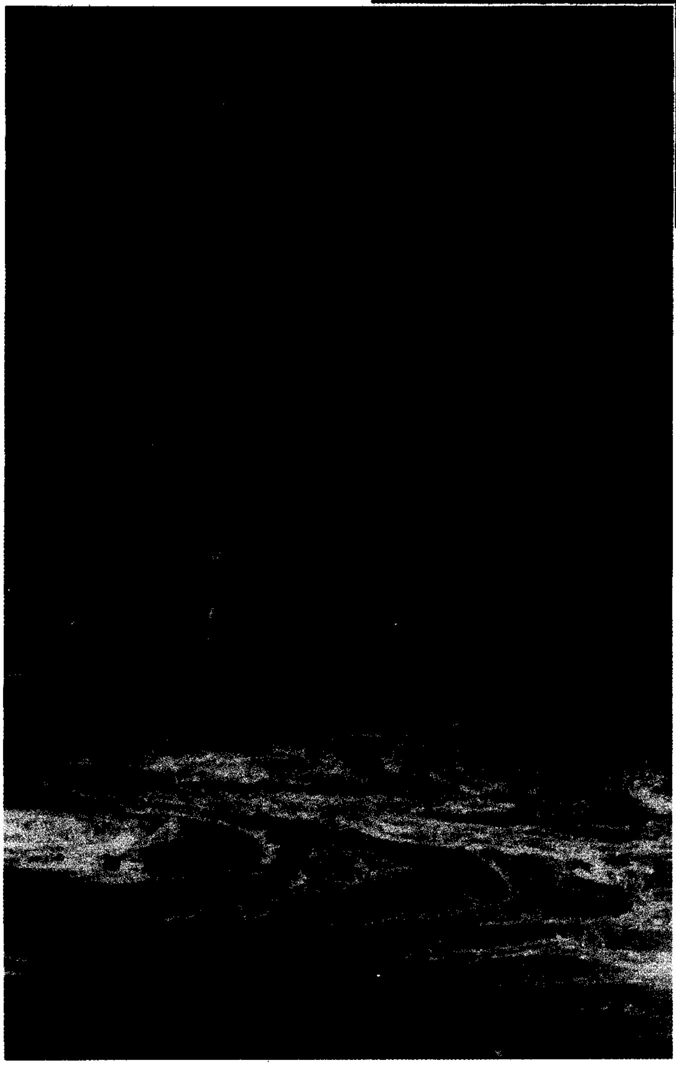
The Environmental Protection Division routinely monitors the quality of all Georgia's surface and ground waters. Contaminants, toxics and dissolved oxygen content are some of the things lab technicians analyze samples for.

Water Conservation

A Guide for Georgia

Contents



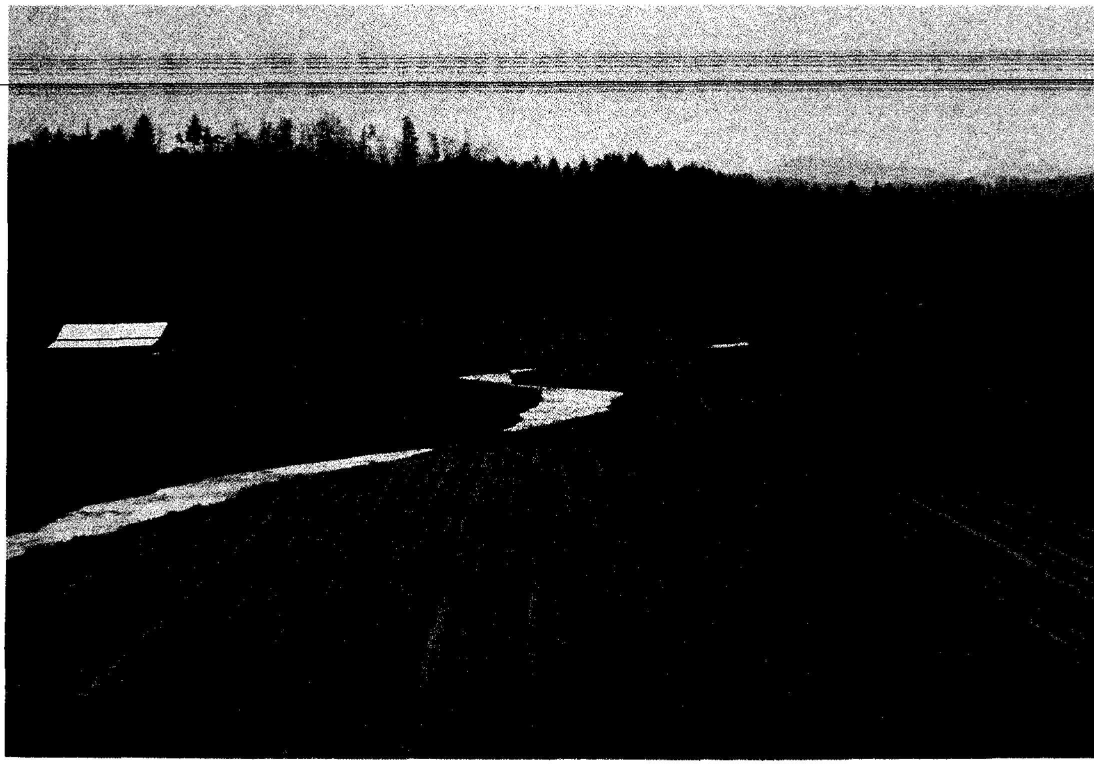


Introduction

Prolonged droughts during the 1980s, and the growth that attended these years, placed new demands on Georgia's limited water resources. Local governments and citizens realized that water is a finite commodity that no one can afford to waste. **Water conservation will be needed from now on, not just during water shortages, but routinely, and will require the participation of every water user.**

The most water is used in the home, addressed in Section II of this publication. Of the many conservation methods presented here, those designed to reduce **residential use** will yield the greatest potential water savings. If used by every home, ultra-low flow plumbing fixtures and "dry" landscaping techniques (found in Section III), just two of the conservation measures discussed in this book, will save enormous volumes of water. In the metro Atlanta region, reducing water used in the home by eight gallons per person, per day would result in savings of 30 million gallons a day by the year 2010. This would only require that all residential toilets be replaced by ultra-low flow models.

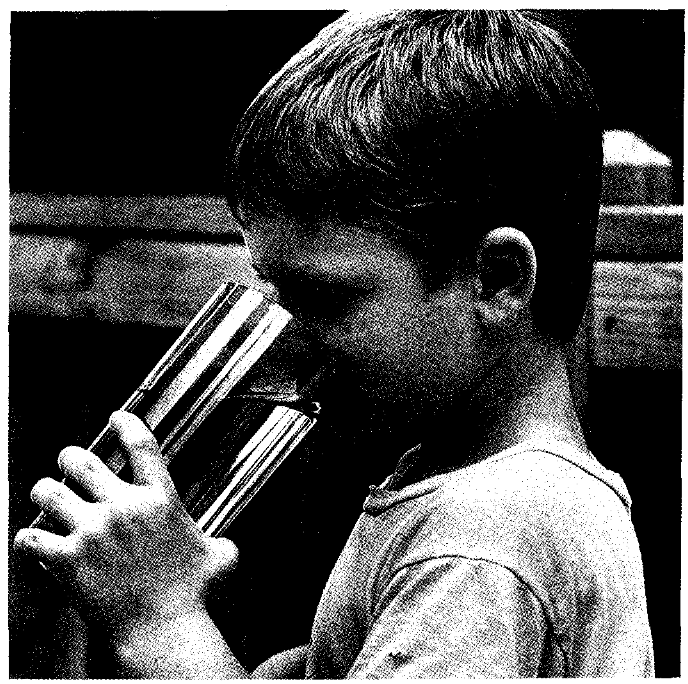
Growth will continue in Georgia. The north and central areas have experienced the most significant population boom, and the infrastructure of communities in these areas will continue to be stressed beyond their capacity to accommodate more and more people. South Georgia also continues to undergo remarkable changes as well. In 1974, there were only about 110,000 acres of irrigated farmland in the entire state. By 1986, one million additional acres were brought under irrigation, nearly all of them in South Georgia, which represents a stunning growth rate of about 900 percent in little over one decade. Equally dramatic is the growth in demand for irrigation water. Other high water-use industries are concentrated in South Georgia, besides agriculture. While groundwater supplies are plentiful now, resource depletion is a real threat.



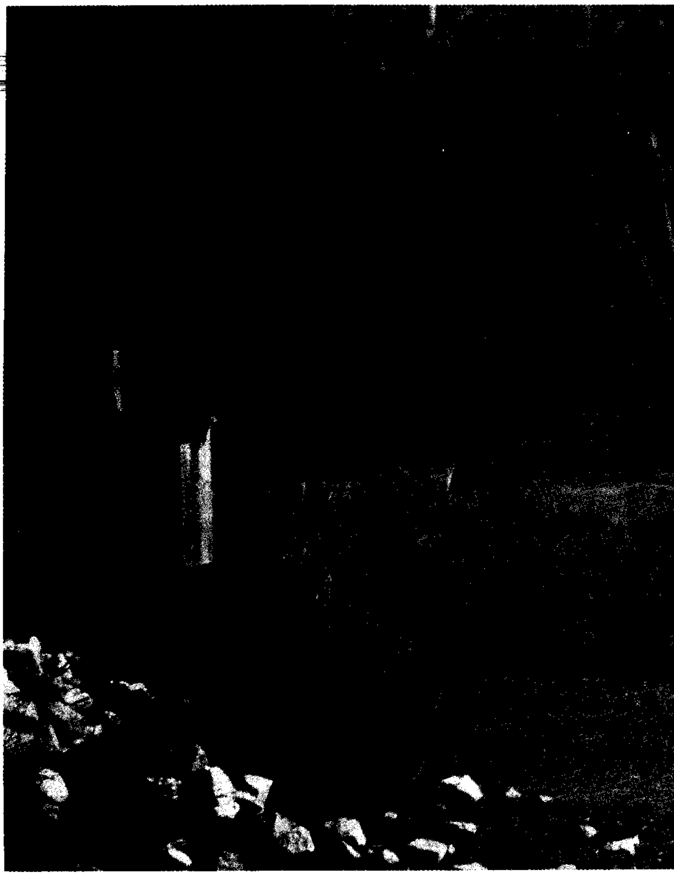
Conservation is the only way to protect groundwater aquifers from the often irreversible consequences of over-pumping.

For **local governments and water utilities,** conservation measures for whom are addressed in Section IV, managing water quantity and quality will be an increasingly difficult challenge. Guidance is found in this section for better planning and cooperation between local governments, resource managers, planners, jurisdictions and the public. Ordinances enforcing the State's ultra-low flow plumbing codes are a necessity in every community, and not only in high-growth areas. Other ordinances sometimes specify acceptable water-use practices, including landscaping codes. There may be no better way to beat the high cost of peak demand. Local cooperation also extends to developing realistic pricing policies that serve as incentives to conserve water. In the future, joint ventures that benefit several communities or an entire region may be necessary. A **regional approach** will be most effective in protecting water supplies. Where new supplies or better treatment is needed, joint ventures enable cost-sharing in the construction and operation of jointly-used systems and facilities.

Finally, agriculture, commercial conservation and large industrial water saving techniques will be addressed, in Sections V, VI and VII. All Georgians have great incentive to be careful stewards of the limited fresh water resources found in this state. While adequate supplies of high-quality water have been a cornerstone of our prosperity, we can no longer be take these supplies for granted. Now is the time to become involved in the effort to conserve this vital natural resource. With the tool of effective conservation in the hands of a conservation-conscious public, the threats of water shortages, economic curtailment, halted development, and a lower standard of living need never become realities.



Some of the uses of water include (from left, clockwise): hydroelectric power generation; commercial and business operations; agriculture; and, of course, water is used for drinking.



Dry ponds and lakes and diminished stream volumes were prevalent in Georgia during the droughts of the 1980s. At left, Fort Yargo State Park's lake in 1987.

The Water 'Crisis'

As the 1980s ended, news of droughts, smog, unwanted landfills, chemical dumps and polluted beaches were common in the United States. Many headlines addressed concerns about **water** — its availability, its quality, its future. By the year 2000, about 20 percent of communities in the nation will experience water shortages. This is simply because **fresh water resources are limited,** and populations are demanding more water than ever before. And as more and more homes, businesses, institutions and industries use increasing quantities of this finite resource, the quantity of water in streams and rivers is decreasing, reducing their capacity to dilute and assimilate resulting **wastewater.**

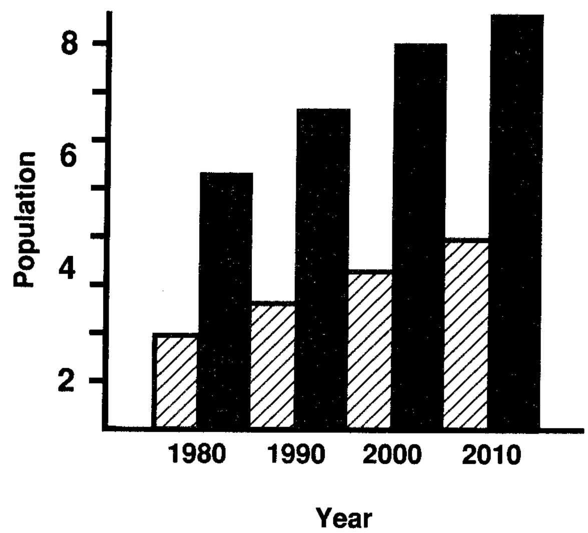
Some people compare the challenge of securing enough fresh water, and protecting its quality, to the energy crisis of the 1970s. Now, as then, managing demand is as important as managing supply. This means that **water conservation** is perhaps the most basic and comprehensive solution to our water "crisis." As with recycling and using less energy, **water conservation** is one of the best ways to stop the costly waste of resources, at home or in work surroundings.

Why is conservation necessary now? Because we will continue to depend heavily on water, for homes, businesses and to support our overall economic infrastructure, we must now begin to think carefully about the ways in which we use it. More and more water will be demanded by Georgia's growing population, and this means **more extensive treatment** of water quality will be necessary to make it suitable for human use. Wastewater treatment will also become more expensive in order to comply with increasingly stringent state and federal regulations. Unless individuals take the responsibility to use **less water** through conservation, nature's gradual process of cleansing streams will soon be overwhelmed and clean water will be unavailable. In some densely populated areas, water supply and treatment capacities just cannot be stressed further.

Community reservoirs, regional reservoirs, groundwater and existing surface water sources cannot meet water demands. Routine water conservation will also be necessary to meet the long-term needs of growing populations. Reservoir planning must preserve delicate ecosystems like wetlands and achieve agreement among communities who will share the water supplies, and development of a reservoir is a lengthy process. Likewise, the geologic investigations needed in north central Georgia that would provide additional **groundwater supplies** also require time.

In any event, it is necessary to operate on the assumption that a **limitless supply of low-cost water in Georgia is a thing of the past.** Many experts advise that unless steps are immediately taken, such as the proposed reallocation of Lake Lanier, metropolitan Atlanta will exhaust its water supply during this decade. Without additional long-term water supplies in place, demand in many fast-growing areas in North Georgia will exceed supplies by the year 2010. Drinking water demand alone is expected to double by the year 2030. Based on these factors alone, conservation becomes an imperative for today.

What will conservation entail? Effective conservation depends most on the commitment of individuals to conserve water as a way of life. Routine water conservation will postpone expensive capital outlay for new treatment plants. Water-saving plumbing fixtures, special landscaping/irrigation methods, leak detection and repair, reliable metering, realistic price structures and other means also play important roles. But only to the extent that individuals get actively involved in conservation will these tools become effective. **The results of routine conservation could amount to savings of about 30 percent of the water used in homes; 20 to 30 percent used outdoors; 20 percent or more in businesses; and as much as 50 percent per employee in industries.** Across-the-board,



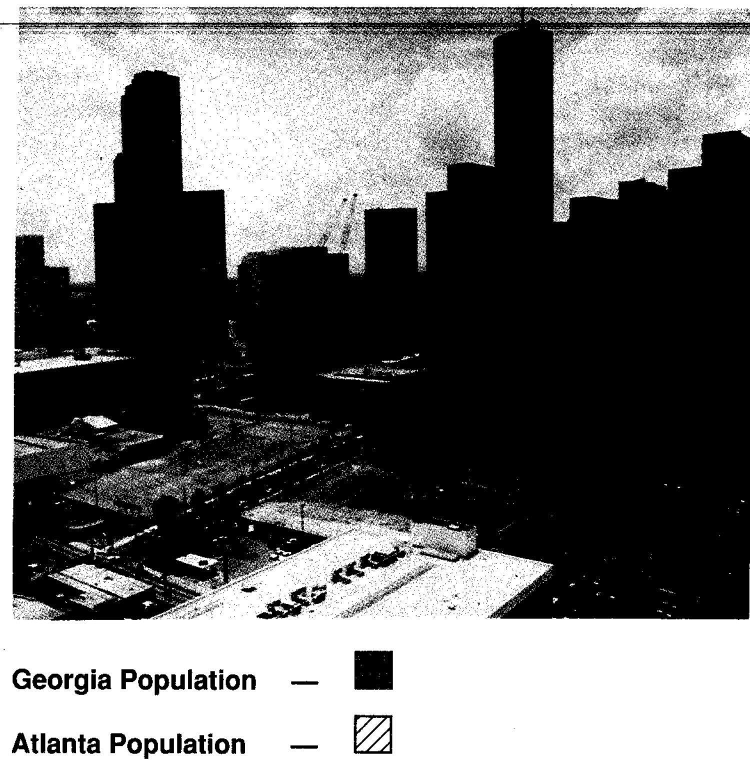


Fig. 1 — Metropolitan Atlanta and the surrounding area will be home to nearly half Georgia's total population by the year 2010, representing a 100 percent increase over 1980's population.

such savings can greatly help avoid water shortages and facilitate continued quality growth and prosperity.

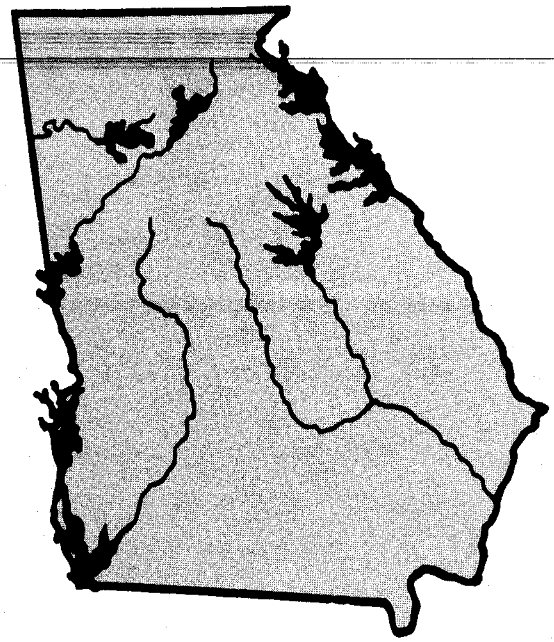
Using this guide is a good way to begin effective, routine conservation. It features a variety of practical ways to conserve water for homeowners, landscapers and farmers; institutions, commercial businesses and industries; and local leaders and water system managers.

Georgia's Conservation Strategy. The state is pursuing water conservation objectives through a comprehensive body of laws administered by the **Georgia Department of Natural Resources** through its Environmental Protection Division (EPD). Conservation incentives are linked to local government. They include **water permits** and **licenses;** administrative **regulations** and **procedures; building** and **plumbing codes;** and state-supported **funding programs** for water works and other projects involving resource management. **Regional authorities** and **local governments** are encouraged to develop similar incentives within their jurisdictions. This guide to conservation emphasizes **adoption of local ordinances regarding ultra-low flow plumbing fixtures,** and **outdoor residential water use.** Public **education** is also indispensable to successful conservation. Citizens must be shown how they can **save water** where they live and work.

Motivating Factors: Growth and Drought

Georgia's traditionally abundant, high-quality water supply has supported remarkable growth in recent years. The state is fortunate to have over 20,000 miles of rivers and streams and over 400,000 acres of lakes and reservoirs, replenished by an annual mean rainfall of over 50 inches — the nation's fifth highest yearly average. The state also has one of the world's largest and highest-quality aquifer (groundwater) systems. **The continued availability, or lack of, a reliable supply of high quality water has been acknowledged by the state's leaders as the single most important factor, and potentially, the single most limiting factor, our continued successful growth will face.**

Metro Atlanta and North and Central Georgia. Between 1980 and 1990, Georgia came to be ranked as the eighth fastest growing state in the nation, and metro Atlanta as the sixth fastest growing city. During this period, the state's population increased by about 18.5 percent. Although **metro Atlanta** accounts for only four percent of Georgia's total land area, over one-third of the state's population resides here. (By the year 2010, the metro Atlanta and surrounding area is expected to be home to nearly half the total population, representing a 100 percent increase over the 1980 census.) **(See Figure 1.)**



Surface Water

20,000 miles of streams
418,000 acres lakes/reservoirs*
594 sq. miles of estuaries

*(publicly owned)

Fig. 2 — Surface water distribution in Georgia.

Growth has not been limited to the metro Atlanta area. By 1990, other metro areas were experiencing burgeoning growth as well — towns like Gainesville, Athens, Augusta, Macon and Cartersville. Rural populations and economies were also on an upswing. With growth, all these communities were stressed by excessive demands on limited water resources.

As the 1980s brought three record-breaking dry spells to Georgia and a cumulative rain shortfall of nearly 70 inches, **north and central Georgia** were severely impacted. In this area, the state's densest population centers are found, and many communities suffered water shortages for the first time. As stream flows hit record lows, many down by as much as one-fourth, water levels in major reservoirs like Lanier, Allatoona and West Point fell five to 15 feet below normal pool. Water shortages led to rationing in homes, bans on outdoor uses, curtailment of industrial operations and, in turn, employment was affected. When rain did come, water supplies improved only slightly, as dry soil and vegetation quickly absorbed all the moisture. North Georgia communities that depend on well water had to drill new wells because dry conditions had caused low well yields.

South Georgia. Here, the effects of drought have been more moderate. Reduced aquifer replenishment and increased water withdrawals resulted in lower groundwater levels. In Southwest Georgia, water table declines of two to six feet were noted, and some record low levels in wells were also measured. As in North Georgia, some water systems experienced shortages and lost pressure during peak demand periods. Many communities had to lower well pumps into wells to keep them from pumping air. Many South Georgia farmers, without enough water for crops or livestock, sustained losses. Overall, Georgia agriculture and industries lost millions in damages.

Conservation and Drought. Drought was valuable for its lessons. One lesson was that **conservation can reduce the impact of droughts.** Conservation also is necessary in the absence of dry weather. Experience has shown that when drought becomes prolonged, the public ably demonstrates efficient water use, but the attitude that conservation is a temporary measure must change. Because routine conservation is the only way for our water sources to remain adequate, the notion of conservation must be understood as "standard operating procedure."

Routine conservation also helps offset the problem of uneven distribution of **surface water supplies** in our state. No rivers flow into Georgia, which makes our water supply totally dependent upon in-state rainfall. Also, most of our streams have their headwaters in the northern half of the state, along the Piedmont and Valley and Ridge Provinces, where many major population centers are located. In these areas, streams and rivers are not flowing at their fullest capacities. Atlanta, in fact, has a smaller watershed area than any other major metropolitan area in the nation. Conservation is also an important safeguard for Georgia's **groundwater supplies. (See Figures 2 and 3.)** Although

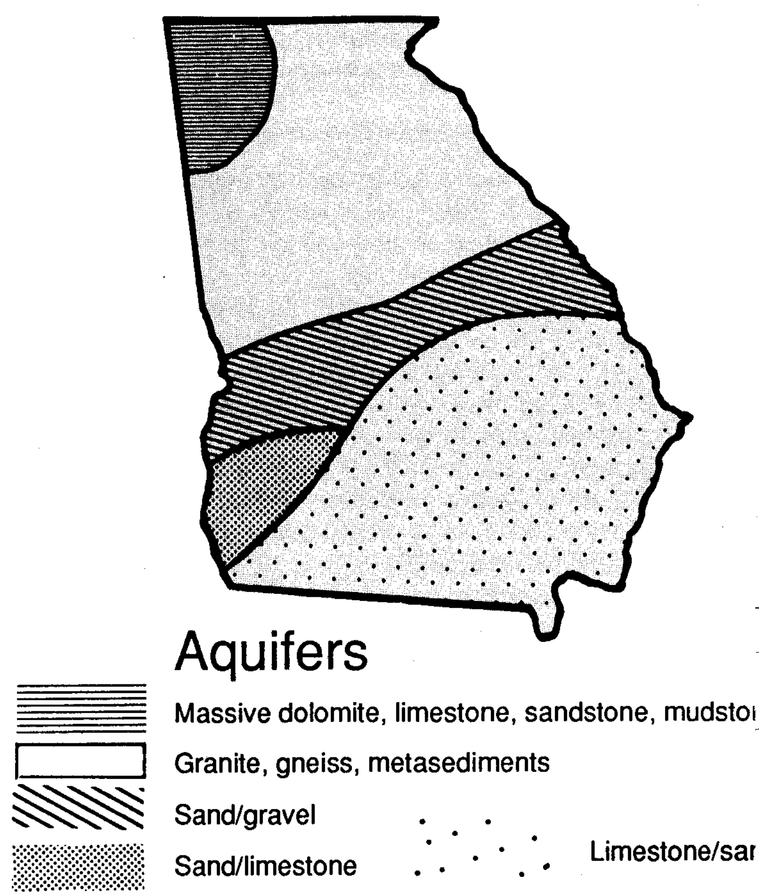


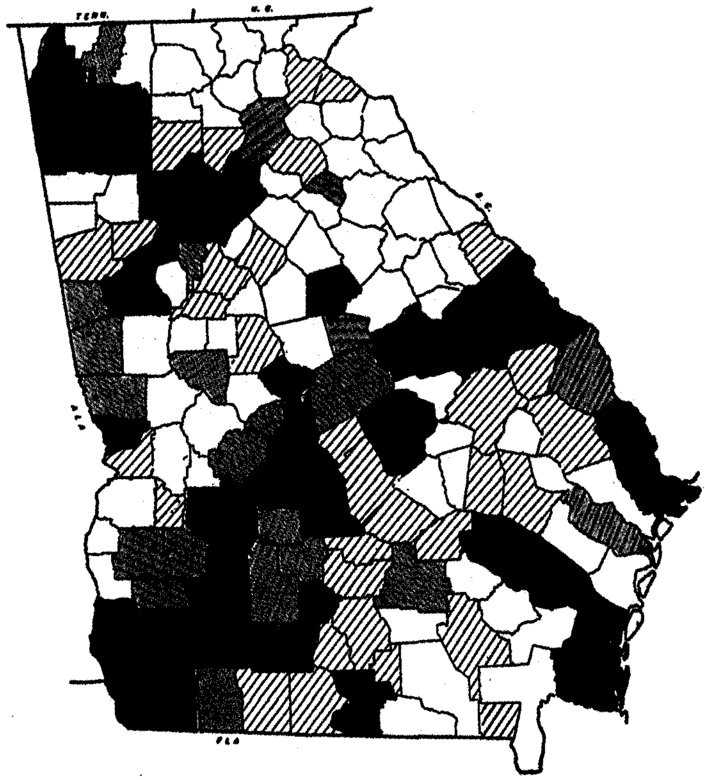
Fig. 3 — Georgia's groundwater supplies.

in general, there is ample groundwater for current and anticipated needs in South Georgia, withdrawal rates have doubled due to increased demand by municipalities, agriculture and industry. Groundwater withdrawals are returned to streams, not to aquifers; and with only 12 percent of rainfall entering recharge areas, replenishment is a very slow process. To avoid having wells "run dry" due to over-pumping, withdrawal rates must correspond with levels of expected annual recharge. **Water conservation can provide an important safety valve in this regard and help prevent permanent aquifer damage.**

Who Uses What? To properly manage Georgia's surface and groundwater resources, it is important to know how much water is used; for what purposes it is used; and where use is most intensive. **(See Figure 4.)** A report on water use is regularly prepared by the Environmental Protection Division's Geologic Survey, in cooperation with the U.S. Geological Survey. Developed county-by-county, this information is useful to lessen the prospect of shortages and water conflicts in specific areas.

Power generation uses the most water in Georgia, yet only four percent of all water withdrawn for this purpose is consumed. Ninety-six percent is returned, unchanged, into streams. **Public supply** is an area of water use rising steadily, primarily in north Georgia for populations, while in South Georgia **agricultural irrigation** use has greatly increased. **Industrial water use** has declined since 1970, due to improved conservation by industry, including water reuse and recycling. New methods of determining total water use and certain reductions in production are other reasons for the decline.

In Georgia, EPD has targeted **public supply** and **industrial water use** as categories especially as in need of effective conservation. This guide targets long-term conservation measures for these and other user groups and emphasize their benefits. The methods outlined will prove valuable for those who want to save substantial sums of money on water, sewer, electric, gas and maintenance bills, while contributing to Georgia's environmental quality and economic viability. To delay implementing the routine conservation needed in Georgia homes and businesses today is to hasten the onset of shortages, and in general, a lower quality of life.



Total Water Use by County

(millions of gallons/day)

- ☐ — .0 to 5
- ▨ — 5 to 10
- ■ — 10 to 20
- ▩ — 20 to 60
- ■ — 60 to 989

Fig. 4 — Surface and groundwater use by county.
Source: Georgia Geologic Survey, 1987

	1970	1980	1987	% of Total	% Change 1970-87
Thermoelectric power generation	3,944	4,438	3,322	57	-16
Public supply	564	718	899	16	+59
Domestic	59	138	135	2	+129
Agriculture	63	605	775	13	+1130
Industrial	932	826	684	12	-27
Total	5,562	6,725	5,815	100	+5

Fig. 5 — Water use by category in Georgia in millions of gallons per day (mgd).

II. Home Conservation

In the **home** conservation can save the largest amounts of water, regionally and statewide. **(See Figure 5.)** The U.S. Department of Housing and Urban Development (HUD) says the average person uses nearly 80 gallons of water in the home daily. **(See Figure 6.)** Outdoor lawn-watering and washing cars can double or triple that amount. Most indoor use takes place in the bathroom, and the largest percentage of water used goes down the toilet. In a non-conserving home, flushing the toilet can use over 10,000 gallons of water per person yearly.

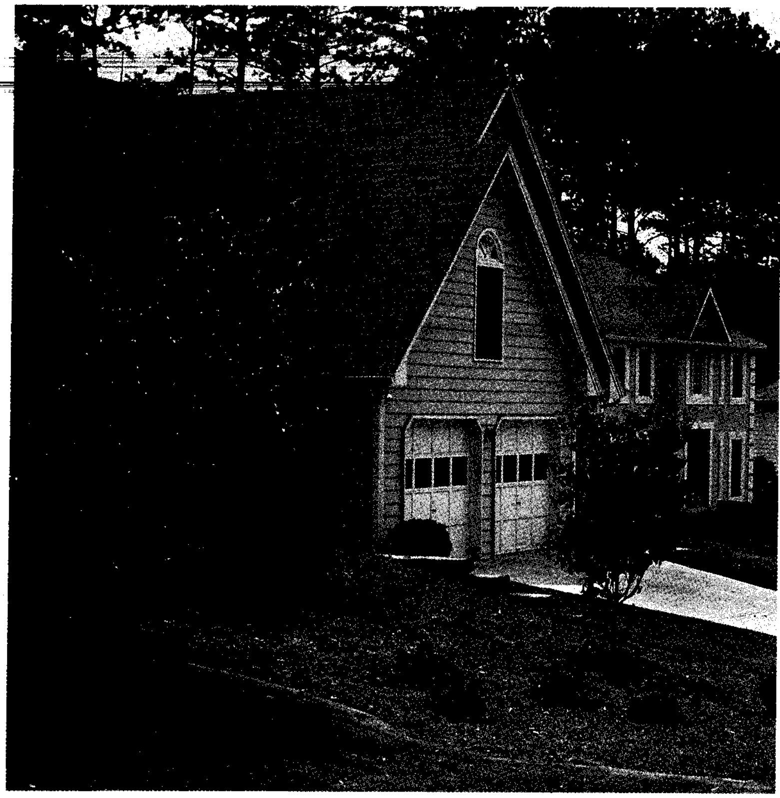
Turning a water- and energy-wasting home into one that is efficient means:

- **Installing ultra low-flow plumbing devices and fixtures**
- **Leak detection and repair**
- **Use of water-efficient appliances**

Retrofitting. To retrofit existing plumbing, a **toilet dam, showerhead restrictor** and **faucet aerator** may be purchased for less than $25 per set, to cut water use an average 22 percent and by as much as 50 percent with **no changes in life-style.** A toilet dam isolates tank compartments to reduce water volume, saving about one gallon per flush, per dam. A maximum of two dams may be used in large tanks. One to two dams will save about four to eight gallons a day per person.

Alternatively, a **volume-displacement device** can be used. A water-filled plastic bag or plastic bottle weighted with stones can save up to a gallon per flush. (Inserting bricks into the tank is not recommended because loosened sediment can clog valves and drains.) A retrofit alternative is to **purchase all new fixtures.** In 1990, a two-bathroom home could be equipped with a new set of ultra-low flow fixtures for about $300; 50 percent or more can be saved on water and sewer bills. Installing an **ultra-low flow showerhead** (two gallon flow per minute) would cost about $15, and save as much as $150 per year on water and water-heating bills. Some low-flow showerheads feature a

Ultra low-flow plumbing fixtures like this are required by Georgia law in all new construction. Retrofitting older homes with such water saving devices is simple, and saves 50 percent or more on water and sewer bills.



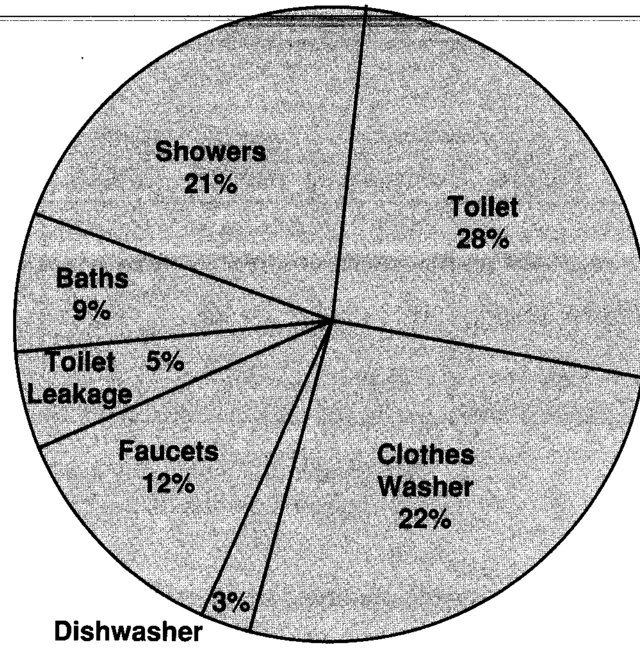


Fig. 6 — Water as used in the typical home.

Residential water leaks not only increase monthly water and energy bills, they erode a community's water resources and overtax water treatment facilities with added waste flow, worsening water pollution. Fifty percent of all households are estimated to have leaks of some type.

"soap up" valve that temporarily stops flow without altering water temperature. Some faucet aerators also have an on-off valve to shut off flow intermittently, increasing overall water and energy savings. In the metro Atlanta region, full conversion to **ultra-low flow toilets** by the year 2010 could save up to 30 million gallons of water daily. Products with still lower flow standards are being introduced, which could cut indoor water use by as much as 70 percent.

Leak Detection and Repair. Residential leaks increase monthly water and energy bills, and erode a community's water resources. They also overtax treatment facilities with added waste flow. **Fifty percent of households are estimated to have leaks of some type.** A one drop-per-second leak wastes seven gallons a day. A steady faucet drip wastes 20 to 30 gallons daily, or up to 11,000 gallons a year. A leak as small as one-sixteenth inch can lose 100 gallons a day. HUD studies show that up to 20 percent of toilets are likely to be leaking. Test your toilet for leaks by putting dye tablets or food coloring into your supply tank at night. If, without flushing, color appears in the bowl by next morning, you have a small, invisible leak that could be wasting as much as 200 gallons a day — enough to wash four loads of laundry. If your toilet is leaking, a plunger ball or flush valve (flapper) may need to be replaced. It is easy to fix it yourself, with an inexpensive kit from most hardware stores.

Undetected Leaks. To test for undetected leaks, turn off all faucets inside and outside. Make sure no one flushes a toilet or is operating a water-using appliance. Then take a reading of your water meter. Wait at least 30 minutes (longer if possible) and read it again. If the readings are different, your home has a water leak. Studies show that metered homes generally use 20 percent less water than unmetered homes. The only unmetered households should be those whose water supply comes from private wells or springs.

Reduce Water Pressure. Because high water pressure can contribute to leaks and equipment breakdowns, consider lowering pressure. In single-family homes equipped with a pressure regulator, a reduction of 30 to 40 pounds per square inch (psi) less than the standard 80 psi water utilities typically provide may be practical. If so, it could yield a three to six percent savings in water use.

Conserving Water And Energy. Large volumes of water are needed to make most forms of energy available to us. Large amounts of energy are also needed for water treatment and pumping processes that bring water to our homes. To conserve one of these resources is to conserve the other. **The less energy we use, the less water needed to produce energy. The less water we use, the less energy required to treat, distribute and heat water.**

Heating water usually consumes 15 to 20 percent of the total energy used in the home. Almost always, significant money is saved through conservation. Among the best ways to achieve savings include:

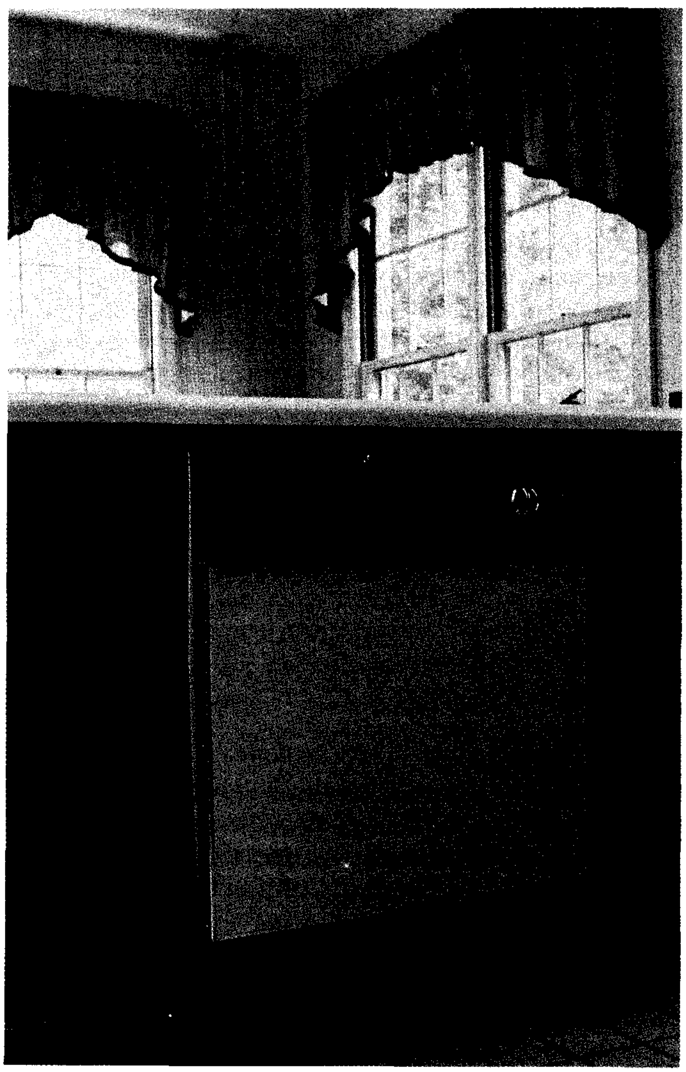
•Taking **shorter showers** (no more than five minutes).

•**Getting rid of hot water leaks.** One drop of hot water per second will, over one year, waste the amount of energy needed to run a color television set for a year, or a stereo for five years.

Fixture	Non-conserving	Usage* (GPCD)	Savings (GPCD)	Low flow	Usage* (GPCD)	Savings (GPCD)	%	Georgia Law Ultra low-flow	Usage* (GPCD)	Savings (GPCD)	%
Toilet	5-7 gpf	20-28	0	3.5	14	6-14	40	1.6	6	14-22	75
Showerhead	6-10 gpm	30-50	0	3.0	15	15-35	63	2.5	12.5	18-38	68
Faucets	4-7 gpm	20-35	0	3.5	18	3-18	35	2.0-2.5	10-12.5	10-23	60

*Assumes four flushes; one five minute shower; five minutes of faucet use per day.
GPCD = gallons per capita per day; GPF = gallons per flush; GPM = gallons per minute

Fig. 7 — Water-saving plumbing devices can save 60 to 70 percent of water used in homes.



Water efficient appliances use about 30 percent less water than older models. Clothes and dish washers should always be fully loaded for maximum water efficiency.

•**Insulating hot water pipes.** About four gallons a day can be saved by having less water run before it is hot.

•**Turn down your water heater thermostat;** the U.S. Department of Energy suggests a setting of 120° F. Some dishwasher manufacturers recommend 140° F (always follow manufacturer's recommendations).

•**Install a timer** that heats water only during those times of the day when needed.

•If your water heater was designed to be turned on and off at will, **turn off your heater** when you go away for a weekend or longer (but again, follow manufacturer's recommendations).

Water-Efficient Appliances. Dishwashers and clothes washers use large amounts of water, much of which requires energy to heat. The average dishwasher uses about 25 gallons per load. New, conserving models use about 30 percent less water, saving about six or seven gallons per load. On average, clothes washers use 40 to 50 gallons per cycle. More efficient models can save about four gallons per average washload, or about 16 gallons per full load.

Whenever possible, fully load these appliances. When less than fully loaded, use water-level controls or the fewest number of washes and rinses. Also, try to avoid the permanent press cycle on your washing machine. It can use 10 to 20 more gallons for an additional fill.

In New Construction. Consumers should be aware that Georgia's amended Water Conservation Law requires **ultra-low flow plumbing fixtures** in new residential and commercial construction and in plumbing-related renovations and repairs beginning April 1, 1992. Useful sources for identifying water-saving products and where they can be purchased are consumer magazines. Also, consult with your local government or water and sewer utility for information about the availability and proper installation of these devices. **(See Figure 7.)**

III. Landscaping For Conservation

Georgia's 1980s population surge brought extensive residential and commercial development. Outdoor water use for landscaping burgeoned especially in major urban centers. When drought-emergency watering restrictions were imposed, thousands watched helplessly as lush landscapes "dried up". Without drought-resistant landscapes, such losses could become more common.

As populations grow, more municipalities can be expected to mandate routine outdoor watering restrictions, reallocating their limited water from plants to people. At the very least, such restrictions are likely during summer's peak demand period.

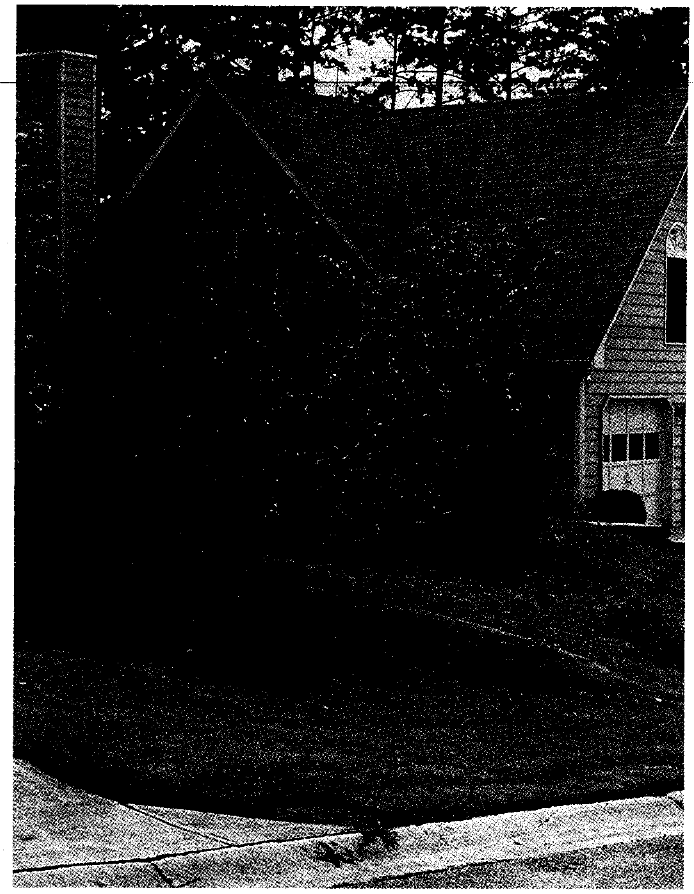
Beat the Peak. Between 60 and 80 percent of all household water is used for outdoor landscaping during summer, and this usage is prohibitively expensive. Water systems must maintain excess treatment and supply capacity year-around just to have the added capacity needed for a few weeks of peak summertime demand. Landscapes are typically over-watered by 20 to 78 percent. As much as one-third is lost to evaporation if applied at the wrong time of day.

Xeriscape* (pronounced, "zera-scape") means **water efficient landscaping.** The term was coined in Colorado in 1981 and later adopted by the National Xeriscape Council. Xeriscape requires implementing concepts that will save water in all phases of a landscape plan, including its maintenance. Several states, including Florida and California, have adopted the concepts. To some, Xeriscape implies cactus gardens or barren landscapes, but this is not true. New or exotic plants are not necessary. Most of our own native and introduced southern plants have a high degree of drought tolerance and fit well into a Xeriscape. You don't have to totally redesign your landscape, either — just your thinking about ways to reduce irrigation. Every landscape, new or established, can be more water efficient with few sacrifices.

It has been estimated that the traditional landscape's life-cycle costs are one to two percent for design; three to five percent for installation; and 95 percent for maintenance. Xeriscaping can reduce maintenance costs by as much as 87 percent and cut outdoor water use by 50 percent.

Since Xeriscape principles were originally developed for the more arid regions of the U.S., some are not applicable to Georgia soils and climates without modifications. The Georgia version of Xeriscape that follows was prepared by the University of Georgia Cooperative Extension Service, and is presented in outline form. Bear in mind that the principles are interrelated, and should be viewed as a total package to achieve the most water efficient landscape possible.

***Xeriscape and the National Xeriscape Council logo are registered trademarks of the National Xeriscape Council, Inc.**



The "Georgia Xeriscape" is related to principles used to develop the original Xeriscape for arid, western climates, but has the same result of achieving the most water-efficient landscape possible. Above: limiting yard turf area is a good conservation measure.

The Georgia Xeriscape

1. Proper maintenance and design. Besides the usual design procedures, a Xeriscape design includes zoning of the landscape into three water use zones: low, moderate and high. Low water-use zones require little or no supplemental water after establishment. Moderate water use zones contain plants requiring some supplemental water during hot, dry weather. High water use zones are limited areas in the landscape where plants are given their optimum water requirements at all times. These are usually the so-called "high impact" or most visible areas of the landscape, such as the entryway to a home.

Many of our native and cultivated plants (juniper, crepe myrtles, yaupon hollies) can be planted in a low water use zone and survive weeks of limited rainfall. Moderate water-use zones require some water on hot, dry days and would include plants like azaleas, dogwoods, red-buds and herbaceous perennials.

High water-use zones require regular watering: turfgrass and annual flower beds are examples. While completely redesigning a landscape may not be a feasible

Native Plants for The Georgia Xeriscape

Plants for low water use zones: will survive weeks of limited rainfall

- **Juniper**
- **Crepe myrtles**
- **Yaupon hollies**

Plants for moderate water-use zones: require some water on hot, dry days

- **Azaleas**
- **Dogwoods**
- **Red-buds**
- **Herbaceous perennials (like annual phlox)**

Plants for high water-use zones: Need regular watering (limit use and place in low-lying areas)

- **Turfgrass (Alternative groundcovers: pine straw, mulch, moss ivy, bark chips, etc.)**
- **Annual flower beds*: (Use only for "beauty spots" like home entranceways: low maintenance day lilies, zinnias, begonias, marigolds, irises, etc.**

option for everyone, the need to find ways of reducing excessive outdoor water use is a common objective.

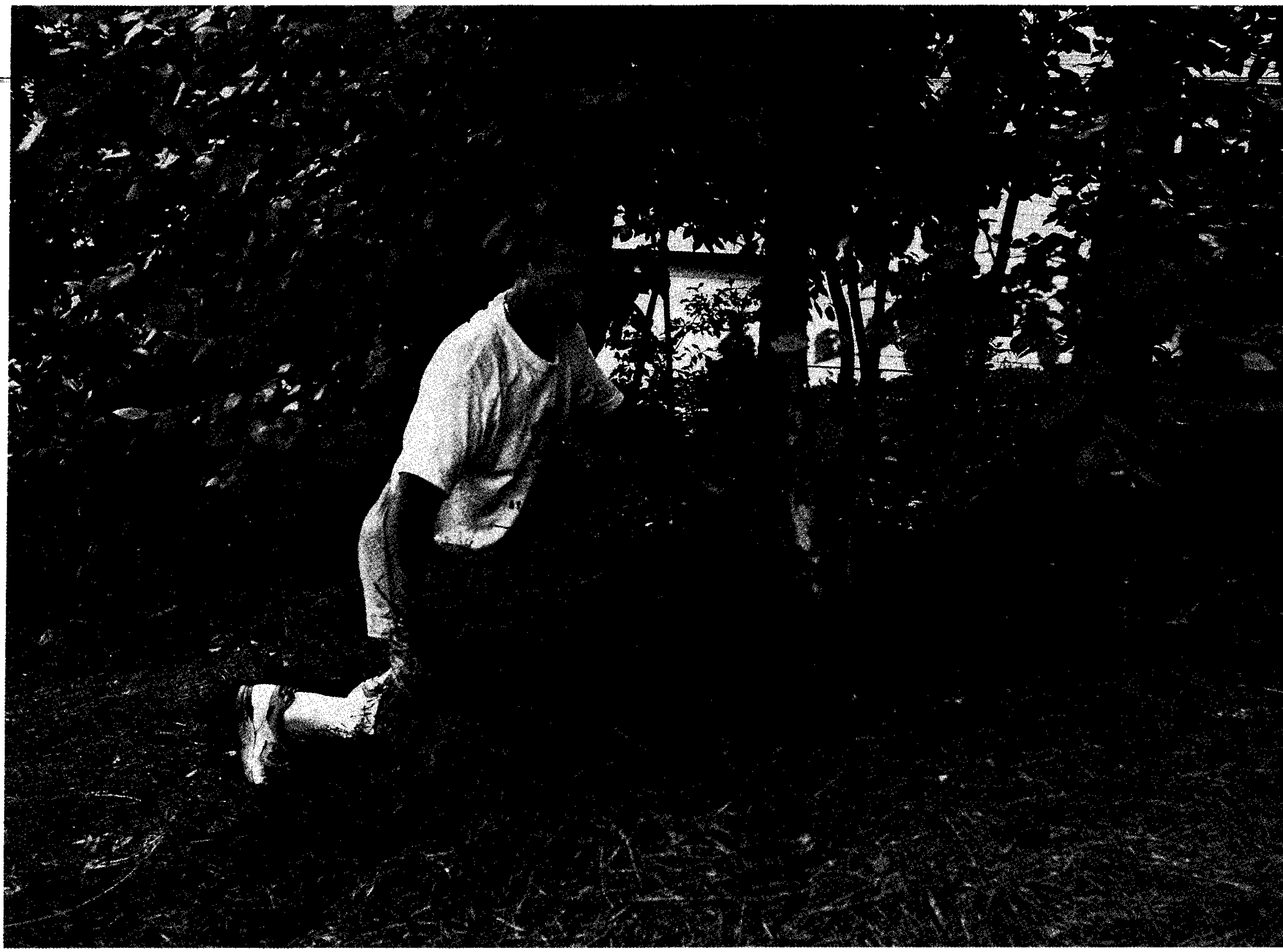
Shade is a very important consideration during the design of a water-efficient landscape. Whether it is from plants or structures, shade cools the landscape and reduces water loss. A shaded landscape can be as much as 20 degrees F cooler than a landscape in full sun. Patios, drives, walks and other surfaces made of brick, concrete or asphalt, should be shaded to prevent their radiating heat and increasing water loss.

2. Practical turf areas. Locate turfgrass in areas of the landscape where it will provide the most functional benefit, such as recreational areas or on slopes to prevent erosion. Separate turfgrasses from ornamental plants in the landscape so they can be watered separately. Most turfgrasses can be located in any of the three water use zones. But the amount and frequency of irrigation should be adjusted accordingly. Established turfgrass in low water use zones or moderate water use zones can be allowed to go dormant during periods of limited rainfall and will recover when rains begin.

3. Efficient irrigation. Irrigation should be tailored to meet needs of plants being watered and should be operated efficiently and effectively at all times. Drip systems or microsprinklers are more efficient in their water use than sprinklers and should be used for ornamental plants whenever possible. When using sprinklers, you can avoid excess evaporation of water by watering between 9 p.m. and 9 a.m. Most established ornamental plants and turfgrasses can survive long periods without supplemental irrigation. Daily watering is not recommended, especially when using sprinklers; it encourages a shallow root system and causes plants to demand repeated irrigations.

4. Soil improvements. When planting ornamental plants or turfgrasses, cultivate the soil deeply throughout a large area. Dig a large hole when planting to improve soil structure, reduce compaction, break up hard-pan layers and improve the infiltration of water and essential elements into the soil. The goal of soil improvement should be optimum soil conditions for best root growth.

5. Mulching. Mulch is vital to a water efficient landscape. It conserves soil moisture and helps prevent weeds that compete with ornamental plants for water. Mulch also reduces certain soil-borne diseases that stress plants and cause them to have a higher demand for water. The best mulches are organic, fine-textured and non-matting. Pine straw or pine bark mini-nuggets are excellent mulches for a water efficient landscape. Avoid rock mulches because they radiate heat that promotes water loss. Landscape fabrics placed under organic mulches will improve water retention in the soil while allowing water, nutrients and gases to freely penetrate.



6. Appropriate plant selection. You need not purchase unusual or exotic plants to have a water efficient landscape. Many native plants and most of the introduced species you will find in garden centers and nurseries can survive long periods of limited water availability once they are established. The key is to select plants according to site conditions and environmental stresses. Ask about the water requirements of the plants you choose and zone plants in your landscape according to their water needs.

7. Maintenance to reduce water needs. Many horticultural practices can save water by developing a hardy, more efficient plant. For example, proper mowing involves mowing a turfgrass at the recommended height and mowing often enough to remove no more than one third of grassleaf height at each mowing. This helps the plant maximize root growth which, in turn, reduces supplemental water needs. When drought occurs, raise the mowing height 25 to 50 percent.

Avoid **shearing plants** or giving them high-nitrogen fertilizers during dry periods, because these practices encourage water demanding new growth. Follow a "proactive" approach to pest control by scouting for pests regularly and controlling them before they weaken plants and cause them to need more water.

Mulching is vital to a water efficient landscape. It conserves soil moisture and helps stop weeds that take water away from ornamental plants. Irrigation drip systems or micro-sprinklers are more efficient in water use than sprinklers. Sprinklers should only be used at night or in the early morning to avoid evaporation.

Local water supply facilities must incorporate water conservation planning if drinking water supplies are not to be seriously curtailed in densely populated areas throughout Georgia.

IV. Local Government Water Management

Local governments can promote more efficient water use through **conservation planning.** Demand management is the prime focus of these efforts, involving issues like:

- **Plumbing code enforcement and retrofit programs**
- **Local ordinances and incentives**
- **Drought emergency and contingency plans**
- **Public education programs**
- **Pricing policies**

Ultra Low-Flow Plumbing Fixtures. These are now "the law." Municipal and county authorities are urged to adopt and enforce the updated Georgia Water Conservation Law, calling for ultra-low flow plumbing fixtures. The following State requirements apply to any new construction, plumbing-related repairs or renovations involving residences (effective April 1, 1992) and commercial buildings (effective July 1992):

The law requires that a city, county or authority adopt and enforce these standards in order to be eligible to receive any State water or sewer facility grants or loans.

Retrofit Programs. Local authorities can also achieve significant water and energy savings by encouraging retrofitting of existing plumbing. In high-growth areas, an estimated 30 to 40 gallons per day per household can be saved through a community-wide retrofit campaign.

Studies show that the **most effective programs involve the purchase, distribution and installation of devices by local authorities.** Such programs prove cost-effective where there is a growth market for new water and sewer connections. In general, for every seven homes successfully retrofitted, one new connection is made possible. It might also be beneficial for water utilities to offer an incentive, such as reduced water and sewer connection fees when new homeowners and businesses retrofit plumbing.

Another approach involves **mailing retrofit kits** to residents and businesses for their personal installation. Costs could be recouped through a water bill surcharge. On average, about one-third of devices distributed in this manner are installed. A follow-up program would improve installation rates. To better assure a steady and continuous rate of retrofitting, local governments can also consider **adopting an ordinance requiring an inspection for ultra-low flow devices** each time a house is sold (and before the new owner moves in). Requirements can be designed to not interfere with the sale of the house. Adopting this approach alone could increase retrofit rates significantly in five to 10 years.

Local Ordinances and Peak Demand. Specific restrictions on outdoor water use have proven effective in reducing demand. In the past, they typically applied only on a short-term emergency basis. However, more and more communities are adopting ordinances banning wasteful outdoor water practices permanently. Depending on water-use patterns and desired rates of reduction, approaches to cut water waste include:

- **Permanent watering restrictions, daily or hourly**
- **Prohibition on hosing driveways or sidewalks or excessive watering resulting in street runoff**
- **Prohibiting outdoor water leakage**
- **Requiring the use of outdoor equipment and devices that use minimum amounts of water**
- **Requiring water-efficient landscaping standards**

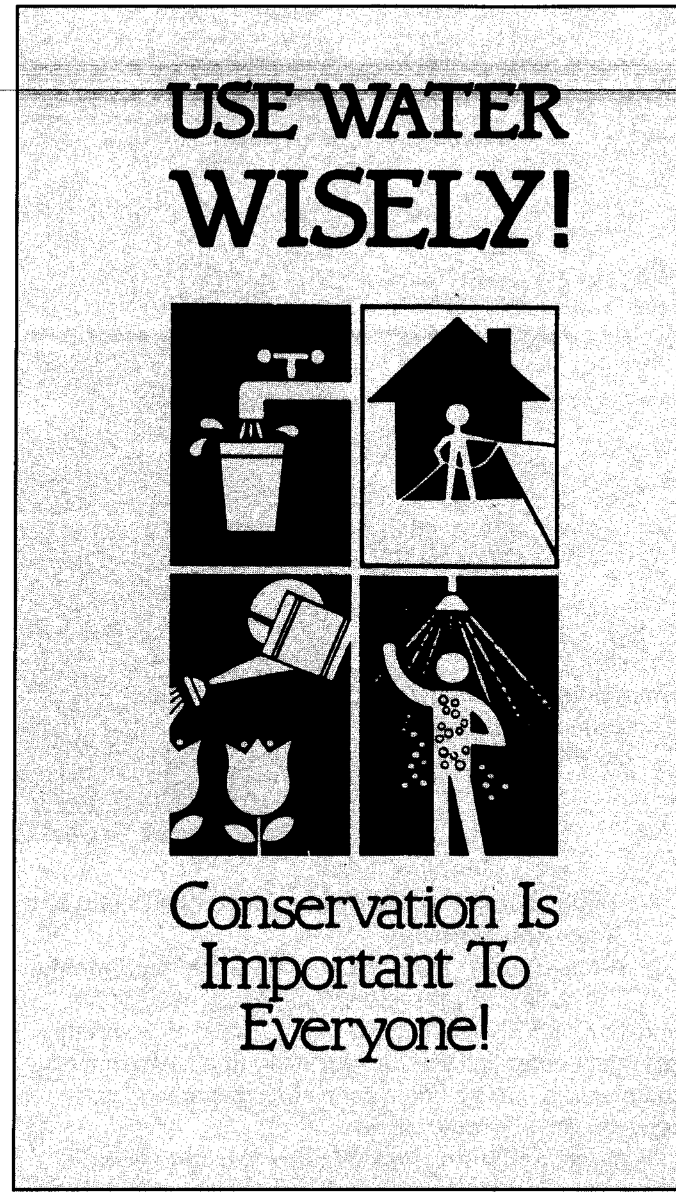
One of the most important targets for local ordinances is summer's **peak-demand period.** Lasting an average of two weeks, peak demand occurs when **(1) Georgia's seasonal rainfall is at its lowest level,** and **(2) Irrigation by the public and farmers is at its height.** Drought or no drought, setting outdoor watering restrictions during this brief but critical period **could postpone the expenditure of millions of dollars to expand water plant capacities.**

Experience has shown that **summer surcharges** above normal water rates are an effective conservation incentive. Stiff excessive use charges or fines can also be imposed for noncompliance. This type of seasonal rate structuring typically includes a basic rate for normal levels of domestic and sanitary use. Surcharges would only apply to water use above normal levels.

Emergency Plans. Emergency water shortages can arise periodically due to drought, operational problems at water facilities, or if water sources become temporarily contaminated. During a crisis, emergency conservation is needed to ensure that adequate water is available for priority needs. Using information on water supply and source yield, varying levels of shortage can be predicted. In general, water systems whose supplies are closely matched by demand are most vulnerable to crises, and always need to be ready for contingencies.

An emergency plan will establish criteria for identifying different stages of shortage. Appropriate actions for reducing demand are then mandated at each stage of need. As with all local ordinances, **enforcement mechanisms like citations and fines** are necessary to improve compliance rates. In the most dire situations, shutting off the water supply may be necessary.

Public Education. Most people take water for granted. If they are to become actively involved in water conservation, they will need to understand why it is important. **Education** is most effective during a crisis because public awareness is high. Under ordinary circumstances,

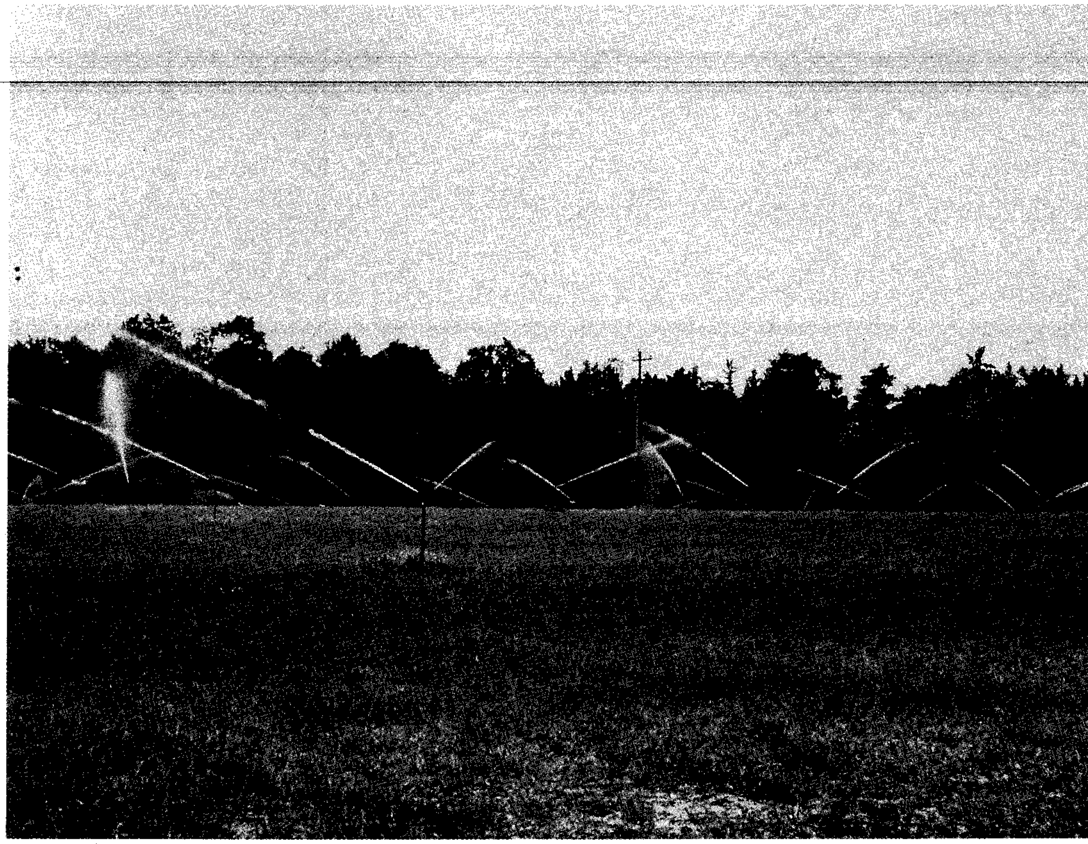


Public education, in the form of fliers and pamphlets distributed throughout communities, is very important to local water conservation efforts. Order this "waterwise" brochure from the Georgia Environmental Protection Division, 205 Butler St. S.E., Suite 1152, Atlanta 30334.

however, the public needs frequent reminders that routine conservation is necessary to avoid emergency shortages. Local authorities are encouraged to hold public meetings and involve citizens in the development of an ongoing water conservation program. Citizen involvement ensures better results: a program that responds to public needs will receive continuing support.

The U.S. Environmental Protection Agency (EPA) estimates water-use reductions of 10 to 25 percent through public education. In most cases, program benefits will outweigh costs. A variety of tools can be used to inform people about their conservation responsibilities and community goals, including:

- **Water and energy bill inserts**
- **Flyers, posters, billboards**



Spray irrigation of treated wastewater onto community parks, golf courses and other green areas is an excellent way to 'recycle' water.

- **Public service announcements on local radio and television stations**
- **Conservation exhibits, seminars and workshops**

The public school system is an excellent setting in which to instill good water-use habits, and may help with education programs that can positively impact surrounding communities, such as promotions demonstrating "water wise" homes and landscapes.

Municipal & Industrial Wastewater Recycling. Depending on health, safety and cost factors, direct reuse of municipal or industrial wastewater may be possible. Opportunities for recycling treated wastewater include:

- **Irrigating parks, golf courses, greenbelts, streetscapes and domestic landscaping**
- **Reuse for fire-fighting purposes**
- **Reuse as industrial cooling water**

Georgia's more than 500 municipal wastewater treatment plants and approximately 700 industrial (privately owned) wastewater facilities treat about 1.1 billion gallons of wastewater each day. In the 1980s, about 125 wastewater land treatment systems were brought into operation. Some are national models for this progressive form of water conservation. Since 1982, for example, treated municipal wastewater has been sprayed in an area above the Clayton County water supply reservoir. This pretreated wastewater is allowed to percolate through the soil and recharge the groundwater supply. It is a water conservation technique that:

- **Increases the rate of aquifer recharge over that of rainfall alone**
- **Reduces wastewater treatment costs and delays need for plant expansion**
- **Protects water quality of streams and rivers through reduced discharge**

The soil mantle removes some contaminants as wastewater seeps downward. Other contaminants (bacteria growing nitrates) are absorbed by pine trees. Tests show no negative effects to groundwater quality resulting from this innovative approach to water conservation. **Baxley, Ga.** has developed a system for providing treated irrigation water to a nearby golf course. They are also exploring a plan for using treated wastewater in homes, offices and factories through a dual-distribution system: high-quality water for drinking and showering, treated wastewater in a separate system for watering lawns, washing cars or flushing toilets. Similar dual water systems (potable and nonpotable) are already in use in some areas of the country.

Pricing Policies. Water is a commodity in limited supply, which is overused and underpriced. An informal Department of Natural Resources survey reveals that the average annual price Georgians pay for water and sewer services is about:

- **One-sixth the cost of telephone charges**
- **One-eighth the cost of natural gas**
- **One-tenth the cost of electricity**
- **Half the average cost of garbage collection bills**
- **Less than half what the average household pays for cable television**

If your local utility's pricing strategy is not based on the real cost of water and sewer services, then waste is encouraged. Many local governments and water utilities are taking a closer look at pricing as a conservation tool due to:

- **Growing demand on limited resources**
- **High cost of developing new supply sources**
- **High cost of improving or expanding water**

treatment facilities

- **•High cost of water quality regulations**
- **•Fewer federal cost-sharing dollars**

Flexible, Fair Pricing. Given these mounting concerns, it no longer seems a question of "if" water rates increase, but rather "when" and "how much." Consumers respond favorably to pricing policies that are well reasoned, flexible and fair.

Effective policies are tailored to the characteristics and circumstances of each service area. Differences in population and socioeconomic factors need to be considered alongside such variables as water source, treatment and customer services. A cost-of-service study that considers current conditions and future needs would prove helpful in designing fair rates.

Universal Metering. The first step to developing equitable pricing is universal metering. It enables cost burdens to be allocated based on the actual usage of each customer. Local governments are encouraged to consider ordinances that require meter installation in all new or renovated construction. Metering can also be linked to all projects receiving government assistance, grants or loans. Moreover, installation rates can be improved by offering a billing rebate to low-income water users and others who do not as yet have metered service. Regardless of which pricing method is used, studies show a 13 to 45 percent reduction in water use once meters are installed.

Designing Water Rates. As the price for a product goes up, demand goes down. To select an appropriate water rate, determine which price level will cause consumers to reconsider their water-use habits and conserve. At the same time, the new rate should reflect the total cost of providing water services. To impose a fair rate, the following information must be estimated accurately:

- **•Water-use reduction goal for the service area**
- **•How much water use will drop relative to price increase ("price elasticity")**
- **•Percentage of change in price needed to reach the reduction goal**
- **•Amount of revenues that will result from setting a new rate**
- **•How new revenues will compare with operating costs**

Studies show that water and sewer rate increases are most effective in curbing outdoor water use, especially during peak-demand periods.

Choosing a Price Structure. Once an effective water rate is determined, the next step is to select a suitable price structure. Both water rate and price structure influence water use.

•Flat rate. Used in unmetered systems. A fixed sum is charged per customer, regardless of the amount of water used. It does not provide any incentive to conserve, and is likely to encourage waste. A flat rate is usually based on size of the service line or class of user.

•Decreasing Block. Used by many utilities. A series of block prices decrease as the quantity of water use increases. It does not encourage water conservation, and may actually encourage waste. Usually, this structure is applied in communities having large-volume water users (business and industry) to help maintain a stable economic base. Many consumers consider it unfair because low-income users and those who conserve wind up paying the highest rate. (The perception is that small users "subsidize" large users.)

•Increasing (Inverted) Block. Not used often. A series of block prices increase as the quantity of water use increases. Basically, it is a sound mechanism for reducing peak or average use, but is considered unfair to large users because their water-use efficiency is not reflected in lower rates. Whenever this structure is used it is more effective to set rates on a marginal cost-pricing basis.

•Sliding Scale. Not used often. This concept is similar to the Increasing Block, except price level per unit of water is based on average daily consumption. It has the same conservation advantages and user disadvantages as the Increasing Block.

The Price of Water Is a Bargain!

Did you know that the price most Georgians pay for water is:

- **•One-sixth the cost of telephone service**
- **•One-eighth the cost of natural gas service**
- **•One-tenth the cost of electricity**
- **•Half the average cost of sanitation bills**
- **•Less than half the average cost for cable TV**

Seasonal, or 'peak' demand occurs in Georgia during very hot summer months, and during this time the price of water should increase sharply to provide economic incentive to reduce wasteful usages.

•**Uniform Block.** Used increasingly by utilities. All users pay the same rate per unit of water, regardless of the amount used. It may be somewhat effective in reducing average use since conservation is rewarded with lower water bills. Small consumers consider it more equitable than the Decreasing Block structure. Large-volume users also consider it fair.

•**Seasonal (Peak Demand).** Used increasingly. Price per unit increases sharply during summer's peak demand period. It provides an economic incentive to reduce wasteful irrigation. Those who cause the peak — and the need for extra plant capacity — pay for it. Usually, peak rates apply to amounts exceeding average winter use. Both large and small users consider it fair. It is also referred to as a "Summer Surcharge."

•**Life-Line.** Rarely used. A low price is set for minimum use of necessary water by low- and fixed-income groups that cannot afford high prices. It might help to reduce average use within these groups.

Avoiding Negative Impacts. While local governments and water utilities want to improve conservation, they must also consider potential impacts. The following are typical.

1. What if utility revenues fall below operating cost? A properly designed, fair pricing policy can improve water utility revenues, even as it helps cut water use. A balanced approach will account for the special circumstances of the service area, peak periods, as well as operating costs. To the extent that conservation improves, the utility would benefit from lower operating expenses, including lower treatment and energy costs.

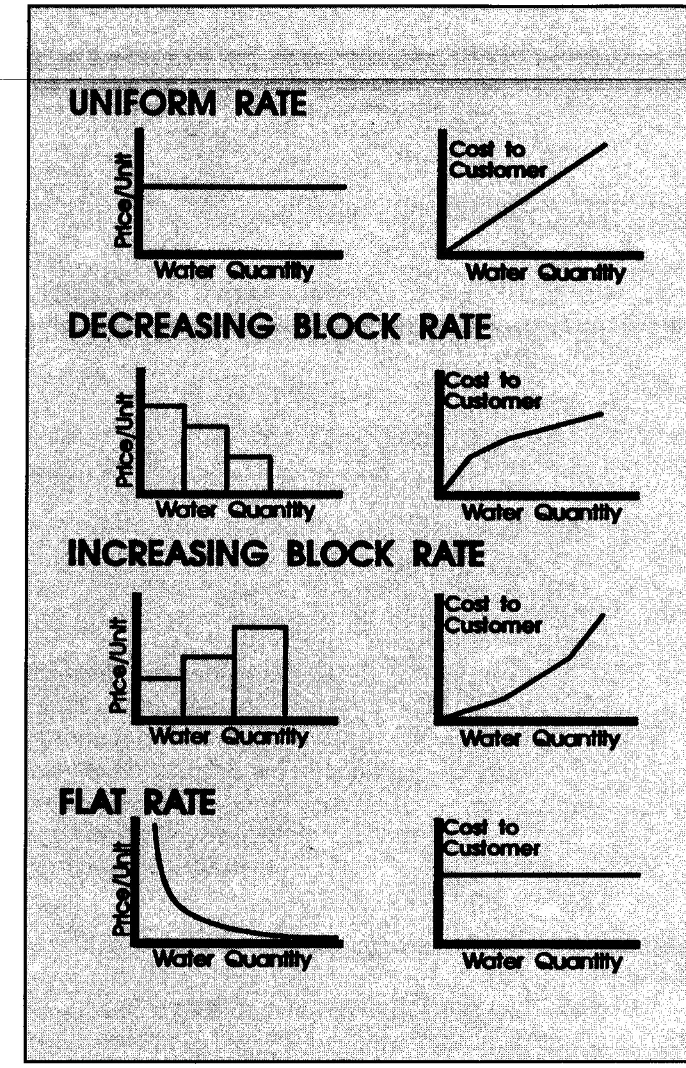
2. A rate increase would be unpopular with the public. Before a water rate and pricing structure is changed, the matter should be submitted for public review and comment. In general, the public is moving toward a fair-play attitude of "pay for what you get." Polls show that three out of four citizens consider themselves "environmentalists." A good communications effort will get the message across that:

•**Higher rates can be managed through conservation.** The money consumers save on water and energy bills will help offset a price increase.

•**Water is a premium commodity.** Although consumers are expected to use less water, rates will have to keep pace with the increasing costs of service. Compared to what they pay for other utilities, water will likely remain one of their best bargains.

•**Consumers would face even stiffer prices if the utility were pressed to expand its supply and treatment capacities without attempting to improve conservation.**

Fig. 8 — Typical rate structures



3. Increasing cost to large volume users would hurt business and industry. In turn, this would weaken the city and county's economic base. There are several alternatives to a decreasing block structure that large users would consider fair, as well as the public **(see Figure 8)**:

- **Uniform Block Structure**
- **Excess-Use Structure**
- **Seasonal (Peak Demand) Structure**

In addition, many large water-using industries favor **Cost-Based Rate Contracts.** These arrangements can promote conservation at rates companies consider to be fair.

Negotiated contracts enable large users to define their service and cost requirements, while water utilities define their service and pricing concerns. Industry and large businesses can secure reasonably priced, adequate and reliable water services. Water utilities can provide for an adequate flow of revenue to recover capital and operating costs. **Long-term contracts** are commonplace between the business community and electric and gas utilities. Water utilities, however, have tended to be the exception, not the norm.

Billing System. Once the right pricing "mix" is decided, the billing system will probably have to be updated. It is important that customer billing is easy to read. Consumers need to track water use and cost to improve their conservation practices. A legible bill will state clearly:

- **Current cost of water per unit**
- **Current usage**
- **Consumption rate and cost from prior bill**
- **Increase/decrease from previous bill**
- **Water conservation tips and utility "hotline" telephone number**

Whenever a price change is contemplated, potential problems and adverse consequences should be carefully analyzed. Once a new price is chosen, a gradual transition is recommended to ease the impact on various classes of consumers.

Supply Management for Water Utilities

A prime focus for conservation by water utilities is supply management. By increasing management efficiency, operating expenses can be reduced while revenues improve. Moreover, capital expenditures for plant expansion might be postponed.

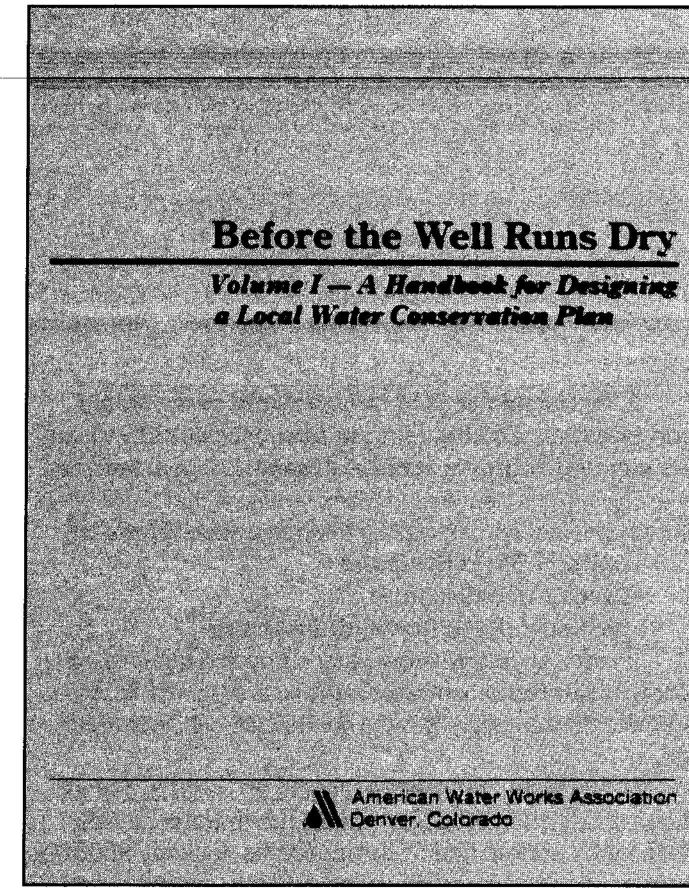
Unaccounted-for Water. Due to rising demand and costly federal regulations, many utilities are being forced to operate more efficiently with less money, and many are reducing their unaccounted-for water as a major priority. **Unaccounted-for water is the difference between the amount of water entering the distribution system and the amount of water billed to customers.** Many of Georgia's water systems have excessive amounts of unaccounted-for water. Levels range from an average 15 percent to nearly 50 percent. According to survey data, at least 40 percent of all water systems need programs to reduce their losses.

Georgia's Environmental Protection Division considers 10 percent or less of unaccounted-for water to be an acceptable level. Water utilities are encouraged to develop programs that meet that goal.

Water Audits. A water audit is useful for calculating how much water is "lost" as far as accounting and billing are concerned. Basic steps include:

- **Testing meters for accuracy; evaluating repair/replacement options**
- **Determining the amount of authorized, unmetered use**
- **Evaluating leak detection and repair programs**
- **Determining unauthorized, illegal use**
- **Examining water pressure; preventing backflow**

A minimum 12 months of detailed production and sales data will be needed to conduct an audit. For more



Routine meter maintenance should be a top priority for all water utilities. The American Water Works Association Manual may be consulted for detailed meter test procedures and standards of accuracy.

accurate results, analyze water records over a five-year period.

Meters. The value of **universal metering** cannot be overstated. All sources of water supply and all service connections should be metered. Even if water is given free to certain authorized customers (municipal facilities, schools, churches), they should, nevertheless, be metered. Next to consider is **meter accuracy.** Management can decide the cost-effectiveness of a testing and repair program done in-house or by contract.

Consult the latest American Water Works Association (AWWA) Manual for detailed test procedures and standards of accuracy. **Routine meter maintenance should be a top priority for all water utilities.** This is a must where industry and other large-volume users are concerned. Inaccuracies in only a few industrial meters can have a serious impact on water records and revenues. The following maintenance schedule is recommended:

Meter	Test Interval
Production/Master	Annually
2" and larger (industrial)	Annually
5/8" (residential)	10-15 years

Replacement Programs. Old and worn meters have been affected by water volume and chemicals. In many cases, it might prove more economical to install new meters than to attempt the repair of old ones. Faced with an unacceptably high level of lost water, one utility undertook a three-phase program to replace its meters:

1. Replace large meters (two inches and larger) having the poorest accuracy

2. Replace smaller meters with severe declines in accuracy

3. Replace all other meters

The program was completed over several years. Replacement costs were kept as low as possible by buying reliable meters made of corrosion-resistant plastic. The utility's ultimate goal was to have each customer pay a fair share for water and sewer services. Many citizens received higher bills due to more accurate readings, and reduced their water consumption. Nevertheless, revenues increased while pumpage costs declined.

Leak Detection and Repair. A cost-benefit analysis is important to determine whether a leak detection and repair program is worth undertaking. The decision-making process can begin with an inventory of all obvious sources of unmetered water use and loss, such as:

- **Sewer flushing**
- **Storage tank overflows**
- **Leaking hydrants**
- **Firefighting use**
- **All authorized, unmetered service**
- **Illegal hook-ups**

Deduct these estimates from total water production, less total metered usage. The result is an estimate of undetected water loss. If this "hidden" water loss is substantial (well over 10 percent), a leak detection survey may be necessary.

In general, a sound maintenance program is of utmost importance. Always keep good records of water production and use. Maintain valves and hydrants routinely. Inspect old and replace corroded water lines, and protect pipes against corrosion. These practices are standard procedure for managers whose systems have low levels of water loss.

Illegal Water Use. By far, meter and leakage problems are the major causes of unaccounted-for water. Nevertheless, illegal water use should not be ignored. It is possible that large amounts of water are being "stolen" in your service area. For example, in one manufacturing plant, employees were observed washing down equipment with hoses connected to a water line clearly labeled "for fire use only." A water system can discover this type of unauthorized use by installing detection devices on fire lines. Also, provide fire hydrant meters for use at construction sites and for filling tank trucks. Surveillance of the water system is also recommended. Utility personnel and police should be instructed to report unauthorized use, as well as any observed leakage.

Water Pressure & Backflow Prevention. Another important factor in supply management is water pressure. If it is too high, it can contribute to costly equipment breakdowns and leakages. If it is too low, there is the greater danger of backflow contaminating drinking water supplies. Studies show an average reduction of 30 to 40 pounds per square inch (psi) results in a three to six percent decrease in community water use. If a water system has relatively high water pressure (well above 80 psi), it might be advantageous to consider lowering pressure. **However, a comprehensive backflow prevention system must already be in place.**

Community valves and hydrants should be maintained routinely, to stop unmetered water loss like leaks.

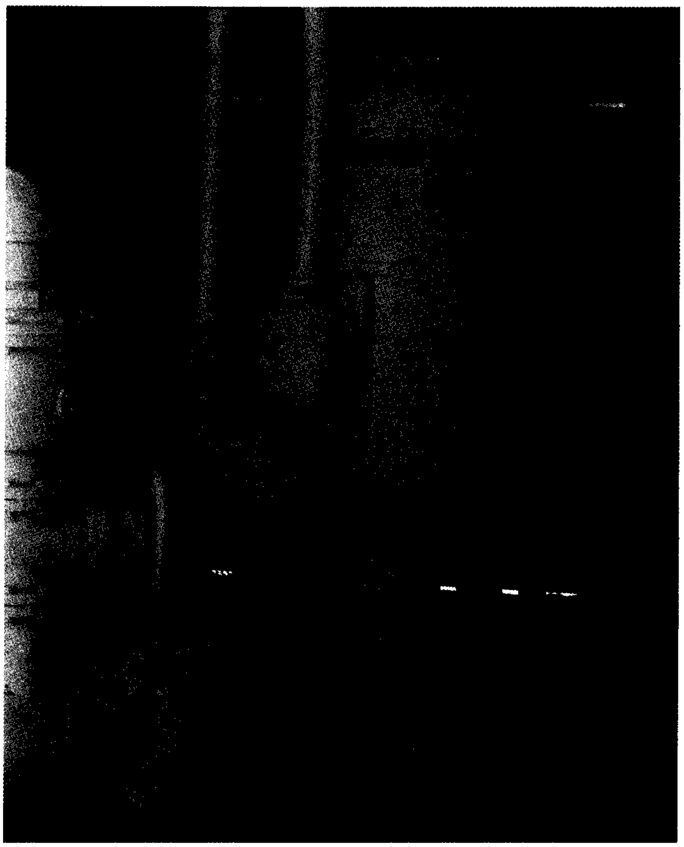
There are other reasons why reducing water pressure may not be desirable. It might interfere with firefighting, or the operation of certain agricultural irrigation systems, for example. Also, certain topographies may dictate higher pressure so that all connections are well serviced. In such cases, it might be useful for the water utility to encourage action on the part of its customers. A pressure-reducing valve could be purchased by the customer for installation at the supply inlet. A rebate or temporary discount on water and sewer bills might be a useful incentive.

Wastewater Flow. Significant improvement in water conservation will affect the flow volume and composition of raw wastewater handled at treatment plants. A reduction in wastewater flow can reduce plant overload. In turn, the cost to operate and maintain hydraulic equipment could be reduced. At the same time, lower wastewater flows can result in higher concentrations of pollutants in sewers prior to wastewater treatment. For example, a 40 percent reduction in waste flow could increase the concentration of pollutants by about 65 percent. Many experts believe more concentrated pollutants can result in increased treatment efficiencies, and moderately improved water quality.

Pumping Energy: Reducing Costs. Producing enough high-quality water to meet growing demand is a challenge for all utilities and is especially difficult for Georgia's small rural systems which operate on modest budgets. **Energy** is the single largest expense for most water systems. About 85 percent of the energy consumed by a utility is used to pump water. If water comes from wells, pumping energy can be as high as 95 percent of total consumption. High-service pumping costs can range from $10,000 to $30,000 a year (per mgd pumped). Plant heating, ventilating, air conditioning and lighting can cost another $30,000 annually, depending on plant size. In view of the large sums involved, water managers cannot afford to ignore opportunities to save energy.

Energy Audits. An **energy audit** will help determine pumping efficiency. The system manager can begin by summarizing historical data on levels and patterns of water use. Accurate records on energy consumption and pumping schedules are also needed. For a general overview of your system's pumping efficiency, take a reading of the electrical power meter. Then divide the kilowatt-hour usage by the amount of pumpage. The result is a reading of kilowatt-hours per million gallons. The higher this figure is, the less efficient, and more costly, is your pumping system. Good pumps function at efficiency levels of 75 to 85 percent. Efficient motors run at about the same level or slightly higher. After factoring energy losses inherent in the system, a good pumping plant will be one that achieves a 65 to 70 per-cent level of overall efficiency. Pumping plants with less than 55 percent overall efficiency should plan to make improvements. Pump modifications and repairs are worthwhile if projected energy savings cover repair costs in three to five years.

Improving Pump Efficiency. To optimize pump performance, an investigation of operating procedures and



If a community pumps water from underground wells drawdown should be kept to a minimum. Changes should be made to allow maximum well yield with the minimum possible drawdown. (Top: a community well pump.)

flow rates is needed. This information should be analyzed in tandem with detailed water and energy use records. The best combination of pumps for a particular set of conditions needs to be determined by the plant operator. That person should be familiar with the system's typical flow patterns and peaks on an hourly, daily and weekly basis. The most efficient pump combination will be the one providing the minimum flow required. In general, use the least number of pumps required to maintain adequate water flows. One pump operating two hours will use less energy than two of the same type of pumps operating one hour. Moreover, the lower the flow rate, the less pumping energy needed. **Variable-speed pumps** are more efficient than constant-speed systems. The performance of constant-speed pumps, however, can be improved. Adjust them in parallel fashion so that each delivers a portion of peak flow. A large number of small pumps can be used or a small number of large pumps. Realize, however, that the larger the pumps, the more over-pumping (inefficiencies) will occur during low-demand periods. Also, adequate standby capabilities should be in place in case of pump failure.

If water is pumped from **underground wells,** drawdown should be kept to a minimum. Excessive drawdown increases static-head pressure and pumping energy. Study the well's construction. If necessary, make changes to allow withdrawal of the maximum required yield with the minimum possible drawdown. The well pump should be sized to reduce frequent starting and stopping. Also, a well should generally not be pumped more than 16 hours a day.

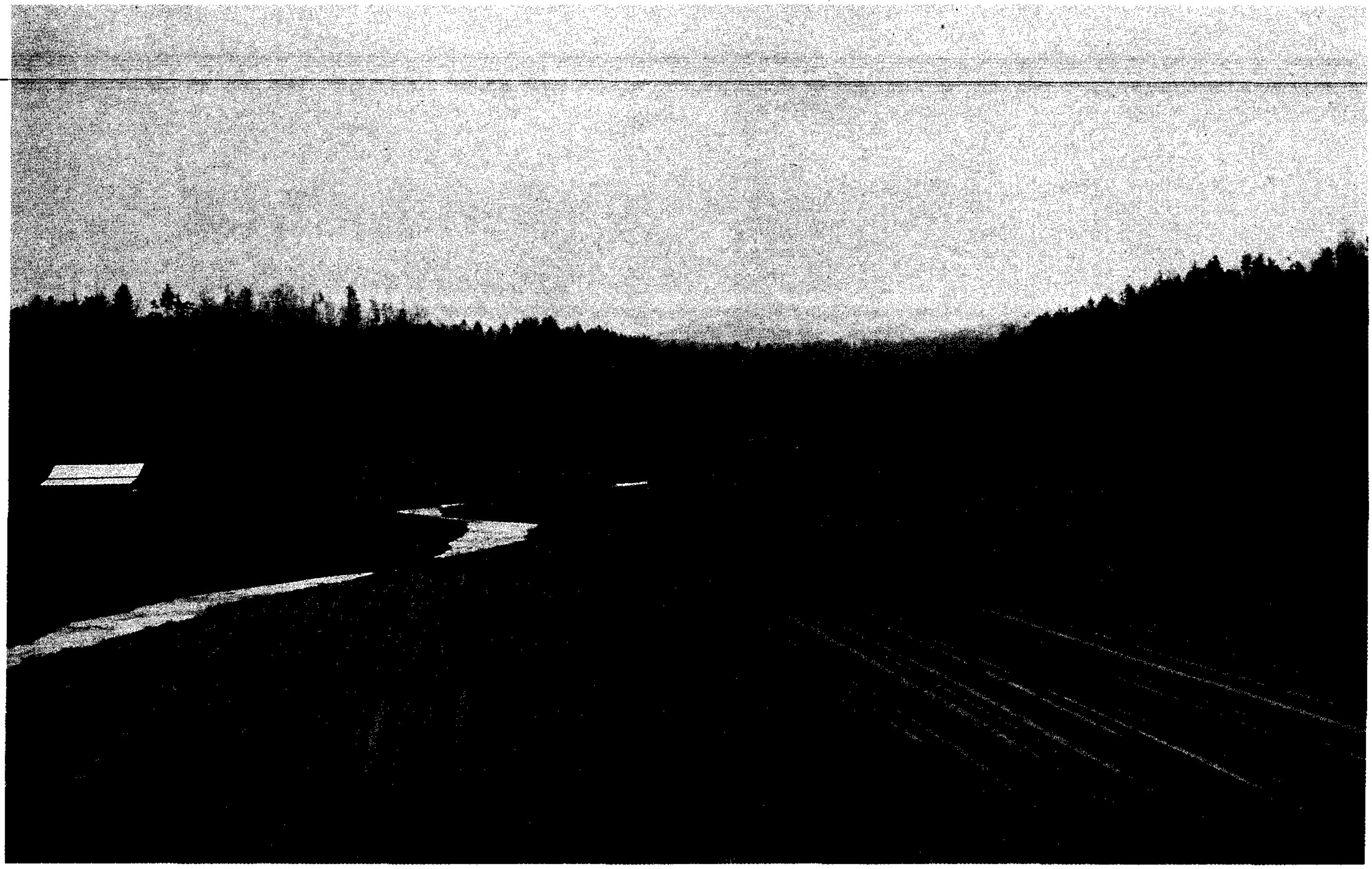
Finally, pumping energy can be saved by filling storage tanks during low-consumption hours and (where applicable) during times of off-peak electrical rates.

Off-Season Efficiency. After treatment, water is typically stored in clear well or ground storage tanks. The water is then transferred to elevated tanks for distribution. When water levels in both ground and elevated tanks drop to preset points, the pumps are activated (either automatically or manually). In general, pumping efficiency tends to be poor during the low water-use period of winter, and good during high water-use in summer. That is because pumps use energy inefficiently during times of low consumption. More energy is used to start up motors and pumps on more occasions than is necessary. These start-ups use five to six times more energy than the amperage needed to keep pumps running.

A solution worth considering is to readjust storage tank levels. Water levels can be decreased to a safe operating level during off-season periods of low consumption. Once the pumps do turn on, they will run a longer time with greater efficiency. Moreover, with less starting and stopping, maintenance and equipment costs can be controlled.

How much should tank levels be allowed to drop during the off-season? Water managers need to examine plant conditions and service area needs carefully. A cautious approach is advisable. Water levels can be dropped very gradually, while system reliability and fire protection needs are carefully monitored.

Determining Electrical Input. The overall efficiency of each pumping system can be checked periodically for variations. This procedure requires taking measurements of the pumping head, flow rate and electrical power input. **Measurement of voltage and amperage is a dangerous operation and should be done only by qualified personnel.** After measurements are taken, calculations can be made.



Agriculture is the second-largest water use category in Georgia.

V. Conservation For Agriculture

After public supply, **agriculture is the largest water-use category in Georgia.** In 1987, combined usage for row crops and livestock production amounted to 775 million gallons per day. About 94 percent of this went toward crop irrigation.

Row Crops. According to experts, much of the water used in irrigation systems is excessive. In Georgia, crops are being irrigated at an average depth of eight inches. While extra water might bring a small increase in crop yield, at a certain point, it can decrease yields while increasing salt buildup and soil erosion.

The U.S. Department of the Interior cites two prime reasons for wasteful practices:

- **Overuse of low-cost water in lieu of improving the irrigation system itself**
- **Farmers' inaccurate estimates of how often to irrigate, and how much water to apply relative to soil moisture conditions**

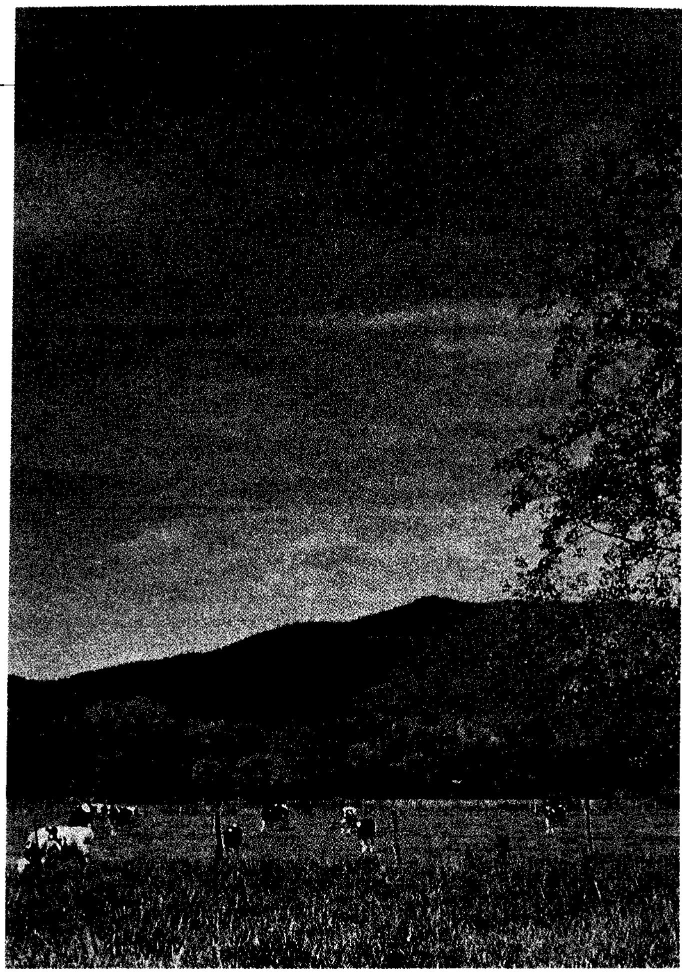
Correcting these practices is good stewardship, and boosts farm income. Because large amounts of water and pumping energy are involved, greater irrigation efficiency can cut production costs while improving crop yields. Even a five to 10 percent water reduction can mean significant cost savings.

Irrigation Systems. Large sprinkler systems are commonplace on Georgia farms, particularly mobile types that rotate around a central pivot. Advantages of these systems include easy application of fertilizers and pesticides. Also, there is less need for land leveling. Some disadvantages exist as well. Sprinkler systems demand high energy to lift and distribute water; and more water is lost to wind carry and evaporation than with drip systems or gravity-based methods.

Wherever possible, **drip-trickle irrigation is recommended,** to cut waste by delivering precise amounts of water to each crop. Similarly, drip systems administer fertilizers and pesticides efficiently, reducing the overall quantities used. Fewer pests and weeds result when water is applied only at the roots.

Drip systems can be used effectively on almost any terrain. Because they operate with low water pressure, less pumping energy is needed. These features are especially useful in connection with low-capacity wells. Improved drip systems that are self-flushing and clog-resistant have been introduced in recent years. Over time, savings on water, energy, fertilizers and pesticides, along with good crop yields, would offset investment costs.

Best Management Practices. To preserve Georgia's water and land resources, farmers are encouraged to use



Livestock enterprises like farming cattle and pigs use billions of gallons of water per year. In Georgia, the poultry industry alone uses 11.3 billion gallons yearly.

as many non-chemical methods as possible. Use of pesticide substitutes, minimal plowing, crop rotation, resistant varieties and cover crops are some that can produce good yields while protecting the environment.

Livestock. Georgia agriculture also includes extensive livestock operations. Poultry is the largest enterprise, requiring about 11.3 billion gallons of water each year. Other livestock operations (cows, cattle, pigs) use another 10 billion gallons annually.

Water conservation efforts for the livestock industry would focus on the cleaning of confinement buildings and mechanical equipment used for production. Conservation methods discussed in earlier sections apply here. The average livestock business could save 20 percent or more on water and energy use if they will:

- **Retrofit water devices with high pressure-low volume sprays and hose nozzles**
- **Conduct routine leak detection, repair and maintenance programs throughout water system**
- **Install water meters to gauge actual usage and help spot malfunctions**
- **Insulate hot water pipes; install timers & temperature controls on all heating/cooling systems**
- **Sweep up residues before washing down facilities**
- **Avoid unattended hoses and tank overflows**

VI. Commercial and Industrial Conservation

As with residential use, commercial and public institutions use water for sanitation and landscape irrigation. All the water conservation methods have direct application in commercial settings:

- **Retrofit plumbing; installing new ultra-low flow fixtures**
- **Leak detection** and **repair** programs
- **Water-efficient appliances**
- Design of **water-efficient landscapes** and use of **precise irrigation** methods

Office buildings, apartment complexes, restaurants, hotels, hospitals, schools and golf courses are just some of the water users in this category.

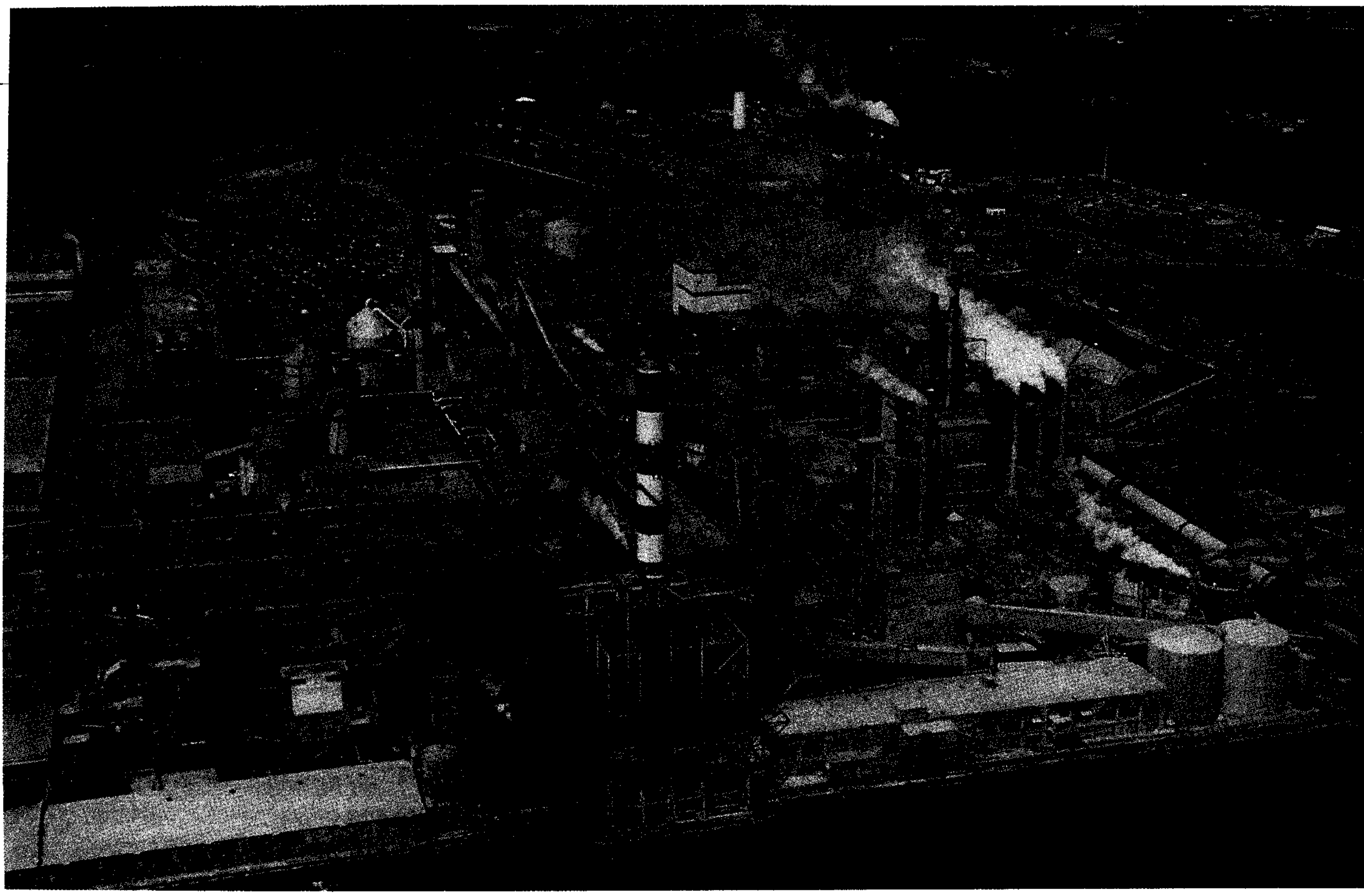
Water And Energy Savings. Commercial and institutional water conservation can pay off substantially. Studies show a handsome 1:25 cost-benefit ratio in this category when **comprehensive retrofit programs** are undertaken. For example, faucets in public lavatories are often left running. Instead of waiting until repairs or replacements are needed, install faucets with **automatic self-closing valves.** Hot water flow could be cut to 0.25 gallons per minute for recirculating systems and a maximum of .5 gallons per minute for non-recirculating systems. Also, hot water pipes can be insulated and energy-saving devices installed that limit outlet temperature to 110°F.

Retrofitting all plumbing fixtures and **installing timers and temperature controls** on heating/cooling (HVAC) systems can cut water demand by 20 percent or more. Even greater water and energy savings are possible by the following:

- **Conducting regular leak detection, repair and maintenance programs** for all water devices including pipes, boilers, AC units and irrigation systems
- **Changing from whole-steam HVAC to more water-efficient systems**
- **Changing from air conditioning towers to air-cooled towers**
- **Installing a condensate recovery system** in cooling towers
- **Closing water loops in cooling systems**

Conduct a systematic **audit** of water use throughout the organization. Set use reduction goals and retrofit and system maintenance priorities. Establish a **water conservation policy** and teach employees to use water wisely. Frequent meter readings and analysis of water bills will help in tracking and evaluating water use.

In some cases, large commercial high-volume water users may be placing heavy demands on public water



Sizeable industrial operations may reuse a portion of the wastewater they generate with a water reuse system. This can reduce the use of potable water up to 75 percent.

systems. It may be possible to convert to **self-supply** by having a well installed. This can be explored with government authorities, especially when significant expansion of operations are planned.

Water Reuse. It may be possible for sizeable commercial and public institutions to **reuse** a portion of wastewater they generate, known as "gray water." Most water-reuse systems pretreat only the mild "gray water" from sinks, fountains, showers and laundry. It is usually recycled for toilet flushing, landscape or golf course irrigation, and air conditioning needs. **These systems can reduce the use of potable water up to 75 percent.**

Water reuse requires two separate distribution systems. Piping for drinking water must be easily distinguishable from piping for the "gray water" system. Incompatible fittings are also needed to protect drinking water supplies from accidental cross-connection.

Businesses and other institutions need to be large water users to justify the cost of capital, installation, operation and maintenance of a water reuse system. In a high-rise office building, for example, it can prove cheaper to install a reuse system that collects "gray water" for flushing toilets, than to pay drinking water bills for the same purpose. (In one case, the cost of 24,000 gallons of water was saved each business day.) Sometimes, all water can be reuse water. Commercial car washes appear to be good prospects for such water-reuse systems.

The decision to install a "gray water" system also depends on the degree of wastewater treatment that can be provided on-site, as well as the intended use of treated effluent. Ultimately, concern for public health and safety determines whether a reuse plan is acceptable. All factors must be studied carefully.

Institutional Landscaping. Often, commercial and public entities have sizeable landscapes. The same basic Xeriscape techniques presented earlier apply, and can save as much as 60 to 70 percent of outdoor use in this class.

Automatic Irrigation Systems, adjusted for different water-use zones, are essential. Irrigation guides can be used to monitor water needs. Better still are sophisticated tensometers that turn the system on or off according to soil moisture readings. Tests show these can save water by 50 to 75 percent. These also produce greener grass since fewer nutrients are leached from the soil. Inexpensive rain sensors can be installed to turn off automatic irrigation systems during showers.

Grading and drainage can also help cut outdoor water use. High water-use plants can be situated to "harvest" runoff from rainfall. Runoff can be also channeled into ponds and pumped back through irrigation lines to rewater grounds.

Large Industrial Conservation

Many top industries use very large amounts of water. Examples of such industries in Georgia include the pulp

Plant washdowns are an excellent use for "gray" or process water. Using hand-held, high-pressure, low-volume spray nozzles in plants is another way to save large volumes of water.

and paper industry, textiles, chemicals and food processing. Faced with high wastewater treatment costs, many industries seek ways to reduce water use. Improved water conservation is being pursued by:

- **Recycling of cooling water**
- **Selective reuse of process water**
- **Water audits**
- **Employee education programs**

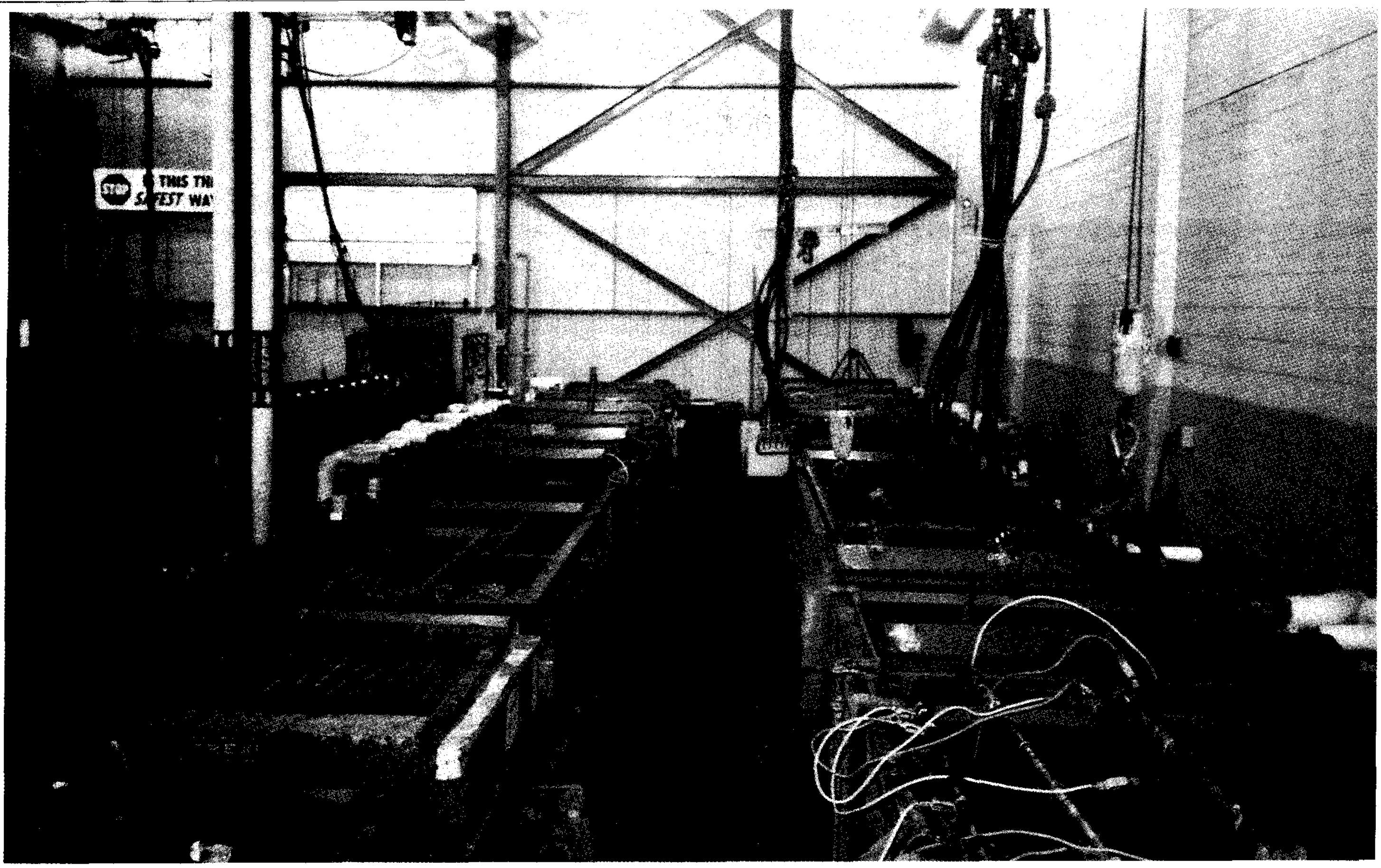
Cooling Water. Water used for cooling and condensing accounts for about 70 percent of the gross water intake of certain high water-use industries. By **recycling this water, the demand for freshwater can be reduced substantially.** Studies show average water savings of 20 to 30 percent. In some cases, gross reductions of 75 to 95 percent were noted. Because it does not come into contact with manufacturing processes, cooling water is usually not degraded. This makes it suitable for several other uses, including product and equipment wash-downs; reuse as process water or preheating process water in a heat exchanger; general cleanups; and landscape irrigation.

Process Water. The quality of water needed for production processes varies between industries. Options for **reusing process water** can be identified by classifying and segregating operations needing high-quality water from those than can accept reused water. Using a sedimentation and filtration system to remove suspended solids may be all that is needed for reuse of process water. In other cases, further pretreatment may be necessary. It may also be possible to "cascade" water from one process to another, rather than reuse it for one purpose. If water quality requirements are met, process water might also be suitable for basic plant washdowns or irrigating landscapes.

Process Modification. Virtually every plant can modify equipment so that certain processes require less water. Examples include:

- **Switching from water-cooling to air-cooling systems;**
- **Installing air cooled air compressors in cooling water systems;**
- **Requiring mechanical seals for pumps instead of water seals;**
- **Reducing the amount of rinse water used by reducing the amount of chemicals used in certain processes; by modifying production equipment to reduce "drag out" after rinsing; and by recirculating the last rinse waters;**
- **Improving drainage and dry-out procedures;**
- **Using condensing systems to recover water vapor that would be evaporated.**

Large amounts of water can also be saved through **more efficient product and equipment shower sprays** and during plant washdowns. Switching from conventional



By cooling process water, the wasteful escape of evaporation can be avoided. This series of processing tanks at Delta Airlines' Operations Center are equipped with coils that cool the water, as well as with backflow prevention devices.

low pressure-high volume fog sprays and hose nozzles (200 gpm) to **high pressure-low volume versions (125 gpm)** is recommended.

Water waste from unattended hoses can be eliminated with **nozzles that must be hand-held.** Attention should also be given to minimizing tank overflows.

Process modifications lower the cost of freshwater intake and wastewater discharge, and lower the cost of chemical use and energy. Even small plants can enjoy significant reductions in operating expenses, along with improved productivity.

Water Audits. A water audit is useful for analyzing current water use. It would begin with an updated schematic diagram of all input and output streams. All significant water-using processes should be metered and the following data collected:

- **Flow rates, water temperatures**
- **Amount of water and fuel used for heating and cooling processes**
- **Amounts of each chemical added (or removed) from production processes**
- **Details of wastewater treatment**

From this information, practical water and energy conservation methods can be determined on a process-by-process, plant-by-plant basis. After establishing water-reduction goals, a monitoring system would be needed to track actual water and energy use. Input from this system would make conservation practices more effective. Ideally, only minimum amounts of water and energy would be required for each process, consistent with overall productivity and quality goals.

From time to time, this analysis will need to be updated. Plans for plant improvements or expansion should include related plans for acquiring the latest water-saving equipment and technology. Whenever plant improvements are made, schematic maps of both process and drinking water systems should also be updated.

Employee Education Programs. Water conservation goals, required practices and monitoring programs must be communicated to employees. Ultimately, success depends on their efforts. In addition to communicating routine practices, management should establish the company's water-use priorities during periods of emergency or drought.

Georgia's Water Management And Protection Laws...

Georgia Water Quality Control Act, as amended

Initially established in 1964, this amended Act integrates control of water pollution with water quality standards. Municipal and industrial discharge into state waters is regulated through a permitting system based on the pollution-control standards of the federal Clean Water Act. Expanded regulations in 1989 set stricter bacterial standards and limits on **111 toxic substances.**

Georgia law includes a program for improving wastewater plants through a **State Revolving Loan Fund**. Water conservation is promoted to reduce waste flows and treatment needs.

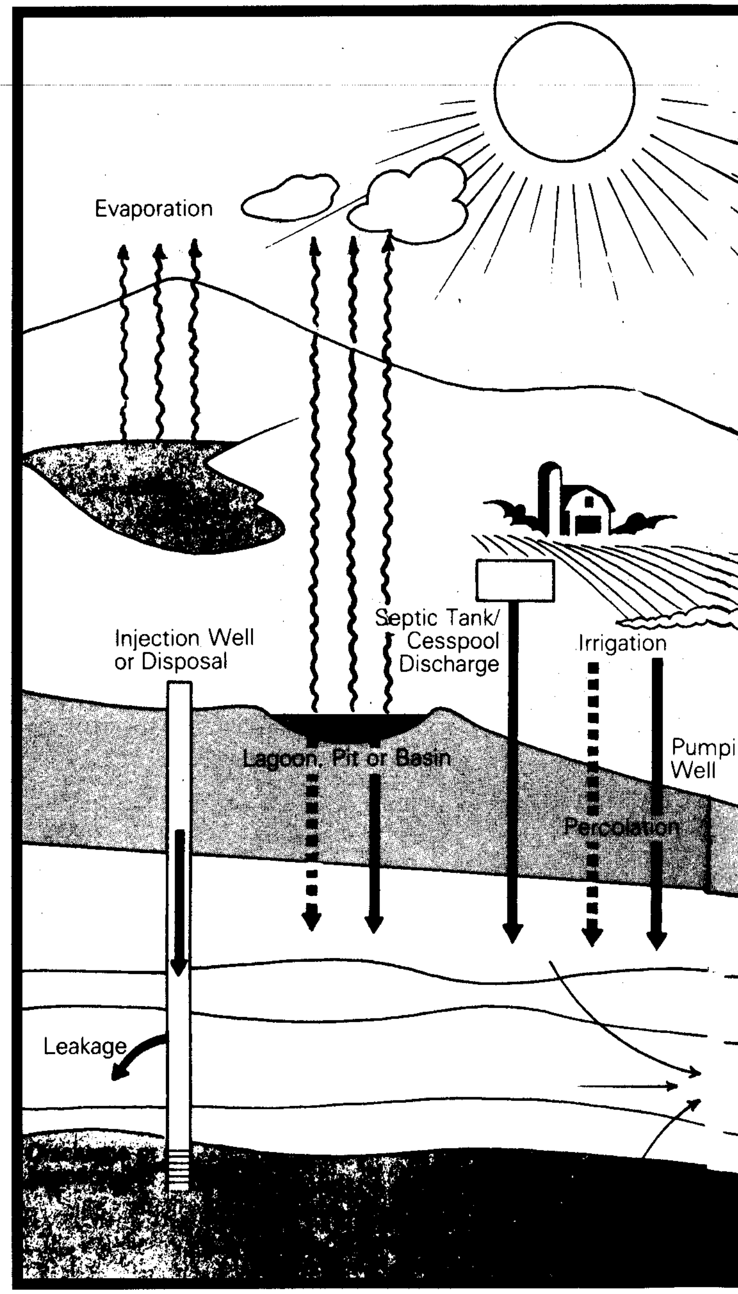
In 1987, EPD prepared an updated Clean Water Strategy that addressed long-term implications of the federal Water Quality Act. Increased emphasis is given to management of **toxic substances, nonpoint** source pollution, purity standards for lakes and estuaries, as well as protection of wetlands and **groundwaters.** The high cost of implementing these objectives further underscores the importance of improved conservation efforts.

Georgia Surface Withdrawal Amendments to the Georgia Water Quality Control Act

Users withdrawing over 100,000 gallons of water per day from Georgia's lakes, ponds, rivers, creeks and other surface waters must obtain user permits and report withdrawals monthly. Permit decisions take into account the protection of stream flows, conservation planning and equitable allocation arrangements among competing users.

Georgia Groundwater Use Act, as amended

Permits and monthly withdrawal reports are required of those who use over 100,000 gallons of groundwater per day. Permit decisions consider water budget data; conservation planning; resource protection factors involving well location and depth; pumping levels and rates; as well as measures designed to protect users' rights.



Agricultural Water Use

Permits are required for farm use of surface or groundwaters that exceed withdrawal rates of 100,000 gallons per day. **Conservation planning** helps ensure adequate supplies for crop irrigation. Permits protect farmers' water rights from competing users and carry no expiration date.

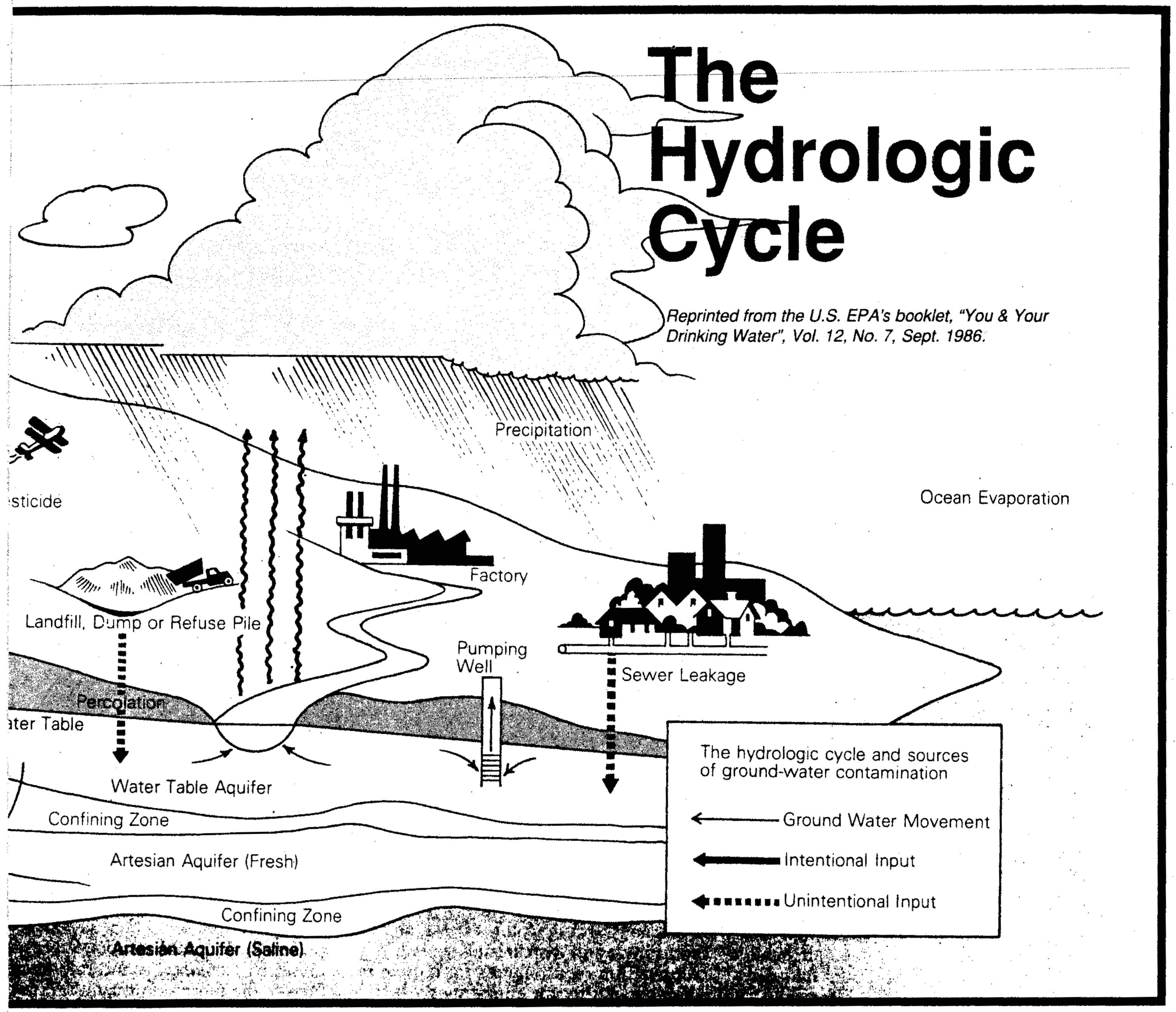
Georgia Safe Drinking Water Act, as amended

The Act provides rules and regulations to guarantee the quality of Georgia's 2,740 public water systems Operating permits for public drinking water systems and treatment plants are required and involve conservation planning.

State rules set "maximum contaminant levels" for organic and inorganic substances, radionuclides and microbials (coliform bacteria and turbidity), according to federal Environmental Protection Agency (EPA) require-

The Hydrologic Cycle

Reprinted from the U.S. EPA's booklet, "You & Your Drinking Water", Vol. 12, No. 7, Sept. 1986.



ments. In 1989, EPA rules became much more stringent and costly. The number of regulated chemical substances increased from 22 to 83, including more volatile synthetic organic chemicals. Further revisions in 1990 include final coliform rules and new surface water treatment regulations. The increasing cost of drinking water treatment reinforces the need for improved conservation.

Georgia Water Conservation Act, as amended

Since adopting this Act in 1978, Georgia has remained on the water-conservation vanguard. The law was amended in 1990 and 1991 to require **ultra low-flow plumbing standards.** These standards apply only to new construction, plumbing related repairs or renovations involving residences (effective April 1, 1992) and commercial buildings (effective July 1992).

A city, county or other authority is required to adopt and enforce these standards by April 1, 1992 to be eligible to receive any state water or sewer facility grants or loans.

In addition, a **statewide uniform codes bill** was adopted to strengthen observance and enforcement of various construction codes at the local level. Effective October 1, 1991, mandatory observance of plumbing codes was required by all builders and contractors in every local jurisdiction. Where cities and counties have not already adopted local ordinances, the bill authorizes the conduct of discretionary enforcement programs.

Georgia Growth Strategies Legislation

In 1989, a legislative package dealing with environmental issues was adopted. It includes the **Georgia Water Supply Act,** which provides for reservoir development. In addition, other laws were passed requiring land-use control standards for the protection of wetlands, watersheds and groundwater recharge areas.

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