

The original concept of *Weeds Trees & Turf*, however, was a magazine for contract applicators, those persons who applied chemicals for non-agricultural purposes outdoors. This concept was quickly broadened as the importance of the sod producer, arborist, and landscape nurseryman was recognized. This "horizontal concept" remains the philosophy of the magazine 20 years later.

Consider what landscape problem solving was like 60 years ago. Diseases of turf were not really considered significant until Piper and Oakly, USDA scientists in Arlington, VA, identified a severe epidemic of "Brown Patch" in turf and recommended use of an agricultural fungicide developed in the late 1800's called Bordeaux mixture. Newer fungicides did not really appear until the late 20's and early 30's when cadmium compounds and thiram were developed.

Developments in slow-release fertilizers and selective herbicides

did not really surface until the 40's when ureaformaldehyde and 2,4-D were discovered. Also at this time, the first growth regulators and synthetic insecticides were created. The foundation for continued chemical development was built in the late 30's and 40's.

Turf equipment companies first surfaced in the 20's with the golf boom. It was not until the late 30's and 40's that small machine shops began to produce specialty equipment for the Green Industries, such as sod cutters, aerifiers, stump grinders, and trenchers. This grass roots type of specialty equipment production continued into the 60's. The results are evident today in established corporations like Ryan, Vermeer, and Ditch Witch (Charles Machine Works). The sod harvester, which revolutionized the sod industry, was first exhibited in the late 60's.

In the late 40's the American Society of Agronomy established a turf section which gave formal recognition to state extension turf re-

search. Nursery research had already gained recognition as an important part of agriculture.

By the early 60's, it was clear that the landscape market was very promising. Not only were chemical and equipment segments in production, but the turf seed market was gaining momentum from the first improved turfgrasses, such as Merion (1951) and Penncross (1954), and NK-100 (1962). Improved vegetative turfgrasses were also released, such as Glen Burton's first improved bermudagrass (Tiflawn) and Meyer zoysiagrass.

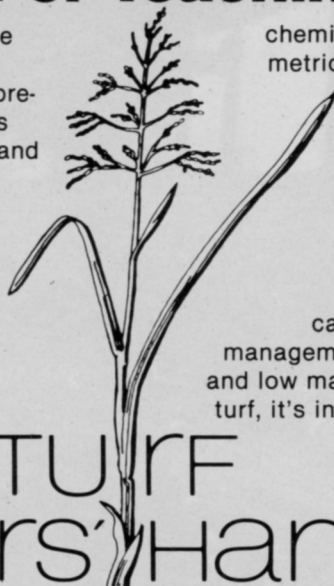
Lady Bird Johnson as First Lady gave the market a boost by making environmental improvement her pet project. The exposure she gave various aspects of the Green Industry had much today with serious recognition of the market.

Weeds Trees & Turf would spend the next 20 years chronicling the creation and growth of old and new market segments. In March, some of these chronicles will be reexamined.

WTT

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chemical applications, and extensive metric-imperial conversion. Business and technical aspects of turfgrass management are covered in this 424-page book. Planning, purchasing, hiring, construction, and plant selection are put together for easy on-the-job reference. Markets covered include lawn care, sod production, golf course management, cemeteries, athletic fields, and low maintenance areas. If it concerns turf, it's in the Turf Managers' Handbook.

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GUIDE TO IRRIGATION DESIGN UNDER DROUGHT CONDITIONS

BY WILLIAM REINECKE



Replacing overhead systems with drip systems can cut water usage in half in areas of ground cover or ornamental plantings. Weed growth caused by airborne seed is also not germinated by overhead watering.

In the past decade many regions throughout the United States have suddenly been required to curtail water usage for non-essential needs. These non-essential needs, in general, have been limited to the washing of automobiles, washing down of sidewalks, children playing in garden hose sprinklers, wetting down of roofs and walls of homes (during summer's heat), and other sundry acts of minimal water usage not considered as necessary to the health or welfare of the public in those communities most heavily stricken by these droughts.

Unfortunately, in many of these communities, the sprinkling of lawns and ornamental plantings around private homes was also unlawful. In one town north of Los Angeles several years ago, the construction of new homes ground to a halt because the local water purveyor was unable to provide this essential commodity to any potential users with the limited source to which this agency was confined. At that time the limitation per subscriber was less than fifty gallons per day. Normal use for customers of the Metropolitan Water District, which serves the Los Angeles area, is close to two hundred gallons per day per person, under conditions of normal supply.

We are now being told drought is expected to become the norm. The great increase in the country's population must, by physical need, require more water than was needed just twenty-five years ago. And even though natural cycling of the waters from lakes, ponds, streams, and oceans does recirculate that which is available by nature, America's agricultural requirements for man-applied irrigation consumes approximately eighty-five percent of all available water. Industry, if my memory is correct, will take another nine to ten per-

Bill Reinecke recently retired as a leading irrigation design consultant in California. His firm, Landscape Irrigation Services, continues to serve the West Coast as an independent irrigation consultant firm. This article represents his thoughts derived over a 30-year career in irrigation.

cent, leaving five or six percent remaining for domestic use. These figures will vary with different communities, but demonstrates a picture of stark reality for water consumers in times of severe drought. It must be finally realized that America can no longer be considered (in abundance) as the land of sky blue waters.

And, of course, the pollution of lakes, streams, rivers, and other waterways by industrial contamination should be no longer tolerated. According to the GNP, American industry is presently obsoleted by other nations with newer manufacturing facilities using modern disposal techniques. Now, then is the time for America to rebound and rebuild with an eye to more automated production and with preferential consideration to resubstantiating our natural resources, of which water is a prime concern.

The practice of competing for the lowest installed cost can cause severe wastage of water due to overspray and inefficient distribution patterns.

It can be expected, during a continued drought, that not only will residential plantings be restricted by law from irrigation, but also to be included will be limitations on parks, cemeteries, athletic fields, and, of course, golf courses, for human consumption will preclude all sorts of "non-essential" demands for this most precious resource, water.

The following pages are prepared to offer suggestions that, hopefully, will be beneficial to any of those agencies who have not yet experienced the trauma of being "caught in a drought."

Irrigation designers' responsibilities

It has been said that the irrigation designers who employ their services in the southwestern parts of this country have more lucidity

than those designers in the balance of the nation. This statement may be fact or fiction. However, the independent, professional designers of this portion of the nation have, by need, become extremely knowledgeable in working to conditions of extreme heat, plant stress, limited water supply, excessive winds and the "Dries," that state of aridity that provokes the designer to overlook all spacing recommendations of heads as stipulated in the various equipment catalogues and to squeeze these outlets to proximities so close as to cause embarrassment to any respectable manufacturer. And yet, experience in the West has become the supreme dictator. And necessity has demanded that spacings of fifty percent of the diameter be established as the maximum norm.

Approximately six years ago my office had the opportunity of reviewing a set of irrigation drawings that had been prepared by a professional designer from the Midwest. When questioning why there were no part circle rotary heads used to protect the buildings, public walks and streets, the response was given that these surfaces are repeatedly wetted by summer rains so why protect them from artificial rain and it saves considerable amounts of money to eliminate the perimeter rows of heads.

This may be true but the prorated savings of both money and water, over the years, realized by only sprinkling in the planted areas will more than justify the initial cost of the additional heads and controls.

Further, in the Midwest and East and southern parts of the country, it is common practice that manufacturer's representatives, or distributors, act as irrigation designers supplying their drawings to the professional offices of architects, landscape architects, or engineers. With this concept in mind, each distributor/designer will attempt to make his "installed-cost" less than his competitor who may be also preparing drawings for the same site and to be delivered to the same professional office. As such, heads are spaced, or stretched, to their maximum or even beyond, part cir-

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cle heads eliminated and systems too heavily loaded to conserve on the control system. These practices cause severe wastage of water due to overspray and unwanted runoff on paved or structural surfaces and, secondly, through inefficient uniformity of distribution patterns. The latter causes severe over watering of some portions of the wetted pattern in order to successfully apply the proper amount of daily required precipitation to the thinner areas of coverage. This action repeated throughout a season of irrigation can cause considerable wastage of water and money.

Further, the responsibility of the head manufacturers should be addressed here. Several brand names of heads manufactured today provide a balanced precipitation between full circle heads and all arcs of the part circle heads of the same model number. However, many manufacturers still do not engineer their products to perform in this manner. They should, for many designers prefer to connect fulls and parts on the same valve and if the heads are not balanced the part circle heads, in many cases, can be delivering twice the amount of water, over their area of throw, as do the full heads. Here, again, this overwatering must be performed just to apply the proper amounts of precipitation in the areas of thinner coverage to be attained by the full circle heads.

Design challenges

Flooding and overwatering should not be tolerated by any designer, contractor, or owner. And this condition exists in the design of stationary shrub heads, stationary pop-up heads, and intermediate throw heads as well as rotary heads. It will be better for all, when the manufacturers upgrade their standards of product design with an eye to potential drought conditions for the less water used is that same amount saved.

Runoff of excessively applied water on slopes is another fine example of poor design and/or lack of control on the part of the water manager of the site. This will be discussed later on in this article.

There are many authorities that advocate the shrinking of irrigated

areas of existing sites, as golf courses and parks, in an effort to reduce water consumption. This includes additions, to these same sites, of hard surface areas by increasing sizes of parking lots and constructing tennis courts, handball courts, etc. Of course, the planted areas removed when using this water conservation method are so small that only a minimal savings could be effected in percentage to the whole. Others suggest cutting down great numbers of large trees to reduce their water consumption without realizing that mature trees take very little from surface water with the majority of their needs coming from deeper rootings into available ground water sources.

Great savings can be effected in many cases where shrubbery or ground covers blanket large areas of ornamental plantings. This can

Many manufacturers do not design their heads to provide a balanced precipitation between full circle and part circle heads of the same model number.

be realized by replacing existing overhead systems with drip (emitter) systems. It has been observed by some authorities that water usage by drip can be as low as forty percent of that delivered by conventional overhead systems. It must be noted, though, that emitter systems, unless totally buried, are extremely susceptible to destruction in public areas that are known to be vandal-prone. Drip systems also save on labor costs, as weed growth caused by airborne seed is not germinated by overhead watering.

The recommendation of some developers is that existing golf courses can save considerable water by reconstruction of the irrigation system to allow watering only on the "landing spots," greens, and tees. All fairways between the tee and the first landing spot or "target" would be left unwatered,

but left in mowed native grasses or ground covers. Then again from that green target all would be unwatered until the next target area, etc.

This, possibly, is a solution for a Pro-Course or any course on which the players are reasonably proficient at their game. In such cases the irrigation water required would be minimal and a great conservation readily realized.

However, such a course could never be anticipated as a Public Course where players of varying degrees of expertise will be using the site. For play would be extremely slow due to hookers, slicers, and random searching for short balls. And so municipal courses must, by the very essence of their purpose, remain as wall-to-wall turfed areas so designed to allow play from novices to proficient non-professionals.

This criteria must, by necessity, result in development of an irrigation system of overall coverage, thus from its very beginning must be considered as one of the enemy in the battle of water conservation.


Design resolutions

Resolutions must then be considered that will, during the design stages, weaken the appetite of this thirsty giant.

Thought must be given to applying a planting that will, under the local environmental atmosphere of the site, generate a hardy, durable, drought tolerant cover that will be resistant to the known seemingly intolerable plagues of nature that usually destroy a fine turf. Many of the states' Universities now have fine experimental test stations that have, for a number of years, been exploring hybrid types of various stands of cold and warm season turf grasses. These agencies are a readily available source of invaluable information and are extremely cooperative and happy to relate the results of their explorations and in a totally non-biased manner. More professionals should take advantage of this service.

Public (municipal) parks must also fall under the criteria of design as the municipal golf courses de-

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An aerial photograph of a lawn. A jagged, cracked line runs vertically along the right side of the image, separating a darker, smoother lawn area from a lighter, more textured area. Two people are kneeling on the lawn. One person, wearing a red sweater and light-colored pants, is on the left. The other person, wearing a white shirt, a blue cap, and light-colored pants, is on the right and is holding a white rectangular object, possibly a piece of paper or a small sign. The text "Are your present fungicides losing their edge?" is overlaid in white, bold, sans-serif font in the center-right area of the image.

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scribed above.

Other measures that result in a substantial water conservation, of any site, are discussed further on under water management.

Tensionmeters are another means of restraining excess precipitation. But, like a computer, they are only as accurate and meaningful as the water manager allows them to be. Many consider that the additive costs of maintenance required for servicing negates the use of these instruments. But, overall, it will be found that dollar volume savings for water use more than compensates for the time given for maintenance—if maintenance procedures are properly ordered.

If one considers using tensionmeters to measure soil water balances, the devices need not be installed at every control system but randomly spotted throughout the site and precisely in the known dryest locations. This will cause a slight overwatering of some areas, but will prevent burn, or dry out, of those known dry locations. Tensionmeter spot locations should be pinpointed only after exploration and experimentation on the site before a final "tuning" of the available soil is achieved. Once this has been accepted, from that time on, it becomes merely a matter of periodic readings and occasional servicing of the instrument.

Another method of reading soil moisture content is by use of the soils probe, or auger. Daily readings are taken and the observer then must communicate his recommendations to the irrigator, if it be a manually operated system, or to the control system operator, if it be an automatically controlled irrigation system. Each will then program into his specific schedule the amount of water to be applied that night. This daily reading habit is finely attuned for the utmost in water savings.

The final method of calculating daily water needs that will be discussed is the pan evaporation method. The pan to be described is not to be confused with the U.S. Weather Bureau—Class A evaporation pan, though, if in the vicinity of the site, the Class A pan can be referred to as a general source of information. However, if the latter

is to be used, adjustments must be made through experimentations of evapotranspiration requirements at the actual field level. The Weather Bureau pan is installed with the bottom of the pan above grade. This differs from the evaporation pan used for irrigation evapotranspiration rates. This pan is called the "Bureau of Plant Industry (BPI) Evaporation Pan." The BPI pan is six feet in diameter, twenty-four inches deep and is placed in the ground twenty-one inches deep. This pan offers a more accurate indication of evaporation at ground (turf) levels than the Class A pan. The BPI pan has an offset stilling well with integral device to accurately measure the periodical amount of evaporation. This pan (BPI) was developed by the Texas Board of Engineers in cooperation with the U.S. Department of Agriculture, Division of Irrigation, and the Texas Agricultural Experiment Station. It is advisable to install a chain link fence approximately ten feet square around the pan to prevent "unaccountable" water losses caused by bathing birds, thirsty rodents, cougars and/or coyotes. The enclosure should be eight feet high and screened across the top. This pan is used to determine irrigation needs by many agencies today throughout the U.S.A.

In California it can be taken that the number of inches of evaporation can be multiplied by a factor of seventy-five (percent), and the resultant figure is the precipitation that must be applied by artificial means to replace the soil water lost between the past reading and the most recent reading. This, then dictates the timing of irrigation cycles if the irrigation system precipitation rate, in inches per hour, be known. And it must be known if one is to properly manage the amounts of water delivered as related to the actual amounts required.

Other multipliers are given for other types of grasses being supplied with water. There have been a number of excellent, and authoritative papers prepared on the fine tuning of daily irrigation needs by the research teams at the experimental test stations previously

mentioned. Copies of these papers are usually provided free of charge to anyone asking. The Department of Plant Science, University of California, has on file a variety of these papers available to the public. Some especially prepared to assist turf owners in preparing for drought.

It was said, forty-five to fifty years ago,

"One inch per week
all over the ground
will grow healthy grass
the world around."

This was a totally unscientific assumption, but perhaps our fathers were more correct in their assumptive powers than many of us are today by using our "eyeball" method of determining the water needs. And fifty-two inches a year is an annual total and does not assist a manager in programming the daily water requirements. But the old adage is remarkably close, though perhaps a little on the high side.

Most managers, through attentive monitoring, can cut fifteen percent from their peak demand watering periods without altering any of the equipment in their present systems. Tests have proven this in Southern California on a park site located near a rather large lake. The annual evaporation near this lake is approximately fifty-two inches. The park managers have recorded application of irrigation, over a five year period, at approximately a thirty-eight inch per year average. Lake evaporation cannot be equated to the BPI pan evap but can be, generally, a good starting point if the pan installation is not available.

Other measures that can be taken are such things as:

1. Only water where and when needed.
2. Improvement of existing irrigation efficiencies.
3. Control of thatch.
4. Prevention of runoff during irrigation cycles.
5. Aeration.
6. Mowing heights.
7. Vertimowing.
8. Lessening of fertilizer applications.
9. Removal of weeds.
10. Application of soil

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