Automatic Irrigation and Conversion

by GEORGE RUDGE and RAY HANSEN

Water has become a critical and valuable resource in the United States. For the first time in our history many areas of the country which previously had ample water resources are experiencing water shortages with the accompanying regulations and restrictions imposed by federal and state agencies. New controls are being developed and implemented which will have far-reaching consequences for all of us.

During the drought period of the mid 1960's in the eastern part of the United States, it became painfully apparent that we must not take this valuable resource for granted. During this period golf courses were among the first to be affected by the stop-gap efforts to conserve water supplies. Some golf courses were restricted to minimal amounts of water for irrigation; others were entirely cut off from traditional sources of supply. There were cases of wells and pumping stations being seized under the right of eminent domain, with financial compensation paid to the courses.

The actions of many agencies during this period were harsh, unduly harsh in many cases. If we are to profit from past experiences we must study the lessons of this period and give full consideration to these lessons in planning and developing irrigation programs.

Many of the conditions which precipitated the water crisis still exist. Subsurface water tables have stabilized, but have shown no significant improvement. Additional reservoir capacity has been offset to a certain extent by increased consumption. The contribution of stream and river purification facilities is still to be realized. It is entirely possible that a crisis of the proportion of the mid 1960's can reoccur.

Practice Conservation

If our golf courses are to have access to the water they need for their survival, they must recognize their responsibilities and obligations to practice the conservation of water resources. In many areas of the country today it is necessary to secure the approval of a state water control agency before sufficient quantities of well water may be used by a golf course. Many of our states that face critical water problems recognize the conservation aspects of automation and are much more sympathetic to the requirements of golf courses and other recreational-type developments which use automatically controlled irrigation systems.

In addition to the problem of water supply, golf courses share a problem which plagues all of us — rising costs and labor availability. The cost of labor, equipment and materials will continue to increase. The availability of adequate, dependable labor is a continuing problem in golf course management. It will become more severe in the future.

Today we have an opportunity to exercise control of our spiraling irrigation costs and to fulfill our responsibilities for water conservation.

Automation of manual irrigation systems, or "conversion" as it is popularly known, offers many immediate and long-term benefits for the golf course. Unlike the system, the benefits are not automatic. Careful planning and proper execution of the plans are a prerequisite to these benefits.

Conversion of a manual irrigation system to fully automatic operation is not a step; it is a program. It is a program of many phases, and the immediate economies are but a portion of the ultimate benefit to be achieved.

Automation is not a panacea. It will not make an inadequate system adequate. It will not compensate for inherent faults or defects of the present system. The system must be capable of performing all the desired functions before automation, or the cost of automation must include the cost of correcting the deficiencies.

No longer do we look to the irrigation system solely for the distribution of supplemental water. Droughts, negligible amounts of beneficial rainfall, high humidity-high temperature conditions, have all played a part in placing more demands upon our irrigation facilities.

Uses of Irrigation

The irrigation system has been called upon to perform a wide range of functions in the past few years. Micro-climate control, that is using water to cool the atmosphere to decrease the transpiration rate of turfgrasses, and fertilizer injection are two of the more recent applications of properly engineered irrigation systems.

We are finding ourselves entering a period where greater demands will be placed upon the capabilities of the irrigation system. For these reasons, conversion to fully automatic operation must assume added significance in our overall turf program!

Arriving at a plan of conversion is a team function. The superintendent, the engineer, and the committee should develop a close working relationship so that maximum utility might be realized from the final system. Together, the superintendent and the engineer can begin developing and analyzing the data which is the basis for any good design.

The first phase of the conversion program should be a detailed analysis of water resources; terrain, soil, and topographical features of the course; pumping equipment and facilities; and piping, valves, and other appurtenances which form the system network. Always bear in mind that the assumptions which were the basis for the original system design may no longer be valid.

Phase one is the time for analysis and examination. Cost information involving labor, equipment, and operation should be developed. This will be the principal basis for judging the economic benefits of conversion and the type of automatic system to be designed.

It is important when considering the desirability of wells as a primary source of water, whether any restrictions have been imposed by state and/or federal agencies.

Use of Wells

Wells have long been used as the primary source of water in turf irrigation. In most areas of the United States, adequate volumes can be received, and the water available has not been contaminated by industrial and sewage effluents. Wells age and deteriorate just like the rest of us. The recovery rate should be tested biannually to determine that productive capacity and the recovery rate of the strata has not declined. This is a relatively simple test and can save a great deal of worry during peak use periods. It is also important to determine that the well, when drilled, was developed for maximum productive capacity.

In completing the evaluation of a well as our primary source of water, it is advisable to conduct a cost study of the entire source complex. This includes not only the cost of depreciation and maintenance of the well, but also pumping maintenance and depreciation cost for the equipment necessary to deliver the water to the irrigation system. These figures should be analyzed and evaluated to determine that maximum efficiency is being achieved in the pumping phase of the system.

Phase one of the conversion program developed the data concerning the course and the condition and cost of operation of the existing facilities. Phase two is the determination of the type of automatic system which best meets the requirements of the course, is compatible to the greatest possible extent with the existing facilities, and complements the overall turf program to the maximum degree.

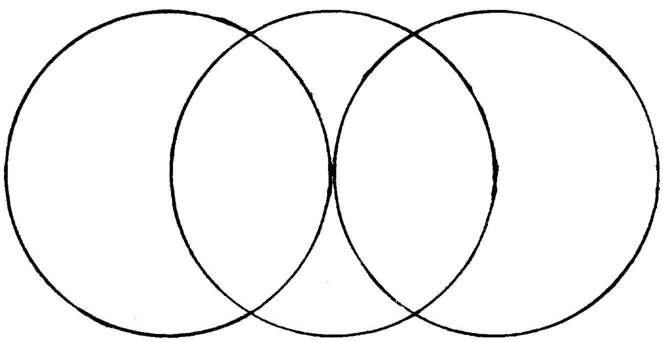
Presently, there are two options for consideration. The first is the single row automatic system. This system offers the same coverage pattern, precipitation rate, and overall water consumption rates as the existing manual system. Its principal benefits are a control of labor expense and a control of the operational time of the sprinklers. The cost of this conversion is relatively low, and disruption to playing facilities can be minimized through proper planning and coordination of construction activities. In most systems of this type the sprinkler head and automatic valve are located in the center of the fairway on the same riser. Electric wires or control tubing are run from the sprinkler-valve location down the center of the fairway to the controller to an electrical source such as the pumphouse, maintenance shop or clubhouse. The controller can be equipped to operate the pumps on a start-stop basis according to the pre-set irrigation schedule.

The Multi-Row System

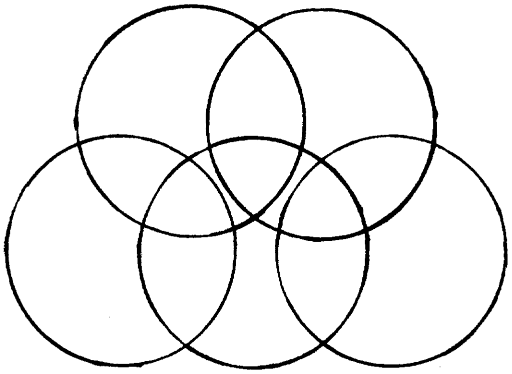
Usually several heads in different locations on the course are operated simultaneously from a single station on the controller. When this type operation is programmed extreme care should be taken to assure that the sprinklers are located in compatible areas. For instance, a sprinkler in a valley should not be combined with a sprinkler irrigating a hillside area. When combining sprinklers for a single station, slope areas should be combined with slope areas, valleys with valleys, etc., assuming that the soil, drainage and prevailing winds are similar.

The multi-row system is a much more definitive method for applying irrigation water. This system utilizes smaller sprinklers with a more efficient spacing and overlapping coverage to achieve greater uniformity in the distribution of the water. Two, and sometimes, three rows of smaller sprinklers are commonly used in this type system.

Exhibit I illustrates the general difference in coverage of a multi-row system and a single row system for the same area.



SINGLE ROW SYSTEM



MULTI-ROW SYSTEM

EXHIBIT I

The principal advantage of the multi-row system is a higher efficiency of distribution and consumption of water.

To illustrate, Exhibit II is a typical water distribution curve of sprinkler head performance.

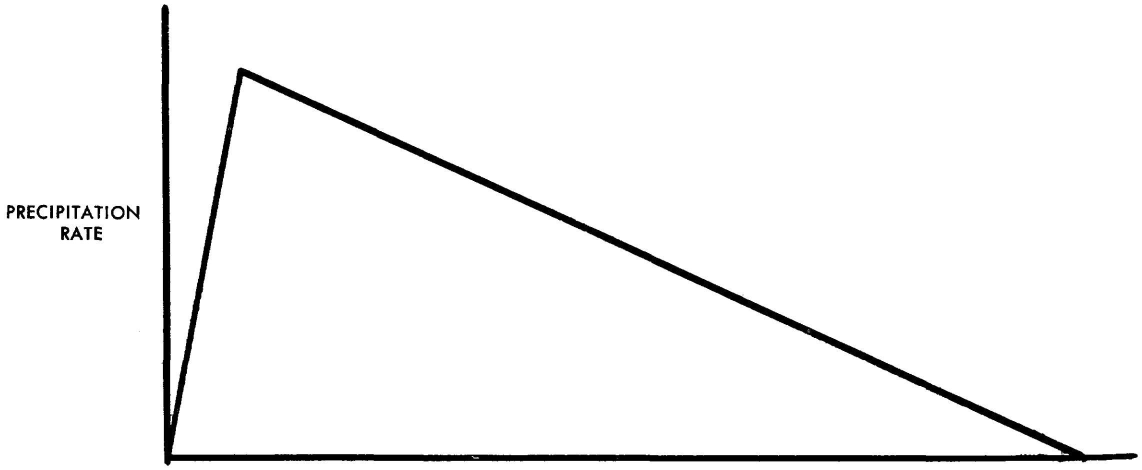
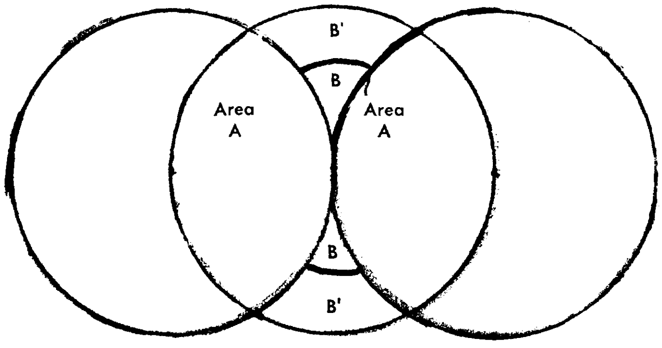
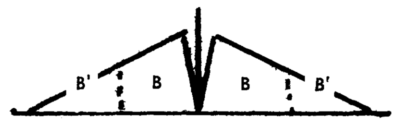


EXHIBIT II

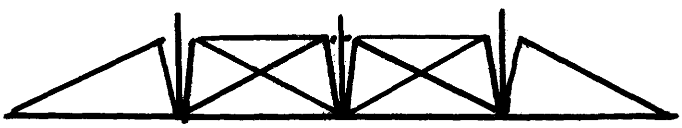
As you will note, the sprinkler distributes more water in the first half of the radius than in the second half of the radius. Because of this characteristic, it is necessary to overlap the sprinkler coverage to achieve an effective distribution of the water.

In a single row system, the water distribution pattern will correspond to Exhibit III.





TYPICAL WATER DISTRIBUTION. AREA B = B'



TYPICAL OVERLAP WATER DISTRIBUTION. PATTERN = AREA A

———— SPRINKLER DISTRIBUTION

– – – – – VOLUME OF WATER DISTRIBUTED

EXHIBIT III

Using a full radius overlap, which is common in single row design, it is apparent that Area A, (Exhibit III), in the system will receive twice as much water as Area B, (Exhibit III). When we consider this factor in conjunction with the distribution curve in Exhibit II, the following becomes apparent:

1) Area B comprises approximately 50 per cent of the course area, and receives only half as much water in a given time as Area A.
2) To provide sufficient water to Area B, Area A must be substantially overwatered.
3) The distribution curve in Exhibit II indicates that twice as much water is distributed in the first half of the radius as is distributed to the second half of the radius. In a single row system, the second half of the radius of coverage comprises approximately 25 per cent of the course area. Thus, if we consider these areas as A, B, and B', we find that in delivering sufficient water to Area A, Area B will receive only half the sufficient water and Area B' only a quarter of the water necessary. Should Area B determine the amount of water to be applied, Area A would receive twice the desired amount, and Area B' only half the desired amount. Most watering programs, consciously or unconsciously, gear their operation schedules to provide adequate water to maintain the fringe areas (Area B'), and as a result apply substantial quantities of excessive and unnecessary water to the center of fairway areas.

Thus, the inherent overwatering characteristics of the single row system result in excessive water consumption, inefficient water distribution, and higher costs in pumping and system capacity investment.

The distribution curve in Exhibit II is also typical of the sprinklers used in multi-row systems. The multi-row system, however, recognizes the characteristics of the sprinkler and compensates for its limitations by triangular spacing which offers a higher degree of uniformity and reduces the fringe areas from 25 per cent of the course area to 8 to 10 per cent of the course area.

The uniform distribution of water which can be achieved with a multi-row system will eliminate the necessity of overwatering 75 per cent of the course to provide sufficient

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water for fringe areas. Water consumption can thus be reduced by 40 per cent or more. The resultant savings in water and pumping costs are a continuous savings to the course year after year.

The determination of the type of system should entail careful consideration of water requirements for tree areas. (A mature tree 22 feet high with a 12-inch trunk will require approximately 250 gallons of water per day.) In order to maintain healthy turf in tree areas, provisions must be made to supply ample amounts of water to meet the tree's daily requirements.

Construction Phase

Phase III of our program is the construction phase, and the success of this phase of the project depends greatly upon the selection of the contractor.

A basic understanding must be reached between the engineer, superintendent and the contractor. Changes and improvements are invariably necessary once construction begins. Therefore, it is most important that the three principals involved have a complete understanding of their respective obligations, not only to each other, but primarily to the club and it's membership. Many of these elements will be covered in the contract, but it should be remembered that NO contract can cover ALL contingencies.

The membership should be made completely aware of what the conversion of the irrigation system will entail. They must be aware of the slight inconveniences they will be subjected to, and how they can cooperate so that the entire operation proceeds smoothly.

The location of the sprinkler heads and controllers is the initial step in the conversion program. The staking operation should be done by the contractor in complete coordination with the engineer and superintendent. This approach will insure a totally complete and workable system.

Controllers must be located so that the areas they operate can be visually observed from their vantage point. This is vital for such activities as syringing, watering in and application of chemicals, and the elimination of dew and frost.

Confining the installation to one, or a maximum of two holes at a time is mandatory. Adhering to this basic policy will provide efficiency as well as a minimum of inconvenience to the membership.

Modern Techniques Essential

The use of modern techniques and equipment is essential in the conversion of an irrigation system. Existing risers are tapped, the automatic valves are installed, and the pipe and wire are moled. The sprinkler heads are set and the wire splices are made. This is accomplished with very little disturbance to existing turf.

Daily records must be maintained. Any changes or modifications must be carefully noted so that a complete and accurate "as built" drawing can be compiled upon completion.

If the investment in automation is to bear fruit, each phase of the conversion program must be pursued with diligence. Analyze the existing facilities and conditions, plan the alterations with due consideration to the future, and execute your plans with qualified, knowledgeable engineers and competent contractors, and you will reap the full benefit of conversion.