indicate a 100 gram check to be the minimum amount even on a small lot of 5,000 pounds. On larger lots data would indicate that 25 grams should be examined for each 10,000 pounds of seed in the lot. For example, an 80,000 pound lot requires an examination of 8 x 25 grams or 200 grams of seed for the presence of undesirable contaminants. When subjected to these standards in the Seed Technology laboratory, over 50% of the lots offered to the trade as "POA ANNUA AND BENTGRASS FREE" are contaminated with serious problems.

Another important new development will be to make a seed count available for premium turfgrass seed. It is a relatively little known fact that there is a wide range of seed counts between varieties and a lesser range within a cultivar. For example, Merion and Common Kentucky bluegrass can run as high as 2,000,000 seeds per pound contrasted with approximately 1,000,000 seeds per pound for such elite varieties as Baron, Fylking, and Victa. Baron ranged from a high of 1,127,141 to a low of 948,987 equal to a 178,154 seed difference or 18.8%. An actual seed count on each lot could eliminate over or under seeding.

I would like to offer a word of caution. The lot number which appears on the test certificate must appear on each tag accompanying every bag of seed in the lot. Again, make certain when the seed arrives that every tag contains the same lot number. One single bag of another less desirable lot could be disastrous.

Looking into the crystal ball, you will soon be able to buy turfgrass seed lots which have been rated as to their performance potential. This concept goes much further than just determining whether a seed is alive or dead. This is the information given to you by the present germination percentage. The PERFORMANCE level (vigor) of a lot of seed is analogous to a young athlete and an old man — both alive, but their performance levels are quite different. Their seed counterparts would both be included as live seed in the germination percentage, but their performance levels would be quite different.

Seed Technology research has shown that seed with a high performance level will produce tillers and rhizomes at a rate of two to three times faster than the same variety seed with a low performance level. This could have great implication for sod growers because they could vastly increase their ability to produce and sell one sod crop per year by purchasing seed which has the high performance rating. Also, the performance of seed has an extremely important bearing on the seeding rate. When a lot has a high performance potential, you can seed at a lower rate and still get a good stand of vigorous seedlings, resulting in mature turf in less time.

Professional turf people who pride themselves on buying quality turfgrass seed will soon benefit from Seed Technology's new test series which will be used by certain quality seed suppliers. The outgrowth resulting from *Poa annua* checks based on 100 to 200 grams, seed counts per pound, bag identification and performance level testing is not yet commercially available, but look for it — IT'S NOT FAR OFF. All these developments are intended to do one thing — make it possible for people who desire quality turfgrass seed to be sure they are getting only the best available for their premium dollar, with no unwanted surprises.

Great Lakes courses serve 28 percent of nation's golfers

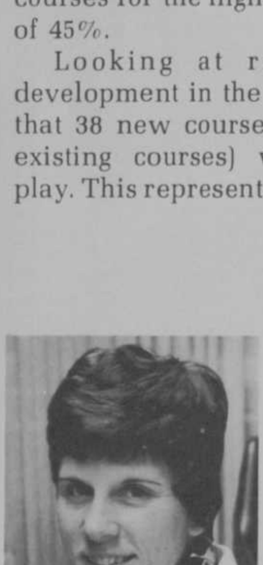
by Lorraine Abbott

Perhaps the most significant characteristic catching the astronautical eye as it scans our North American continent is a cluster of five great bodies of water known as the Great Lakes. Closest company to these life-giving resources are the states of Michigan, Ohio, Indiana, Illinois and Wisconsin. Add to this watery family its southern neighbor, Kentucky, and you have an area stretching 700 miles long and 600 miles wide — the region about which this story of golf will be told. It is a significant story in the American golf scene, for within its sprawling, river-cut boundaries lie close to 2,900 golf courses with over three-and-a-half million people frequenting their fairways. That's 23% and 28%, respectively, of our nation's totals — a formidable standing for an area representing only 12% of the United States.

The past decade has seen a healthy increase in numbers of courses. Between 1968 and 1978 there has been a 24.6% increase while total regional population grew only 4.6%. Michigan added the most courses with 167 (up 37.5%); Ohio added 93 (up 17.6%); Wisconsin increased by 83 (up nearly 30%); Illinois, 69 (up 15%); Indiana, 66 (up nearly 24%) and Kentucky, 50 courses for the highest growth, a jump of 45%.

Looking at regional course development in the past year we find that 38 new courses (or additions to existing courses) were opened for play. This represented over 26% of the national total. Michigan alone had 15 openings, ranking second in the nation behind Florida's 25. Ohio ranked fourth nationally with 10 openings and Illinois sixth with 8. Courses going under construction in the region last year numbered 22, with 24 more on the drawing board.

The outlook for this year and the immediate future projects a positive picture for the continued development of facilities. A review of NGF project files, representing on-going projects in various stages of development, reveals as of this writing a total of 55 courses under construction (40% of which are additions to existing facilities) and 88 courses in planning stages (44% additions). The majority of these are nine hole projects, with the most active states being Michigan, Ohio and Illinois.



Lorraine Abbott has been director of the NGF's Great Lakes Region since September. Director of Educational Services for the past three years, Abbott joined NGF in 1966 as educational consultant.

Rising taxes

Sometimes in larger metropolitan areas of the region a private operator is threatened by rising property taxes and/or the lure of real estate takeovers. In some instances, rather than lose the golf course, the municipality will step in to purchase the facility, with possible intent to lease it back for private operation. Such a move has occurred on 25 occasions during the past decade where NGF has been apprised. Perhaps equally as significant has been the strong will on the part of private operators of public courses to protect their investments by forming state associations for the purpose of generating new ideas and programs for more effective operations as well as for a show of strength in the eyes of legislators who may unknowingly impose unrealistic tax burdens on the owners. Such organizations are proving to be an asset to the growth and maintenance of that category of public golf which represents the greatest percentage of golf facilities in our region, and indeed in the country, today. To date, Michigan and Ohio have formed state associations.

The gesture of a municipal takeover where courses are relinquished by private enterprize indicates once again the value of golf to a community and the importance of retaining green belt areas for its welfare. Federal and state funding programs assist the golf course buyer/builder for this reason, as well as to preserve our land and water resources. Kentucky is a prime example of the latter, whereby its state parks system offers more than fifteen public golf courses, made possible in large part by land and water conservation grants.

With over one-fith of the nation's golf facilities housed in this six-state region it is not surprising to learn that of the 348 active certified golf course superintendents nationwide, 102 or well over one-fourth can be found here. In fact, Illinois leads all other states nationally with 32 CGCS personnel. A survey of a sampling of these provided information on climatic conditions and their effect on course maintenance in various parts of the region. Temperatures range widely here, with moderate to high humidity and precipitation throughout the year. Detroit reports that 34-36" is not unusual rainfall during a year. Winters stretch from December to March in most areas, with sub-zero mercury and deep, long-standing snow cover on many a day. Northeastern Illinois logged a record 114 days of snow cover this past winter, at times as much as 60" in Chicago. Southernmost state, Kentucky, on the other hand escaped the snow, suffering instead much rain, sleet and ice.

Climate

Our temperate-zone climate lends itself well to the cooler strains of blue- and bentgrasses. Most courses will maintain bluegrass fairways with either bluegrass or bentgrass tees and bentgrass on the greens. A few highly exclusive clubs will sport bent fairways as well, such as the prestigious Muirfield Village Golf Course in Dublin, Ohio. Roughs are generally composed of bluegrass and fescue. A milder climate prevailing in southern Illinois and Indiana will permit bermuda grasses and the increasingly popular zoysia to be sustained. Present but unwanted by most superintendents is the familiar *Poa annua*. Some tolerate it, others attempt to combat it, and in a few instances one will "join it".

Typical landscape of the Great Lakes Region includes gently rolling terrain and scenic tree cover. This is Cog Hill Golf & Country Club, Lemont, Illinois, owned and operated by Joe Jemsek.

Freshly constructed Hulman Links Golf Course in Terre Haute, Indiana represents a more southern part of the region.

Winter left much for Great Lakes turf managers to do this spring. Bob Williams, veteran superintendent in the Chicagoland area, reported large amounts of pink and grey snow mold damage to tees, greens and sodded areas. "The quick onset of winter brought a snow cover before the ground had the chance to freeze, resulting in a 'greenhouse effect' ", said Williams. "Many were caught without the opportunity to spray for the disease, and those who did spray still found the problem this spring." Dr. John Street, turf specialist at the University of Illinois, reinforced these remarks and added reports of winter kill downstate where turf was exposed to ice and freezing rain. Recovery has been slow due to an extremely cold spring in central and northern portions of the region, thus delaying the effects of treatment and growing weather until late May-early June. Frost was recorded as late as May 20 in northern Illinois.

Williams further reported the prevalance of insects and compaction in greater amounts this year — a situation remedied by frequent aeration to break up the topsoil. Overflowing rivers in the downstate flatlands of Illinois, Indiana and Ohio created much debris and ice damage. Tree and rodent damage were concerns in some areas.

By contrast, Kentucky experienced a relatively mild winter according to Thomas Stoker, manager of Louisville's nine municipal courses. "Our biggest problem wasn't from the weather", he replied, "but from damage caused by sledding".

Pests

Aside from winter snow mold in hard-hit areas this spring, turf diseases most frequently encountered throughout the region include Dollar Spot, Brown Patch, Fusarium Blight, Pythium and Leafspot. Insects and pests commanding the attention of many superintendents were reported to be cut worms, sod web worms, white grubs, moles, Bill Bugs, Cinch Bugs and the much talked about Ataenius Beetle — a major topic at the Chicago District Golf Association's spring greens seminar.

Curtailing the growth of crabgrass, goosegrass and once again, *Poa annua*, was an additional challenge mentioned by some superintendents. Good success was reported in treating for these diseases and pests through the use of contact and systemic fungicides and pesticides — both in wet and dry applications.

Budgets

Maintenance budgets reflect large amounts for chemicals in addition to fertilizers, water for irrigation, equipment repair/parts, and by no means least, labor costs. Labor is becoming an increasing problem for some municipalities. Louisville's Thomas Stoker points out, "Our biggest problem is trying to obtain good seasonal help. Funding has been reduced to where we can't afford the Federal minimum wage, although we do somewhat exceed that set up by the state."

Again, like many other regions, large metropolitan area courses are facing a major challenge in dealing with the increasing shortage and expense of water — so much so in the Chicagoland area that a research proj-

Convert to automatic irriga

ect has been launched to test the effects of recycled wastewater on local turfgrasses. Instrumental in the project are local chapters of the Golf Course Superintendent's Association, the Chicago District Golf Association and the University of Illinois, all working in cooperation with the Highland Park Sanitary District. If successful, the project will stimulate more districts in the 5-county area to consider a means of recyling their water for golf course irrigation. Such a move would not only better utilize this precious resource but would do so in a manner that may well reduce the expense of disposal while at the same time enable the municipality to comply with federal regulations for wastewater purification set by the Environmental Protection Agency.

As is typical for other regions of the country, budgets for maintenance range widely — from $75,000 to $125,000 in middlesize Springfield, Illinois to a range of $120,000 to $200,000 in metropolitan Detroit, and all points in between. According to Mark Hardyman of Muirfield, LTD in Dublin, Ohio, "A nice private club could range between $200,000 and $300,000; but most 18-hole courses average about $180,000, or $10,000 per hole." A survey of nineteen facilities in northern Illinois and Indiana showed maintenance budgets ranging between $82,000 and $230,000 with a median amount of $156,000. This survey also revealed a range in superintendent salaries from $14,000 to $38,000 with a median of $23,400. Seasonal help added to the crew varied from 3 to 20 workers, the median number being 6.

Maintenance

The barametric nature of maintenance costs has direct effect on the overall expense of course operation. This in turn will influence the level of greens fees for its players. "Golfer News," a popular northeastern Ohio newspaper based in Cleveland, reported that "Greens fees will be up at practically every golf course this year (1978) .... The trend has been for maintenance costs to take ever larger bites out of increased income. A five year comparison between 1972 and 1977 shows an increase of 41.9% in the maintenance costs per hole."

As reflected in a regional survey of GCSA chapter officers, specific maintenance practices vary according to the particular weather conditions of a given locale. Proximity to the Great Lakes brings cooler temperatures, and generally operators in far northern portions enjoy cooler summers than their southern counterparts. A digest of survey responses revealed some common practices, with their frequency varying according to a daily analysis of weather and course usage by the players.

Mowing programs were reported as 5-7 times a week on greens, 2-4 times weekly on tees, 3-4 times a week on fairways and once or twice weekly for rough. Topdressing is done periodically as needed throughout the season while major aerifying and fertilizing is generally done spring and fall. Depending on conditions, superintendents will overseed annually or bi-ennially. Constant watch for turf diseases and pests results in a carefully planned program of chemical applications based on preestablished formulae for prevention or cure of the infections.

Education

Each spring educational seminars

draw superintendents together to share information and learn better methods of taking care of their courses. Oscar Miles of Broadmoor Country Club in Indianapolis is presently researching a practice whereby his maintenance procedures will be determined solely by checking soil temperature each day. Bill Lyons of Lyons Den Golf in Canal Fulton, Ohio has developed a "Turf Testing Kit" to facilitate morning analysis of weather and turf conditions. Drs. William H. Daniel and Ray P. Freeborg of Purdue University have recently prepared a publication entitled, **Turf Manager's Handbook** detailing specifications for growing and maintaining all types of turfgrasses.

Earlier this spring while addressing a gathering of superintendents, Dr. Al Turgeon of the University of Illinois made a significant statement, declaring, "With all due respect to the farmers that plant and harvest, sustaining high quality turfgrass over a period of time is the most difficult technology demand in plant culture today. You, the superintendent, have the challenge to be a successful practioner."

The irrigation industry's answer to effluent water usage on turf grass

By John L. Brewer

The Irrigation Industry now has one of the biggest challenges it has ever had.

A commonly unrecognized fact that in excess of 70% of the water pumped in the U.S. is used for irrigation purposes precipitates a real challenge. Potable water once believed to be an inexhaustible supply is now a vanishing resource.

We have the challenge to explore all viable alternatives to reduce the use of fresh water. A solution to the challenge is to utilize effluent water whenever possible in irrigation systems. The challenge is to efficiently utilize this valuable by-product as a resource, not as a product for disposal.

The Irrigation Industry's attempts to efficiently utilize effluent water in turf grass irrigation systems have resulted in many less than satisfactory projects.

The irrigation community has not addressed itself to the fact that typical types of irrigation technologies and equipment used on fresh water irrigation projects may not always be effective when effluent water is utilized on turf grass.

Problems

The following problems must be recognized and dealt with to insure optimum benefits provided by effluent water usage.

Large sprinklers that "blast" water as far as possible are now typically used in single row turf irrigation system designs.

High sprinkler pressure and flow rates required to operate these "water cannons" compels the irrigation system designer to specify large horsepower pumps that are high in capital and consume excessive energy.

Large sprinklers require high pressures that:

Cause extremely high pressures to be experienced in the piping system, valves and sprinklers, increasing maintenance part and labor costs, and reduces product life.

Pressures of 6 times the working pressure can be experienced in the system because of water hammer. These pressures exceed maximum pressure ratings of irrigation products and will render them inoperative.

As an example, a slow closing gate valve can cause three times operating pressure to be experienced in the irrigation system. With the automatic control valves, 6 times the working pressure can be experienced in the irrigation system if the valve opens or closes rapidly.

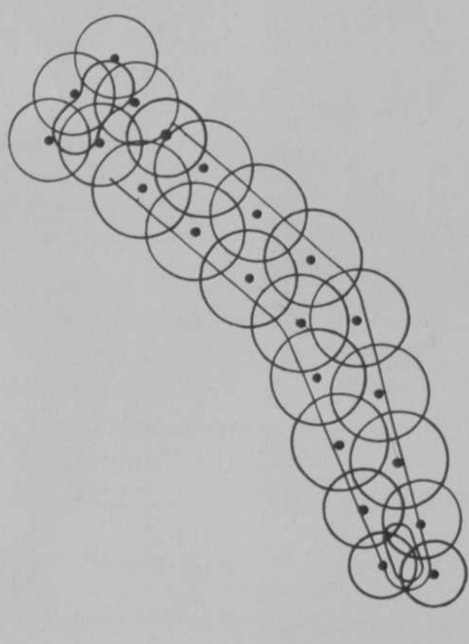
Pipe

The piping industry has a solution to this situation, and we would be wise to take heed and be aware of what may be a problem. "Pressure pipe" commonly used in irrigation systems has a safety rating of 2:1 or twice its maximum operating pressure.

If the irrigation system utilizes 160 psi pressure pipe, its safety rating is 320 psi. If the system pressure is 100 psi, the resultant water hammer pressures can reach 600 psi. Double the rating of the pipe in the system, over-stressing the capabilities of the piping system.

A pipe break experienced in a potable water project is annoying. A pipe break in an effluent project can be hazardous or disastrous.

To reduce this concern, "class" pipe should be used to insure the maximum protection against typical water hammer pressures. Class pipe has a safety factor of 4:1 or four times its rated pressure. If 160 psi pipe is used, the safety rating is 640 psi or above the water hammer pressures experienced.



Sprinklers

Large sprinklers are not always conducive to uniform application or lower rates of precipitation. Often times low precipitation rates and uniform application of water is essential to the correct operation of effluent water projects.

The high water pressure and high angles of trajectories required for proper operation of large sprinklers can create tremendous distortions of the water pattern and objectional wind drift.

Distorted water patterns and high rates of precipitation of water create overwatering and underwatering conditions within the area of coverage.

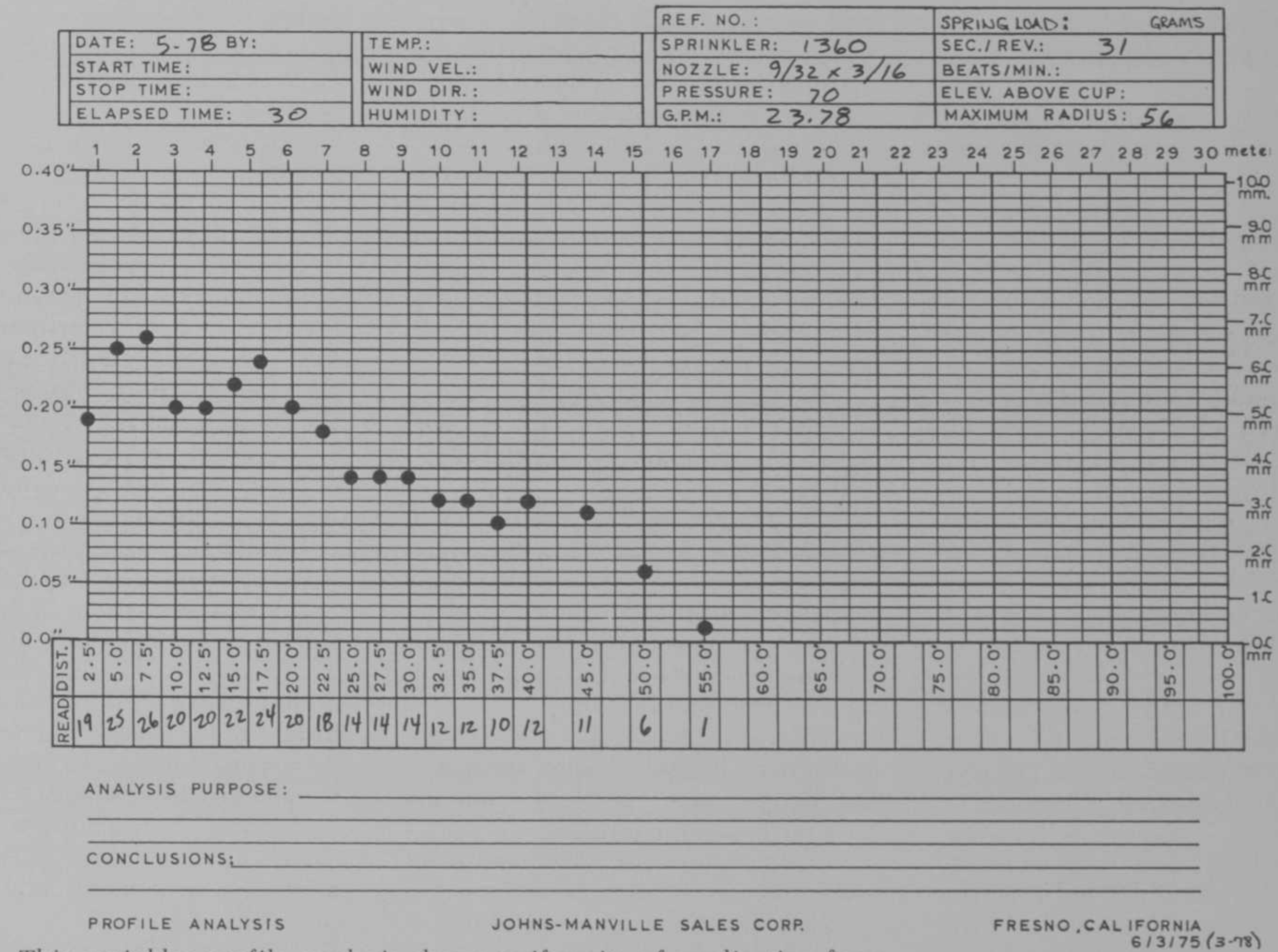
Soil compaction, effluent water runoff and puddling of water and nutrients will occur and will overload the soil and destroy the grass. An even more hazardous condition can be created if runoff of effluent flows onto adjacent property or streams or rivers.

A typical low pressure, double-row irrigation system required 40-60 psi at the base of the sprinkler with advantages over high pressure, single row systems of:

a. Lower capital cost for the pumping system.
b. Lower power and maintenance costs because of smaller pump horsepower requirement.
c. Lower water hammer pressure shocks on pipe, valves and sprinklers.
d. Larger water droplet sizes on low pressure systems are more effective against wind distortion than higher pressure systems.
e. Larger water droplet sizes resist wind drift more effectively than the small droplet sizes of the high pressure systems. Justification of the concerns created when wind drift of effluent is experienced is largely unproven.

Large sprinklers with 27° or 28° angles of trajectories aim water streams high into the air which increases the possibility of wind drift and distortion by wind. Greater levels of concern are created, the higher the effluent water stream is thrown into the air.

John L. Brewer is Market Manager for Buckner Irrigation Systems, Johns-Manville, in Fresno, Calif.



This sprinkler profile analysis shows uniformity of application for a particular sprinkler under a given set of conditions.

Uniformity

In the past, there has been little regard to uniform application of water within the turf grass irrigation system.

Spacings of sprinklers has been based solely on the percentage of their diameter as determined by each manufacturer.

This spacing generalization is based upon theoretical sprinkler profile patterns that were developed by Christensen in 1942.

Christensen's rule of thumb method of determining sprinkler spacing and resultant water uniformity was acceptable in the 1940's and 1950's when water and power costs were low and usage of effluent was at a minimum. In the 1960's and 1970's, the cost of water and power has increased phenomenally and usage of effluent water is booming.

Now there are new techniques of optimization of water applications in irrigation systems. One such method is the computer selection of sprinklers and optimization of sprinkler spacings. This analysis utilizes actual sprinkler profile performances obtained from sprinkler test facilities. Sprinklers are operated and actual sprinkler profiles (the amount of water deposited at different distances from the sprinkler) are obtained at the actual pressures and appropriate nozzle sizes required for the irrigation system.

The actual sprinkler profile data is input into a computer. The computer then simulates the overlap of water from the adjacent sprinklers in the system.

The reports generated provide data for the analysis to allow optimization of the uniform application of water.

The report is a summary of the actual performance data obtained from the tested sprinklers and indicates the performance of the sprinkler at the sprinkler spacings of interest to the end user. Included is the Sprinkler Spacing, sprinkler spacing as a percentage of the sprinkler diameter, Uniformity of Coefficient, Precipitation Rate in inches per hour and Water Accumulation times for each spacing for ⅛", ¼", ½", ¾" and 1" of accumulated water.

The Water Accumulation Table indicates catchments being spaced on a 2½ ft. grid. Each number indicates a single catchment with each number indicating the variance in accumulated water from the mean amount of water caught in the spacing. This report can be read similarly to a topographic map. The high numbers indicate the high concentrations of water application, i.e. mountains, the low numbers indicate the low areas of water or deserts.

Remember the goal is to use every square inch of the soil as a living filter and to insure that runoff will not occur. This cannot be accomplished if poor water distribution is experienced. Further analysis of the uniformity of the application of water can be made by reviewing a Histogram which is derived from the water accumulation quantities obtained in the water accumulation table.

Histogram analysis provides rapid visual indications of the uniformity of applied water within the sprinkler spacing.

Irrigation equipment proven dependable on fresh water irrigation systems is not always adaptable to effluent water projects.

Valves

Automatic control valves for irrigation usage have proven to be a concern and a problem where non-potable water is utilized. A typical problem experienced has been clogging of the small orifices in the control valves. Small particles of contaminants in the water eventually clog small orifices in the valves or valve-in-head sprinklers and render them inoperative.

Recent valve construction and design changes were made to eliminate the clogging problems experienced in automatic control valves.

Some recent valve design changes include:

1. Filtering out the contaminants that are in the water that flow through the valve control orfices.

   Some valve manufacturers provide small grit filters that filter the contaminants out of the water. These filters are used on 2-way solenoid control valves or 2-way valve-in-head sprinklers. Unfortunately, the design of the 2-way solenoid products are such that water flows through the small control ports as long as the solenoid is energized and the valves are open.

   Eventually the solenoid will be exposed to contaminants and clog, thus rendering the valve inoperative.

   If the valve or valve-in-head solenoid is energized for 4 hours a day, water and contaminants will flow through the small control ports for the time the valve is open, 4 hours.
2. One of the more effective methods of reducing the concerns associated with the non-performance of automatic control valves is to utilize three-way solenoid control valves.

   The three-way solenoid operated valves only let water in the small orfices when the valve is in the opening and closing modes. Thus, by reducing the amount of water flowing in the small ports, the probability of the valves clogging is reduced.

   For example, if the valve is open for four hours, the water flowing through the small ports is experienced for only 30-40 seconds.

Controls

Over the years, many types of automatic control sysstems have been developed to effectively irrigate golf courses. They were of the designs that eliminated or improved upon the manual operation of the irrigation systems. The performance requirements established for the golf course markets were broad in scope and could generally suffice.

These same systems are not sufficient when effluent water is utilized on turf grass projects.

Several aspects particular to effluent water utilization on turfgrass make the selection of the type of automatic system important.

Flexibility in both programming and operational characteristics is extremely important. Effluent utilization systems require exacting techniques to insure proper application of the effluent within the irrigation system.

Optimization of automatic controls for irrigation systems utilized on effluent water projects is essential to insure total control of the system, reliable performance and data accumulation for state and federal reporting requirements.

The following features and related benefits outline basic requirements established for effluent water projects:

Central control of golf course automatic systems is extremely beneficial utilizing effluent water because of the control capabilities provided.

Central control provides manual or automatic control of the complete golf course from one location.

Provides individual field controller irrigation start, stop, syringe or manual advance functions from the Central Processor location.

These features provide benefits of either complete automatic shut-down of the irrigation system or complete manual shut down of the system during inclement weather. Total system shut down is important to reduce the possibility of runoff of effluent into low areas or adjacent lakes or streams.

Provides capability of syringing dew or frost off of greens and/or tees.

Allows complete irrigation system start up before scheduled irrigation time to increase available water in extremely high temperatures and high turf stress situations.

Central control provides capabilities of automatic environmental control. Optional programmable automatic rain shut-down on a daily basis is extremely important to insure runoff of the effluent is not experienced. Display of daily rainfall amounts and yearly accumulated rainfall levels provides data often required to satisfy state and federal reporting requirements.

Optional wind direction and wind speed indicators connected to the central processor provide control of the irrigation systems in situations where wind direction and speeds create objectionable wind drift of the effluent into areas adjacent to the golf course.

The irrigation system can automatically switch the irrigation portion to a non-critical wind drift portion of the course until the wind direction and speed reduces below a programmable threshold. At this point, the system will automatically return to the original irrigation location and complete the scheduled time programmed on that location.

The field control units must have features for ease of operation, accurate timing, and flexible programming.

Ease of operation to allow use of the control system by all responsible personnel. A very complex programming system will not be utilized by all responsible personnel and too basic of a system will not provide the flexibility required to optimize the irrigation system.

Accurate timing features are mandatory to insure proper and consistent water application.

Under- or overwatering that results in effluent runoff or excessive turf stress will occur if inconsistent station timing is experienced.

Flexible field controller programming capabilities are mandatory to provide features such as:

Syringe for frost or dew removal to protect greens and tees.

Manual start to allow on-site starts for irrigation after fertilizing or additional irrigation in high turf stress periods.

Programmable skip days to stop the irrigation schedule from one up to nine days without reprogramming the field controller. After the number of omit days is completed, the program automatically resumes conserving time and elimininating effluent runoff.

Multiple station repeats will provide from zero to nine repeats to minimize runoff by applying small amounts of water more frequently with delays between applications.

Station repeats are ideal where heavy soils, slopes, low areas or seed germination is experienced.

Computed total irrigation time for an irrigation sequence for any day is valuable for reporting of total effluent water used. This is often required by state or federal water authorities.

With an appropriate rain collector connected to the field controller, the field controller has the capability of automatic shut down or yearly rain fall accumulation data that is extremely desirable for remote sections of the golf course.

In conclusion, since the concept of effluent water utilization on turf grass is a controversial subject, caution must be stressed when the project is in the design stage.

Present design concepts and product technologies utilized must be carefully scrutinized to optimize the system's operation, to minimize the concerns.