USGA® GREEN SECTION

Record

Volume 38, Number 1

January/February 2000

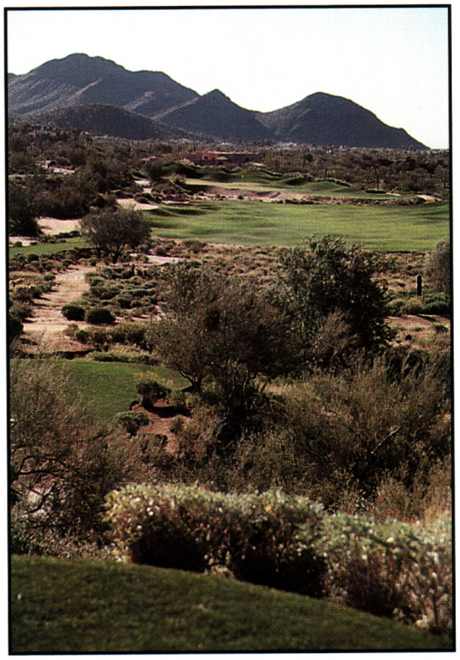
Fairway Overseeding

A PUBLICATION ON TURFGRASS MANAGEMENT BY THE UNITED STATES GOLF ASSOCIATION®

JANUARY/FEBRUARY 2000
Volume 38, Number 1

*Cover Photo:
Agronomic practices such as vertical mowing are instrumental in providing good seed/soil contact for establishment of the overseeding grasses.*

Scalped plugs can be avoided. Technique can make the difference. See page 6.



Getting everything you want is not going to fit into the day-to-day fluctuations of the golf course. See page 24.

USGA® GREEN SECTION
Record

Where concentrated cart traffic occurs due to bunkers, mounds, or trees, the bermudagrass will transition poorly.

Fairway Overseeding: Does It Make Dollars or Sense?

Objectively evaluating the impacts of fairway overseeding will determine if your course is ready to make the necessary sacrifices.

by BRIAN M. MALOY

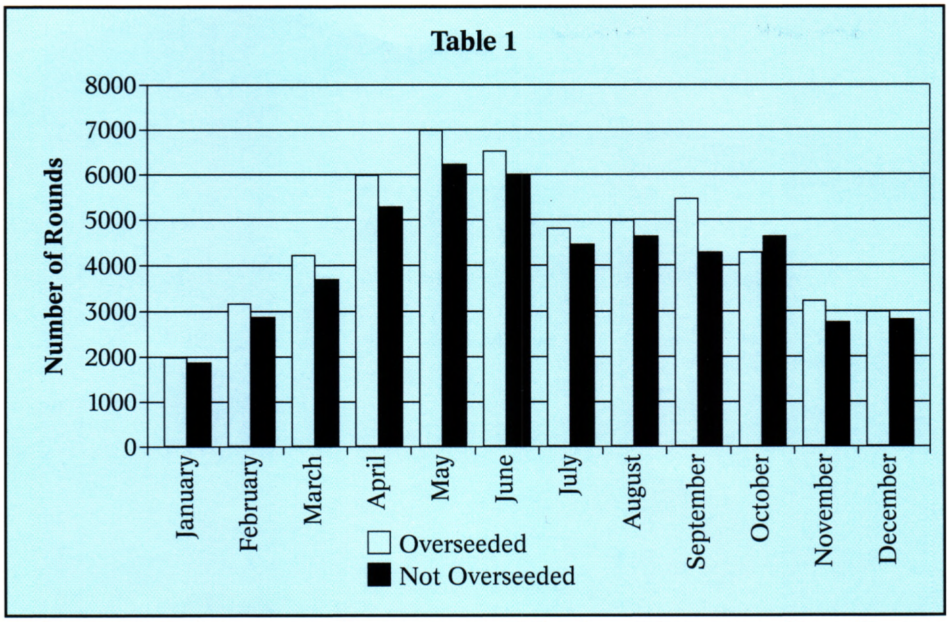
FAIRWAY OVERSEEDING is a practice that has become surrounded in controversy at many golf courses in the southern half of the United States, where bermudagrass is the dominant turfgrass species. The benefits of winter overseeding are of course widely publicized in popular golf magazines where advertisers make every effort to lure golfers to their courses with glossy pictures of emerald green fairways. Unfortunately, the side effects that become evident during the following summer season are rarely, if ever, advertised as they would send golfers running to neighboring courses that do not overseed their fairways.

The need to overseed is best determined by whether a course relies on making the bulk of its income during the cooler months of the year or the warmer months of the year. For example, there are many golf courses located in the southern states that typically receive the majority of their annual rounds between November and June by attracting seasonal residents, northern vacationers, and business travelers.

Courses that elect not to overseed their fairways generally are those with a majority of year-round residents who play all season long. Unfortunately, it is at these very courses that problems develop when a small group of golfers want the fairways to be green in winter and in perfect playing condition during the summer. Analyzing six common arguments used to promote fairway overseeding can reveal serious flaws, which, in turn, may change your mind on this topic.

Flawed Arguments

The first argument is that overseeding will increase the total number of rounds played throughout the year. This statement is rarely valid for crowded courses that generally find it impossible to squeeze another player onto the starter's sheet. A good case in



Indian Creek Golf Course, Dallas, Texas, tested the theory that overseeding will increase the total number of rounds played throughout the year. The overseeding did not create sufficient additional rounds of golf from October through March to warrant its expense. The length of day and climatic conditions had a greater impact on the number of rounds played.

point is Indian Creek Golf Course, which is a 36-hole facility in the Dallas metropolitan area. Given that there are two courses, they decided to test the argument by overseeding the fairways on one and not the other. As Table 1 reveals, there was no significant difference between the total number of rounds played at each of the two courses from October through March. In fact, the greatest difference in the totals was due to inclement weather and shorter days that affected the total number of rounds equally on both courses.

The second argument in favor of fairway overseeding is that it does not really cost as much as some experts say, leading to the conclusion that the practice should not be based on economics. Advocates of overseeding usually try to propose that the cost does not go beyond that of the seed, which ranges from $350 to $550 per acre. In reality, however, the total cost is much greater.

For most courses in the Southwest, the cost of overseeding ranges from $750 to $1,500 per acre since the seeding rates used are much higher. Additional costs to consider include the expense of water, fertilizer, equipment maintenance, fuel, and labor for additional mowing. Often overlooked costs are the need to purchase bermudagrass sod for areas that transition poorly the following summer and the purchase or rental of additional equipment to complete the process of overseeding.

The third argument for fairway overseeding is that the transition back to bermudagrass the following summer need not cause problems, as it can be successful if managed properly. Just ask any Green Section agronomist in a region where overseeding is practiced and he will tell you that the transition from perennial ryegrass to bermudagrass is rarely pretty. Transition problems are as much a part of overseeding as pain is a part of dental work. Further complicating the challenge of a smooth transition are the many new varieties of perennial ryegrass that have become more heat tolerant and, as a result, more persistent during early summer. This persistence increases the competition for space, nutrients, water, and sunlight between perennial ryegrass and bermudagrass, with the latter suffering long-term consequences.

Consider this analogy: Overseeding fairways at a rate of 400 pounds of seed per acre is equivalent to spreading 11 weed seeds per square inch across your home lawn and then expecting the bermudagrass to emerge unscathed the following spring. Now, raise the seeding rate to 1,000 pounds per acre as is done at desert southwest resort courses. Can you really believe that one turf species can be grown on top of another without causing problems?

The fourth argument is that fairway overseeding improves the winter survival of bermudagrass. This is not true, according to Dr. Robert Carrow, Professor of Turfgrass Stress Physiology at the University of Georgia. Bermudagrass under stress from competition has a lower percentage of stored carbohydrates, which in turn increases the percentage of water in the viable tissue. Hence, freezing temperatures below 10°F create ice crystals inside individual cells, causing their outer walls to burst open. In other words, the bermudagrass is more prone to the phenomenon of winterkill.

Dr. Carrow reports that some overseeded courses occasionally fare better when more irrigation is applied on the fairways. This reduces the potential of winter desiccation and/or may provide some insulation during short periods of extreme cold.

The fifth argument should receive little credence without a survey that accurately details the pros and cons of overseeding. Those with an agenda often say, "We've spoken with a majority of the membership and they want the course overseeded this winter." The first question that should come to mind is, "Were the individuals surveyed told that in many cases the true cost of overseeding exceeds $100,000 and that the condition of the course next summer will more than likely suffer as a result?" Odds are these details were kept secret.

To determine if the membership of The Country Club of North Carolina wanted the course overseeded, a survey was taken in 1989. The results showed that 14% of the members were in favor of overseeding, 54% were against overseeding, and 31% had no opinion. What is interesting is that the members favoring overseeding played just 2,000 rounds per year, whereas those against overseeding played 15,000 rounds per year, and those with no opinion played less than 3,000 rounds per year. As made evident by this survey, a decision to overseed fairways at a particular course may be more of a case of the squeaky wheel getting the grease than the actual desire of a majority of the membership. (Note: The Country Club of North Carolina currently overseeds 18 of 36 holes to satisfy all segments of the membership.)

Lastly, argument six: fairway overseeding will produce more so-called high-quality rounds. Depending on the seasonal use of a golf course, it is actually possible that overseeding can negatively affect the total number of high-quality rounds played. The result depends on (a) which seasons the majority of rounds are played, (b) the duration of normal bermudagrass dormancy, and (c) the duration and severity of disruption caused by the annual transition from perennial ryegrass to bermudagrass.

To analyze this situation, compare the two following courses with differing annual usage in the Green Section's Southwest Region. The first course is The Southern California Golf Association Members' Club at Rancho California (SCGA) located in Murrieta, California. This course is a daily-fee operation that has a loyal year-round clientele. The peak of the golfing year occurs between April and October (see Table 2) when the extended daylight hours allow SCGA members to enjoy the course. The second course is Sun City Vistoso Golf Club located in Tucson, Arizona. This course is host to a desert resort community where up to 60% of the golfers are temporary residents and the peak of the golfing year occurs between November and May (see Table 3).

Based on the following scenarios, winter overseeding affects each course quite differently:

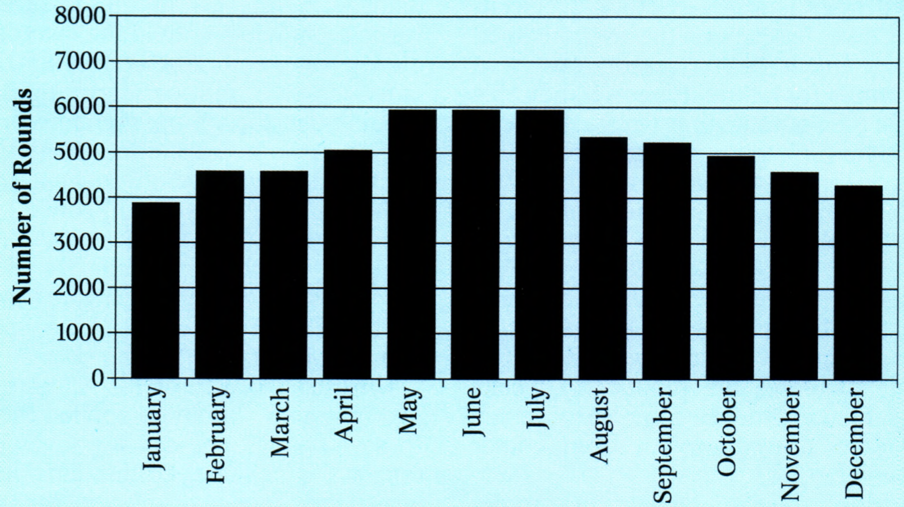
Scenario 1: Assumes overseeding is not practiced and that poor playing conditions are defined as dormant fairways from December through March.

Scenario 2: Assumes the course is closed during October to complete overseeding and that poor playing conditions are defined as immature, thin turf during November and December and July 15th through September, when the effects of transition occur.

To see how overseeding would serve the two courses differently, please note Table 4.

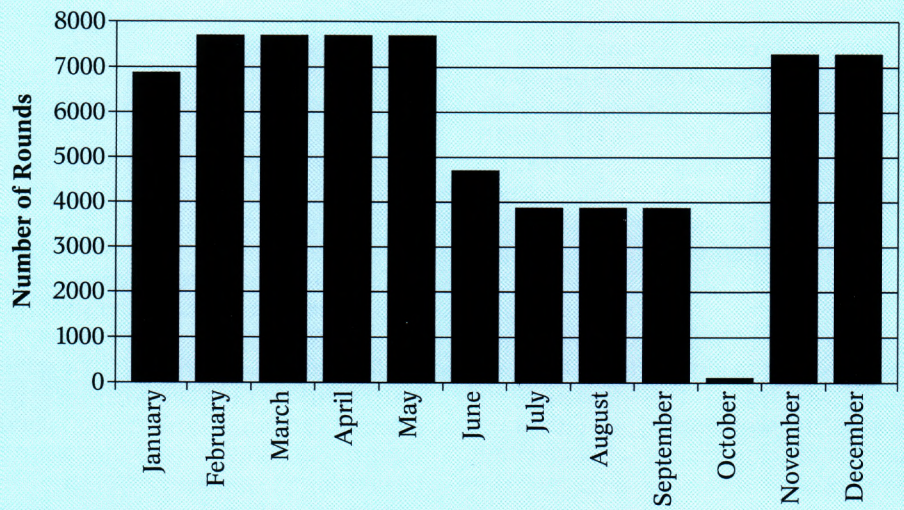
The quality and playability of the perennial ryegrass during the winter and the degree of disruption caused by the transition back to bermudagrass the following summer are the criteria used to judge the success of fairway overseeding. The whole process can best be described as a balancing act between the maintenance practices required for each of two turfgrass species. If overseeding is a sound decision for your course, you must have realistic expectations and understand that with the good comes some bad. Also, you must be aware that certain sacrifices will be required that ultimately interrupt course usage, increase operating

Table 2



The SCGA Members Club in California is an example of a facility that receives balanced year-round play. Spring, summer, and fall play is slightly higher than the winter months, with a total of 61,600 rounds for the year.

Table 3



The majority of the 70,000 annual rounds at Sun City Vistoso Golf Club in Arizona take place from November through May. During the shorter days of winter, two shotgun starts per day are required, five days per week.

Table 4

Example:	California		Arizona	
Overseeding Scenario	**#1**	**#2**	**#1**	**#2**
Rounds Played — Good Conditions	46,150	38,000	48,800	52,500
Rounds Played — Poor Conditions	15,450	18,600	26,200	17,500
Rounds Lost Annually	0	5,000	0	5,000

When analyzed quantitatively, the number of rounds played under good conditions justifies overseeding the Arizona course, but not the California course.

costs, and disrupt summer playing conditions.

Proper Timing — Setting overseeding dates based upon the last scheduled tournament of the season can be a formula for failure. Research indicates that the optimum time to establish seed is when soil temperatures are between 72°F and 78°F at a four-inch depth. This equates to air temperatures of between 60°F and 70°F at night and 80°F and 90°F during the day. Overseeding too early increases the potential of seedling diseases and bermudagrass competition, while overseeding too late increases the number of weeks required to produce complete coverage due to slowed growth from cooler temperatures.

Monitoring soil temperatures to determine the optimum planting date is far superior to blindly selecting a calendar date. Since this method is not entirely practical, selecting a calendar date based upon historical soil temperatures is the most common course of action.

Proper Seedbed Preparation — One of the greatest causes of a poor winter overseeding is improper seedbed preparation. Reducing the density of the bermudagrass canopy through moderate vertical mowing is important to allow good seed-to-soil contact. Vertical mowing is disruptive to play, but essential for success!

As the growth of bermudagrass slows in early fall, it begins storing carbohydrates that help it tolerate low temperatures and provide a source of energy to fuel spring green-up. If vertical mowing is done while daytime temperatures are above 85°F, the still actively growing bermudagrass will expend stored carbohydrates to immediately repair and recover from the damage. With this in mind, severe vertical mowing should be avoided during overseeding preparation because it will reduce bermudagrass hardiness in the spring, therefore producing a poor transition. (If excess thatch needs to be removed via aerification to make seed-to-soil contact, it should be scheduled at least 30 days prior to overseeding, while the bermudagrass is actively growing, to avoid spotty or blotchy results from seed germinating in open holes.)

Unrestricted Watering — After seeding, irrigation should be applied three to seven times per day for seven to ten days to facilitate germination. Here again, the practice of overseeding unavoidably disrupts playing conditions in the fall. Late evening watering must be avoided, since seedlings that remain wet all night often develop disease problems.

Irrigation System — All other factors being equal, the quality of overseeding depends largely on adequate quantities of uniformly distributed water applied frequently throughout the day. For a successful winter overseeding, it is imperative to have a state-of-the-art irrigation system capable of being programmed for repetitive watering cycles. Replacing a poor irrigation system to support the practice of overseeding usually costs in the neighborhood of $1,300,000.

Closing the Course — To produce optimum playing conditions from December through June, courses in the Desert Southwest typically will be closed for the month of October. This is essential because of the disruption caused by vertical mowing, seeding, and, most of all, frequent watering.

Traffic Control — The additional moisture needed for seed germination causes large wet areas that, when combined with cart traffic, cause significant soil compaction and physical seedling damage. For these reasons courses that close for less than 30 days should have continuous paths, enabling them to restrict cart traffic until the seedlings mature. If the course is not closed and traffic cannot be restricted, the quality of the overseeding will be greatly diminished.

Chemical Budget — Various herbicides and plant growth regulators, such as diquat, mefluidide, and maleic hydrazide, have been used with mixed results to reduce bermudagrass growth or desiccate its foliage to reduce vertical mowing requirements. Most recently, trinexapac-ethyl has been shown to effectively reduce bermudagrass growth with less severe side effects. Although the purpose of the trinexapac-ethyl application is to reduce bermudagrass growth during seed germination, it can also increase density. Therefore, vertical mowing is essential to encourage seed penetration into the canopy.

Seed Budget — Fungicide-treated seed is inexpensive, and it is the best insurance against seedling diseases. This is particularly important for courses that are located in areas with high humidity and precipitation. Having the seed treated will increase its cost by just 5¢ per pound or $2.50 per bag.

Equipment Budget — Mowers must be maintained with razor-sharp reels to prevent pulling up developing seedlings or producing a ragged cut on mature turf. Cool-season grasses used for overseeding perform best when maintained with lightweight mowers to reduce wear and tear on turning areas on fairways. Heavy-duty mowing units are needed for overseeding, scalping preparation, and to effectively penetrate an actively growing bermudagrass canopy to reduce thatch development. Rotary mowing equipment is necessary to produce the highest quality overseeded roughs during winter. To avoid serious scalping of bermudagrass roughs during the summer, reel-type mowing equipment is required. In essence, two complete mowing equipment inventories are needed to provide optimum winter and summer conditions when maintaining both cool-season and warm-season grasses.

Seedbed preparation during overseeding creates a dusty working envi-

Most golfers prefer the dark green color of perennial ryegrass. Unfortunately, due to the improved heat tolerance of the perennial ryegrasses, they compete with the bermudagrass base longer into the summer season.

ronment that can damage equipment. Hydraulic oil coolers, radiators, and air filters become plugged with debris, causing overheating and severe mechanical wear. This increased wear, combined with the additional winter mowing requirements, shortens the useful life expectancy of equipment by 15% to 20%.

Species Selection — Blends of improved perennial ryegrasses typically are used for overseeding due to their rapid germination and establishment rates and dark green color. *Poa trivialis* use is reserved primarily for greens and occasionally tees in moderate climates where more serious transition problems are likely to occur. The slower germination and establishment rates of *Poa trivialis*, however, are found to be undesirable when compared to perennial ryegrass. Fine fescues also have been tried for overseeding, but they cannot match the density and color provided by perennial ryegrass. More recently, research is focusing on developing intermediate ryegrasses that lack the ability to persist into the heat of summer.

Seeding Rate — The normal rate for fairway overseeding ranges from 400 to 600 pounds of perennial ryegrass per acre. It is not unusual, however, to hear reports of seeding rates as high as 800 to 1,100 pounds per acre in the Desert Southwest to improve early season density. Besides nearly doubling the seed cost per acre, these increased rates have a negative impact on bermudagrass the following summer.

Conclusion

Obviously, there are a number of factors that need to be considered in determining if fairway overseeding is appropriate for your facility. In fact, several sacrifices must be made by golfers in order to enjoy excellent overseeded fairways during the winter and spring. Failure to make the necessary concessions will result in an inferior fairway overseeding. More often than not, the difference between what the golfers expect and what can realistically be achieved will add up to disappointment.

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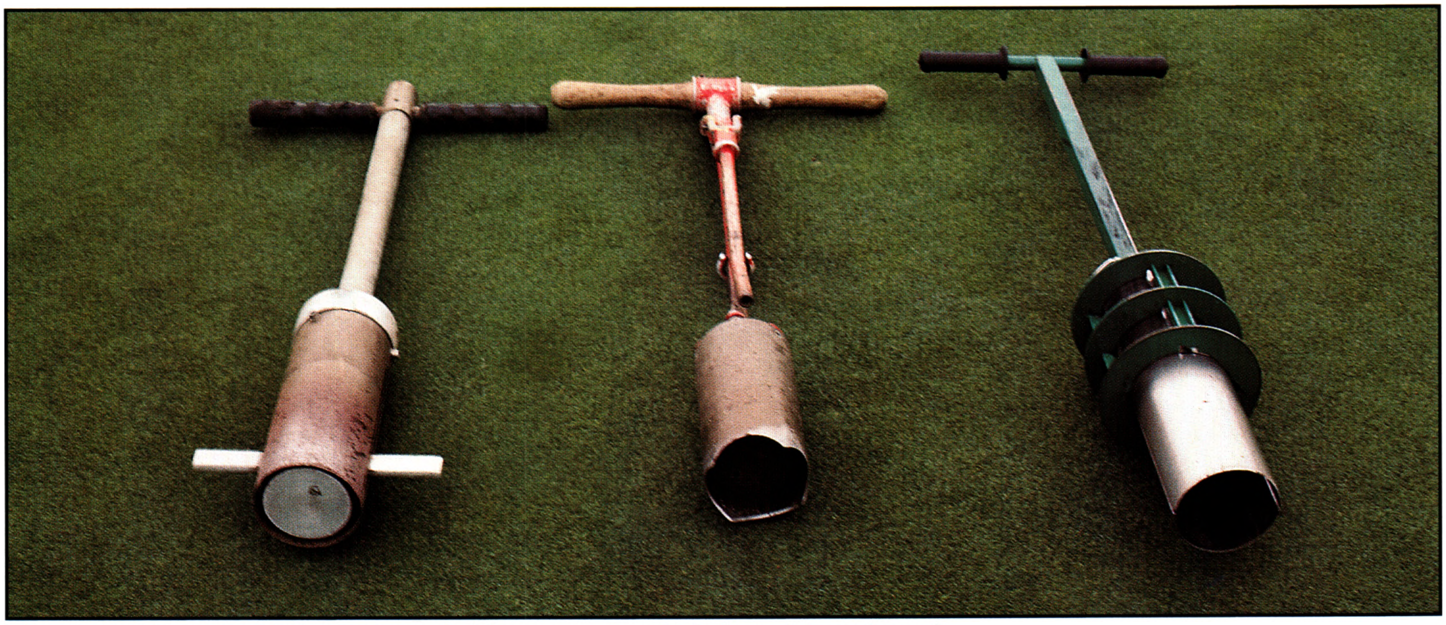
The overseeding grass in the rough was more competitive than at the lower height of cut in the fairways. As a result, the majority of the bermudagrass has been lost in the rough.

HOLE PLACEMENT

The art of cutting the hole.

by KEITH A. HAPP



There is a wide array of hole-cutting tools. The manner in which the task is performed is as important as properly preparing the tools before the first hole is cut.

MANY TOOLS are available to cut a new hole in a putting green surface. However, the manner in which this task is performed may be as important (if not more) as the equipment used. Although a great deal of effort goes into conditioning a putting green for play, arguably no element of putting green preparation may be as critical or as well scrutinized as the placement and installation of the hole. The fact that this task is performed so frequently places even more significance on the technique used. Although "practice makes perfect," there is, unfortunately, not much room for error on the putting green. Employing proper technique produces satisfactory results. This article will highlight the entire procedure by discussing each step.

Preparation

Before attempting to cut a new hole in a putting green, the tools must be prepared. For example, the hole-cutting tool *must* have sharp edges and the outer surfaces should be clean. This allows a sharp edge to be maintained when the hole plug is removed. Cleaning the outside edge of the hole-cutting tool also will help minimize heaving when the soil plug is removed. The diameter of the hole will be consistent from surface to surface, and the "volcano effect," which is often blamed for missed putts, can be avoided.

It is beneficial to have a working knowledge of the game of golf when identifying potential hole locations. Although there is no such thing as an illegal hole location, at times placement can be unfair. The slope of the location and the speed of the green often determine if a site is usable. A quick check can be performed by starting a golf ball rolling from above the hole. If the ball accelerates (due to gravitational force) as it passes the hole, the location may be unsuitable for use.

A rule of thumb is to position the hole in the center of a 3-foot diameter area that is on the same plane. As stated in Decision 16/6 of the Rules of Golf, when cutting a hole on a slope, the hole should be cut vertically, regardless of slope. It is not required that all points of the rim of the hole liner be equidistant from the surface of the green, but they should be at least one inch below the surface.

Cutting the Hole

When the hole location is determined, the cutting process can begin. A clean towel should be used throughout the entire hole-changing process. Positioning the towel on the turf and placing the tools on the towel will greatly reduce the potential for turf damage from oil, dirt, or other debris.

The hole shall be 4.25 inches in diameter and at least 4 inches deep. If a liner is used, it shall be sunk at least one inch below the putting green surface unless the nature of the soil makes it impractical to do so. Fitting the hole-cutting tool with a level indicator will help to ensure that the hole is cut properly. A level indicator becomes increasingly more important when holes are cut in heavy soils. Several cuts may be needed to obtain the necessary hole depth. Depending on the tool used, the plug can be removed in sections or all at once.

Inserting the Liner

Once the hole is cut, the hole liner can be inserted. Exercise caution when this is performed. First, wipe the outer side of the hole liner clean of debris. As the liner is inserted, do not damage

Resist the temptation to exert abnormal force when setting the hole liner. The area near the new hole location can be easily damaged.

the edges of the new hole. Insert the liner halfway into the hole and then place the liner-setting tool into the top of the liner. Before the liner is pressed into the hole, turn the setting tool at least 180 degrees to make sure it fits properly. Then, slowly but firmly press the liner into the freshly cut hole until the setting device contacts the putting surface. There is no need to exert abnormal or excessive force when setting the hole liner. Hammering or jumping on the device many only serve to damage the immediate area around the new hole location. Once the liner is properly positioned, remove the setting device by first twisting it 180 degrees and then lifting vertically.

Replacing the Hole Plug

The next step is to fill the old hole with the freshly removed sod/soil plug. Consistent hole depth is key to the easy replacement of the plug. If hole depth varies, the replaced plugs can be scalped or else sink below the surface of the green.

Begin by examining the root depth of the sod/soil plug. Many times, especially at the end of the summer, turf roots become weak and do not hold the soil profile together. Soil must then be placed in the old hole and repacked prior to inserting the sod plug. Many times, turf managers opt to completely replace poor soils with a modified mix of sand and organic matter.

Once the soil is packed, the sod plug can be inserted into the hole. Prior to pressing the sod plug level with the surface, determine if soil must be added or removed. If the plug appears to be too high, remove some soil from the bottom of the hole. Resist the temptation to shave soil from the bottom of the sod plug. This can cause damage to the sod plug by removing viable roots. When the sod plug is fit properly into the hole, fold the outer edges of the plug under slightly so that when the plug is pressed into the soil profile the seams (the interface of the plug and the hole wall) will match. An ice pick, a long-bladed knife, or other piercing type of tool then can be used to knit the edges of the hole and the plug together.

The final step in the hole placement process is to moisten the plug and immediate area around the old hole with water. Moistening the plug minimizes shrinkage during harsh environmental conditions. Rewetting the plug also stimulates root growth, which is critical to the healing process. Another important aspect of using water to seal the plug is to help ensure that a level playing surface is created when the hole plug is reinserted. Wetting the plug creates a swelling effect. The plug can be leveled with little fear of it being scalped during the mowing process.

A towel or small cloth can be used to clean the flagpole before it is inserted into the hole liner. For special events, the interior edge of the soil profile above the hole liner can be painted so that it is more visible to the players as well as spectators. This is often performed for televised golf events. Specialized tools are available to complete this task.

Conclusion

Cutting a hole in a green is often looked upon as a menial task. However, in the game of golf the hole is the final destination, and if there is a flaw it will be noticed by all those who play the course. Those who consider cutting a hole in a green to be an art as well as a true science designate this element of daily course preparation to key employees. The science of this procedure comes when soils, water content, and root health are examined. For example, changing the hole on a daily basis provides the opportunity to implement integrated pest management strategies, if necessary. As with all facets of course preparation, attention to detail must be keen. Positioning and cutting the hole well is an essential ingredient to offer consistency from day to day.

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Wetting the plug will allow it to be leveled with a reduced chance of shrinkage or swelling. Moistening the plug greatly reduces the potential for scalping when mowing is performed.

TOMMY WITT PHOTO

HELP NEEDED: *Equipment Manager*

Training candidates to fill open positions in the golf turf industry.

by TINKER CLIFT

The shortage of students in the Turf Technician Specialization program is surprising in light of the high entry-level wages paid to graduates. For every graduating student, there are an estimated 10 to 15 positions as an equipment manager waiting to be filled.

ALL SUCCESSFUL golf course superintendents have one very important trait in common, and that is the ability to find and train good employees. Without good employees, the daily operation of the golf course would be paralyzed by individuals standing around waiting for direction or, worse yet, acting solely on their own accord.

One of the most difficult positions for golf course superintendents to fill is that of equipment manager. This individual is a key member of the staff and plays a central role in the daily operations of the golf course. Not only does this person maintain the equipment inventory in sound mechanical condition, but he or she plays an important role in the overall dynamics of the maintenance facility. Imagine a maintenance facility at 6:00 a.m. with a group of employees drinking their second cup of coffee while waiting for a disorganized equipment manager to adjust the fleet of walk-behind mowers. If it happens to be the morning of the club championship or another important golf event, the situation would best be described as a disaster.

In addition to keeping the equipment running smoothly, good equipment managers also provide strong leadership by maintaining high professional standards. The ability to lead by example is very important because the equipment manager's office is often situated in the middle of the maintenance facility where several times each day he or she is in direct contact with nearly every member of the maintenance staff. If the equipment manager has a habit of showing up late for work or has a general demeanor that is unproductive, the entire crew's attitude can quickly sour, and the subsequent condition of the course could decline.

Finding good equipment managers is usually very difficult because there are rarely more than one or two competent candidates in a local community. So scarce are the candidates that, in some instances, superintendents have found it necessary to coax equipment managers from other golf courses to apply for a vacant position even at the risk of damaging a long-term relationship with another superintendent.

Turfgrass Technician Specialization Program

In the fall of 1997, the Board of Directors of the Texas Turfgrass Association wrote a letter to the president of Texas State Technical College (Waco, Texas), requesting that the staff take action to fill the void in the job market for trained equipment managers. Upon receiving the request from golf turf industry leaders, Texas State Technical College added a Turfgrass Technician Specialization Program to the Golf Course and Turfgrass Management Technology curriculum. Students receive an associate's degree upon completion of this two-year program.

In May of 1998 several college representatives, including representatives from Texas State Technical College, met with members of the golf turf industry at the Golf Course Superintendents Association of America headquarters in Lawrence, Kansas. At this meeting an advisory council was formed to address the nationwide shortage of equipment managers.

The first task undertaken by the advisory council was to develop a skills requirement profile, learning objectives, and instructor profiles. Since the program at Texas State Technical College was already in place, the information developed by the advisory council was simply used to adjust the Turfgrass Technician Specialization Program.

The curriculum at Texas State Technical College was assembled after interviewing ten prominent equipment managers from across the state of Texas. During two days of intensive interviews, facilitators developed a list of valued skills for a person in this position.

Skills Requirement Profile

- Perform reel maintenance on mowing equipment.
- Operate all golf course equipment.
- Perform preventive maintenance on equipment.
- Repair golf course equipment.
- Interpret and maintain technical manuals.

• Order specialized parts and keep inventory records.

• Maintain accurate maintenance records.

• Maintain an equipment maintenance facility.

• Lead maintenance crew activities.

Additional skills not necessarily related to the completion of the equipment manager's specific job description also were identified as necessary and valued.

Valued Skills

• Management skills.

• Golf-specific skills that emphasize a basic understanding of the superintendent's role and course managerial structure, the game of golf, agronomy and horticulture, and the effects of agronomic practices on the game of golf.

• General education skills.

In developing a curriculum, Texas State Technical College also tried to keep the future of each student in mind by adding turfgrass science and golf course management to the list of required courses. The additional courses of study are intended to provide each graduate with an opportunity to accept a position as an assistant superintendent or superintendent, should an appropriate opportunity present itself.

At this time Texas State Technical College also offers an Associate of Applied Science Degree. As for the future, the College is in the process of establishing a one-year Certificate Program and getting it approved by the Texas Higher Education Coordinating Board.

Having a successful Turfgrass Technician Specialization Program requires a large pool of resources in terms of equipment teaching aids. To meet these demands, the college is grateful to several equipment manufacturers for their generous support. They, too, realize the need for well-trained equipment managers who are capable of maintaining and repairing an ever-growing list of sophisticated mowers and specialty inventory items.

To facilitate training on all outdoor power equipment, the Equipment and Engine Training Council and Texas State Technical College have joined forces. At present, the College has certified two instructors with the Equipment and Engine Training Council and is awaiting accreditation for the program.

With high entry-level wages brought on by a shortage of good equipment managers, it is surprising that there is a shortage of students in these training programs. Currently, approximately 20 students per year graduate from our program with an associate's degree. For every graduating student there are an estimated 10 to 15 jobs waiting to be filled. Perhaps the perception of being a low-paid, unappreciated golf course mechanic instead of a valued equipment manager is at least partially to blame.

A successful training program for equipment managers requires a large pool of equipment and teaching aids. To meet this requirement, Texas State Technical College has benefitted from the support of several equipment manufacturers and local dealerships.

As a group, the turf industry has done little in the way of addressing the perceived status of equipment managers. In response, Texas State Technical College and one major turf equipment manufacturer have put together a video that is distributed to high schools throughout Texas and military base transition offices. The objective of this video is to demonstrate the level of professionalism displayed by successful equipment managers.

Since the need for good equipment managers is a national problem, the solution must be addressed on a national scale. Every golf facility needs to recruit potential students in the local community and bring to their attention the opportunities available at colleges that offer legitimate educational programs. For a list of such colleges, contact the Golf Course Superintendents Association of America at 800-472-7878.

To afford students an opportunity to study at Texas State Technical College, scholarships and financial aid are available to qualified applicants. More than eight out of every ten students receive financial assistance at some level.

For The Future

The equipment manager of the future will need better skills to keep up with advancing technology. The extensive use of global positioning and computerization are on the horizon for turf machinery. Unfortunately, some turf machinery manufacturers have decided to withhold new technology from production because it would create problems that could not be easily solved in light of the shortage of qualified equipment managers.

Texas State Technical College is in a position to teach all of the new and emerging technology that turf machinery will be equipped with in the future. The College has electronics, laser, computer, and robotics technologies that boast reputations of excellence. In addition, there will also be top-notch programs for automotive and diesel technology.

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"Ground under repair" should be marked consistently throughout the course. When in doubt, miss on the no paint *side.*

DO YOU KNOW THE RULES?

You should. Here's why.

by R. A. (BOB) BRAME

THE RULES OF GOLF, as defined by the United States Golf Association and the Royal and Ancient Golf Club of St. Andrews, Scotland, provides uniformity in golf for all players everywhere. In fact, without the Rules, golf would not be golf. Although that may sound a bit melodramatic, it's true. When we fail to play by the Rules, the scores we shoot are worthless. The anchor or common denominator is lost. Clearly, it is not possible to play by the Rules if you don't know the Rules. While this applies to all golfers, an elevated importance exists for those who maintain the playing field. The golf course superintendent must know the Rules to prepare the course properly for play.

The most obvious tie between the Rules and maintenance is marking the golf course. It is impossible to properly mark out of bounds, water hazards, and ground under repair without carefully considering how the Rules will be administered. Ideally, the person interpreting the Rules or answering players' questions should take the lead in course marking. Often, this is the golf professional. However, the golf course superintendent is part of the team and should understand how marking impacts rulings. Once the initial marking has been defined, it is the maintenance staff that must keep the stakes in place and/or the lines freshly painted.

How about the ground under repair? If it is under repair, then repair it so the marking won't be permanent. Repairs should be made as quickly as possible so that white lines can be eliminated. Equally important, ground under repair should be marked consistently throughout the course. When in doubt, err on the side of no paint. Sprinkler heads, valve box covers, and open stone drainage trenches do not need to be marked as ground under repair. Relief is allowed without the presence of white paint.

"That's not a legal hole location," says the aggravated player as his ball rolls off the putting surface. What do the Rules say about hole locations? In reality, there are several factors to consider when determining a hole location, but if it is cut on the putting surface, it is legal.

Bunker raking and edging will impact rulings and, therefore, playability. Is the ball in the bunker or not? The actual mowing of greens also is important. It should be easy to determine when a ball is on the putting surface. Thus, a distinct edge/line should exist where the putting surface and collar come together. The examples could go on, but it should be clear that course maintenance and the Rules are inseparable.

It also should be recognized that a working knowledge of the Rules when playing golf will increase the superintendent's credibility. When players know the course is being maintained with the Rules in mind, their impression of the superintendent's professionalism will be elevated. Equally important, playing regularly allows communication and dialogue about course conditioning to occur on the golfers' level. If you struggle to break 110, take some lessons. The course is being maintained to play the game of golf. The superintendent's agronomic and Rules knowledge should combine with regular play of the golf course to offer golfers an enjoyable experience.

Take a Rules seminar or workshop every couple of years, and apply the Rules to course marking and maintenance. Use the proper terms — *flagstick*, not *pin* (despite the continued errors of television commentators); *bunker*, not *trap*; *through the green*, not *waste bunker* or *grass bunker*. Play the course you maintain once a week, if possible. Make it known that you understand how to play the game and that you appreciate the Rules, which make golf golf.

BOB BRAME *is the Director of the Green Section's North Central Region. He visits courses in Kentucky, Indiana, and Ohio. Don't talk about "pins" or "traps" during Bob's visit to your golf course.*

Effective Use of Seawater Irrigation on Turfgrass

This article is the second in a three-part series on water quality, the first of which appeared in the November/December 1999 issue.

by R. R. DUNCAN, R. N. CARROW, and MIKE HUCK

THE PROBLEM: Availability of adequate water in terms of quality and quantity will be the number-one issue affecting turfgrass management in the 21st century.

Global demand for fresh potable water is doubling every 20 years. Irrigated areas have increased about 1% per year worldwide during the 1990s. During the past 30 years, the population of the United States has increased 52% while total water use has increased 300%. Renewable water resources per person decreased 50% between 1960 and 1998 in the United States. Another 50% reduction is projected by 2025. By 2000, 20% of all U.S. communities will experience water shortages in the form of water rationing or short-term cutoffs. Competition for potable water will force turfgrass managers to search for alternative water resources — from recycled wastewater to seawater.

Water is available in many different forms. Seawater (34,486 ppm salt) encompasses 96.5% of the total global water supply (Gleick, 1993). Fresh water reserves total 2.5%. Groundwater, which makes up 1.7% of the total global water supply, includes 55% saline and 45% fresh water. A total of 30.1% of fresh water comes from the groundwater.

Lake water reserves (0.013% of total water resources) include 0.006% of total saline and 0.007% of fresh water. Swamp water (0.0008% of total water reserves), river flows (0.0002%), glaciers plus permanent snow cover (1.74%), and ground ice/permafrost (0.022%) account for the remaining global water reserves.

Crop plants normally utilize 40-45% of the water applied through irrigation, with the remaining 55-60% lost as runoff, deep percolation, or evaporation/evapotranspiration. Turfgrasses are probably slightly more efficient in water use than most crop plants due to greater canopy coverage of the soil and their perennial nature.

Water is available in many different forms. The ability to irrigate a golf course with seawater has long been a dream. This dream will soon become a reality as turfgrass-quality ecotypes of seashore paspalum tolerant to ocean-level salt concentrations become commercially available.

The Dilemma

Water quality and availability have a dramatic influence on site-specific turfgrass management strategies, regardless of whether salt-laden effluent (recycled water), ocean water, or blends of the two sources are used as the water source. Saltwater intrusion is a major concern in coastal areas (Newport, 1997; Todd, 1997). Water withdrawal from coastal groundwater can contribute to degradation of water and soil quality. Renewal time for groundwater resources is estimated at 300 years (Gleick, 1993).

Salinization of irrigated land occurs when dissolved salts accumulate in the upper soil layers on naturally saline lands, on lands with poor drainage, in arid/semi-arid regions, or on lands utilizing salt-laden effluent (recycled water). The percentage of irrigated lands affected by salinization includes 20-25% in the United States, 13% in Israel, 30-40% in Egypt, 15% in China, and 15-20% in Australia (Gleick, 1993). The use of highly saline irrigation water greatly enhances the potential to degrade soil by salinization unless definite construction and management practices are followed. Accumulation of excess total salts (salinization) and sodium (sodic soil formation) in the soil is more rapid as irrigation water quality declines. *The dilemma confronting turfgrass managers is how to effectively use water of poor quality without causing excessive salt problems that will result in substantial decline in turfgrass quality and performance.*

Potential climatic changes will complicate water and salt management. Possible climatic changes projected globally from increasing CO_2 atmospheric levels include:

- 2-5°C increase in temperature;
- 0- to 32-inch increase in sea level;
- Precipitation increase of 7-15%;
- Direct solar radiation change -10% to +10%; 5-10% evapotranspiration increase (Woodward, 1992).

These climatic changes will significantly affect turfgrass management in the 21st century. Because of these changes, most recreational turf will possibly be mandated to be irrigated with nonpotable resources (California Assembly Bill 174, Oct. 1991). Desalinization is one option as an alternative water resource, but cost comparisons and the volume of water produced are key considerations (California Coastal Commission, 1999).

Irrigating with Seawater

With the availability of ocean-level, salt-tolerant turf species, using seawater for irrigation becomes a viable option in turfgrass management. The focus of this article is to emphasize those critical issues that arise when this worst-case water option (i.e. seawater) is selected as the irrigation source. The basic principles are applicable to sites using salt-laden effluent.

Irrigating food crops, as well as turfgrass, with seawater requires that a number of basic guidelines be considered (Glenn et al., 1998):

1. Halophyte turfgrasses (salt-tolerant species such as seashore paspalum, saltgrass, or alkaligrass) and landscape plants should be planted.
2. Golf courses should be constructed on sandy, well-drained coastal sites for long-term sustainability.
3. Water should be available at sufficient volumes to leach salts, minimizing the concentration of salts in the rootzone and preventing dry down of the surface caused by evaporation and percolation. High leaching events are critical, and proper irrigation scheduling is essential to success. All irrigated areas on the golf course, including roughs, surrounds, and mounds must be managed as primary areas.
4. Salts must be removed by drainage systems and be properly disposed of to prevent contamination of any potable groundwater under the site and to prevent soil salinization.
5. The cost of pumping from wells near the ocean is increased due to increasing irrigation demands (for proper leaching). Minimal water lifting is required, which offsets some of those costs.
6. Coastal aquatic sites are impacted (especially saltwater intrusion) and should be carefully monitored.
7. Maintenance costs may be 50% higher than in non-salt affected areas because of continuous application of amendments to minimize salt buildup and corrosion damage to maintenance, irrigation, and other equipment, requiring more frequent replacement.
8. Highly trained turfgrass managers are necessary because of the site-specific complexity of the salt-related problems.
9. Unnecessary traffic on turf should be reduced or eliminated to (a) offset the lack of wear recovery caused by growth reduction resulting from salt stress and (b) avoid compacting saturated soils that are frequently irrigated to field capacity in order to promote leaching.

Pre-Construction Considerations

Grass Selection

As we enter the new millennium and potable water becomes a more scarce resource, continued development of salt-tolerant species (turfgrass, trees, ornamentals, and other landscape plants) will become increasingly important for all recreational landscapes, including golf courses. Research funded by the USGA has resulted in the development of high-quality, environmentally friendly and ocean level salt-tolerant seashore paspalum turfgrasses for use on greens, tees, fairways, and roughs. This grass currently provides a unique opportunity in temperate and tropical climates to utilize alternative water resources for irrigation. Additional research and breeding efforts to improve salt tolerance of cool-season species (some private companies have made this a priority) will extend alternative water use to northern climates.

Irrigation with ocean water (34,486 ppm salt), brackish water (at salt concentrations < 34,000 ppm), seawater blended with other nonpotable water resources, or salt-laden effluent is now feasible (Duncan and Carrow, 2000). The problem of saltwater intrusion into coastal aquifers that results in unintentional application of seawater onto golf courses, and coastal or lowland saltwater inundation from storm surges/salt deposition now can be addressed with the most salt-tolerant turfgrass (Carrow and Duncan, 1998). These extreme cases of the ultimate poor water quality require serious and diligent pre-construction, establishment, grow-in/post establishment considerations for successful turfgrass management. The site-specific nature of salinity-challenged environments causes the most complex and, often, most confusing situations involved in turfgrass management. Mistakes or omissions become readily apparent and amplified once the grass is planted and the turf responds to its environment.

Growth rates of all turfgrasses, including seashore paspalum, are reduced when exposed to increasing levels of salinity. Older bermudagrass (Tifway) and creeping bentgrass cultivars (Seaside, Seaside II, SR1020, and Mariner are better choices) will tolerate only about one-third ocean level salt, and therefore may be suitable for use with some effluent and/or brackish sources, depending on water quality. However, selected ecotypes of seashore paspalum can tolerate straight ocean water (TDS = 34,486 ppm salt, EC_w = 54 dSm^{-1}, SAR = 57.4 meq L^{-1}, Na = 10,556 ppm, Cl = 18,980 ppm, Mg = 1,304 ppm, Ca = 420 ppm, K = 390 ppm, SO_4 = 2,690 ppm, HCO_3 = 146 ppm). Landscape plants also must be able to tolerate high total salts and toxic Cl and Na levels. Careful planning and proper managment are the keys to success when using seawater for irrigation on turfgrass.

Water Quality Assessment

Monitor water quality by location and over time, especially if the source is brackish or the water is obtained from a well subjected to saltwater intrusion where the salt water retreats during wet periods or encroaches during dry periods. Intrusion of salt water into a well head can occur abruptly and, consequently, regularly scheduled water quality testing will be necessary. If salt-laden effluent is used directly or blended with seawater, quality should be monitored over time. Relatively inexpensive electrical conductivity meters can be easily used by turf managers for on-site monitoring of total salinity. Seawater drawn from wells may be influenced by local soil conditions, such as those exhibiting higher bicarbonates (HCO_3^-), or from excessive levels of other components, such as heavy metals or boron or extremely low pH (<5.0) conditions where Al or Mn levels might be extremely high. Knowledge of water constituents and their fluctuation over time is essential for making management decisions.

Commercially available, putting green quality seashore paspalum tolerates low mowing heights and ocean-level salt concentrations in the irrigation water.

The Irrigation System

Irrigation system design efficiency includes sprinkler head spacing for uniform coverage, nozzle size tailored to soil texture (percolation rate, e.g., fine-textured soils may require low application rates), and individual sprinkler head control to ensure flexible scheduling. Pulse irrigation is essential on soils with low infiltration and percolation or with poor or slow drainage characteristics since it can be difficult to effectively manage and match precipitation rates of large turf sprinklers to the infiltration rates in these salt-challenged soils. Pulse irrigation provides water to the turf at a rate up to runoff and then stops to allow for infiltration/percolation, followed by repeated cycles. The intermittent application of water throughout a daily irrigation cycle via pulse irrigation provides for:

1. Maximum leaching of excess salts.
2. Minimal buildup of excess Na, which causes soil structural breakdown (sodic soil conditions).
3. Minimal bicarbonate precipitation and sealing at the surface of sandy soil profiles caused by light, frequent irrigation.

The number-one management requirement of all salt-affected turfgrass sites is leaching to remove excess salts or to prevent sodium and chloride accumulation. The leaching requirement (LR) is the quantity of water required to maintain a moist soil profile with consistent net downward movement of salts below the turfgrass rootzone that is over and above turf evapotranspiration (ET). Turfgrass ET can be high due to coastal winds or high temperatures, especially during establishment when soil evaporation is excessive. Total saltwater needs include LR + ET + correction for irrigation design inefficiency. Total water use could average 30-50% higher using ocean water compared to non-salt affected situations.

The additional volumes of water needed to leach salts delivered by seawater or other poor-quality recycled or brackish water can require special consideration when designing the hydraulic capacity of the irrigation system. Pipe sizes need to be increased to avoid excessive flow velocities that cause subsequent water hammer and fatiguing damage to PVC components. Inadequate pipe sizing will result in a longer window for total operating time, resulting in sprinklers operating before dusk and after dawn, interfering with both maintenance operations and golf play. A general rule of thumb when designing the irrigation system is that no greater than an 8-hour window of operation should be needed to irrigate the golf course at maximum ET while including the proper leaching fraction.

A "dual" mainline irrigation system to allow irrigation of salt-sensitive areas (cool-season grass putting greens, clubhouse landscape areas) with a better-quality water also is an option. Another alternative is a system of multiple storage lakes that allow blending of alternative water sources for leaching. Under either of these scenarios, reverse osmosis could be incorporated into the system to supply water for occasional leaching, blending, or management of salt-sensitive areas. Any of these options should be included in the design phase on a cost-effective basis.

A dual irrigation system would prove beneficial for:

1. Blending seawater with wastewater to dilute the total salts and high Na^+ levels (improve overall quality).
2. Irrigation of golf greens with reduced salt-laden sources (such as reverse-osmosis water).
3. Use of alternative water resources during periods of high volume leaching.
4. Application of fertilizer or other amendments through the irrigation system.

Desalinization is one option as an alternative water resource, but cost comparisons and volume of water produced are key considerations (California Coastal Commission, 1999).

Corrosion of irrigation hardware and other equipment exposed to ocean water also is a major concern and should be addressed within the design specifications. Plastic pipe and sprinklers are naturally preferred where feasible. Where steel components are normally specified, epoxy coating, high-grade stainless steel (Austenitic) or ductile iron fittings on PVC mains should be investigated for improved longevity and economic feasibility. Custom manufacturing using seawater-resistant nonferrous metal blends and marine or reclaimed water grade equipment and paint also may be options for consideration. Components exposed to salty sprinkler spray (wetting and drying cycles) will deteriorate more rapidly than those that are always submerged. Items such as controller cabinets should be manufactured from stainless steel or plastic and be maintained in a relatively watertight condition to inhibit corrosion of internal electrical components and connections. It also is imperative that all buried wiring splices are made with the highest-quality waterproof-type connections. Another option would be to install a radio-operated control system (such as OSMAC from Toro and FREEDOM from Rainbird) that eliminates the need for hard wiring of a low-voltage signal loop between the computer central control and the satellites. This type of system would eliminate a number of additional and potentially troublesome electrical connections that are prone to failure under highly saline conditions.

Highly sandy soils are very desirable since leaching is much easier on sands compared to fine-textured soils that have lower infiltration/percolation/drainage rates. Additionally, sandy soils that drain more rapidly will return to playable conditions in less time following leaching and will resist compaction from maintenance equipment and other traffic when wet. Continuous paved cart paths and cart restrictions on the turf also are recommended to minimize traffic damage from stresses due to:

1. The reduction of turf growth and recovery from wear caused by salt accumulation.

2. Excess compaction when traffic occurs on saturated soils following regular leaching events.

Salt Disposal

The golf course design must include plans for environmentally sound disposal of leached salts (and/or brine if reverse osmosis is used) when seawater is to be used for irrigation. The primary considerations involve:

1. Avoidance of salt accumulation below the turfgrass rootzone in an increasingly concentrated form. Eventually, this zone of salt accumulation will rise to the soil surface and cause catastrophic injury to all plants and their root systems.

2. Prevention of leachate or salt seepage into a potable water source or freshwater off-site area, or contamination by saltwater intrusion due to excessive removal from the good water source.

Both considerations involve proper land surface contouring and adequate deep-tile drainage lines (3-5 feet) with outlets either directly into the ocean or into a carefully constructed and impervious well or holding pond. The 34,486 ppm of total salts in seawater is equivalent to 2,153 lbs. of salt per 1,000 square feet per foot of seawater applied. Deep coarse sands (>0.50 mm) with high percolation rates (>10 inches per hour) are strongly preferred when seawater is used for irrigation.

Long-Term Maintenance Costs

Seawater irrigation requires proactive management to minimize the constant threat of saline-sodic soil conditions and their resulting impact on turfgrass performance. Increased budgeting needs include:

1. Extra chemicals (gypsum, acids, lime, micronutrient fertilizers, highly soluble fertilizers) that will be needed continuously and periodically at high rates. Some of these added costs are offset by reduced needs for herbicides and other pesticides and a less expensive water source.

2. Cultivation equipment (both surface and subsurface types) to maintain water movement for efficient leaching of salts through soils. Fine-textured soils will require much more aggressive cultivation programs than sandy soils. The effectiveness of a cultivation operation is typically reduced by one-half on high-Na sites and cultivation frequency must be increased. Both deep (10-12 inches) and shallow (3-5 inches) aeration practices are essential for proper salt leaching. Deep-tine cultivators include Verti-drain, Soil Reliever, Aerway Slicer, and Deep-drill. The Yeager-Twose Turf Conditioner is less effective for deep cultivation (i.e. > 7 inches), but has excellent chemical injection capabilities (capable of applying 80-90 lbs. gypsum per 1,000 square feet at a 7- to 8-inch depth). The Hydroject units also can be used to enhance seawater irrigation percolation into the soil profile.

3. Extra irrigation equipment. The corrosive nature of the high salts in ocean water will require constant monitoring and more frequent replacement of certain components like sprinkler heads and irrigation pumps. Injector systems can occasionally be used to treat seawater. Acidification (H_2SO_4, N-phuric acid, or urea sulfuric acid, sulfur dioxide generator) to aid in the formation of gypsum ($CaSO_4$) in the soil by reaction with surface-applied lime ($CaCO_3$) is one method of supplying considerable Ca^{2+} to replace Na^+ on soil cation exchange sites (CEC). The excess Na combines with the available SO_4 from the acids to form Na_2SO_4, which then can be leached.

Another method of supplying high levels of Ca^{2+} ions to counter high Na^+ levels in seawater is a gypsum injector linked with the irrigation system. $CaCl_2$, $Ca(NO_3)_2$, or other highly soluble amendments can be added with this unit. Although seawater contains relatively low HCO_3^- (146 ppm), water that is pumped from ground wells near the ocean can occasionally contain levels exceeding 550 ppm, which would benefit from acidification to remove the excess bicarbonates. This removal releases the Ca and Mg in the water to counteract the excessive Na in the seawater. Additional lakes, pumps, and piping for blending, dual irrigation systems, and desalinization/reverse osmosis equipment will raise ongoing long-term maintenance costs.

4. Accelerated equipment replacement schedules for maintenance equipment and course accessories are commonly required on sites with saline irrigation sources. Daily exposure to salt-laden irrigation spray, exudation water, and runoff deteriorates metal components on mowing equipment, utility vehicles, and course accessories such as signs, benches, and ball-washers (much like the corrosion on automobiles in northern climates caused from salting and deicing highways). Undercoating and rustproofing treatment of undercarriages on all equipment is recommended. A potable water source also should be used when washing equipment after every use to slow the corrosion process.

5. *The turf manager must be well trained in order to maintain high-quality turf.* Salt-related problems are site-specific and very complex because of multiple environment/turf interactions.

Sand Capping and Drainage

If saline-sodic soil is dredged from an ocean bay and added as the topsoil for the turfgrass rootzone, several practices are suggested to alleviate the high total salts and excess Na that cause considerable soil structural deterioration:

1. Deep-tine (10-14 inches) aerate and apply 200-600 lbs. gypsum per 1,000 square feet to the soil surface and rototill into the top six inches. Higher rates may be needed for heavier clay soils.

2. Apply an additional 200 lbs. gypsum per 1,000 square feet to the surface and cap with two inches of coarse sand. Till into the top 1 or 2 inches of soil.

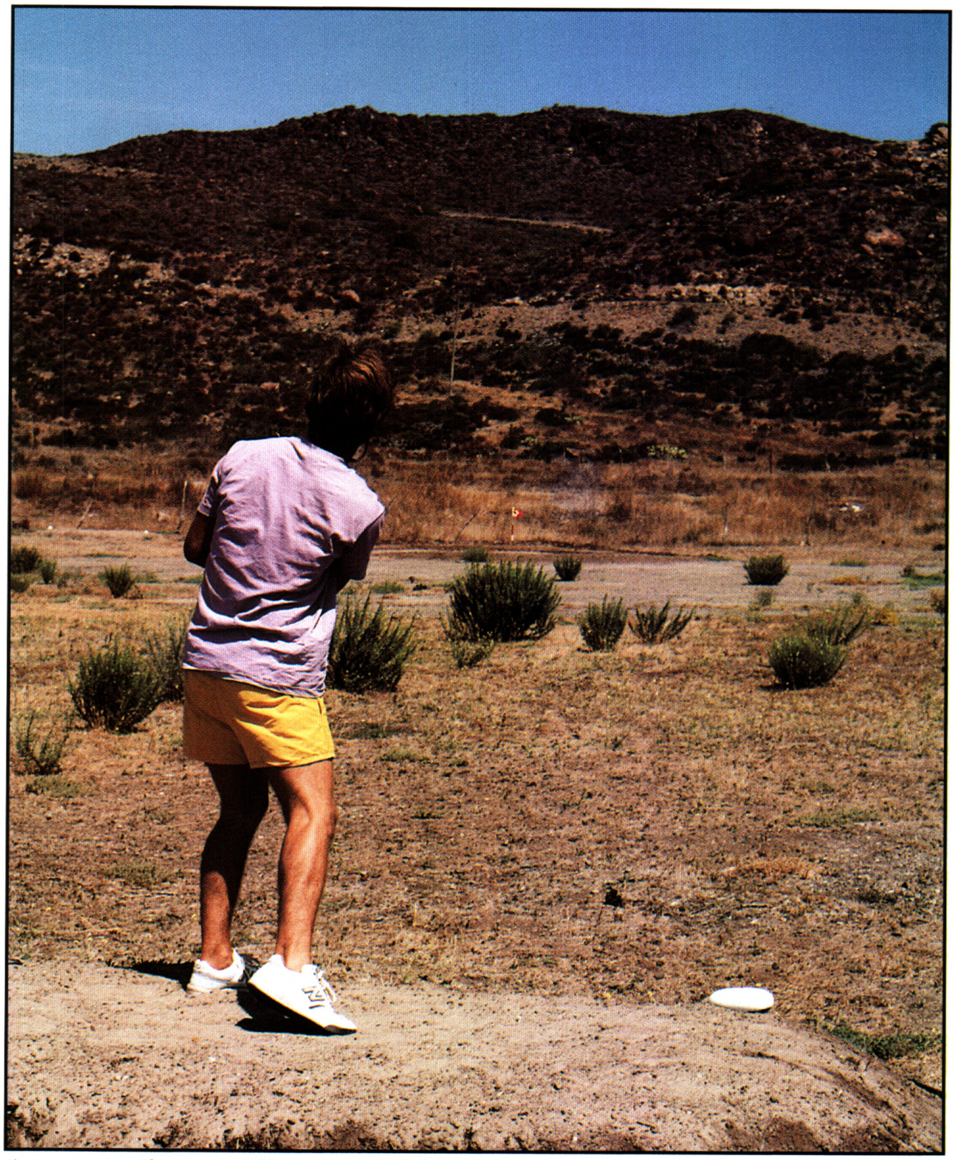
3. Cap with an additional six inches of coarse sand. The more coarse the sand (especially 0.5 to 1.0 mm range and none exceeding 2.0 mm), the better the rate of percolation and the faster the leaching with less volume of seawater irrigation. Coarse sand in the 1.0 to 2.0 mm range should probably not exceed 10-20% (by volume) of the total coarse sand to minimize damage to golf clubs and maintenance equipment.

If fine-textured soils that are high in silt and clay content have low infiltration and percolation rates, application of a 6- to 12-inch coarse sand layer (cap) over the existing soil will enhance the leaching effectiveness in the rootzone and help maintain water infiltration by reducing surface soil compaction. Incorporating 4-5% organic matter into the coarse sand prior to capping will (a) provide improved water-holding capacity, (b) help maintain a moist soil profile for a longer time frame compared to straight sand with no organic matter, and (c) minimize or slow down upward movement of salts concentrated below the rootzone when surface evaporation demands exceed seawater application rates.

Wind + high temperatures + exposed sandy surfaces during establishment and early grow-in can place very high evaporative demands on the overall turfgrass system. *Heavy leaching at night to keep the salts moving downward followed by periodic seawater applications during the heat of the day in an effort to maintain uniform soil moisture and prevent upward movement of concentrated salts are the key irrigation maintenance practices for successful establishment and grow-in of turf with seawater irrigation.*

One additional alternative — a fairway system with full drainage — could be considered. The concept involves creating the world's largest USGA green by letting the subsoil seal with excess Na^+ (creating a lake bottom) and installing a subsurface drainage system below the sand cap. The drainage system allows collection and disposal of the salt-laden drainage water, if engineered correctly, and also protects any potable groundwater or aquifers in the immediate area. Construction costs are initially higher, but savings in deep aeration, gypsum applications, and associated labor to perform these maintenance operations could conceivably pay for the drainage system over a six-year period.

For example, approximately 2,378 lbs. gypsum (23% Ca) per 1,000 square feet must be applied for every 12 inches of seawater irrigation to counter the high Na^+ concentration. In deep sands with < 2-3% silt and clay, the gypsum rate can be reduced by 50-70%. However, sand-capped sites still require the higher gypsum rates to maintain non-sodic conditions in the subsoil. For practical purposes, assume the golf course covers 100 acres and the gypsum costs $100 per ton, or about $2,178 per month (at 100 lbs. per 1,000 square feet per month, or about $5,180 per acre-foot of seawater). Assuming a 7,000-yard course and $6.00 per linear foot for solid perforated pipe including main drains and occasional drain basins, 30-foot lateral spacing would cost about $997,000 and 20-foot lateral spacing would cost about $1,432,800 initially for the fairway drainage. If the gypsum rates could be reduced to 50% for treating the sand cap (instead of keeping the subsoil draining) and utilizing subsurface drainage, the system could pay for itself relatively quickly. With heavy rains from monsoons, hurricanes, or tropical storms, this drainage system would be extremely beneficial for rapid removal of excess water.


As we enter the new millennium and fresh water becomes increasingly more scarce, alternative water supplies and salt-tolerant turfgrasses for golf become a much better option than the "other" alternative.

Establishment

All turfgrass and landscape plants are more sensitive to high-salt problems during initial root formation and early establishment. Besides the high-salt impact on the root system, the turfgrass growth rate will be reduced, prolonging the grow-in period. Additionally, salt accumulation on the soil surface occurs very rapidly when seawater is used for irrigation unless appropriate management practices are used. Proper management techniques can minimize the need for an expensive replanting. Factors to consider include:

1. *Reduction of total salts for establishment.* Seawater has a total salinity level of $EC_w = 54\ dSm^{-1}$. Total salts will only be reduced below 54 dSm^{-1} (a) after a heavy rainfall or prolonged rainy period, (b) by use of better-quality water sources (effluent, brackish, reverse-osmosis water), or (c) by blending with lower salt-containing water sources.

2. *Alleviation of Na-induced soil physical problems in the surface zone.*

Aggressive deep and shallow aeration, gypsum application, cultivation, topdressing, and leaching are key management options. Gypsum applications should always be made immediately following aeration to avoid creating a Na^+-affected layer deeper in the soil profile.

3. *Maintenance of a uniformly moist soil profile.* Preventing the soil surface EC_e from rising above 54 dSm^{-1} when seawater is the sole source of irrigation water will require:

(a) *Keeping the salts moving* — a continuous program of supplying sufficient water volume is necessary to maintain net downward movement of salts away from the rootzone and soil surface, and to prevent them from rising back up by capillary/absorptive water movement.

(b) *Maintaining moist soil profile conditions between irrigation events* so that salts do not concentrate in the soil solution or rise by capillary action from below the surface zone. *If the salts move down at EC_e = 54 dSm^{-1} and concentrate, high evaporation in sandy soils can bring the salts back to the surface at EC_e > 54 dSm^{-1} and kill the young turf seedlings.*

Light, frequent seawater irrigation at establishment or on mature turf without adequate leaching will result in rapid surface resalinization and subsequently lead to turfgrass failure even with the most tolerant turfgrass cultivars. Scheduling high leaching events at night will minimize competition from wind and the high evaporative daytime demands when using seawater. On sands, the nighttime leaching event should be sufficient to move surface salts (i.e. the wetting front in the soil profile) to at least 12 inches and on fine-textured soils to at least 16-20 inches depth. This will minimize capillary rise of more concentrated salts back to the surface and into the turfgrass rhizosphere. This heavy leaching event may be done over two nights on fine-textured soils if percolation rates are low. Seawater irrigation scheduling during the day should be frequent enough to maintain a continuous and uniformly moist soil profile with minimal surface drying. A monthly gypsum application of 100-200 lbs. per 1,000 square feet can be surface-applied as a sodic-soil preventative strategy when using seawater for irrigation.

4. *Adequate initial fertilization and careful monitoring of micronutrients with continuous leaching events.* A spoon-feeding approach (frequent applications, 1/10 to 1/2 rates) is necessary on seawater-irrigated sites, with total annual fertilizer nutrients applied at 1.5 to 2.0 times that used on areas irrigated with non-salt-laden water. While higher annual rates of fertilizer are required, the rates per application are similar to non-salt-affected sites, but the frequency is greater. Use of highly soluble fertilizers and fertigation through a well-designed irrigation system is very beneficial.

Adequate phosphorus (2-3 lbs. P_2O_5 per 1,000 square feet) should be applied to the surface at planting to promote establishment. Soil test analysis will reveal the need for additional nutrients in conjunction with nutrients supplied by the seawater. High leaching events can deplete micronutrient (Fe, Mn) levels, and careful monitoring is necessary on a continuous basis. Potassium, Ca, and Mg also are subject to leaching losses and should be monitored closely.

As the bermudagrass succumbs to high salt levels, seashore paspalum (lighter color) fills in the putting green.

Post-Establishment/Mature Turf

The use of seawater for turfgrass irrigation produces two very important results that significantly impact management strategies:

1. *Seawater supplies additional nutrients that require adjustment in fertilization protocols,* and chemicals that are applied to replace excess Na^+ on soil CEC sites necessitate additional nutritional adjustments (Table 1).

• *All ions in Table 1 contribute to overall high total salts,* with Na^+ and Cl^- ions contributing the most salts because of total quantity. As long as adequate irrigation water is applied, chloride is easily leached. Excess chloride can detrimentally affect nitrate uptake.

• *Excess Na^+ will rapidly cause a severe sodic-soil condition (soil structural deterioration) unless high quantities of Ca^{+2} ions are added* to replace Na^+ on the CEC sites and sufficient water is added to leach the ion away from the turfgrass root system. A sodic-soil situation is much more serious on fine-textured soils than on sands. At least 547 lbs. elemental Ca^{+2} per 1,000 square feet or 2,378 lbs. gypsum (23% Ca) per 1,000 square feet must be applied for every 12 inches of seawater irrigation to counter the high Na^+ concentration. In deep sands with < 2-3% silt and clay, the gypsum rate can be reduced by 50-70%. Sand-capped sites will still require the higher gypsum rates to maintain non-sodic conditions in the underlying soil, unless a complete subsurface drainage system has been included (discussed in sand-capping section).

• Additional highly soluble Ca sources could include $CaCl_2$ or $Ca(NO_3)_2$, which could be applied through injector systems. Lime ($CaCO_3$) can be applied to the soil to react with SO_4^{-2} in the seawater to form gypsum. Approximately 170 lbs. lime per 1,000 square feet per 12 inches seawater irrigation is needed to react with 168 lbs. SO_4^{-2} in the seawater.

• A 3:1 to 8:1 ratio of Ca:Mg is preferred in irrigation water. Ca deficiency may occur below 3:1 and Mg deficiency

Table 1
Quantity of nutrients applied with typical seawater irrigation

Ion	lbs./1,000 sq. ft. per 12 inches seawater	meq L^{-1}	ppm	% of Cations
Ca^{+2}	26.2	21.0	420	3.5
Mg^{+2}	81.4	106.8	1,304	17.9
K^{+}	24.3	9.9	310	0.8
Na^{+}	659	458.8	10,556	76.9
SO_4^{-2}	168	56.0	2,690	—
Cl^{-}	1,185	534.6	18,980	—
HCO_3^{-}	9	2.4	146	—
CO_3	<1	—	—	—
N			11.5	—
P			0.06	—
Mo			0.01	—
Fe			0.002	—
Mn			0.0002	—

above 8:1. The 1:5 ratio of these two elements in seawater is usually not a problem since large quantities of Ca are applied as an amendment to replace Na^{+} when using seawater for irrigation. If extra Mg is needed, dolomitic lime can be used as a slow-release Mg source, or a soluble Mg source can be applied by fertilization.

• Even though 24.3 lbs. K is applied per 1,000 square feet per 12 inches seawater irrigation, *high Na^{+} suppresses K^{+} uptake.* A routine spoon-feeding program with KNO_3 or K_2SO_4 is recommended. On sand-capped areas or well-drained deep sands, adding 5% by weight of medium to coarse zeolite (0.25-1.00 mm diameter) will enhance selective retention of K^{+} ions.

2. *High leaching requirements will enhance the leaching of all nutrients.*

• N-P-K fertilizers should be applied in a spoon-feeding approach at 1.5 to 2.0 times annual rates (compared to sites with good-quality water).

• Slow-release fertilizers applied frequently in 1/10 to 1 lb. per 1,000 square feet per application increments can be used as the base fertilization with fertigation of water-soluble sources used to supplement turfgrass nutrition. Spot fertilization of wear/traffic areas with granular, quick-release, soluble fertilizers may be necessary.

• The micronutrients Fe and Mn may require extra foliar applications at 0.025 Fe and 0.013 lbs. Mn per 1,000 square feet every two to three weeks. Additional granular applications may be needed several times per year. A good micronutrient fertilizer should be applied at the recommended rate, but 1.5-2.0 times more frequently.

Summary

Seawater irrigation on turfgrass is feasible with:

• Highly salt-tolerant turf species.
• Coarse, sandy soil profiles.
• Irrigation strategies that keep salts moving with regular leaching events and keep the soil profile uniformly moist to minimize concentrated salts from rising into the rootzone.
• Good surface and subsurface drainage design.
• Environmentally safe disposal of excess salts.
• Careful nutrient management and continuous monitoring.
• The entire course must receive high-level management.

Pros for Using Seawater Irrigation

• Non-interruptible supply of irrigation water during shortages/droughts/rationing.
• Reduced water costs when compared to "purchased" potable or recycled water.
• Reduced pumping costs compared to similar quality brackish wells.

Cons for Using Seawater Irrigation

• Higher ongoing maintenance costs: cultivation (labor, replacement tines, equipment repairs), amendments, equipment replacement (undercoatings), salt/brine/drainage disposal.
• Higher construction costs: sand capping, additional drainage, enhanced irrigation systems, reverse-osmosis equipment.

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Ozone is pumped into a pond to circulate the water column and increase oxygen concentrations.

POND AERATION

Do not overlook this tool to manage and improve water quality in your ponds.

by JIM SKORULSKI

POND AERATION is a tool that is often recommended in pond management programs. However, an incomplete understanding of the role of aeration in a pond management program can lead to large expenditures and disappointing results. What is the role of pond aerators in management programs, what aerator devices are most effective, and when and how should they be used, are all-important questions that should be understood before proceeding with an aeration system.

A basic understanding of oxygen's role in ponds and lakes is crucial. Dissolved oxygen in the water column is integral in many biological and chemical processes that keep the pond system in balance. Oxygen diffuses into the water column from the atmosphere and is produced by aquatic plants and algae. It is utilized by bacteria during the decomposition of organic matter. Dissolved oxygen also drives chemical reactions that cause metals to precipitate out of the water and into the sediments, where they combine with phosphorus and other nutrients, making them unavailable. Low oxygen concentrations increase the activity of anaerobic bacteria that drive reactions that force the metals back into solution and allow nutrients to re-enter the water column. Lakes or ponds that are rich in nutrients are more susceptible to undesirable algae blooms. Anaerobic decomposition also creates methane and hydrogen sulfide gases that are responsible for noxious odors. Dissolved oxygen also is required by fish and aquatic organisms for survival.

Lakes and even shallow ponds naturally stratify by temperature during the season. Surface waters are warmest and usually have the highest concentrations of oxygen. This upper layer in lakes is called the epilimnion. Temperatures drop, as do oxygen levels, in the deeper waters. The benthic layer is found at the very bottom of lakes and contains decaying organic material and sludge. Stratification is less pronounced in shallow water systems. Stratification may be disrupted, causing the lake or pond to "turn over" in the summer months. This action allows the oxygen-deficient water and nutrients to move to the surface, creating rapid and excessive growth of algae and sometimes leading to fish kills. Pond aeration is used to maintain oxygen concentrations throughout the entire water column.

Oxygen concentrations in the water column can be monitored with an oxygen meter, which measures dissolved oxygen (D.O.) at any depth in the column. Oxygen saturation is dependent on temperature and can vary day to day. At 0°C (32°F) water is fully oxygenated, containing 14 mg/l dissolved oxygen. At 25°C (77°F) the oxygen content drops to 8.3 mg/l. Aeration can increase dissolved oxygen when levels become deficient. Maintaining D.O. levels at or near 5 mg/liter provides an aerobic environment. It is best to start the aeration before D.O. levels drop to very low concentrations and before an algae bloom occurs.

There are several types of aerating devices. Aerating devices create turbulence that allows the water to intermix with the atmosphere. Fountains are probably the most popular aeration devices seen in golf course ponds. The fountains circulate the surface waters that already have the highest concentrations of oxygen. But lowering a fountain's intake will improve its ability to circulate more oxygen-deficient water from deeper in the water column. Fountains are also popular with golfers for aesthetic reasons.

Pond bubblers are actually more effective aeration devices, as they circulate large volumes of oxygen-deficient water deeper in the water column. The systems are relatively inexpensive and consist of a 1-1.5 hp electric motor, an air hose, and a diffuser unit. The diffusers are placed at the bottom of the pond to pump air that displaces up to 50,000 gallons of water to the surface per minute, where it is recharged with oxygen.

Ozone or activated-oxygen systems are also used to aerate ponds and lakes. These systems displace large quantities of water as well and may infuse free oxygen radicals into the water. The free oxygen radicals drive the oxidation reactions that make nutrients unavailable. The ability of the units to infuse the oxygen radicals into the water column is questioned by some. The units are also more expensive and may not be necessary for smaller pond systems.

Aeration by itself is not a "magic bullet" that will solve all your pond management problems overnight. Nutrient loading is still the critical factor that must be dealt with before a pond can be brought back into balance. Ponds overrun with algae and aquatic weeds may initially require chemical treatment programs to bring the system into balance. A successful management program requires a complete understanding of pond ecology, a good monitoring program, and an integrated approach that utilizes all the cultural, biological, and chemical management tools available. Utilize the services of an aquatic management company to analyze your system and help determine what the best long-range approach might be. The North American Lake Management Society or Aquatic Plant Management Society can provide a list of management companies and other informational sources that are helpful.

Treat aeration as one of many tools available to manage water resources on the golf course. When used correctly, it may keep the pond in balance, help maintain water quality, and, indirectly, help prevent algae blooms from occurring.

JIM SKORULSKI *is an agronomist in the USGA Green Section's Northeast Region, where he advises golf course superintendents on pond water quality and many other aspects of golf course management.*

Pond aeration can be an effective tool but is not the magic pill in all cases. Use an experienced consultant or extension specialist to examine the pond and develop a comprehensive management program tailored specifically for the site.

Sharing the Success of Good Stewardship

A successful effort to create environmental education opportunities right in a school's backyard.

by CHRIS PEKAREK

In 1992, Village Links at Glen Ellyn, in Glen Ellyn, Illinois, was the seventh golf course in the nation to achieve certification through the Audubon Cooperative Sanctuary Program for Golf Courses (ACSP). As part of their ongoing participation in the ACSP, golf course staff have reached well beyond the boundaries of the course. In 1995, they developed a Backyard Wildlife Program to help community residents integrate wildlife habitat into their own backyards, and later that year they began working with local elementary schools to share their expertise on wildlife and habitat enhancement.

TAKE A look at most elementary schools and you will see familiar expanses of grass and parking lots that surround school buildings. While these hold up especially well with the constant trampling of energetic youngsters, a typical schoolyard is rarely a landscape for learning. In fact, schools frequently pay hundreds of dollars each year to transport students to nature centers and other sites where they can engage in hands-on scientific investigation. But what if kids could find a dynamic natural environment right outside the classroom on the school grounds? What if they could participate in transforming part of their school grounds into a sanctuary for wildlife and an exciting place to learn?

In 1995, we began just such a project at Ben Franklin Elementary School in Glen Ellyn, Illinois. As part of our outreach efforts through the Audubon Cooperative Sanctuary Program for Golf Courses (ACSP), we adopted the nearby school to share our expertise and help students and teachers reap the many rewards of good environmental stewardship.

Creating a Dynamic Learning Environment

Our project involved planting a butterfly garden and restoring a small prairie on the school grounds to create two dynamic learning stations. The 400-square-foot butterfly garden was planted with butterfly bush (*Buddleia* sp.), six varieties of native forbs, and five varieties of native grasses. The prairie restoration site was planted with 400 native prairie forbs and grasses covering a 1,000-square-foot site. In addition, observation benches and nest boxes for cavity-nesting birds were installed at both sites.

The butterfly garden and prairie restoration projects replaced 1,400 square feet of mowed turfgrass and broadleaf weeds. Both projects were chosen to provide hands-on learning stations for the kindergarten through fifth-grade students. The two projects helped improve the aesthetics of the school grounds and provided habitat that attracted a variety of birds, butterflies, and other insects.

Project Goals

- Provide hands-on outdoor learning stations at the school.
- Involve the students in the project so they would feel pride in their school.
- Communicate to the students that they can take action that has a positive impact on their environment.
- Demonstrate to the community the importance of educating students about environmental and conservation issues.
- Share the habitat enhancement expertise the golf course has developed as a member of the ACSP for Golf Courses with our adopted school.

From Planning to Planting

The projects were planned in cooperation with two teachers, students of the Very Important Planet Club (the V.I.P. Club is the school's environmental organization), parents, and golf course staff. To raise money for the butterfly garden, the parent/teacher's organization sold shirts, while the golf course raised funds for the prairie site through an annual plant sale. The golf course supplied all materials through wholesale contacts.

First, the sites were measured and laid out. The sod was stripped using a rented sod cutter. To amend the soil, a 2-inch layer of mushroom compost was spread over the butterfly garden site and rototilled in. In contrast, the prairie site was not amended or rototilled.

Students who belong to the V.I.P. Club planted the butterfly garden. All 600 students of the school turned out to plant the prairie in just one afternoon. To keep it manageable, two classes of approximately 45 students worked on the prairie site at one time. Golf course staff were on site to explain to the students the benefit of native prairies. Teachers assisted the students in planting the potted prairie plants. Both sites were mulched with 3 inches of shredded hardwood mulch to help control weeds and retain moisture. Finally, school maintenance staff installed observation benches and bird nesting boxes at both sites.

The cost of implementing both projects was approximately $600 ($200 for the butterfly garden and $400 for the prairie restoration). However, the projects will actually save money for the school by reducing field trips to offsite locations. (Field trips cost $300 per trip.)

Rewarding Results

The sites provide hands-on, easily accessible learning stations that enhance the classroom experience by supporting lessons students learn in their curriculum. Very few of the students ever had the chance to view a butterfly garden or native prairie. The school used to take a few dozen students on field trips to a local arboretum to view similar plants. Now all 600 students can view these native plants several times each school year. Everything from studying plant parts to identifying and enhancing habitat for

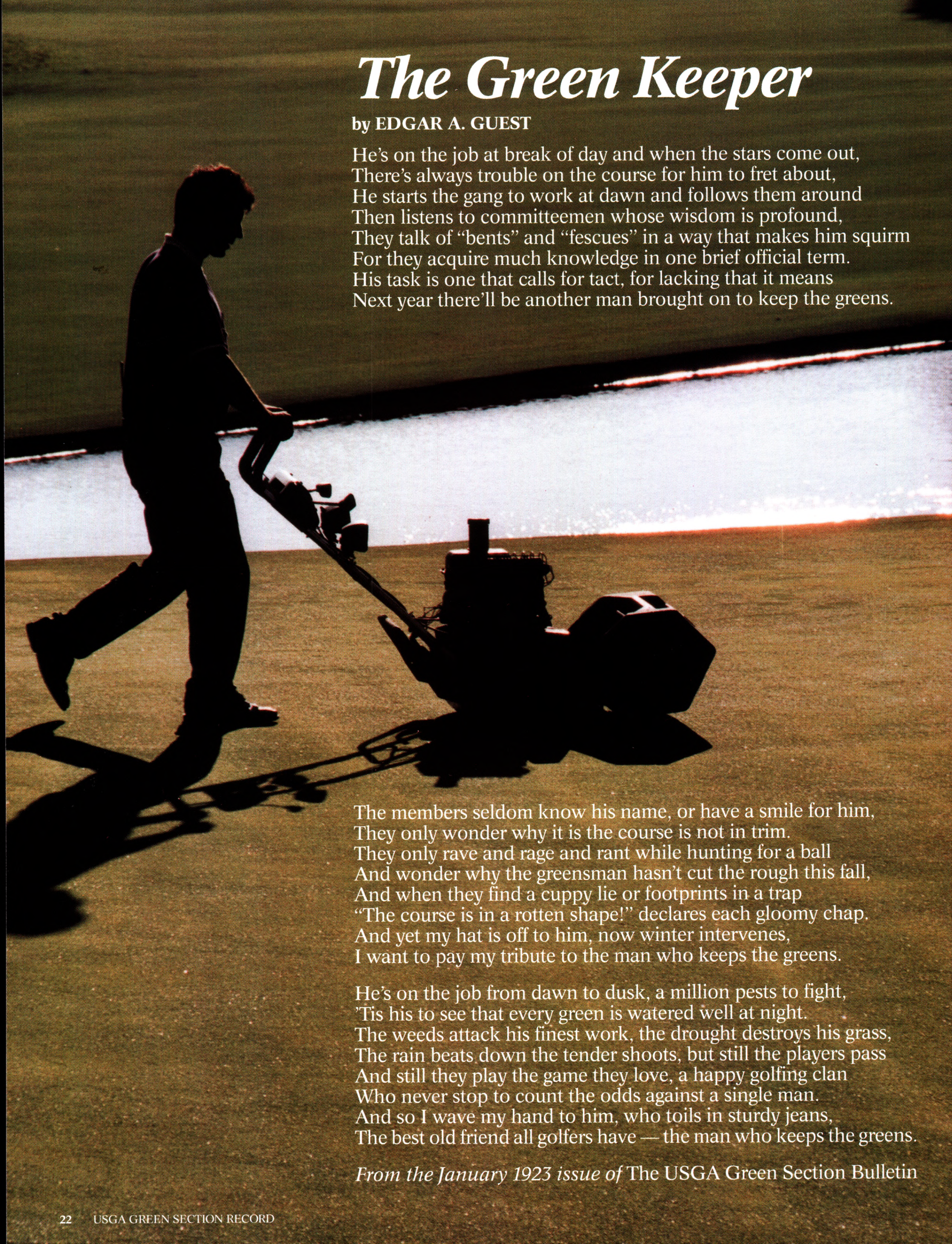
Ben Franklin Elementary School student body planting prairie site at school.

wildlife can now be learned firsthand, right at school.

Response from the local community is extremely positive and generated a lot of interest. Publicity included a newspaper article on the prairie planting, an award presented to the school by the town officials, and local cable television coverage of the award presentation. As an added benefit, the golf course achieved a new level of standing in the eyes of town residents. Village board and recreation commission members comment on the positive aspect of the golf course being involved with the local schools.

One of the most satisfying aspects of our golf course involvement with the school was simply serving as a catalyst for the project and accomplishing something that the school would not have done on its own. What seemed easy to us — planting a butterfly garden and native prairie — was not simple to the school. Their gratitude and the stewardship lessons we helped create for so many students made the project rewarding for everyone involved.

CHRIS PEKAREK *is the assistant golf course superintendent at the Village Links of Glen Ellyn, a public golf course in Glen Ellyn, Illinois. If you would like more information about this project, contact him at 630-469-2077, ext. 2, or via e-mail at chrisP6712@aol.com.*



The Green Keeper

by EDGAR A. GUEST

He's on the job at break of day and when the stars come out,
There's always trouble on the course for him to fret about,
He starts the gang to work at dawn and follows them around
Then listens to committeemen whose wisdom is profound,
They talk of "bents" and "fescues" in a way that makes him squirm
For they acquire much knowledge in one brief official term.
His task is one that calls for tact, for lacking that it means
Next year there'll be another man brought on to keep the greens.

The members seldom know his name, or have a smile for him,
They only wonder why it is the course is not in trim.
They only rave and rage and rant while hunting for a ball
And wonder why the greensman hasn't cut the rough this fall,
And when they find a cuppy lie or footprints in a trap
"The course is in a rotten shape!" declares each gloomy chap.
And yet my hat is off to him, now winter intervenes,
I want to pay my tribute to the man who keeps the greens.

He's on the job from dawn to dusk, a million pests to fight,
'Tis his to see that every green is watered well at night.
The weeds attack his finest work, the drought destroys his grass,
The rain beats down the tender shoots, but still the players pass
And still they play the game they love, a happy golfing clan
Who never stop to count the odds against a single man.
And so I wave my hand to him, who toils in sturdy jeans,
The best old friend all golfers have — the man who keeps the greens.

From the January 1923 issue of The USGA Green Section Bulletin

Research Committee Meeting

The USGA Turfgrass and Environmental Research Committee held its 1999 winter meeting at Valderrama Golf Club in Sotogrande, Spain. Prior to the meeting, the committee participated in the U.S.-Europe Golf Environment Summit.

The meeting brought together more than 80 representatives from Europe and the United States to present and discuss research results and conservation initiatives impacting golf courses. The conference examined the lead taken by golf in the environmental field and how the game can contribute to stewardship and sustainability in the wider environment.

Left to right, first row: Ray Anderson, Tommy Witt, Jim Watson, Jimmy Ortiz-Patino, Charles Peacock, Mike Kenna, Kimberly Erusha. Second row: Jim Snow, Teri Yamada, Pat Cobb, Bob Shearman, Jeff Nus. Third row: Jim Moore, Buzz Taylor, Ali Harivandi, Jim Latham, Paul Rieke, Noel Jackson, Ron Dodson.

Subscription Rates Change for the *Green Section Record*

It has been five years since the subscription cost for the *Green Section Record* was increased. Due to rising production costs and an increase in the size of our magazine, the 2000 subscription rates must be increased. Following is the annual fee schedule for 2000:

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2000 GREEN SECTION NATIONAL & REGIONAL CONFERENCES

NATIONAL CONFERENCE		
February 19	Morial Convention Center	New Orleans, Louisiana
FLORIDA REGION		
April 11	Palm Beach Gardens Marriott	Palm Beach, Florida
April 13	Tampa Westshore Marriott	Tampa, Florida
MID-ATLANTIC REGION		
February 8	Raddison Monroeville Conference & Expo Center	Pittsburgh, Pennsylvania
March 16	DuPont Country Club	Wilmington, Delaware
MID-CONTINENT REGION		
March 8	Brook Hollow Golf Club	Dallas, Texas
March 9	Brae Burn Country Club	Houston, Texas
April 4	Old Warson Country Club	St. Louis, Missouri
April 5	Happy Hollow Club	Omaha, Nebraska
April 25	Little Rock Country Club	Little Rock, Arkansas
NORTH-CENTRAL REGION		
March 21	Marriott East	Louisville, Kentucky
April 4	Country Inn Hotel	Waukesha, Wisconsin
NORTHEAST REGION		
March 28	The International Club	Bolton, Massachusetts
March 29	Desmond Hotel	Albany, New York
SOUTHEAST REGION		
March 21	Milliken Chemical, Inc.	Spartanburg, South Carolina
April 3	To Be Determined	Birmingham, Alabama
April 24 or 26	TPC at Sugarloaf	Duluth, Georgia
NORTHWEST REGION		
March 8	Holiday Inn	Termopolis, Wyoming
March 13	Waverley Country Club	Portland, Oregon
April 10	Waialae Country Club	Honolulu, Hawaii
SOUTHWEST REGION		
March 14	Orange Tree Resort	Scottsdale, Arizona
March 21	Industry Hills Golf Club	City of Industry, California
March 23	Castlewood Country Club	Pleasanton, California
March 28	Lakewood Country Club	Denver, Colorado
March 29	University Park Marriott	Salt Lake City, Utah

CONSISTENT PERFECTION

Golf course management in an "everything now" society.

by BOB BRAME

I WISH I HAD a nickel for every time I've heard someone say, "We just want it to play the same every day." Usually this comes from a course official with authentic sincerity beaming through an energetic smile. Sometimes I respond tactfully, but sometimes more bluntly, like: ". . . and the people in hell want ice water." The bottom line is, we don't always get what we want, especially when dealing with Mother Nature. Isn't the ebb and flow of course playability, as a result of weather conditions, the essence of golf? Isn't the premise of the game to play the course the way you find it and play your ball where it lies? Many would nod yes, and yet turn and reiterate their desire for the same playability day after day.

We live in a society where business is conducted in seconds and minutes, rather than days, weeks, and years. Faxes and e-mail create immediate information flow. This has undoubtedly helped fuel the desire for immediate and perfect conditioning of golf courses. The attitude seems to be that, surely, in such a high-tech world something can be done to correct any problem or improve any situation. No doubt about it, something *can* be done, but it takes time. We are playing the game of golf on Mother Nature's home court and the only thing that happens fast is crop failure. While today's superintendent has more tools to work with, it is still a living, dynamic surface.

The primary purpose of the Stimpmeter® is to allow a superintendent to monitor the consistency of ball roll speed from green to green on a given day. Where the game originated in Scotland, a few have argued about the need for consistency on a given day, but it has become the *focus* of American golf. In fact, we not only want them all the same each day, but we want it to roll the same day after day. This leaves the superintendent trying to counter high temperatures, high humidity, rainfall (too much or too little), or frost, to provide the same speed all the time. Then, when some turf weakening or loss occurs, the quick retort is, "We didn't want you to kill them; we just wanted them fast." Hello.

Mother Nature rules, so relax and enjoy the game. The golf course is never going to play the same every day, and playing the ball as it lies is the basic premise of the game.

How about bunkers? Here again, it is common to hear, "Our bunkers aren't consistent" or "There is too much (or too little) sand." They're hazards! Where did we get the idea that hazards should all play the same? At many courses, bunkers are the most expensive footage being maintained. In fact, it is not uncommon to see bunkers being hand raked daily and the greens mowed with triplex units. What's wrong with that prioritization of funds? Why not shift to the use of walk-behind mowers on greens and then rake bunkers once or twice a week, touching up footprints from the previous day's disturbance on the off days.

Poa annua control is also tied to the "consistent perfection" syndrome. Everyone (golfers, committee members, owners, officials, and superintendents) continues to look for the silver bullet. We want it out of here and we want it done yesterday. But don't raise the mowing height or dry the surfaces — keep 'em fast and make sure they hold! Recognizing that moisture in any form will slow green speed, it's kind of tough to offer fast pace and surfaces that will hold a sculled nine iron. Dry is the target for both healthy turf and good playability. If this means your shot doesn't hold the green, play a different shot. Yet, ultimately it is Mother Nature who will determine what the pursuit of dry actually produces.

The harsh weather of 1995 and the drought of 1999 are examples that clearly illustrate Mother Nature's ultimate control of golf course playability. You'd think we'd learn to work with her and not try to fight the inevitable. Ultimately, an agronomically solid foundation and the realization that golf turf conditioning will vary depending upon weather conditions are the key components in avoiding the "consistent perfection" syndrome/trap. Cut the superintendent some slack, unless of course you have a direct line on tomorrow's weather. When we figure out how to e-mail or fax Mother Nature, then perhaps we can zero in on "consistent perfection." In the meantime, relax and enjoy the game. In reality, neither consistent perfection nor perfect consistency are realistic.

BOB BRAME *is the Director of the North Central Region and works out of Covington, Kentucky. He visits courses in Indiana, Kentucky, and Ohio.*

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Subscriptions $18 a year, Canada/Mexico $21 a year, and international $33 a year (air mail).

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GREEN SECTION RECORD (ISSN 0041-5502) is published six times a year in January, March, May, July, September, and November by the UNITED STATES GOLF ASSOCIATION®, Golf House, Far Hills, NJ 07931. Postmaster: Address service requested — USGA Green Section Record, P.O. Box 708, Golf House, Far Hills, NJ 07931-0708.

Periodicals postage paid at Far Hills, NJ, and other locations. Office of Publication, Golf House, Far Hills, NJ 07931.

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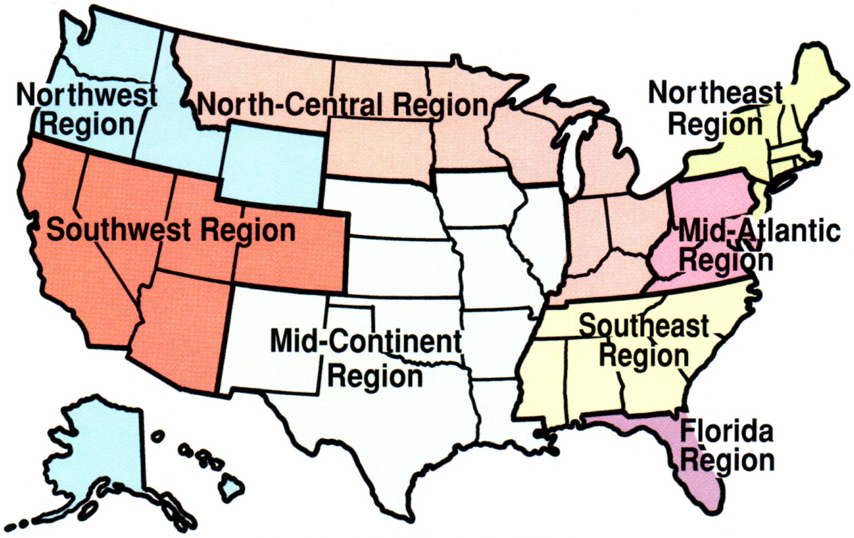

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TURF TWISTERS

OFF-SEASON PLANNING

Question: In the fall, our golf course superintendent melted the frost off the greens with the sprinklers so that the golfers could play earlier in the morning. Now that it's January, our superintendent refuses to turn on the sprinklers and I'm not sure why. (Oklahoma)

Answer: When the morning temperature is still above freezing in the fall, frost on the greens can be quickly removed with a couple of revolutions of the sprinkler heads. During the winter, when the morning temperatures are close to or below freezing, small applications of water from the irrigation system will often result in ice accumulation. When ice forms, it takes longer for the greens to thaw, and thus, the course may not be fit for play until late morning or early afternoon. For the many golf courses that have to drain their irrigation systems for the winter, sprinkler use for dissipating frost isn't a practical solution.

ESTABLISHES

Question: I want to rebuild some tees and reestablish the surface with hybrid bermudagrass sod, but the only time our management allows me to do the project is during the winter when the bermudagrass is dormant. What do you think about using overseeded sod? Will it root well enough so that we can use it before the end of winter? (Arizona)

Answer: If your only alternative is to do the project in the winter, then overseeded sod is a good choice. While the bermudagrass will not begin active root growth until soil temperatures are around 75°F, the overseeded perennial ryegrass should hold the sod in place well enough for firm footing and good playing quality. You should allow at least four weeks for the sod to establish before opening the tee.

A PATH FOR THE FUTURE

Question: Our golf course is in the midst of a major battle over the direction the course will take in the future. One side wants a "Championship" golf course with many physical changes, while the other side doesn't want to spend any money on necessary course upgrades. Does the USGA have maintenance standards established or do you have suggestions on ways to bridge the gap? (Alabama)

Answer: It is not possible to manage a golf course via a "cookbook" approach. Many factors, including growing conditions, budget, golf course superintendent expertise, construction method, climate, etc. all play a role in how a course should be managed. First and foremost, the superintendent should work in conjunction with the course officials to develop a long-range plan. This plan should include both a financial plan and an architectural plan. Saving dollars and completing changes in-house that are based upon the personal opinion of single-digit golfers has ruined many a golf course. At the same time, there also are many courses that are in need of upgrading, yet the older members are loath to make changes, even if these changes make sense and will have a positive impact. The best answer is the selection of a quality golf course architect who can listen and create a plan, and the course should follow through for the benefit of the majority of the players.