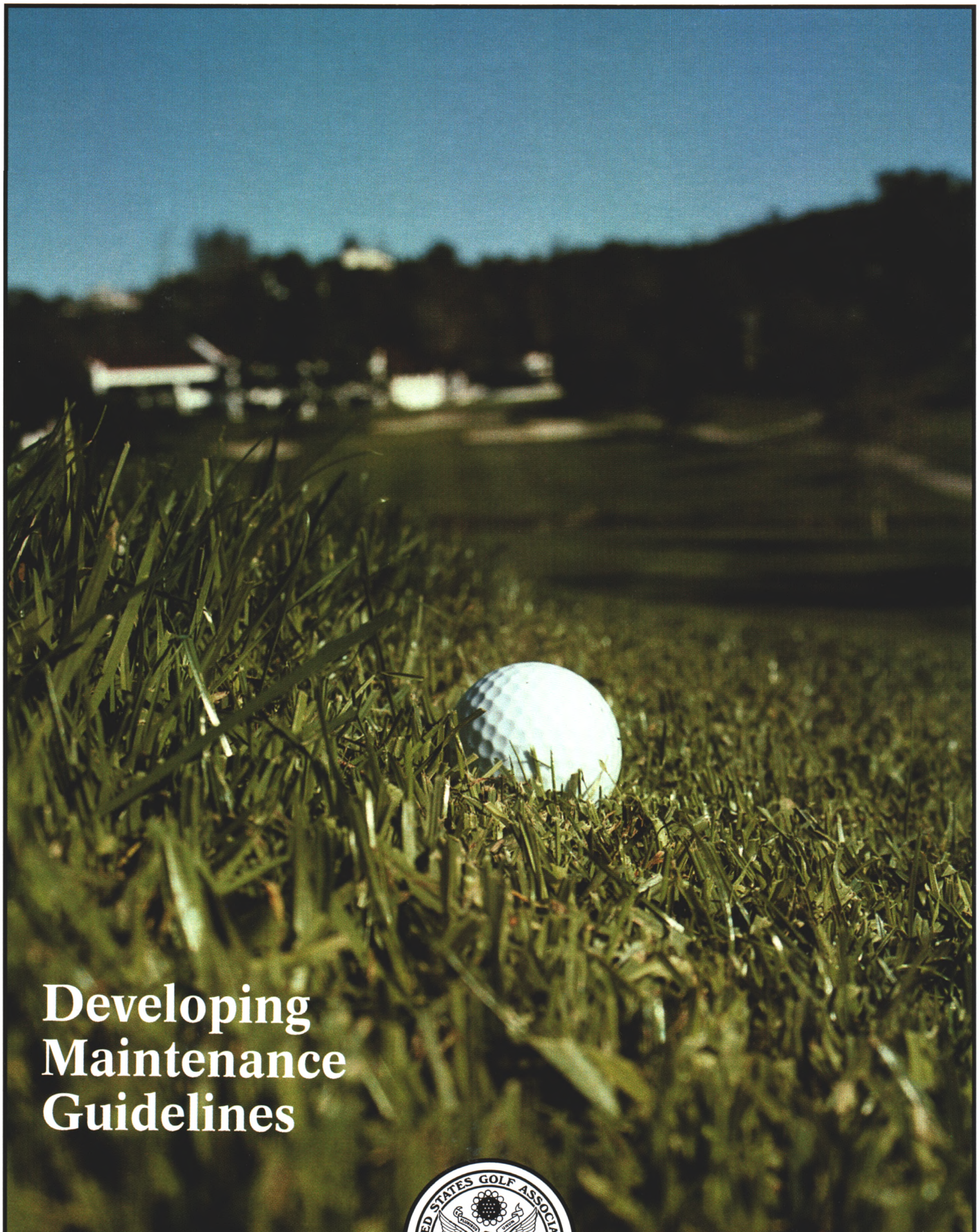
USGA® GREEN SECTION
Record
Volume 35, Number 2 March/April 1997



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

MARCH/APRIL 1997
Volume 35, Number 2

*Cover Photo:
Mowing frequencies and a range of acceptable mowing heights should reflect the needs of the majority of golfers at the course while protecting the health of the turf.*

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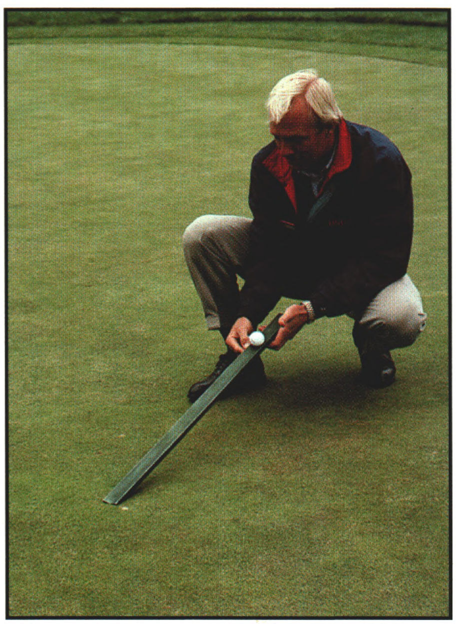
Based on feedback from frustrated golfers who cannot find their golf balls in water hazards, many superintendents maintain low-cut turf to the water's edge. This practice encourages shoreline erosion because the soil is no longer held in place by riparian vegetation. *See page 10.*



Stimpmeter measurements on level greens provide a numerical way to characterize green speed. *See page 12.*

Bunker maintenance is a time-consuming yet integral part of the daily maintenance program that should be detailed in the maintenance guidelines.

WHEN IN DOUBT — SPEC IT OUT

Developing maintenance guidelines for your golf course can clarify priorities and serve as a useful budgeting tool.

by PATRICK J. GROSS

IT IS HUMAN NATURE to make comparisions, and that is especially true when it comes to golf courses. It seems every golfer has a built-in rating system of what constitutes a well-maintained golf course. People often ask if the USGA has any published maintenance standards. The answer is that while the USGA Green Section agronomists work closely with course officials and superintendents to improve golfing conditions, there is no cookie-cutter formula for proper golf course maintenance. Every golf course is different. Consider the number of variables inherent in each course, such as differences in microclimate, course architecture, terrain, amount of play, soils and construction techniques, water quality and availability, budgets, staff size, and many other factors. With so many variables, it is next to impossible to draw an accurate comparison. Instead of comparing your course to the one down the street, it is much more beneficial to accurately determine what it takes to make your course the best it can possibly be.

The corporate world has long recognized the benefit of developing a comprehensive business plan with specific goals and objectives for their company and its employees. The plan clearly states the role of each person in the organization, with specific performance criteria provided so that there is no misunderstanding about the expected outcome. How many golf courses can say they have a plan like this for the routine maintenance of the golf course? Green committees come and go, superintendents are hired and fired, and golfers' expectations are raised based on the latest televised tournament. The actual daily conditions are usually the result of the superintendent's personal maintenance philosophy and his interpretation of comments and complaints from the golfers. Who usually suffers, given such a wide range of opinion and lack of a clear goal? The golf course *and* the superintendent. Developing a set of maintenance guidelines for the golf course will clarify maintenance priorities and keep the entire organization moving in the right direction.

Why Are Maintenance Guidelines Needed?

There are several good reasons to develop maintenance guidelines for your course. First, it is a project that requires the superintendent and committee to organize and analyze the priorities for golf course maintenance instead of assuming that everyone has the same goals and standards in mind. Getting it down on paper makes it easier to analyze the situation and see exactly what it takes to maintain a golf course in the manner the golfers want it. In the process, the desires and expectations of the golfers are clarified, and objective standards are set for the routine maintenance and playing quality of the golf course. Developing such a document also removes subjectivity and provides a formula for comparing the desired results with the available resources. In the end, the guidelines become an objective standard that is measurable and provides a reference for future decision making.

Another reason in favor of developing maintenance guidelines is the short tenure of most green committee members and green chairmen. With only a short time to serve the club, most of the attention is on quick fixes and addressing personal preferences. The composition of the committee swings from low handicappers to high handicappers, and there is never a clearly stated vision regarding the ongoing maintenance of the golf course. The venerable golf course architect Dr. Alister Mackenzie summarized it best by stating, "The history of most golf clubs is that a committee is appointed, they make mistakes, and just as they are beginning to learn by these mistakes they resign from office and are replaced by others who make still greater mistakes, and so it goes on." The maintenance guidelines can be a valuable tool to speed the learning curve and provide guidance and continuity for future committees.

Another temptation is for committees to act like golf course architects, adjusting or altering the course to suit their particular style of play. In some instances, architectural modifications are necessary and the maintenance guidelines can provide a framework to analyze and implement changes.

Finally, the maintenance guidelines are a useful tool to answer complaints from disgruntled golfers. It is impossible to please everyone. When a golfer is upset about a particular maintenance practice on the golf course, it is better to point to the maintenance guidelines to show that the superintendent is operating according to the plan. This makes the conversation objective and avoids personal criticism of the superintendent and maintenance staff.

"The development of maintenance guidelines should be a cooperative effort between the superintendent, green committee, golf professional, and general manager. Once completed, the guidelines are a useful tool to communicate with golfers and compare the desired level of maintenance with the available budget resources."

Who Determines the Guidelines?

The development of the maintenance guidelines should be a cooperative effort between the green committee, superintendent, golf professional, and general manager. Each of these parties has a particular role to play.

Green Committee: The main role of the green committee is to define the expectations for playing quality on the golf course and offer the necessary support to achieve the desired goal. The members of the committee should be thoroughly familiar with the layout of the golf course and the seasonal variations. They should fairly represent the needs of all levels of players at the course. The committee should consider several factors, including course architecture, the average handicap of the golfers at their course, the available budget, tournament schedules, and the amount of play the course receives annually. By analyzing this information, the committee should be able to provide a clear vision regarding the desired maintenance of the golf course. Then, the committee must approve a realistic budget that allows for the fulfillment of these expectations.

Superintendent: The superintendent has the greatest influence on the playability of the golf course and has the most critical role to play in the development of the maintenance guidelines. Superintendents are often in a difficult position in trying to balance the agronomic needs of the course with the expectations of the golfers. Everyone wants good quality conditions, but many do not know what they really are. The superintendent should start by discussing his or her maintenance philosophy with the committee. The superintendent should then translate the desired playing conditions into specific programs and maintenance practices based on the agronomic needs of the golf course. The superintendent should provide the committee with the necessary details about the maintenance operation, including agronomic conditions, equipment, materials, and labor. It is then possible to guide the discussion toward realistic expectations based on the prevailing agronomic conditions on the golf course. The superintendent then formulates a realistic maintenance plan and a budget that reflects what is needed to accomplish the desired results.

Golf Professional: The golf professional should offer constructive criticism about playing quality as it relates to the various abilities of the golfers who play the course. Since the golf professional probably has the most contact with the golfers, he or she can pass along comments and concerns about maintenance issues. Familiarity with the strengths and weaknesses of the golf course is important, as is a good knowledge of the Rules of Golf and course marking. The golf professional also can offer feedback on maintenance issues that affect the pace of play.

General Manager: The general manager should participate in all discussions, providing an overview of the golf course maintenance operation in relation to other functions at the course. The general manager should provide information and support regarding budget resources. Like the golf professional, the general manager has frequent contact with golfers and should pass along any constructive criticism that can add to the development of the maintenance guidelines.

Developing the Guidelines

Since each course is different, the maintenance guidelines should reflect the specific needs of your golf course. There should be a general listing of the day-to-day maintenance practices that detail the who, what, and when of golf course maintenance. It is important to be realistic and flexible with the development of the guidelines since there is no way to account for every whim of nature. Keep the guidelines as brief as possible; there is no need to go into great detail about specific products or equipment specifications. Your regional Green Section agronomist can help with the process by offering advice and recommendations on maintenance issues to determine what is right for your course. The following is a sample list of items that should be addressed as part of the maintenance guidelines. This is only a partial list, and you may wish to add topics based on the particular needs at your course.

Cutting heights and mowing frequencies: Since quality turf conditions are dependent on mowing frequencies, the committee and superintendent should agree on how often each area should be mowed, considering the available labor and equipment. A range of acceptable cutting heights should be prepared for all areas of the golf course that protects the agronomic condition of the turf while providing acceptable playing quality for the majority of golfers. Important factors to consider include: turf variety, height of the rough, including or excluding an intermediate rough, and mowing heights for greens, tees, and fairways.

Cultivation programs: The timing and frequency of core aeration and topdressing should be mentioned in the guidelines. Details are not necessary as long as there is basic information presented to let the golfers know when cultivation practices are scheduled and what to expect.

Green speed: Much has been written on the subject of green speed, but many courses go about determining the proper speed for their greens in the wrong way. It is best to first determine the proper mowing height for healthy turf, and then translate that information into relative green speeds for regular and championship play. Due to advances in equipment technology, it is now possible to mow the greens below 1/8", but just because you can mow the greens low does not mean you should push the limit. As noted in the following table, there are times during the year when you may not want to mow the greens too low or schedule championships since this would compromise the health of the turf. As an example, you may wish to present the information in a manner similar to the accompanying sample table of putting green mowing heights and green speeds.

Color versus playing quality: This is where a meeting of the minds is essential. The green committee, superintendent, golf professional, and general manager must come to an agreement on whether the maintenance priority is on promoting lush green turf or optimum playing quality. To the superintendent, this indicates the type of fertility and irrigation practices that must be implemented to achieve the desired results.

Course setup: There should be some general policy on how the course should be set up each morning, including the positioning of tee markers and rotation of hole locations.

Course marking: This includes guidelines for marking ground under repair, the position of out-of-bounds and hazards on the golf course as well as how these areas are to be maintained.

Bunker maintenance: In addition to the frequency of raking and trimming operations, it is good to mention other factors, such as the desired firmness and playing quality of the bunker sand, how often sand is added to the bunkers, thickness of the grass lips, and other factors.

Golf cart policy: The damage caused by golf carts directly impacts course maintenance and playing quality. Any golf cart restrictions should be included in the guidelines as a reminder to the golfers and as a guideline to the maintenance staff for course setup.

Course closure for rain, frost, and winter play policy: Policies and procedures for closing the course due to inclement weather should be included in the guidelines, along with

Sample Putting Green Mowing Height and Green Speed

	Mowing Height	Speed for Regular Play	Speed for Championships
Jan	9/64" to 5/32"	Fast	Medium fast
Feb	9/64" to 5/32"	Fast	Medium fast
Mar	9/64" to 5/32"	Fast	Medium fast
Apr	1/8" to 9/64"	Fast	Fast
May	1/8" to 9/64"	Fast	Fast
Jun	5/32" to 3/16"	Medium fast	Medium
Jul	3/16"	Medium fast	(not recommended)
Aug	3/16"	Medium fast	(not recommended)
Sep	5/32" to 3/16"	Medium fast	Medium
Oct	9/64" to 5/32"	Fast	Medium fast
Nov	9/64" to 5/32"	Fast	Medium fast
Dec	9/64" to 5/32"	Fast	Medium fast

who is responsible for making the determination.

Environmental issues/IPM thresholds: Special environmental issues that affect the maintenance of the golf course should be noted. Depending on state or local laws, there may be specific restrictions on re-entry periods after a pesticide application. Any general comments regarding IPM thresholds for weeds, insects, and diseases also are worthy of including so that the golfers are aware of the goals for your pest control program.

Fairway widths and mowing contours: The total acreage and width of the fairways influences the maintenance and playing quality of the golf course. The larger the fairway, the more time and labor necessary for mowing and maintenance. Fairway widths and mowing contours also are a function of course architecture and can influence the pace of play.

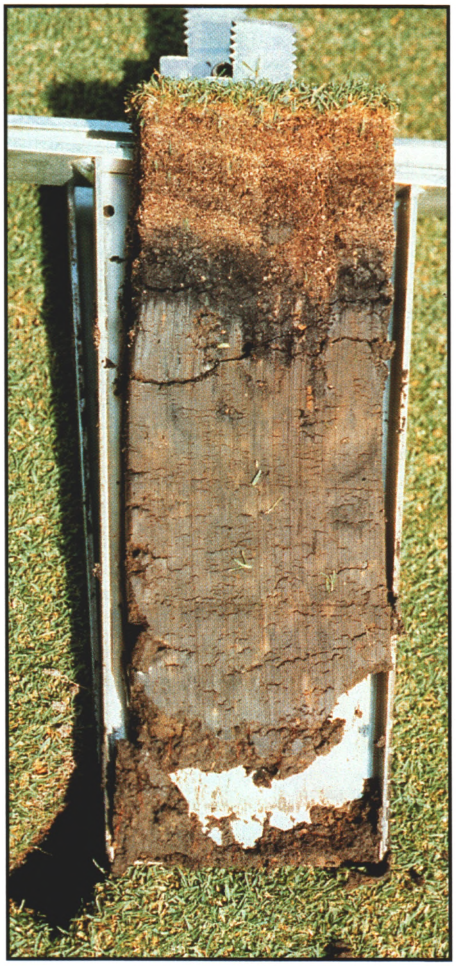
Tree maintenance: Tree maintenance, or the lack of it, affects the appearance and strategy of playing the golf course. Consideration should be given to the frequency of tree pruning, how it is to be performed, and what effect it will have on playability. Guidelines for tree planting and the architectural significance of specific trees on the golf course also should be noted.

Winter overseeding: For many courses in the southern part of the United States, the question of whether or not to overseed can have serious financial impacts. It also may be a controversial topic among golfers or club members. If winter overseeding is practiced at your course, guidelines should be developed concerning when seeding will be performed, how the grow-in period will be managed, and a description of transition programs in the spring.

Putting It All Together

To begin the process, the Green Committee may wish to formulate a questionnaire to get a representative idea of how golfers like to see the course maintained. After analyzing the responses, the Green Committee should meet with the superintendent, golf professional, and general manager to gather more information. Any specific problems or unusual site conditions that affect maintenance should be discussed. The committee should carefully consider all aspects of the golf course and its maintenance, including architecture, agronomic requirements of the turf, the average ability of the golfers at your course, pace of play, labor and equipment resources, seasonal variations, tournament schedules, and other such items. For the purposes of the guidelines, it is important to focus on maintenance issues and separate any long-range planning items. The group can then collectively work on development of the maintenance guidelines.

The next step is for the superintendent to take the guidelines and formulate a maintenance plan and budget that accurately reflects the desired mainenance level. This will require listing the required tasks and doing a detailed analysis of the labor, equipment, and supplies necessary to complete the work. The superintendent may wish to list different options to accomplish the goals and include information on more efficient equipment or methods. It is important to be as detailed as possible when performing the analysis in order to provide realistic budget estimates. Providing a breakdown of the cost per job or per unit-area would also be useful so that any changes to the maintenance program can be quickly calculated.



Poor agronomic conditions such as heavy thatch and poorly drained native soil greens put limitations on the realistic expectations for course playing conditions.

After the budget is developed, another meeting should be held to compare the budget to the maintenance guidelines. This is where the rubber meets the road. Many committee members are shocked when they learn exactly what it takes to provide top-quality golfing conditions. At this point, some negotiation and adjustments may be in order to bring the desired maintenance level in line with the available budget resources.

Once the guidelines are finalized, they should be approved by the board of directors and put to a vote of the membership. This insures stability and continuity regardless of changes in the committee or maintenance personnel.

Conclusion

Everyone who plays golf has an opinion and philosophy on how a golf course should be maintained. These subjective expectations are often at odds with the available resources to maintain the course. The real benefit of developing maintenance guidelines is that it allows for an objective comparison between the desired level of maintenance and the available budget resources. Many courses want champagne and caviar but are only willing to pay for Kool-Aid and beer nuts. The exercise of developing the maintenance guidelines also becomes an eye-opening experience for the green committee, superintendent, golf professional, general manager, and golfers by demonstrating the many factors that go into maintaining a top-quality golf course on a consistent basis. Once the maintenance guidelines are developed, the green committee possesses an important tool to communicate with golfers regarding the acceptable standards for daily maintenance and a way to respond to complaints. What is more important, the maintenance guidelines clarify the goals of the maintenance program and provide an objective standard to evaluate the golf course. It is always dangerous to assume that everyone has the same goal in mind when it comes to the conditioning of the golf course. So whenever there is any doubt, it is always better to spec it out.

PATRICK J. GROSS *is an agronomist in the Green Section's Western Region.*

Pesticide Storage: One Step Ahead

Proactive is always better than reactive. This is especially true with the planning and construction of a pesticide storage building.

by GARY W. BOGDANSKI

WHERE does a superintendent begin when planning to construct a new pesticide storage facility? With no definite regulations established concerning pesticide storage, a superintendent may feel somewhat bewildered as to what is considered *proper storage*, and may wonder if an existing or planned facility meets the requirements of future regulations. Many guidelines and regulations touch on various aspects of a complete pesticide storage/handling facility, but the rules differ from state to state and agency to agency. Because the existing pesticide storage area at The Sharon Golf Club was outdated, a new pesticide and fertilizer facility was constructed using a proactive approach to the design.

Getting Started

Our first step in planning the new pesticide storage facility was to formulate a design that fit the needs of the golf course. Needs were discussed among many golf course personnel, and we reviewed the Material Safety Data Sheets (MSDS) of the particular chemicals stored at The Sharon Golf Club. MSDS aid in defining the type of storage that is required. In our case, the local fire department, zoning department, and county building department govern the actual building structure that is required, based on what will be stored. I designed the storage facility by using a computer-aided design (CAD) system. CAD facilitated the numerous changes that were made to the design before the final presentation. I drew a very basic design after reviewing the guidelines offered by a number of information sources. I then solicited input on the design from all agencies that had jurisdiction regarding this type of facility. We also considered the laws of other states, since it is possible that some of these laws may be implemented at some point in the future.

After studying all of the recommendations, I updated the basic design, which resulted in a complete, final blueprint consisting of 12 sheets. Electrical, plumbing, construction details, and even shelving locations were drawn on the layout. These details were very valuable in visualizing the final building. After presenting our final design to the County Building Department for review and approval, a building permit was issued and the contractor began construction.

The Facility

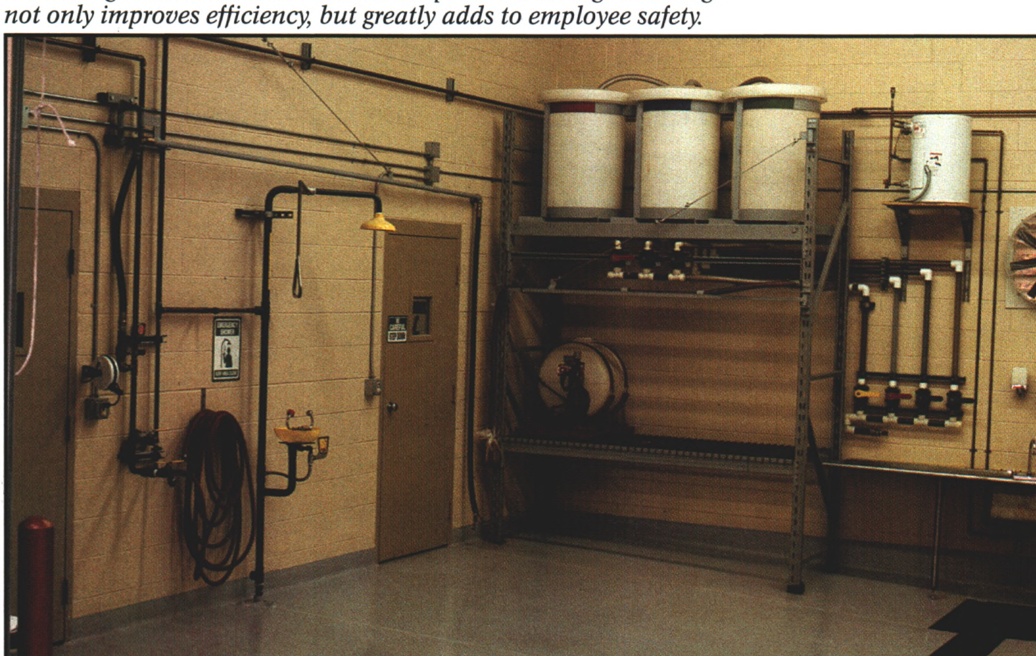
The new facility at The Sharon Golf Club is located approximately 140 feet from the maintenance complex. Adequate separation addressed two concerns: first, that operations in this building do not involve other maintenance activities, and second, to eliminate the possibility of a fire spreading from building to building. Only authorized personnel have access to the pesticide storage building. The building was constructed with masonry block with a stick frame wood roof structure and plywood decking. The 1600 square feet consists of four rooms: two pesticide storage rooms, a mix-load area, and fertilizer storage. Block walls isolate fertilizer storage from the pesticide area. The walls separating all of the rooms extend completely to the roof decking to act as a fire stop.

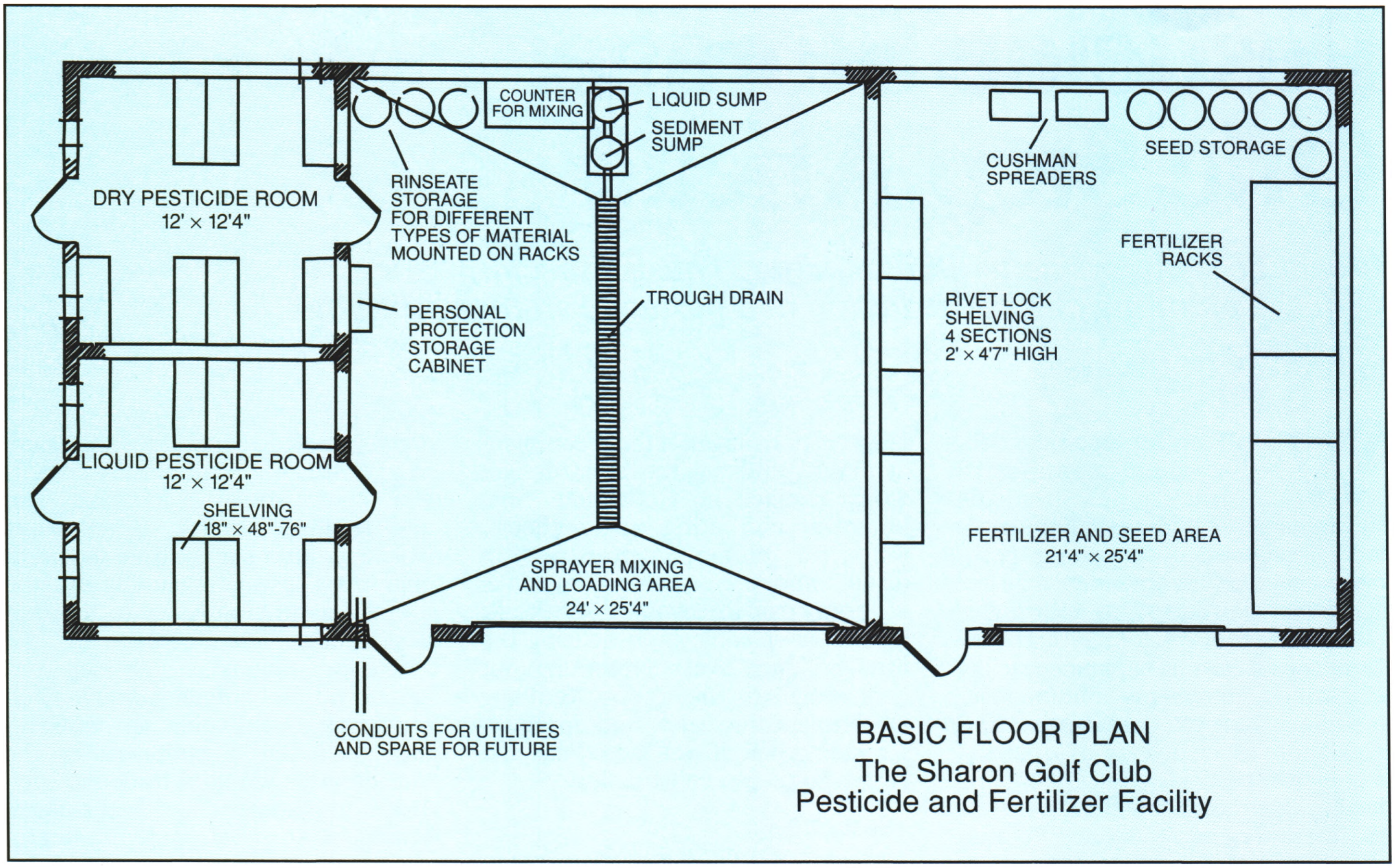
The building is entirely self-contained, with no outgoing drains. Each room has a ventilation fan wired to the light switch. Signs placed on the outside walls are used to define each area as to pesticide or fertilizer storage. Telephone and alarm systems are provided to the building.

Pesticide Storage Rooms

Both pesticide storage rooms are identical in design with the exception of electric heat added to one room, allowing winter storage of any unused pesticide. By having two separate rooms, pesticides can be isolated in several different ways: dry or liquid, fungicides, insecticides, and herbicides. Pesticides are stored on steel shelving.

A well-organized mix-load room in the pesticide storage building not only improves efficiency, but greatly adds to employee safety.





Each room has two sets of doors. One door opens directly into the mix-load area. The second door opens to the outside, which is a fire code requirement.

Each of the two pesticide storage rooms has a six-inch step-down, secondary containment area that is capable of holding 500 gallons. The floors and the first six inches of the walls are a monolith concrete, pour-coated to protect it from pesticide exposure. A Tennessee Valley Authority acceptable concrete coating of phenolic epoxy was applied in four layers for a total of 15 mils thick. The first two layers are colored differently from the top coats. This color difference allows a contrast to appear if the integrity of the coating begins to wear thin.

The ceilings of the pesticide storage rooms are two layers of ⅝" fire code drywall. Even though the majority of substances stored are not combustible, the ceiling does provide a fire wall. Here again, the MSDS determines the type of construction.

To achieve the best possible air flow, we exceeded the minimum ventilation requirements set by OSHA. Our state division of safety and hygiene was helpful in suggesting appropriate methods. Each room has a corrosion-resistant fan connected to the light switch that is mounted outside the room. Positive ventilation is then assured upon entering the room. The fans are ducted to within 16" of the floor to remove vapors that are heavier than air. Natural ventilation is achieved by the placement of open louvers mounted through the block wall. The louvers in the storage rooms have fusible links that close in the event of fire.

Mix-Load Area

The mix-load room is used to fill the sprayers and collect rinseate for recycling. The room is large enough to accommodate parking of all the application equipment. The concrete floor is coated with the same phenolic epoxy, but sand was added between coatings to provide a non-skid surface. The saw-cut joints are filled with an epoxy caulk to seal and maintain a secondary containment system. This containment area can hold about 600 gallons. An article by Ronald T. Noyes on the specifications of mix-load pads and rinseate systems is included in the MWPS 37 publication (see source table).

The floor is sloped toward the center, to a stainless-steel trough that is connected to a stainless-steel sump. The uniquely designed sump is a double-lined, stainless-steel double sump. An inspection tube, permitting visual verification of a sump leak, is located between the sump and outside lining. The first sump is a settling sump with a strainer basket to catch large debris. An overflow pipe located near the bottom of the first sump allows rinseate to flow to the second sump, from which a pickup tube runs to a stainless-steel transfer pump.

Three 55-gallon tanks constructed of high-density polyethylene are mounted on an overhead rack. Tanks with conical bottoms were used to allow for complete drainage of the tanks and any settled particles. By having more than one tank and separate valves for each tank, the rinseate can be segregated into such categories as fungicides, insecticides, herbicides, or any possible combinations of materials. Keeping the tank size small ensures quicker processing rather than accumulating large amounts of rinseate. Because we used translucent tanks, the amount of rinseate can be verified at a glance. The rinseate is pumped up into the tanks and dispensed via gravity. An overhead boom can be swung out and placed in the spray tank. When the appropriate valve is opened, the rinseate tank is emptied. A fourth valve can be used to pump rinseate directly from the sump to a spray tank. Irrigation water is used to fill spray equipment utilizing a different overhead boom. The end of the boom has a droop hose with a cam lock fitting, and couples directly to the sprayer's anti-siphon valve.

The mix-load room is equipped with an emergency shower, eyewash station, and first-aid kit. A stainless-steel counter and sink provide an area for small container mixing and hand washing. All plumbing fixtures drain into the rinseate sump. A frost hydrant was installed for cold weather use. The potable water used to supply the building is protected by a back-flow prevention device. Future plans include an open mixing system to process water-soluble fertilizers.

Fertilizer and Seed Storage

The majority of fertilizer used at The Sharon Golf Club is granular. In Ohio, regulations for this type of fertilizer are very basic. The material is to be stored indoors on a dry, impermeable surface. Previously, we stored fertilizer where the equipment was parked. This type of storage frequently resulted in the equipment damaging the fertilizer bags and spilling fertilizer. By including the fertilizer storage in the new building, the material is isolated from damage. The fertilizer storage area is consistent with typical warehouse storage.

We allowed plenty of area around the building for delivery truck unloading. Along one wall is an 18-ton capacity pallet racking, allowing for fertilizer pallets to be stacked with a fork lift truck. On the opposite side of the wall, steel shelving with a three-ton capacity is used to store individual bags. All of the fertilizer application equipment is stored in this room. Seed is stored in metal garbage cans that provide protection from rodent damage. Each can is labeled as to the type of grass seed. A hanging warehouse scale is used to measure out small amounts of seed or fertilizer. This area is furnished with an emergency eyewash unit.

Conclusion

The construction of a modern pesticide facility is directly related to the type of material to be stored. From the MSDS various requirements can be determined: for example, fire protection systems, special electrical requirements, community right-to-know, emergency planning, and employee handling procedures. We keep one copy of the MSDS where the product is stored and another at the maintenance building office. A good way to start on a new facility is to make a list of possible information sources and then contact them to ask questions and solicit information. Use this knowledge to develop your own storage facility. Even though our new facility incorporates more safety features than are required by Ohio laws, we want to be one step ahead.

GARY BOGDANSKI *is the equipment manager at The Sharon Golf Club in Sharon Center, Ohio. He's responsible for the maintenance of all equipment and buildings at this northern Ohio club.*

Sources Contacted for Guidelines on Pesticide and Fertilizer Storage at The Sharon Golf Club

The sources shown are to be used as a guide only. Contacts will vary according to the state and county in which you are located.

Source	Guidelines Received
EPA's Pesticide Program implemented by the Ohio Department of Agriculture.	Regulates the EPA's Pesticide Program concerning use and storage, Ohio pesticide law
Golf Course Superintendents Association of America (GCSAA) Lawrence, Kansas 66049	Quinn, Patrick. "Standards for Pesticide Storage Buildings," *Golf Course Management*, July 1990 Golf Course Superintendents Association of America, Pesticide Storage Facilities, Greentips fact sheet
Medina County Emergency Management Agency Sharon, Ohio	Emergency response planning, National Fire Codes
Midwest Agricultural Chemicals Association (MACA) P.O. Box 2125 Northside Station Sioux City, Iowa 51104	Booklet: "The 'How To's' of Agricultural Chemical Storage"
Midwest Plan Service (MWPS) Iowa State University Agricultural and Biosystems Engineering Dept. 122 Davidson Hall Ames, Iowa 50011	Kammel, David, R. Noyes, G. Riskowski, and V. Hofman. "Designing Facilities for Pesticide and Fertilizer Containment," First Edition, 1991. MWPS-37 publication
Sharon Center Fire Department Sharon, Ohio	State and local fire codes
St. Paul Fire and Marine Insurance Co. (The Sharon Golf Club insurance company)	Received information and input from the Risk Management Department
State Division of Safety and Hygiene Ohio	State funded, on-site consultation service addressing OSHA issues
Tennessee Valley Authority (TVA) Environmental Research Center Muscle Shoals, Alabama 35662	Broder, Michael F., and D. T. Nguyen. "Coating Concrete Secondary Containment Structures Exposed to Agrichemicals." Tennessee Valley Authority, June 1995. Circular Z-361.

The Kiwis Have It Right!

Golfers in New Zealand are being influenced by American maintenance standards viewed on television. Is it right or wrong?

by LARRY GILHULY

CAN YOU IMAGINE a location on Earth where golf is played for the fun of it? Where it costs only a few dollars or less for 18 holes? Where fairway irrigation isn't found on most golf courses, hence the courses play fast and firm? Where greens are now mowed as low as the dust on a hardwood floor and where bentgrass still dominates the putting surfaces? Where annual budgets are well below $100,000 and many courses are maintained by only one to three employees? It still exists in the wonderful land called New Zealand, but you'd better hurry before it all comes to an end!

The American Influence

Turn on your TV any weekend and you will observe an agronomic delicatessen prepared for the greatest men, women, and senior players in the world. Weeks, months, and, in some cases, years of advance planning have peaked these golf courses for the players and television cameras. The unfortunate side-effect of TV golf has been the trickle-down desire of private, resort, and public players to have the same type of conditions on their course as seen at the latest Tour event. In America, the battle to educate golfers continues; however, the real tragedy is the influence TV golf is having on golfers away from our shores. With the introduction of Sky television into New Zealand, the over-green, over-watered, over-budgeted, and *expensive* game of American golf is starting to influence maintenance practices there.

The New Zealand Influence

For a number of reasons, golf and its maintenance in New Zealand are conducted in a manner that is better for the game. Smiles abound despite the inevitable mishits, grumbling about course conditions is minimal when compared to the cacophony of complaints registered at many U.S. courses, and many courses are mowed by sheep!

1. Golf is affordable. It is very common to pay $250 per month or more to play golf in many parts of the U.S. This is after the invitation fee that can often range from $5,000 to $100,000. In New Zealand, $250 NZ pays for the entire year! *That* is affordable golf!

2. Green is not the dominant color on golf courses. With the lack of irrigation systems for the fairways and roughs, native browntop dominates the golf course in most cases. The golf courses play fast and firm on sometimes-dormant bentgrass fairways, while *Poa annua* often does not have the opportunity to make a strong foothold compared to courses with the added expense of an irrigation system.

3. The New Zealand Sports Turf Institute agronomists. This group of highly trained turf consultants ranks as high as any group of agronomists in the world. Those responsible for the maintenance of golf courses, sports fields, and lawn bowling are very fortunate to have the services of these individuals at a very affordable cost.

4. Reasonable putting green mowing heights. This is another area where overseas TV is causing a negative change in New Zealand golfing circles. By maintaining slightly high mowing heights while striving for smooth, rather than fast, surfaces, the native browntop bents continue to thrive. Unfortunately, the desire for fast greens, as seen on Sky TV, is beginning to change green populations to higher percentages of annual bentgrass. The combination of green color and fast greens does not bode well for the future of golf in New Zealand if affordable golf remains the ultimate goal!

5. Minimal chemical usage. With the lack of fairway irrigation, slightly higher putting green mowing heights, low cost of golf, a generally benign climate, and lower expectation levels by the players, golf in New Zealand does not require the chemical inputs that are common at high-budget courses in the United States. Chemicals are used; however, environmental issues currently are of no great concern. If the current trend toward the color green continues, the increased use of water and plant protectants will inevitably lead to environmental questions.

6. Reduced fertilizer use. As with the use of chemicals, fertilizers are used far less in New Zealand than in the U.S. By providing minimal inputs to turf growth, labor costs and mowing requirements can be controlled. Unfortunately, as the game becomes increasingly popular and green the color most desired, fertilizer usage and costs will escalate, thus moving New Zealand further from affordable golf.

7. The lack of motorized power carts. Let's face it. Power carts are here to stay in the U.S., but we should not be exporting the idea that golf is meant to be played while riding! Golf is meant for walking, and that is what New Zealand golf is all about. What a refreshing change to see virtually every player walking the course, carrying on a conversation between shots, and getting exercise at the same time. Also, the endless ribbons of gravel, asphalt, and concrete are certainly not missed!

8. The lack of automatic irrigation systems. The overall climate in New Zealand is very similar to the Pacific Northwest. Given the mild climate and the desire to make golf affordable, many golf courses in New Zealand do not possess automatic irrigation systems for the fairways and roughs. While some of the expandable clays can make playing conditions unacceptable, the alternate solution of automatic

With natural features like these, who needs bunkers, water, or trees?

irrigation will ultimately lead to the ruination of golf in New Zealand as it is played today! Bold words, indeed; however, consider the initial positive point about affordable golf. As soon as an automatic irrigation system is installed, the expectation levels of the players will rise accordingly. The superintendent will be put under great pressure to produce a green golf course, thereby leading to overwatering, overfertilizing, increased annual bluegrass, increased chemical usage, and a golf course that will play much longer than in "the good old days." Costs will rise substantially, and affordable golf will cease to exist. Only those who resist the temptation of overusing the new irrigation system will have a chance to keep costs in line!

9. Good playing conditions are provided with very little funding. The golf course superintendents in New Zealand must be hard working, resourceful, and willing to put up with more than their American counterparts. Staff sizes generally run from one to three, with five to six representing the extreme. Many courses have only two or three mowers for the entire 18 holes. Budgets are well under $100,000 NZ (about $70,000 U.S.). Salaries are low, and many superintendents are not even invited to the green committee meetings! Despite all of this, superintendents produce playing conditions that are quite good, and in some cases, superior to those found in the U.S. If the trend continues, the "bump and run" may become the "bump and splat"!

10. Many courses are maintained by sheep. Where else can you go where virtually every small town has golf at a rate that is affordable for all levels of income? By combing nature's lawnmowers and allowing local rules to dictate preferred lies, golf in its truest form can be enjoyed without the high cost of mowers, fertilizer, chemicals, and labor. While many of the sheep-grazed courses may not be mistaken for Augusta National, they do present exactly what golf is all about — camaraderie, challenge, and fun!

Is the grass always greener on the other side? It is if you are comparing the color of golf in America to New Zealand. But is this right? Should golf be played on immaculate fields of green that cost hundreds of thousands of dollars, or is it meant to be more affordable and more rough around the edges? Every golf course must answer this question individually, but I, for one, believe the Kiwis have it right!

LARRY GILHULY *is the Western Director for the USGA Green Section. He provides information on golf course management from the Alaskan fjords to the swaying palms of Hawaii, with the Pacific Northwest in between.*

The turbulence created as water passes the end of the wall that is used to control shoreline erosion will begin to back-flush soil from behind the structure. This process is exacerbated when flood waters flow over the top of the wall. In the end, these walls usually collapse, or the soil behind them must be continually replaced.

TAMING WILD WATERS

Using soft engineering principles to control erosion and create a wildlife habitat.

by LON MIKKELSEN

WHO AMONG US has not had a perfect round of golf spoiled by an errant shot landing in a water hazard? The truth is, most golfers consider streams and lakes to be nothing more than obstacles. In fact, if it weren't for the occasional complaint about the grass not being mowed to the water's edge, golfers probably would not give water hazards any serious thought.

In reality, streams often play multiple roles in the golf course landscape. The most obvious is that they are used by golf course architects to add challenge to the course layout. As significant as this role is to the game, an even more important role is the ability of a stream to contain and release surface and subsurface runoff water from the course.

For a stream to function properly in the golf course landscape, certain criteria should be taken into account during its design and routing. These criteria can be broadly divided into two categories — structural and environmental.

From a structural perspective, the design of a stream should take into consideration shoreline erosion, sediment accumulation, cost of maintenance, public safety, ground stability around bridge foundations, and downstream flooding. From an environmental perspective, wildlife habitat, noxious weed proliferation, and the transport of pesticides and fertilizers are crucial concerns.

Until recently, the relationship between structural and environmental design criteria was either discounted or, worse yet, completely ignored. This failure gave birth to single-objective designs that, in many cases, have had recurring financial consequences.

Single-objective designs are those that take into consideration a single criterion and generally ignore the multitude of forces that cause a stream's personality to change over time. Using structural criteria, an example of a single-objective stream design would be one that focuses on shoreline erosion above all other criteria. This design is very common and can be found on most golf courses. The conspicuous feature of this design is a fixed, vertical wall constructed with available materials, such as gabion cages, concrete or railroad ties.

The Achilles' heel of a fixed, vertical wall is that it sometimes limits the cross-sectional area of a stream channel during peak flow. This limitation causes the velocity of the water to increase through the restricted area. By increasing the velocity of the water, it has a greater capacity to pick up sediment, thereby down-cutting the streambed. After several flood cycles, the floor of the streambed is lowered and the water then begins under-cutting the foundation of the wall. If the foundation of the wall is not undermined because, for example, the streambed is solid rock, then the turbulence created as the rapidly moving water passes the end of the wall will begin to back-flush soil from behind the wall. This process is exacerbated when flood water also spills over the top of the wall. In the end, walls used to control shoreline erosion eventually collapse, or the soil behind them must be replaced continually.

Problems also can develop by using single-objective design criteria. A case in point would be the artificial creation of spawning areas for various fish species. If the hydrology of the stream is not fully understood, the spawning areas could quickly disappear. In the process of creating these spawning areas and other wildlife habitat, the stream channel is usually modified. During normal storm events, the stream acts like a conveyor belt, dropping sediment into the spawning areas.

The starting point for designing a successful stream or restoring a degraded one is to examine the drainage basin (watershed) on which the golf course resides. Keep in mind that the size and shape of a stream channel are largely influenced by the characteristics of the watershed.

Prior to urbanization, a watershed has the capacity to store, and then slowly release, large quantities of surface runoff — much like a sponge. As urban development occurs, the characteristics of a watershed (i.e., the water's routing, volume, and velocity) usually change. In developing or urbanized landscapes, watersheds tend to lose their retentive ability as an increasing percentage of rainfall lands on impervious surfaces, such as rooftops and pavement. Once in contact with these surfaces, the water usually is intercepted by a pipe or ditch that routes it directly to a nearby stream. The cumulative effect of decreased water retention throughout a watershed can greatly increase the peak flow of the receiving stream channel. Thus, the impact of urbanization on waterways has ranged from minor stream bank and shoreline erosion to catastrophic flood damage and stream channel degradation.

Except for direct modifications by man, streams change in response to drainage events, which are caused by storms and intensified by urbanization. While the interval between storms is somewhat erratic, the pace of urbanization proceeds at a relatively steady rate. Thus, changes in a stream's hydrological personality are somewhat predictable, but may lag behind urbanization's effect on storm water drainage. In addition, it often takes many drainage events before urbanization changes are fully manifested in stream channels.

Many of our watersheds are now undergoing a rapid rate of change. The unsteady nature of an urbanized stream causes more than channel alterations. It forces a change in the way golf courses are managed. Green committees, superintendents, and golf course architects have to reevaluate course play, infrastructure, and course layout.

These reevaluations are necessary when the current hydrology (stream flow) is no longer supported by the stream channel. The old stream channel must adjust to increase its capacity to convey flows resulting from altered hydrology. Channel widening and down-cutting, bank erosion, sediment deposition, loss of vegetation, and undermining of bridge and wall foundations are just a few of the responses one can expect from a stream's changing hydrological personality.

Added to the typical structural problems is an increasing awareness of environmental issues and a need to incorporate them into any restoration project. Creating and maintaining buffer zones along streams and lakes to lessen the impacts of pesticides and fertilizers, erosion and sediment control, and creating or enhancing habitat for fish and wildlife are just a few considerations imposed on course managers when designing or undertaking stream and lakeside restoration projects.

Realizing the potential effects of urbanization on a watershed, it may be helpful to work with city, county, and state agencies and planning boards. By working in a cooperative manner, the peak flow down a water channel can be controlled by periodically storing storm water in available flood plains. Such flood plains can be incorporated into a watershed by including them in the design of parks and golf courses, or by adding retention reservoirs downstream from large impervious surfaces, such as shopping mall parking lots.

Traditional methods of preventing bank erosion are becoming outdated in many cases, since they do not address a full list of structural and environmental concerns. The challenges posed to design and restoration professionals have developed into a need to provide multi-objective designs that resist erosion and address environmental concerns. The development of soft engineering principles is a natural outcome of these events.

Soft engineering is based on the philosophy of working with nature by examining a stream's natural communicators and understanding its hydrological personality, both present and future. To prevent catastrophic shoreline erosion and create a stable wildlife habitat, construction materials must be selected for each section of a stream channel based on the water velocity and flow characteristics. After the stream channel has been constructed, a broad range of native riparian vegetation must be established to provide a highly resistant erosion barrier.

In some cases, the fundamental elements of soft engineering must be adjusted to avoid conflict with golf course management considerations. These considerations include the pruning of vegetation to prevent obstruction of play, shading of greens and tees, and/or maintaining viewing corridors. The merits of soft engineering designs include relatively low-cost erosion protection, habitat enhancement, water quality improvement, and a natural appearance.

Designing stream channels that are a true asset to the architectural theme of a course, that resist shoreline erosion, and provide valuable wildlife habitat is an ominous challenge. To be successful, the design must consider multiple structural and environmental objectives. If these objectives are not carefully balanced using soft engineering principles, the eventual result will be a catastrophe — either structural or environmental.

LON MIKKELSEN *is a principal with Inter-Fluve, Inc., located in Hood River, Oregon. Over the past 12 years, Inter-Fluve, Inc., has restored or created more than 350 miles of stream channels and hundreds of acres of lakes and wetlands in urban and rural environments.*

GREEN SPEED PHYSICS

The laws of physics applied to golf course maintenance practices.

by ARTHUR P. WEBER

MOST ALL putting greens are neither level nor plane, some being more or less severely contoured and sloped than others. Consequently, Stimpmeter readings, taken over such dissimilar surface profiles, correlate differently as a linear measure of green speed. That is to say, green speed ratings, popularized as they have been by averaging Stimpmeter measurements taken on reasonably level greens, do not fairly and accurately serve as speed indices common to all putting greens. Rather, by preparing an "as built" green to Stimpmeter readings adjusted for its inherent angularities, uniformity of speed can prevail from green to green, stabilizing the composures of golfers and green superintendents in the process.

By mathematically interpreting the physics fundamental to a golf ball rolling over a putting green upon release from a Stimpmeter, indices are derived, as angularity-consistent measures of speed rating characteristic of "as-built" slow-to-fast greens. These indices are graphically plotted to facilitate their use by golf course superintendents, golf committees, tournament officials, and the like.

Modeling Golf Ball Roll

The coefficient of friction between a golf ball and the putting green surface over which it rolls can be quantified by using a Conservation of Energy model as the computational basis for analysis. Stimpmeter measurements, supplemented by green slope measurements over which the Stimpmeter readings are made, are fundamental to the applicability of such an analysis to all putting greens, no matter their angularities or undulations, however severe.

When coefficient of friction values result from Stimpmeter measurements either taken on or normalized to level greens, the measurements range from a low of about 6 feet for what are categorized to be slow greens to a high of about 12 feet for fast greens. But therein lies a rub, because all greens are not level; rather, they are architecturally contoured with slopes, if not marginally, for drainage. Moreover, few putting green slopes are unidirectional; most are compound contoured. Notwithstanding, golf course putting green speeds can be equalized and controlled, over the full range of slow-to-fast, by correlating Stimpmeter and putting green slope readings to coefficient of friction values. Said another way, using Stimpmeter measurements made on level greens as numerical benchmarks to characterize slow-to-fast greens, Stimpmeter readings can be indexed for all 18 golf course greens, having first surveyed their angularities, to comparatively measure up to a desired benchmark speed.

Coefficient of Friction

For the purpose of the analysis, the coefficient of friction can be generalized to encompass, without distinction, the static, dynamic, and rolling coefficients of friction that prevail during the putt of a golf ball starting at rest and rolling to a stop. It can be normalized to an all-inclusive parameter because of its dependence on many variables. Among them, the most influential of which would be the height of cut, are the morphological and growing characteristics of the turfgrass species, the turf density and uniformity, the thatch layer, the dimpling pattern and the construction of the golf ball, the season, the wetness, even the time of day.

Despite the influence of these variables and others, the green speeds of "as built" undulating greens can, with reasonable accuracy, be articulated and prepared analogous to the benchmark green speed indices from Stimpmeter measurements taken on level greens.

Level Putting Surfaces

The mathematical parameters and variables affecting the energy conservation relationships, when making Stimpmeter measurements on a reasonably level putting surface, are depicted in Fig. 1, where:

W = weight of golf ball, 1.62 oz.

H = height of Stimpmeter notch above horizontal upon golf ball release, in.

Θ = angularity of Stimpmeter notch above horizontal upon golf ball release, 20.5 deg.

L = Stimpmeter length, 36 in.

V_1 = initial golf ball velocity across the putting surface from the foot of the Stimpmeter, ft./sec.

V_0 = final velocity of golf ball after rolling across the putting surface to a stop, zero

$\bar{S}$ = Stimpmeter reading, ft.

f = coefficient of friction between rolling balls and the putting surface, dimensionless

g = gravitational acceleration constant, 32.2 ft./sec.

Only $\bar{S}$ and f, as a function of $\bar{S}$, are variable; the other parameters, in addition to W, Θ, L, and g, remain constant, to wit:

$$H = L \sin \Theta \quad (1)$$

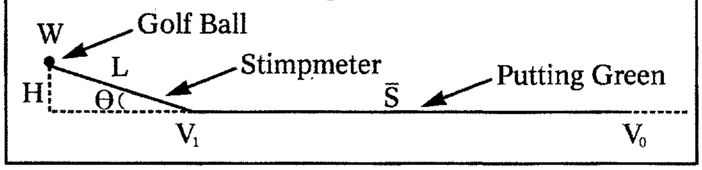
$$= (36)(\sin 20.5) = (36)(0.350) = 12.6 \text{ in.}$$

and subsequently, the total Potential Energy, PE, stored in the golf ball prior to release down the Stimpmeter is:

$$PE = WH \quad (2)$$

$$= (1.62)(12.6) = 20.4 \text{ in.-oz.}$$

Figure 1



but only a part of which becomes vectorially carried horizontally as an equivalent Kinetic Energy, KE, at velocity, V_1, or:

$$KE = PE \cos \Theta \quad (3)$$

$$= (20.4)(\cos 20.5) = (20.4)(0.937) = 19.1 \text{ in.-oz.}$$

the remaining potential energy 20.4 - 19.1 = 1.3 in.-oz. being dissipated as the golf ball impacts vertically to the putting surface from the foot of the Stimpmeter. However:

$$KE = \frac{1}{2}\frac{W}{g} V_1^2 \quad (4)$$

or

$$19.1 = \frac{1}{2} \frac{1.62}{(32.2 \times 12)} V_1^2$$

$$V_1 = \sqrt{\frac{(19.1)(2)(32.2)(12)}{1.62}} = 95.5 \text{ in./sec.}$$

The Kinetic Energy is all dissipated by frictional resistance as the golf ball rolls to a stop from V_1 to V_0 along the Stimpmeter reading. Hence:

$$KE = W\bar{S}f \quad (5)$$

or

$$19.1 = 1.62\bar{S}f$$

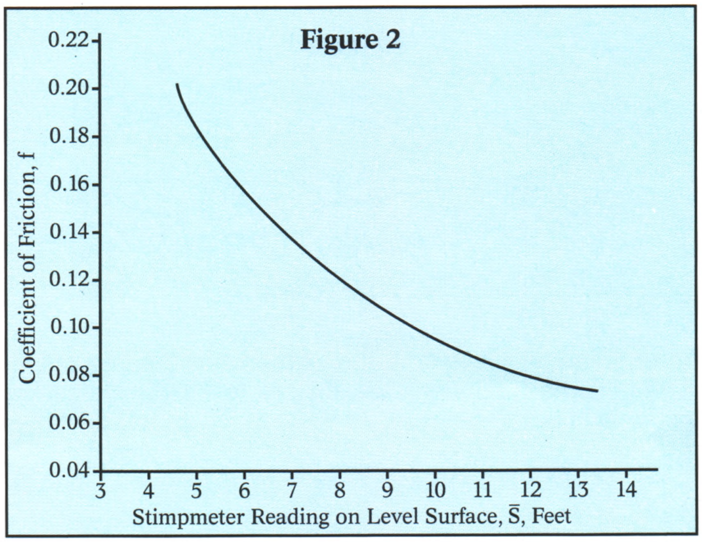
and transposing the coefficient of friction as a function of the Stimpmeter reading is signified by:

$$f = \frac{(19.1)}{12} \frac{1}{(1.62\bar{S})} = \frac{0.983}{\bar{S}} \quad (6)$$

Typical calculated values deriving from Equ(6) are:

$\bar{S}$, feet	f
5.0	0.197
6.0	0.164
8.5	0.116
11.0	0.089
12.5	0.079

These values can be plotted (see Fig. 2) to establish the coefficient of friction, f, for all Stimpmeter readings, $\bar{S}$, taken on a reasonably level surface.



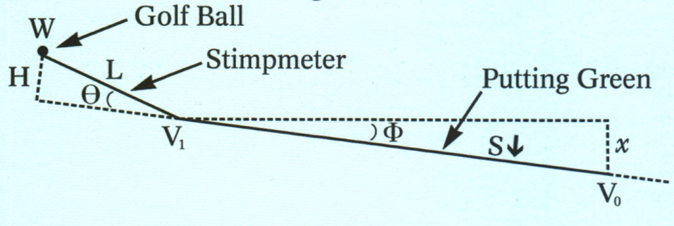
Obtaining a realistic Stimpmeter reading on a green that is not level provides challenges to get a number that is representative of the true surface conditions.

Downsloped Putting Surfaces

A similar analysis can be made for a downsloped putting surface, as depicted in Fig. 3. As before, the Potential Energy initially being carried vectorially by the golf ball, as it rolls off from the base of the Stimpmeter, = WHcosΘ. However, as the ball rolls down along the slope to its stopping point, where $V_0 = 0$, additional PE is acquired by the golf ball the steeper the downslope angle Θ, the value of which is:

$$= WX \cos \Phi \qquad \textbf{(7)}$$

Figure 3



Accordingly, where S↓ is the Stimpmeter reading taken downhill, the total Potential Energy to be dissipated by friction will be:

$$WH \cos \Theta + WX \cos \Phi = WS{\downarrow}f \qquad \textbf{(8)}$$

But,

$$X = S{\downarrow}\sin \Phi \qquad \textbf{(9)}$$

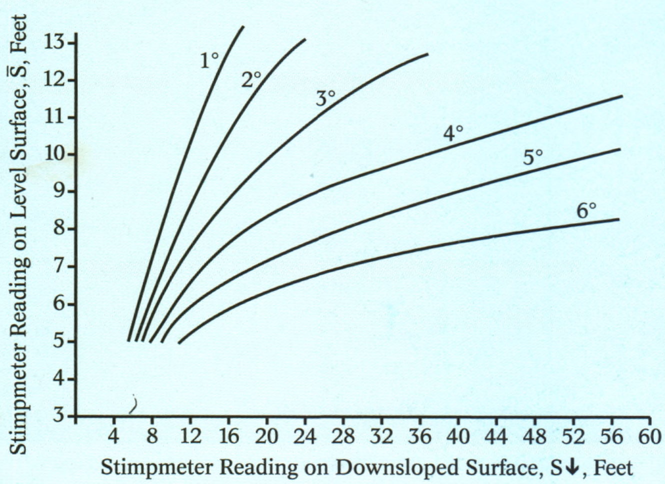
Or,

$$WH \cos \Theta + WS{\downarrow} \sin \Phi \cos \Phi = WS{\downarrow}f \qquad \textbf{(10)}$$

And, canceling W out of each term of Equ. 10 and substituting the value of the fixed parameters, H = 12.6 inches and cos 20½° = 0.937,

$$S{\downarrow} = \frac{(12.6 \times 0.937)}{f - \sin\Phi\cos\Phi} = \frac{11.8}{f - \sin\Phi\cos\Phi} \qquad \textbf{(11)}$$

Figure 4



From the afore-calculated values of the coefficient of friction, f, over a range of slow to fast Stimpmeter readings taken on a level putting surface, S̄, the following equivalent values of S↓ can be calculated from Equ. 11, based upon the prevailing downslope angle.

	S̄	S↓					
f	**0°**	**1°**	**2°**	**3°**	**4°**	**5°**	**6°**
0.197	5.0	5.48	6.07	6.78	7.74	8.94	10.8
0.164	6.0	6.71	7.62	8.78	10.5	12.8	16.4
0.116	8.5	9.98	12.1	15.4	22.1	33.9	81.9
0.089	11.0	13.8	18.2	26.6	51.8	492	∞
0.079	12.5	16.0	22.3	36.4	109	∞	∞

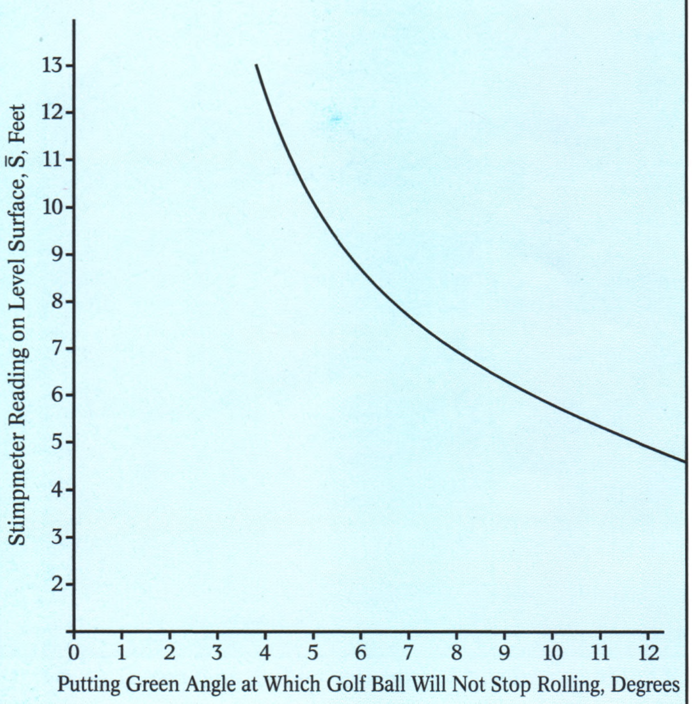
Again, these calculated values can be plotted as a family of curves representing the tabulated downslope angles and interpolated in between to establish downhill Stimpmeter readings and, therefore, putting green speeds comparable to such readings and speeds on a level surface. See Fig. 4.

The calculated Stimpmeter reading becomes infinite, ∞, e.g. the ball will not stop rolling downhill, when in Equ. 11 sin Φ cos Φ becomes equal to or greater than the coefficient of friction, f. Then

$$S{\downarrow} = \frac{11.8}{f - \sin\Phi\cos\Phi} = \frac{11.8}{0} = \infty \qquad \textbf{(12)}$$

From Equ. 12, the following tabulation can be made of the maximum or limiting downslope angles at which a ball will not stop rolling versus the coefficients of friction that prevail on slow to fast feel putting surfaces.

Figure 5



f	$\bar{S}$	Limiting Downslope Angle
0.197	5.0	11° - 40'
0.164	6.0	9° - 40'
0.116	8.5	6° - 30'
0.089	11.0	5° - 10'
0.079	12.5	4° - 30'

These values are plotted in Fig. 5 to establish the limiting downslope angles for all values of $\bar{S}$.

Upsloped Green Surfaces

Conversely, for golf balls rolling uphill, Stimpmeter reading S↑, Equ. 12 becomes

$$S\uparrow = \frac{11.8}{f + \sin\Phi\cos\Phi} \qquad \textbf{(13)}$$

Again, the following equivalent values of S↑ can be calculated and plotted in Fig. 6 from Equ. 13, based upon the prevailing upslope angle.

	$\bar{S}$	S↑					
f	0°	1°	2°	3°	4°	5°	6°
0.197	5.0	4.57	4.24	3.95	3.68	3.46	3.27
0.164	6.0	5.40	4.94	4.55	4.20	3.92	3.67
0.116	8.5	7.34	6.51	5.85	5.29	4.84	4.47
0.089	11.0	9.19	7.93	6.97	6.18	5.59	5.09
0.079	12.5	10.1	8.63	7.51	6.60	5.8	5.37

Comparison of Fig. 6 with Fig. 4 graphically demonstrates how downslope has a much more pronounced effect upon the Stimpmeter reading than does upslope, especially the faster the green is maintained. Although Stimpmeter measurements made on the upslope, being shorter, are simpler to measure, downslope values, being substantially longer and as a consequence more sensitive to measurement, more appropriately serve to characterize green speed for the golfer.

The Brede Formula

By merging Sir Isaac Newton's motion equations for the up and down slope movements of objects into one equation, A. Douglas Brede developed the following formula (*USGA Green Section Record*, November/December 1990):

$$\text{Green Speed Corrected for Slope} = \frac{2 \times S\uparrow \times S\downarrow}{S\uparrow + S\downarrow} \qquad \textbf{(14)}$$

Application

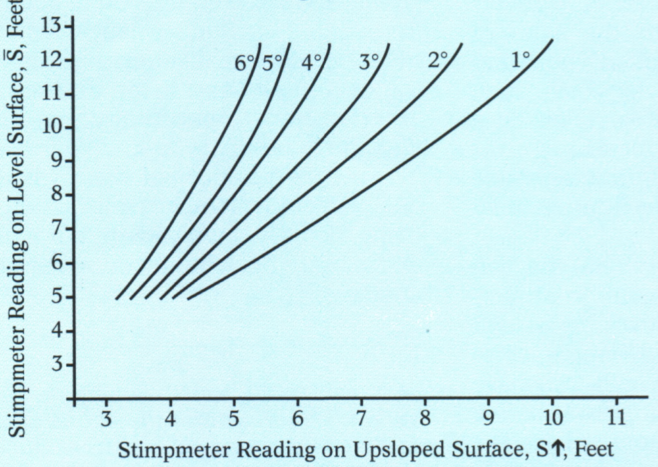
Both the conservation of energy model and the Brede formula have been validated by actual measurements. The conservation of energy model, by including green slope as a variable in calculation, serves to beforehand, having decided upon a desired Stimpmeter speed rating, establish the downhill and/or uphill Stimpmeter readings to which the putting greens need to be prepared. The Brede formula serves, only after the fact, to establish the speed reading that would have prevailed on a level green where, because of green slopes, the traditional two-direction average method would have resulted in an incorrect speed rating.

To measure green slope, a two-man sight-level survey or team need not be used. Instead, one of the new electronic leveling devices, such as a one-man "Smart Level" with a digital readout accurate to ±0.1 degrees serves the purpose. Like the Stimpmeter, it is a simple and fast tool to use.

The sets of curves included in Figs. 4, 5, and 6 define for the golf course superintendent, tournament committees, players, and the like the Stimpmeter readings that should prevail, knowing from prior measurement the angularity of the greens, to control putting speed by indexing these readings to the generally accepted slow-to-fast speed characterizations that result from Stimpmeter measurements made on level greens. For example, at any one golf course, particularly one built with undulating and/or steeply sloped greens, the angularities built into each green can be sectioned and mapped. One of the mapped sections, reasonably consistent in its direction and degree of slope, can then be selected as the basis for Stimpmeter measurement. One or more such sections from the same and other of the putting greens can be similarly selected for Stimpmeter measurement as a check that all are mowed and otherwise groomed consistently in putting speed with each other. As a permanent record, each of the mapped sections can be supplemented with a tabulation of its characteristic green speed versus Stimpmeter readings from Figs. 4, 5, and 6.

Downslope has a much more pronounced effect upon Stimpmeter measurements than does upslope — the steeper the slopes and the faster the cuts, the greater the relative difference. Generalizing, slow-to-medium speed greens, say Stimpmeter reading 5 to 8 on a level green, although they may be undulated upward of 5 to 6 degrees remain reasonably manageable by the golfer. Medium-to-fast greens, say 8 to 12 Stimpmeter reading on a level green, start destabilizing the nerves of golfers when angled upwards of 3 to 4 degrees. Otherwise stated, markedly undulated golf greens, typical of most time-honored courses, would be better maintained with medium-to-slow speed greens, as they had been architecturally conceived to challenge golfers by their contours, not their slickness. To cope with fast greens, surface angularities need be attenuated in fairness to playability by the golfer and, lest we forget, maintenance by the superintendent.

Figure 6



ARTHUR P. WEBER, *a chemical engineer by training, has given generously of his time to golf as a USGA Green Section Committee member since 1984. He is a former green chairman of Old Westbury Golf and Country Club, Old Westbury, New York, and past president of the Metropolitan Golf Association.*

Golf Course Real Estate For Wildlife

A nest box program on your course can have many benefits for wildlife and golfers.

by RON DODSON

NESTING BOXES can be a rewarding component for managing wildlife on the golf course. Nest boxes also can be an important way to educate golfers about wildlife on the golf course and your efforts to promote various species in golf course management activities.

Some of the most common and delightful bird species are cavity nesters. Unfortunately, many golf course maintenance practices promote keeping trees trimmed, thinning out dead or dying trees, and planting new trees in which natural cavities rarely have a chance to develop. By placing artificial cavities (nesting boxes) around the course, you can usually entice birds such as wrens, chickadees, purple martins, bluebirds, screech owls, and kestrels to use the course for nesting. In addition, placing nesting shelves and wire mesh cones will encourage robins, phoebes, and mourning doves to do the same.

Nest Box Construction

Nest box construction doesn't have to be a complicated undertaking. As a matter of fact, the simplicity of most designs makes construction easy. Scrap wood is adequate for most nesting boxes; however, avoid using plywood because the wood separates after a few seasons.

Most nesting boxes do not need a perch. More often than not, a perch will attract curious and pesky sparrows to the entrance hole. The aggressive nature of this species is too competitive to allow more desirable species such as wrens and chickadees to take up residence. Make sure the side or front of the box is easily removed for ease in cleaning out sparrow nests and cleaning the box in preparation for spring. The color of the box is not very important, but natural tones are preferred for most species. Painting the boxes isn't really necessary — a stain or well-weathered wood will work just fine. For a few species, like the wood duck, it is essential to put sawdust, wood chips, or other nesting material in the box.

Placing and Maintaining Nest Boxes

The types of habitat on your course are an important consideration in knowing what birds you can expect to attract. The accompanying chart provides information about the likelihood of attracting certain species depending on whether your golf course is located in a city, suburb, or rural setting. The chart also provides information about nest box construction dimensions and placement specifications for a variety of common species frequently found on golf courses.

Purple martins enjoy their new home. A properly constructed and positioned nest box stands an excellent chance of attracting the desired species.

Nest box placement is an important aspect of successfully attracting birds. Bluebirds prefer a low site in relatively open country, such as the sides of fairways. On the other hand, wrens and chickadees prefer heavier cover, such as a small woodlot area. Flickers, a rather common woodpecker, go for the high-rise style, so find a large tree where you can place the house 8 to 20 feet from the ground.

Placing nest boxes where you can easily watch is half the fun in attracting the birds to the boxes. Most golf course birds don't mind living in close proximity to people. You'll also have the chance to discourage wandering cats or other predators when the houses are located close by.

For older nest boxes, a spring house cleaning is usually in order. Soap and hot water are necessary for removing old droppings or mites. After nest boxes are cleaned, you may want to plug the entrance holes to keep out starlings or sparrows. When a desirable occupant is observed inspecting the house, the entrance hole can be opened. It's surprising that some birds almost have a sixth sense in knowing a human benefactor will soon open the house for nesting use.

The Benefits of a Nest Box Program

Golf course superintendents sometimes feel that a nest box program is a low priority and something they simply don't have time to do. What you need to remember is that it is a highly visible program. Not only can you frequently obtain help from members of the club, you also can encourage community involvement that serves as another source of good public relations.

A nest box program can serve as an educational and community service project for young people. Frequently, a phone call to a local scout troop, a local elementary, middle, or high school, or a 4-H club will provide you with the human resources you need to build and monitor the nest boxes.

A nest box program not only benefits the golf course aesthetics by encouraging more bird species, it also educates golfers about the efforts you're making for wildlife habitat enhancement. It helps develop positive relationships in the community and it can be used as an educational opportunity that may encourage others to follow your lead. Not the least important benefit is the personal enjoyment and satisfaction of being actively involved in attracting and observing wildlife on your golf course.

RON DODSON *"nests" in Selkirk, New York, where he guides the efforts of the Audubon International and its Audubon Cooperative Sanctuary System.*

NEST BOX BUILDING GUIDE

Species	House & Hole Dimensions	Placements	Colors	Likelihood: Urban	Likelihood: Suburb	Likelihood: Rural	Control: Sparrow	Control: Starling	Special Notes
House Wren	4" × 4" or 4" × 6" base × 8" high. Hole 1" centered 6" above floor.	Post 5' - 10' high or can be hung in tree. 60% sun.	White, earth tones	Good	Excellent	Excellent			Easiest to attract of all native birds.
Chickadee	4" × 4" or 5" × 5" base × 8" high. Hole 1½" centered 6" above floor.	Post 4' - 8' high. 40% - 60% sun.	Earth tones	Good	Good	Excellent			Easier to attract than formerly thought. Needs large tree in area.
Tree Swallow	5" × 5" base × 6" high. Hole 1½" centered 4" above floor.	Post 5' - 8' high in open area. 50% - 100% sun.	Earth tones, gray	Poor to fair	Fair to good	Good to excellent	●		Proximity to lake or pond (within 2 miles) a must! Rural areas.
Violet-green Swallow	5" × 5" base × 6" high. Hole 1½" centered 4" above floor.	Post 5' - 8' high in open area. 50% - 100% sun.	Earth tones, gray	Poor to fair	Fair to good	Good to excellent	●		A western bird exclusively. Suburbs.
Purple Martin	Multiple compartments 6" × 6" × 6". Hole 2½" with base of hole 2¼" from floor.	Post 15' - 20' high in open.	White			Fair to excellent	●	■	Open yard with no tall trees is best. Proximity to water is important.
House Finch	6" × 6" × 6". Hole 2".	Post 8' - 12' high. 40% - 60% shade.	Earth tones	Fair	Fair	Fair	●	■	A western bird, common in some eastern areas. Suburbs.
Bluebird	5" × 5" base × 8" high. Hole 1½" centered 6" above floor.	Post 3' - 5' high in open. Sunny.	Earth tones	Poor	Fair	Excellent	●		Likes open area, especially facing a field. Rural areas.
Tufted Titmouse	4" × 4" base × 8" high. Hole 1¼".	Post 4' -10' high. Sun or shade.	Earth tones	Fair	Fair to good	Excellent	●		Prefers to be near or in wooded area.
Flicker	7" × 7" base × 18" high. Hole 2½" centered 14" above floor.	Post 8' - 20' high.	Earth tones	Fair	Good	Good	●	■	Needs 4" sawdust for nesting.
Nuthatch	4" × 4" base × 10" high. Hole 1¼" centered 7½" above floor.	Post 12' - 25' high on tree limb.	Likes a natural cavity	Poor	Poor	Fair	●		Should be covered with bark. Rural areas.
Downy Woodpecker	4" × 4" base × 10" high. Hole 1¼" centered 7½" above floor.	Post 12' - 25' high on tree limb.	Likes a natural cavity	Poor	Poor	Poor	●		Prefers own excavations. Needs sawdust for nesting material. Rural areas.
Hairy Woodpecker	6" × 6" base × 15" high. Hole 1½" centered 7½" above floor.	Post 12' - 25' high on tree limb.	Likes a natural cavity	Poor	Poor	Poor	●		Should be covered with bark. Rural areas.
Crested Flycatcher	6" × 6" base × 15" high. Hole 2" centered 6" - 8" from floor.	8' - 20' high on post or tree limb. Shade preferred.	Simulate woodpecker cavity	Poor	Poor	Fair	●	■	Needs secluded, private spot. Should be covered with bark. Rural areas.
Red-headed Woodpecker	6" × 6" base × 15" high. Hole 2" centered 6" - 8" from floor.	8' - 20' high on post or tree limb. Shade preferred.	Simulate woodpecker cavity	Poor	Fair	Fair	●		Needs sawdust for nesting material.
Wood Duck	10" × 10" base × 24" high. Hole should be an ellipse 4" wide × 3" high, centered 20" above floor, excluding most raccoons.	On post 2' - 5' over water or on tree, 12' - 40' high.	Earth tones	Poor	Poor	Good		■	Shavings or sawdust 3" - 4" needed for nesting if wetlands or lake within ¼ mile, wood duck will explore most nearby habitat.
Sparrow Hawk (Kestrel)	10" × 10" base × 24" high. Hole should be an ellipse 4" wide × 3" high, centered 20" above floor, excluding most raccoons.	On post 2' - 5' over water or on tree, 12' - 40' high.	Earth tones	Poor	Poor	Fair		■	Open approach needed. Box should be on edge of woodlot or in isolated tree.
Screech Owl	10" × 10" base × 24" high. Hole should be an ellipse 4" wide × 3" high, centered 20" above floor, excluding most raccoons.	On post 2' - 5' over water or on tree, 12' - 40' high.	Earth tones	Poor	Poor	Fair		■	Prefers open woods or edge of woodlots.
Robin	6" × 6" base × 8" high. Roof required for rain protection.	On side of building or on arbor.	Earth tones, wood	Fair	Fair	Fair			Use is irregular.
Barn Swallow	6" × 6" base × 8" high. Roof required for rain protection.	On side of building or on arbor.	Earth tones, wood	Poor	Fair	Excellent			Prefers open country.
Phoebe	6" × 6" base × 8" high. Roof required for rain protection.	On side of building or on arbor.	Earth tones, wood	Poor	Fair	Fair			Likes water best.

Darin Bevard Joins Green Section Staff

Darin S. Bevard

Darin S. Bevard has joined the USGA Green Section staff as agronomist for the Mid-Atlantic Region. Darin will work with Stan Zontek and Keith Happ visiting golf courses throughout the five-state region as a part of the Green Section's Turf Advisory Service.

His work experience at several Maryland golf courses will serve him well in the challenges of maintaining turf in the transition zone. Most recently, Darin was the assistant superintendent at Talbot Country Club in Easton, Maryland. He also was involved in course maintenance during the grow-in at Old South Country Club, in Lolhiam, Maryland, and worked on the crew at Harbourtowne Country Club in St. Michaels, Maryland.

Darin received his B.S. and M.S. degrees from Penn State University. Dr. Tom Watschke served as his major professor for his master's degree as he investigated weed control in newly established turfgrass. During his last year of study, he was awarded the Pennsylvania Turfgrass Council Scholarship for outstanding graduate work.

Darin will relocate with his wife, Katie, to West Chester, Pennsylvania.

Schedule Now and Be Budget-Wise

More than a few pennies can be saved by marking an important date on your 1997 calendar.

Golf courses subscribing to the Green Section's Turf Advisory Service (TAS) will receive a $300 discount for full-day and half-day visits if the payment is received at Golf House on or before May 15, 1997. The fees have remained the same for the 1997 season. Contact your regional agronomist soon to schedule your 1997 TAS visit.

1997 Turf Advisory Service Visits

	After May 15	*Early Payment*
Half-day visit	$1,200	$900
Full-day visit	$1,700	$1,400

Physical Soil Testing Laboratories*

The following laboratories are accredited by the American Association for Laboratory Accreditation (A2LA), having demonstrated ongoing competency in testing materials specified in the USGA's Recommendations for Putting Green Construction. The USGA recommends that only A2LA-accredited laboratories be used for testing and analyzing materials for building greens according to our guidelines.

BROOKSIDE LABORATORIES, INC.
308 S. Main Street, New Knoxville, OH 45871
Attn: Mark Flock • (419) 753-2448 • (419) 753-2949 FAX

THOMAS TURF SERVICES, INC.
1501 FM 2818, Suite 302, College Station, TX 77840-5247
Attn: Bob Yzaguirre / Jim Thomas • (409) 764-2050 • (409) 764-2152 FAX

TURF DIAGNOSTICS AND DESIGN
310-A North Winchester, Olathe, KS 66062
Attn: Chuck Dixon • (913) 780-6725 • (913) 780-6759 FAX

*Revised October 21, 1996. Please contact the USGA Green Section (908-234-2300) for an updated list of accredited laboratories.

Zontek Receives Award

Stanley Zontek

Stanley Zontek, director of the USGA Green Section's Mid-Atlantic Region, was presented with the Golf Course Builders Association of America (GCBAA) Don A. Rossi Humanitarian Award at the GCBAA's annual awards dinner held in conjunction with the GCSAA Conference in Las Vegas, Nevada.

The Don A. Rossi Humanitarian Award is given by the GCBAA in honor of the late Don A. Rossi, who was the executive director of the National Golf Foundation from 1970 to 1983, and of the GCBAA from 1984 until his death in 1990. It is presented annually to individuals who have made significant contributions to the game of golf and its growth, and who have inspired others by their example.

As a new Penn State graduate, Stanley joined the USGA Green Section in 1971 as agronomist for the Northeastern Region. In his 25+ years on staff, he has served as director of the Northeastern Region, the North Central Region, and in his most current position as director of the Mid-Atlantic Region. In addition to his ongoing responsibilities to the Turf Advisory Service, Stan has assisted in training nearly half of the current Green Section staff.

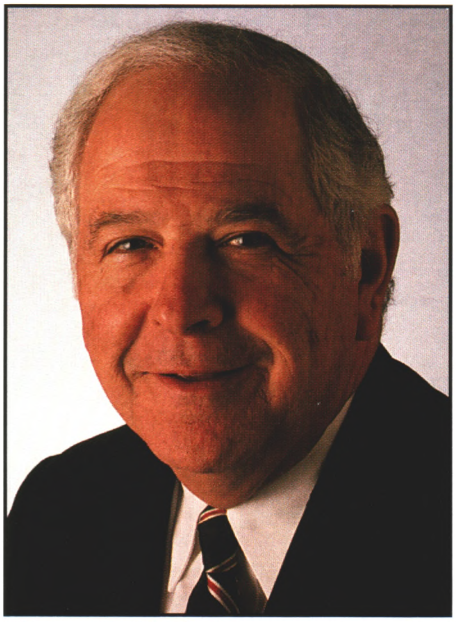
Stan gives freely of his time to the golf industry. In receiving his award he said, "Being named the 1997 Rossi Award recipient is one of the most pleasant shocks of my life." Congratulations, Stan, from all of your friends in golf.

Joe England Named Green Section Chairman

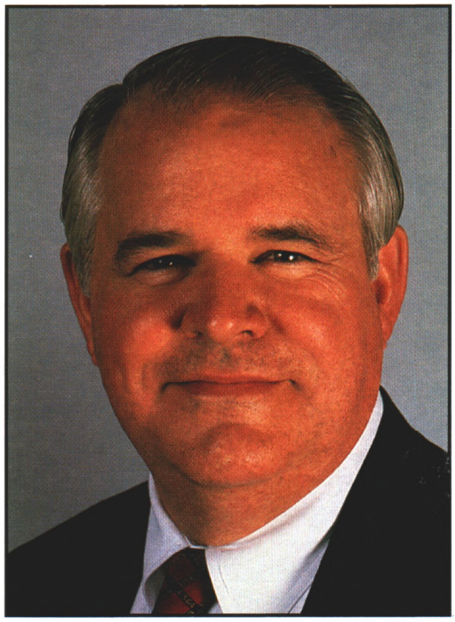
USGA President Judy Bell recently appointed Clarence McD. England III, better known as Joe England, to the position of Chairman of the Green Section Committee. A member of the USGA's Executive Committee since 1996, he replaces Thomas W. Chisholm, who is stepping down from the Executive Committee after a three-year stint as Green Section chairman and seven years on the Executive Committee.

Joe England is no stranger to the USGA. His dad spent three years on the Executive Committee in the mid-1960s. Joe followed in his footsteps as a member of the Green Section Committee (1982-84), and as a member of the Sectional Affairs Committee, before joining the USGA Executive Committee.

In his new position, Joe will provide guidance to the Green Section's many activities, including its Turf Advisory Service, the Turfgrass Research Program, and the Green Section's environmental efforts. He also will serve as chairman of the Green Section's Turfgrass and Environmental Research Committee and the Green Section Award Committee.



Thomas W. Chisholm



Joe England

Sincere thanks and best wishes are extended to outgoing chairman Tom Chisholm, whose tenure oversaw a significant expansion in the Green Section's communication efforts to highlight results from the USGA Turfgrass and Environmental Research Program. Tom also helped win approval by the Executive Committee to develop the new Construction Education Program and fund on-site testing of new bentgrass and bermudagrass varieties on golf course practice putting greens. Fortunately, Tom has volunteered to continue to serve on the USGA Green Section Committee.

First Green Section Internship Awarded

Andy Zimmerman

J. Andrew Zimmerman, a junior in the turfgrass program at the University of Illinois, was selected as the recipient of the first annual Green Section Summer Intern Scholarship.

The Intern program was established to give an undergraduate student, between his/her junior and senior years, the opportunity to spend eight weeks making Turf Advisory Service visits and participating in other Green Section summer activities. Each week will be spent with an agronomist in a different part of the country, including a week making research monitoring visits with Dr. Mike Kenna, director of Green Section research.

Andy brings a solid academic record and practical experience to the Intern program. As he completes his junior year at the University of Illinois, he is a regular on the Dean's List, and has yet to receive a grade lower than an A. He expects to complete his bachelor of science degree as an ornamental horticulture major in May 1998. Andy has worked for two years at Champaign (Illinois) Country Club. His future interests include becoming a golf course superintendent and possibly continuing his education in graduate school.

As part of the Intern program, Andy will conduct a survey to determine management objectives and performance of greens at the golf courses he visits.

The USGA funded the Intern program to provide an outstanding student the opportunity to learn about golf course maintenance from the perspective of the Green Section's agronomists. We believe this experience will have a lasting, positive influence on the student, regardless of the career path taken.

KTURF Calculation Correction

The article "KTURF: A Pesticide and Nitrogen Leaching Model," which appeared in the January/February 1997 issue of the *Green Section Record*, contained a calculation error in the examples given. The correct output values for the nitrogen and pesticide examples should have been 1% and 7%, respectively.

The KTURF model was developed by researchers at Kansas State University to estimate the percentage of applied nitrogen or pesticide that leaches through a 20-inch turfgrass-covered soil profile under various circumstances. It allows users to experiment with different pesticide/irrigation schemes to optimize maintenance practices and reduce the likelihood of leaching beyond the root zone. The model is available via the internet at: *http://www.eece.ksu.edu/~starret/KTURF/*

Let's Give Credit Where Credit Is Due

Oversimplification of the reasons for success, or failure, hinders your ability to learn and teach others.

by JAMES FRANCES MOORE

NO DOUBT ABOUT IT — we are definitely in an age of endorsements. It seems as if every product has signed on a spokesperson. Maybe you, too, would like to see your name in lights. There are two basic requirements that must be met in order to attain this particular brand of notoriety.

First, endorsement candidates must have achieved some degree of success in their industry. Note that there are two types of *success* sufficient to qualify you in this regard. Ideally, your success is due to outstanding personal achievement that has resulted in your name and face being widely recognized by those who might be tempted to buy the product you are helping to pitch. Famous actors and athletes are the most obvious examples of this type of endorsement success.

The second type of success that qualifies you is the fact that you are working for a well-known company or organization. Such endorsements invariably include pictures of the company (or golf course, in our business) in the background in a manner that makes certain the potential customer knows the product is in use at this course. The strongly implied message is, "This course is successful because they use our product." In these cases, the individual's endorsement role is merely to serve as proof that the product is in fact being used.

Assuming you qualify in terms of the success level you have achieved, there is a second requirement you must meet in order to embark on your endorsement career. You must be willing to give total credit for your success (and/or the success of the course you manage) to the product. The message must be clear that without this product, you would not be successful and neither would the course you manage. This product made the difference!

It is obvious that I do not think highly of this endorsement trend in our industry. I have no problem with sharing information about products (both good and bad) and, in fact, I feel it is vital to today's golf course management, with so many new products that have little or no unbiased scientific research to back them up. What bothers me about endorsements is the willingness to give so much credit to a single product.

I recently completed 12 years of visiting golf courses across the ten states of the Mid-Continent Region of the Green Section. During that time, I also had the opportunity to visit courses in many other parts of the United States as well as in other countries. Not once, not a single time, did I visit a successful course or golf course superintendent who attained that success solely as the result of the purchase of a single product. No fertilizer, water treatment, cultivation tool, pesticide, soil amendment, or even green construction method deserved such total credit.

In my opinion, those who are willing to promote the concept that a single product can have such influence do our industry a disservice. They help fuel the hope that by simply buying the right product the green will not have to be rebuilt, the irrigation system will not have to be updated, a well-trained crew with good tenure is not so important, and money can be saved by hiring a superintendent who has limited experience and professional training.

The most important lesson I learned in traveling the Mid-Continent Region over the past 12 years is that the basis of success for golf course management programs (and therefore the most successful courses and superintendents) is actually very simple. The programs rely most heavily on basic turfgrass and business management concepts instead of wasting time searching for the alchemist's formula to turn lead into gold. Please note that I said the programs are simple — not easy. Establishing a sound program by implementing proven management practices requires a tremendous amount of hard work and long-term commitment on the part of the superintendent, the leadership of the course, and the players. Prime examples of these types of management practices include: providing good growing conditions, traffic control, making time for proper soil cultivation, adhering to planting dates appropriate to the turfgrass species, planting a grass suited to the climate, providing good drainage, proper irrigation, and providing good working conditions, just to name a few. Notice that most, if not all, of these goals can be obtained by every course, regardless of budget.

The temptation to seek an easy alternative to commitment and hard work is nothing new — just ask anyone who has ever been on a diet. The temptation often becomes overwhelming to a Green Committee faced with major problems on the golf course. As the industry of golf course management grows steadily more technical, and promises of *miracle cures* more prolific, our employers and our industry are depending on us to commit to long-term improvement instead of the "quick fix."

JAMES FRANCES MOORE *is Director of the Green Section's Construction Education Programs.*

THE USGA

USGA PRESIDENT
Judy Bell

GREEN SECTION COMMITTEE CHAIRMAN
C. McD. England III
P.O. Box 58
Huntington, WV 25706

EXECUTIVE DIRECTOR
David B. Fay

EDITOR
James T. Snow

ASSOCIATE EDITOR
Kimberly S. Erusha, Ph.D.

DIRECTOR OF COMMUNICATIONS
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Subscriptions $15 a year, Canada/Mexico $18 a year, and international $30 a year (air mail).

Subscriptions, articles, photographs, and correspondence relevant to published material should be addressed to: United States Golf Association Green Section, Golf House, P.O. Box 708, Far Hills, NJ 07931.

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: Send address changes to the 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.

Visit the USGA's Internet site on the World Wide Web. The address is:
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Turfgrass Information File (TGIF):
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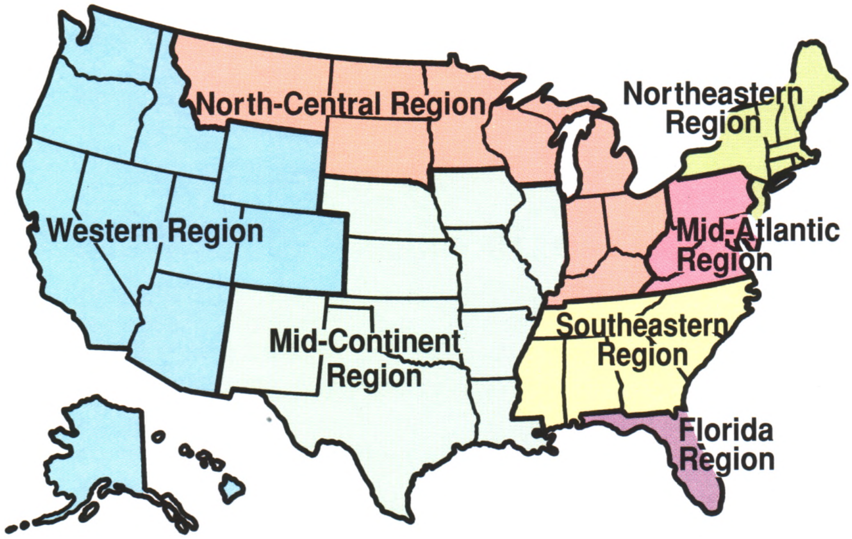
(517) 353-7209



GREEN SECTION NATIONAL OFFICES:
United States Golf Association, Golf House
P.O. Box 708, Far Hills, NJ 07931 • (908) 234-2300 • Fax (908) 781-1736
James T. Snow, *National Director*
Kimberly S. Erusha, Ph.D., *Director of Education*

Research:
P.O. Box 2227, Stillwater, OK 74076 • (405) 743-3900 • Fax (405) 743-3910
Michael P. Kenna, Ph.D., *Director*

Construction Education Programs:
720 Wooded Crest, Waco, TX 76712 • (817) 776-0765 • Fax (817) 776-0227
James F. Moore, *Director*

REGIONAL OFFICES:

Northeastern Region:
P.O. Box 4717, Easton, PA 18043 • (610) 515-1660 • Fax (610) 515-1663
David A. Oatis, *Director* • Matthew C. Nelson, *Agronomist*
500 N. Main Street, Palmer, MA 01069 • (413) 283-2237 • Fax (413) 283-7741
James E. Skorulski, *Agronomist*

Mid-Atlantic Region:
P.O. Box 2105, West Chester, PA 19380-0086 • (610) 696-4747 • Fax (610) 696-4810
Stanley J. Zontek, *Director* • Keith A. Happ, *Agronomist* • Darin S. Bevard, *Agronomist*

Southeastern Region:
P.O. Box 95, Griffin, GA 30224-0095 • (770) 229-8125 • Fax (770) 229-5974
Patrick M. O'Brien, *Director*
4770 Sandpiper Lane, Birmingham, AL 35244 • (205) 444-5079 • Fax (205) 444-9561
Christopher E. Hartwiger, *Agronomist*

Florida Region:
P.O. Box 1087, Hobe Sound, FL 33475-1087 • (561) 546-2620 • Fax (561) 546-4653
John H. Foy, *Director*

Mid-Continent Region:
P.O. Box 1130, Mahomet, IL 61853 • (217) 586-2490 • Fax (217) 586-2169
Paul H. Vermeulen, *Director*
4232 Arbor Lane, Carrollton, TX 75010 • (972) 492-3663 • Fax (972) 492-1350
Brian M. Maloy, *Agronomist*

North-Central Region:
P.O. Box 15249, Covington, KY 41015-0249 • (606) 356-3272 • Fax (606) 356-1847
Robert A. Brame, *Director*
P.O. Box 5069, Elm Grove, WI 53122 • (414) 797-8743 • Fax (414) 797-8838
Robert C. Vavrek, Jr., *Agronomist*

Western Region:
5610 Old Stump Drive N.W., Gig Harbor, WA 98332
(206) 858-2266 • Fax (206) 857-6698
Larry W. Gilhuly, *Director*
22792 Centre Drive, Suite 290, Lake Forest, CA 92630
(714) 457-9464 • Fax (714) 457-9364
Patrick J. Gross, *Agronomist* • Michael T. Huck, *Agronomist*

TURF TWISTERS

WALK AROUND THE GREEN AND

Question: As green chairman, I received a request by the superintendent to walk mow the greens. He already has triplex mowers and these seem to get the job done faster. Why should the club consider walk mowing the greens at all when this method seems efficient enough? (Alabama)

Answer: Triplex mowers were developed to allow courses to mow the greens more efficiently, with fewer staff, and at a lower cost. The mowers were not developed to provide an improved cut. Walk mowers are lighter weight and offer an improved quality of cut over triplex mowers. In addition, the potential for injuring the turf on the cleanup lap around the perimeter of a green is reduced with a walk mower.

MAKE DECISIONS ON

Question: With so many new bentgrasses to choose from, I am having difficulty deciding which ones are best for my course. Can you help? (New Jersey)

Answer: You're right, there are a lot of new bentgrasses to choose from, and until they are thoroughly field tested, it will not be possible to identify all of their strengths and weaknesses. The National Turfgrass Evaluation Program (NTEP) sponsors the national bentgrass trial, located at universities and research stations around the country. These tests are providing useful information about important characteristics of the grasses, but the acid test is not administered until they are planted on golf courses and subjected to real-world stress and varying microclimates. Soon you will have another option as the USGA's new putting green trials get underway at 16 golf courses across the U.S. The project is a cooperative venture between the USGA, NTEP, and GCSAA. Your best bet is to examine the bentgrass trials in climates similar to your own, and to visit courses where the new bentgrasses have been planted in a monostand and subjected to traffic. It goes without saying you can also contact your regional Green Section agronomists and state turfgrass extension personnel for additional information.

WHICH TREES TO REMOVE

Question: Our 15th green is surrounded by tall oak trees and fails to see the sun until later afternoon. After years of playing on thin turf, the Green Committee is still reluctant to authorize tree removal. I have already pruned the lower branches to improve air circulation, cut the invasive feeder roots, and switched to lightweight walk-behind mowers with sectional rollers to minimize physical wear and tear. Can you offer other alternatives? (Iowa)

Answer: At a minimum, greens should receive seven to eight hours of direct sunlight exposure each day. Morning exposure is especially valuable because it helps reduce fungal activity by drying the turf after nightly irrigation and melts light frost before early morning play. With these points in mind, your best alternative is to review your unsuccessful remedial actions with the Green Committee and then resubmit your proposal for tree removal.