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April 2008

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- ❑ 29-Other Golf Course
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- ❑ 31-Golf Course Architect
- ❑ 32-Golf Course Developer
- ❑ 33-Golf Course Builder
- ❑ 39-Supplier/Sales
- ❑ 99- Others (please describe) _____

3. What best describes your title?
- ❑ A-Golf Course Superintendent
- ❑ B-Green Chairman
- ❑ C-Director of Golf/Head Pro
- ❑ D-Club President
- ❑ E-General Manager
- ❑ F-Golf Course Owner
- ❑ G-Builder/Developer
- ❑ H-Architect/Engineer
- ❑ I-Research Professional
- ❑ K-Assistant Superintendent
- ❑ L-Golf Course Management Company Executive
- ❑ Z-Others (please describe) _____

4. Number of Holes: *(check one)*
- ❑ A-9 Holes
- ❑ B-18 Holes
- ❑ C-27 Holes
- ❑ D-36 Holes
- ❑ E-Other

6. Total Annual Maintenance Budget: *(check one)*
- ❑ 1-Less than $50,000
- ❑ 2-$50,000-$99,999
- ❑ 3-$100,000-$249,999
- ❑ 4-$250,000-$499,999
- ❑ 5-$500,000-$749,999
- ❑ 6-$750,000-$1,000,000
- ❑ 7-$1,000,000+

7. Total Course Acreage _____

8. Course Renovation Plans for the Next 12 Months
- ❑ 1-Full Reconstruction
- ❑ 2-Partial Reconstruction
- ❑ 3-Greens
- ❑ 4-Tees
- ❑ 5-Fairways
- ❑ 6-Irrigation System
- ❑ 7-No Renovations Planned

9. If Only a Partial Reconstruction is Planned, Please Indicate the Number of Holes _____

10. What is the Name of the Architect Who Designed the Course? _____

11. What Year was the Course Built? _____

12. Is this course part of a
- ❑ 1-Resort Chain
- ❑ 2-Golf Course Management Company
- ❑ 3-Municipal Course System
- ❑ 4-None of the above

13. What is the name of the Resort Chain, Golf Course Management Company, or Municipal Course System? _____

14. What turf do you maintain on fairways?
- ❑ 1-Bentgrass
- ❑ 2-Poa annua
- ❑ 3-Poa/Bentgrass mix
- ❑ 4-Bermudagrass
- ❑ 5-Bluegrass
- ❑ 6-Ryegrass
- ❑ 7-Overseeded Rye/Bermuda
- ❑ 8-Other (please describe) _____

15. What turf do you maintain on greens?
- ❑ 1-Bentgrass
- ❑ 2-Poa annua
- ❑ 3-Poa/Bentgrass mix
- ❑ 4-Bermudagrass
- ❑ 5-Paspulum
- ❑ 6-Other (please describe) _____

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was a decent one, although it lacked an adequate practice facility, Hardy says. The only place to practice was a small, narrow parcel where players were restricted to using irons. The architects rerouted many holes, allowing the facility to accommodate a full-size driving range.

"Having a range is very important, particularly in a resort location," Hardy says. "Many resort guests love to just come hit balls for a few hours."

Finding enough additional course width and length, while squeezing in a full-sized practice facility, required 50 or more proposed routing plans, Hardy says. Developing a concept that yielded better golf in terms of length, width and linkage, while addressing the Army Corps of Engineers' environmental concerns, were also difficult tasks.

The development team was fortunate the Army Corps of Engineers' regional office is located in Galveston. The team checked each new set of proposed plans with the nearby government office. When the team submitted a formal proposal using the regulators' feedback, they were fairly certain it would be approved.

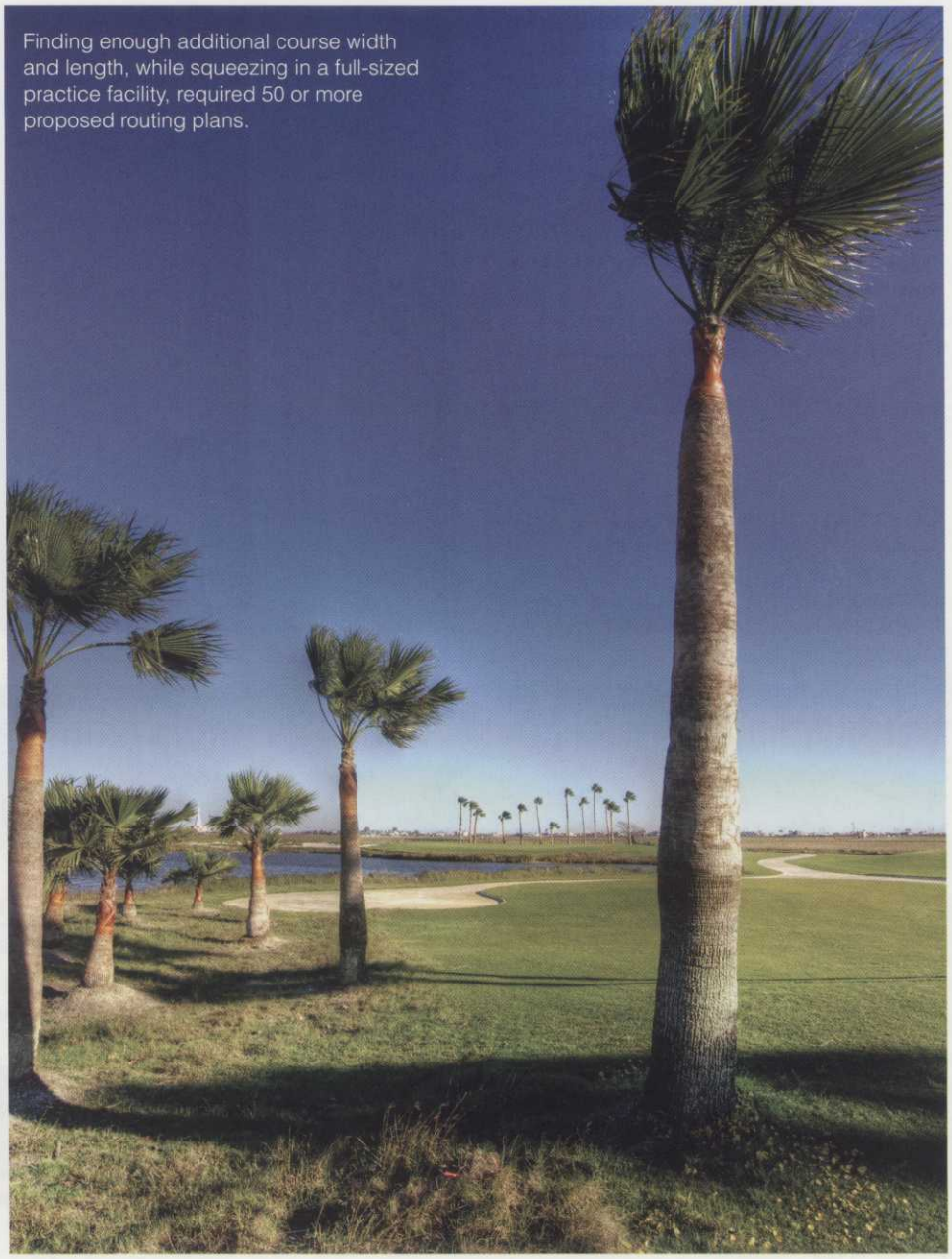
The sandy seaside location coupled with an ever-present wind, which generally blows from 10 to 20 miles per hour, made the site ideal for a links-style layout with jagged-edge bunkering surrounded by native grasses, reeds and fescues. These characteristics, coupled with the high dunes Jacobsen Hardy designed into the layout, are reminiscent of windswept Scottish and Irish links.

The greens are a bit more bold than the usual Jacobsen Hardy style but still are characterized as a links style.

"They're more undulating and have more contour than we usually put in, but they're still very playable," VanHoose says. "As for approach shots, we left an open entryway into every green to encourage bump-and-run play. And there's usually a bail-out area to help the higher handicapper."

The design team did a fantastic job, especially within environmentally sensitive areas, Herz says. The team reversed the first five holes and changed the first six considerably. It tweaked holes seven through nine, significantly tweaked holes 10 through 16, and substantially changed holes 17 and 18.

"We could not have been happier with the final layout," Herz says.



Finding enough additional course width and length, while squeezing in a full-sized practice facility, required 50 or more proposed routing plans.

THE CHOICE OF PASPALUM

The development team started designing the course in August 2006. Construction began in March 2007 and was completed in October 2007. The facility has been growing in through the fall, winter and spring months and is on schedule to open in June.

With the constant threat of hurricanes driving seawater onto the fairways and a city requirement to irrigate the course with effluent water, the problems involving salt build-up within the soil profile weren't about to vanish. Jacobsen Hardy opted to replace the existing Tifdwarf 419 and common Bermudagrass mix with salt-tolerant paspalum, with Sea Isle Supreme on the putting surfaces. Plans were to sprig the grass and sod 20 acres of sloped areas during the summer, but a complication arose when the sod farmer reported the sprigs and sod weren't going to be ready until September.

"We needed to start grassing in June and July, so we regrouped and hit upon a seeded variety of

paspalum called Sea Spray produced by Scotts," VanHoose says. "We used a hydroseeder and sprayed the entire course except the greens. It worked wonderfully, leaving a seamless transition between fairways and roughs. We double sprigged the putting surfaces with Sea Isle Supreme."

Developers believe this is the first golf course in the continental United States that, other than the greens, has been seeded completely with paspalum.

One of the ongoing maintenance issues golf

With a constant threat of hurricanes driving seawater onto the fairways and a city requirement to irrigate the course with effluent water, problems involving salt build-up within the soil profile aren't going to vanish.

course superintendent Steve Yarotsky will face is weed control. Being situated in an environmentally sensitive area, few products are available to control weeds, particularly the original common and coastal Bermudagrass that will inevitably try to reestablish itself.

"Steve is considering using just straight saltwater to control weeds," VanHoose says.

Related to killing weeds, killing the common and coastal Bermudagrass for the paspalum to thrive is difficult.

"We'll figure that out as we go," VanHoose says. "Using salt might be the best solution. It might knock back the paspalum somewhat but not kill it. It will kill the Bermudagrass. Steve can spray a high-salt solution or actually put salt granules on the turf."

Seashore paspalum expert Ronnie Duncan is working on a program that will help control the return of Bermudagrass to paspalum playing surfaces.

"There's definitely a learning curve involved with paspalum," Yarotsky says.

Unexpectedly heavy rains caused by a brush with a major hurricane that dropped eight inches of precipitation in a single day, plus a wetter-than-normal year overall, resulted in a total precipitation that was 15 inches above average in 2007, Yarotsky says. The construction team used matting in the bunkers and other areas to prevent sand and seed from washing away.

Because the existing site was flat, cut-and-fills, new lakes and undulating greens were built to give the course more character. To complete the facelift, landscapers moved 400 existing palm trees throughout the course and added another 300 queen palms. Moody Gardens spent a total of $500,000 on landscaping.

A COMMUNITY ASSET

The $15.5-million complex breaks down like this: $10 million for the golf course, $2 million for renovating the clubhouse, $1.5 million for a steel maintenance building on an elevated location that will withstand winds of 140 miles per hour, and $2 million to expand an existing desalination plant that cleanses the city-generated effluent water piped from two miles away for use at Moody Gardens and the golf course even more. During the summer, the course will use as much as one million gallons of irrigation water daily.

The Moody Foundation's willingness to provide an enhanced community asset and absorb any potential losses means Galveston residents will continue to pay green fees of $25 to $30 while visitors will be charged $50 to $75.

And, just as important, the natural environment will continue to thrive.

"The entire course, but particularly the back nine, is environmentally pristine," Herz says. "Several environmentalists have toured it and loved it." **GCI**

BY JOE MASSEY, PH.D.

Keep in check

Quality control is paramount when conducting pesticide runoff experiments

Surface runoff is one of the largest loss mechanisms for pesticides applied to turfgrasses (Smith and Bridges, 1996; Lee et al., 2000). Considering the importance of turfgrass to urban environments and the need to protect water quality, there's an ongoing need to perform turf runoff experiments to assess the behaviors of new chemicals or products, refine best management practices and calibrate/validate runoff prediction models for turfgrass.

Field studies indicate surface runoff from creeping bentgrass (Carroll, 2007) and Bermudagrass (Massey, 2007) is scalable across a range of plot areas. Thus, there's solid scientific justification for using plot-scale experiments to study the surface runoff of turf chemicals.

Conceptually, conducting a turf runoff experiment is simple. A chemical is applied to grass, and runoff, generated by natural or simulated rainfall, is collected and analyzed for the chemical. In practice, a runoff study involves a number of steps that must be performed carefully to ensure scientifically valid, representative data are produced. Seemingly small oversights in study design or conduct might compromise data from a scientific or regulatory perspective.

The goal of the experiment is to assist researchers, and perhaps those charged with evaluating/interpreting runoff study designs/results, by highlighting certain quality control considerations important to the conduct of a plot-scale turf runoff experiment. The experiment isn't comprehensive, but it presents

A turf runoff study involves a number of steps that must be performed carefully to ensure scientifically valid, representative data are produced.

At Mississippi State University, Joe Massy, Ph.D., presents quality control approaches that have proven helpful when conducting runoff studies.

quality control approaches that have proven helpful in studies conducted at Mississippi State University.

For a review of technical considerations important to the conduct of a runoff study, review Wauchope et al. (1995). The experiment phases addressed are:

- Study planning,
- Plot construction and maintenance,
- Rainfall simulator verification,
- Application monitoring, and
- Sample handling.

STUDY PLANNING

Quality control principle. A detailed study protocol that addresses all aspects of study conduct is critical to the success of any study. Moreover, an approved protocol is required for a study to be submitted to support pesticide registration. A well-designed protocol serves as an invaluable reference throughout a study as many construction and study conduct activities build on one another.

Basis of concern. There are certain study details that shouldn't be left to chance or addressed as an afterthought once the study is under way. Particular attention should be paid to methods used to control and account for water movement in test plots and methods used to account for pesticide application and rate in the turf system. Some pesticides present special considerations, such as those with a propensity to adsorb to plastic and other surfaces strongly (water solubility equals 1 milligram per liter at 25 Celcius), rapidly degraded (soil $T_{1/2}$ equals two days), or those that are relatively volatile (vapor pressure greater than 10^{-4} millimeters of mercury at 25 Celcius). Thus, the researcher must take into account the properties and environmental behavior of the pesticide during protocol development. Sample handling and storage practices also are critical and often compound-dependent.

Approach. A thorough literature review is an appropriate place to begin a study of this scale. Unfortunately, quality control programs aren't always explicitly reported in published works. Consultation with the chemical manufacturer, other researchers and the targeted end-user of the information generated by the study can help address important aspects of study design. In the end, attempting to account for as much of the rainwater and applied pesticide as possible is a good guiding practice in study design and conduct.

TURF PLOT CONSTRUCTION, MAINTENANCE

Quality control principle. The runoff plot should be constructed to capture no more and no less than the actual runoff occurring from the treated plot. Water external to the plot boarders shouldn't be allowed to run onto the treated plot just as the runoff collection apparatus must capture all surface runoff and not leak.

Basis of concern. If water external to the treated plot is allowed to run onto the plot, pesticide concentrations in runoff will be diluted. Runoff that completely bypasses or leaks from the runoff collection apparatus before measurement will reduce the total runoff volume and pesticide load measured during the study. Both of these scenarios won't accurately reflect the

actual amount of runoff that occurred.

Approach. To prevent extraneous water from entering the plot, the plot must be isolated hydrologically from the surrounding area using metal dykes (Wauchope et al., 1990), landscape timbers (Smith and Bridges 1996; Hong and Smith 1997) or flexible plastic discharge hoses filled with masonary sand (Cole et al., 1997). However, for multiple plots, it might be better to use permanent turf-covered soil berms because they are easy to maintain by mowing when less than two inches high.

Plot spacing also is important and dependent on overall experimental design and configuration of the spray equipment and rainfall simulator to be used. Wide plot spacing prevents overspray during pesticide application and rainfall simulation and allows movement of equipment between multiple plots. Knowledge of the distance of throw of the rainfall simulator is needed to determine appropriate plot spacing.

One of the most important considerations in plot construction and maintenance is the interface that exists between the down-slope edge of the plot and the runoff collection apparatus. This interface between the runoff diverter and turf is critical because it represents a potential point of loss for surface runoff. Wauchope et al. (1995) note construction of the diverter-turf interface requires creativity and skill. Several approaches might be used, but in each case, the system must ensure against runoff bypass and potential leaks.

At Mississippi State, we thought it was best to minimize the transition between the sod and diverter by minimizing the thickness of the diverter. Our diverter consisted of 20-gauge aluminum metal bent to a 140-degree angle. The diverter was designed so that it extended into the plot about two inches and into the runoff collection trough about three inches. The soil underneath the diverter was sieved, carefully leveled and tamped so no air space existed under the diverter. Next, the diverter was attached to a wooden box lining the collection trench using silicone sealant and screws with rubber grommets. Before installing the diverter, sod close to the interface was removed using a sod cutter.

Once the diverter was installed, the original sod was placed so that it overlapped the diverter about one inch. The diverter-sod interface was allowed to heal for six to eight weeks before

Before conducting runoff studies, the performance of the rainfall simulator must be verified.

leak testing the remaining portion of the runoff collection system using turf marker dye.

RAINFALL APPLICATION RATE VERIFICATION

Quality control principle. The delivery rate and uniformity of the rainfall simulator must be verified under field conditions.

Basis of concern. Rainfall application rates significantly less or greater than the target rate and/or lacking in uniformity might cause nonrepresentative and/or highly variable results that complicate interpretation.

Approach. Before conducting runoff studies, the performance of the rainfall simulator must be verified. This is accomplished using a formal audit procedure (Wauchope et al., 1995). For example, Carroll (2005) used paper cups spaced on 12-inch centers. Plastic tarps placed over the entire plot area might be used to determine total rainfall delivery. This approach provides a visual assessment of uniformity but doesn't yield a quantitative measure of rainfall uniformity.

The operating pressure of the simulator should be noted during audits and checked periodically during study conduct to ensure the system is operating properly. During runoff events, pan-type rain gauges should be used to record rainfall amounts and uniformity. Note that tall, narrow-top rain gauges might not measure rainfall accurately, causing the steep descent of the artificial raindrops.

PESTICIDE APPLICATION MONITORING

Quality control principle. One must know the amount of pesticide ap-

Catwalks are used to collect application monitors to minimize plot disturbances after a pesticide application (left). The runoff plot should be constructed to capture no more and no less than the actual runoff occurring from the treated plot.