GOLF & WATER

CASE STUDIES IN WATER STEWARDSHIP

AMERICAN SOCIETY OF GOLF COURSE ARCHITECTS

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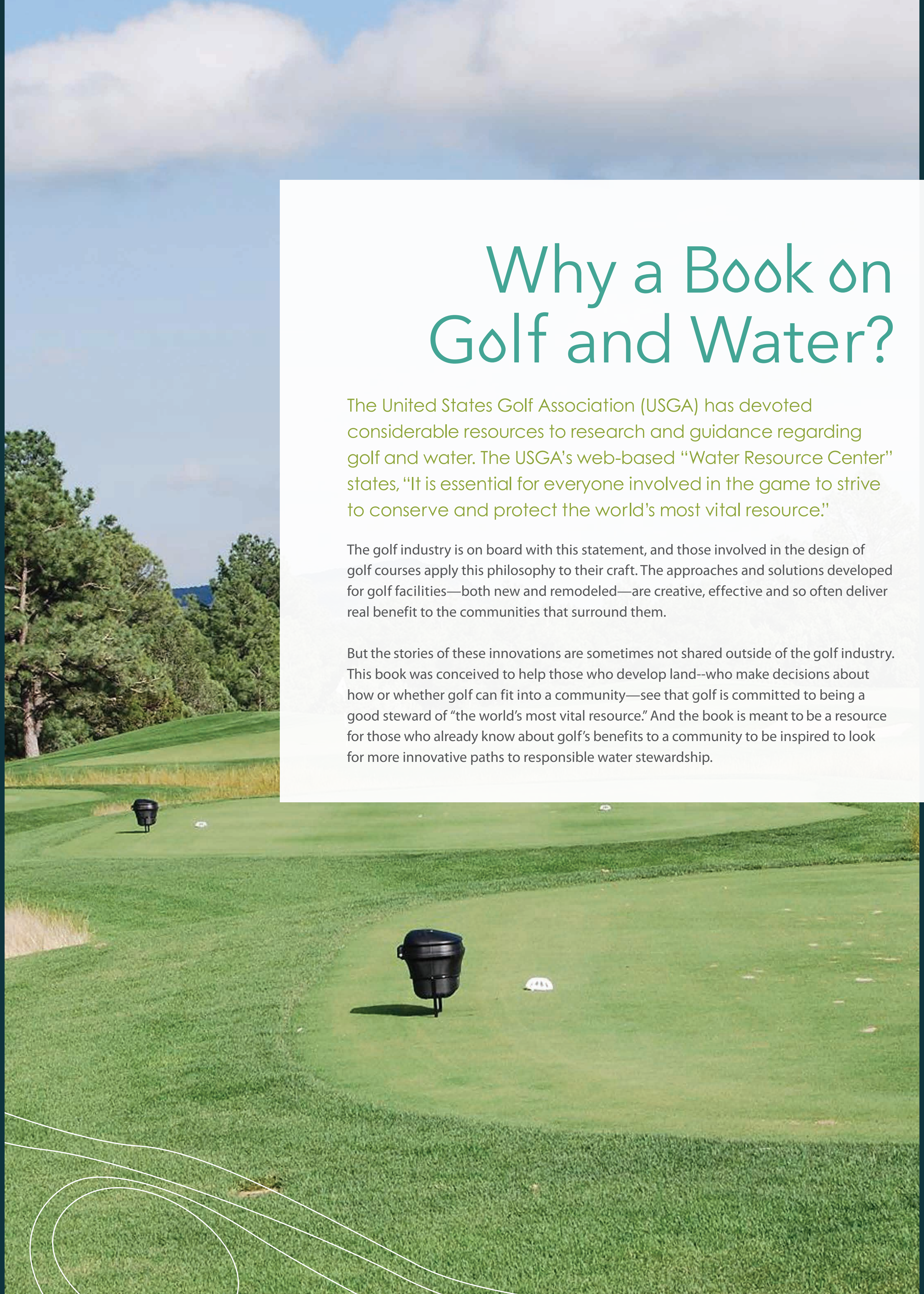


Why a Book on Golf and Water?

The United States Golf Association (USGA) has devoted considerable resources to research and guidance regarding golf and water. The USGA's web-based "Water Resource Center" states, "It is essential for everyone involved in the game to strive to conserve and protect the world's most vital resource."

The golf industry is on board with this statement, and those involved in the design of golf courses apply this philosophy to their craft. The approaches and solutions developed for golf facilities—both new and remodeled—are creative, effective and so often deliver real benefit to the communities that surround them.

But the stories of these innovations are sometimes not shared outside of the golf industry. This book was conceived to help those who develop land--who make decisions about how or whether golf can fit into a community—see that golf is committed to being a good steward of "the world's most vital resource." And the book is meant to be a resource for those who already know about golf's benefits to a community to be inspired to look for more innovative paths to responsible water stewardship.

Every outdoor green space is affected by its environment. And, while technology has given people the tools to sculpt land and divert water, Mother Nature always has the final say in whether those changes to the space can be sustained. When any part of the environmental mix is thrown off, management of outdoor green space must be adjusted to maintain a proper environmental balance.

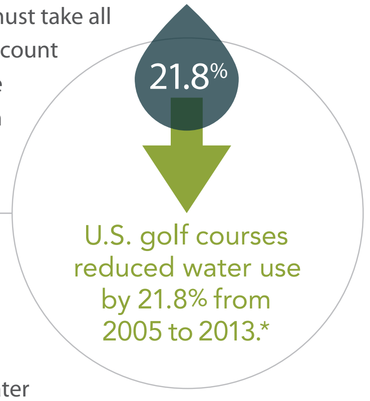
The golf industry is facing several changes to the environmental mix, and is proactively developing innovative solutions to these changes. Drought conditions are affecting areas of the United States where golf is played year-round, and recent record storms in the U.S. southern tier have challenged traditionally dry parts of the country with storm water management issues. The cost of energy needed to bring water to golf courses is rising, and the water that is available for irrigation often includes an imbalance of natural elements and/or solids that affect the efficient and sustainable growth of healthy turfgrass.

All of these changes have spurred the golf industry to develop innovative solutions to boost its sustainability. And, while sustainable practices are being refined across all aspects of the game—welcoming new audiences (especially families) to courses, redesigning layouts so time-crunched players can play fewer holes, and many other non-traditional approaches—the solutions to the complicated challenges water quantity and quality pose are some of the most compelling.

The cost of energy to pump water and the quality of water available for irrigation factor into water management.

Water – The Essential Element

The design of golf courses and the related complex issue of developing a comprehensive and project-specific water management strategy—irrigation, energy, water quality, turf species selection and care, aesthetics—are interrelated components. Water-related design considerations include identification and development of water sources, quality of available water and cost to purchase or deliver it to the site; physical features like topography, vegetation and soils; wetlands and wildlife habitat; strategic placement of turfgrass and native plantings; aesthetic expectations of target golfer audience (and related game experience, i.e., fast and firm) and many others. The design of the irrigation system must take all of these factors into account if it is to be compatible with the overall design of the golf course.



The management of extreme water events is a topic that's just as relevant to the discussion of water stewardship in golf as water scarcity, expense and quality. Tidal surges at the coastlines, hurricanes that come ashore, summer mega-storms and winter melt-off can all cause flooding. Golf courses are often at the frontlines of these extreme occurrences, serving as buffers for communities against flooding and to help with water detention. Again, design must take into account the possibility of these occurrences, and develop solutions for the multiple functions a golf course can serve in a community.

* *Golf Course Environmental Profile, Phase II, Volume I,* Golf Course Superintendents Association of America, 2015

Water is Local

The water situation in the U.S., and internationally, has led many developers and operators to react to water shortages, water inundation or water quality issues. Each course or development is unique, though, with the requirements it must meet, the local water norms, the expectations of the target golfer audience and the budget.

The droughts in the western and southern parts of the United States are the most high-profile instances of areas where golf has had to adapt to drops in water availability. Facilities are managing by some combination of the following strategies:

How are facilities adapting to drops in water availability?

- Reducing consumption of water throughout the course footprint, whether by choosing to take some areas of the course out of a regular irrigation schedule or watering all turf less and developing fast and firm conditions
- Renovating the irrigation system, which can take a number of different routes depending on budget and irrigation needs
- Shifting to sources of reused water, where available
- On new layouts, careful planning to determine the right amount, species and placement of turf varieties
- On existing layouts, strategic removal of turfgrass and replacement with more drought-tolerant turf varieties and/or native vegetation
- Replacement of existing turfgrass with varieties that are drought-tolerant or able to thrive on reused water

On the flipside of areas of the country affected by drought conditions are those managing flooding and storm surge events. While the focus of this book is more on the issues raised by lack of water or poor quality of water and the solutions developed to address those issues, innovative work is being done to help courses cope with too much water with use of drainage, retention and related design solutions. And, just as managing with less water at a golf course benefits the surrounding community, being a place where stormwater can be detained, retained and used for irrigation also helps surrounding property owners cope with increasingly-frequent storm events.

Innovative work is also being done to help courses cope with too *much* water.

Existing golf facilities are removing turfgrass and replacing it with native vegetation or drought-tolerant turf varieties.

Irrigation Technology Advancements

The advances in the technology behind how water is applied to turfgrass go beyond the ability of operators to control how much water is applied and when. The combination of soil moisture sensors, wireless control boxes, pumping station energy use improvements and other design and function-oriented improvements have made the job of the irrigation designer a complex one.

Less Water/ Healthier Turf:

HOW TODAY'S IRRIGATION SYSTEMS PROVIDE VALUE

It may seem counterintuitive, but it is possible to save water, improve turf conditions and save money, all at the same time. It sounds too good to be true, but to see how it works, this article will dispel a few myths, and then show the math.

While most people realize that through efficient irrigation design there can be substantial water savings and improved turf quality, saving money can be a surprising addition to those benefits. To understand how this works, some simple math is required. But first, an old irrigation myth must be dispelled.

QUESTION:
If a golf course has more sprinklers, will it use more water?

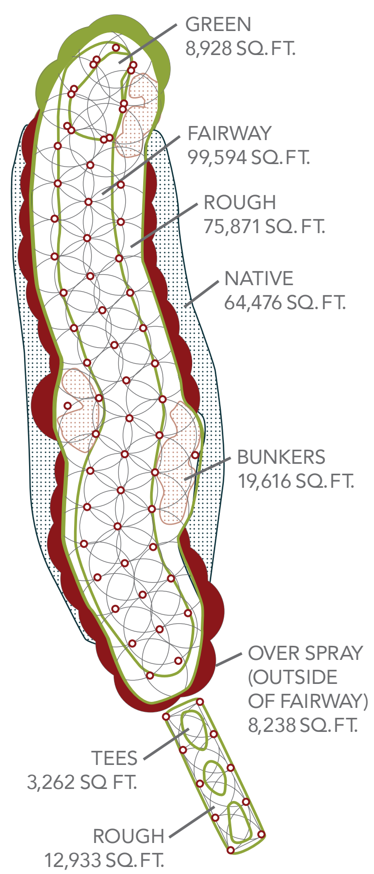
ANSWER:
Not if the design is done properly to deliver higher irrigation uniformity and improved coverage.

At right is a sample golf hole, irrigated in a seemingly simple way, with three rows of full circle sprinklers. Many people believe that having fewer sprinklers and getting the most area out of them by using full circles is the easiest, least expensive and best way to irrigate.

Actually, this "simple" design choice results in several irrigation issues that can be greatly improved upon. To achieve reasonable coverage in this layout, the full circle sprinklers must over-throw the desired grassing line by about 40%.

Doing so results in the red area or over-throw area that is beyond the desired grass line. This water is 100 percent waste, since we have no desire to irrigate those native areas.

In this sample par-4 hole (deemed to be typical), that over-throw area in red is almost 15 percent of the total sprinkler coverage area of the entire hole.



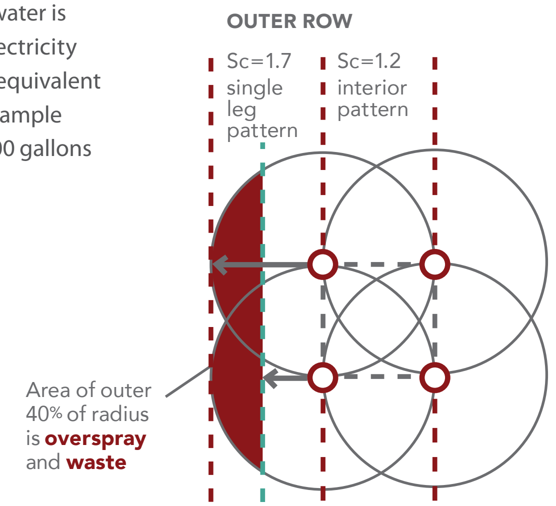
3-ROW COVERAGE PAR - 4 SAMPLE

The next issue is a loss of irrigation uniformity due to the difference in the interior sprinkler pattern vs. the exterior sprinkler pattern. You can see that the interior pattern, where you have three or four sprinklers contributing to the coverage, provides excellent uniformity, and thus a very high Scheduling Coefficient (Sc) of 1.2 is achieved.

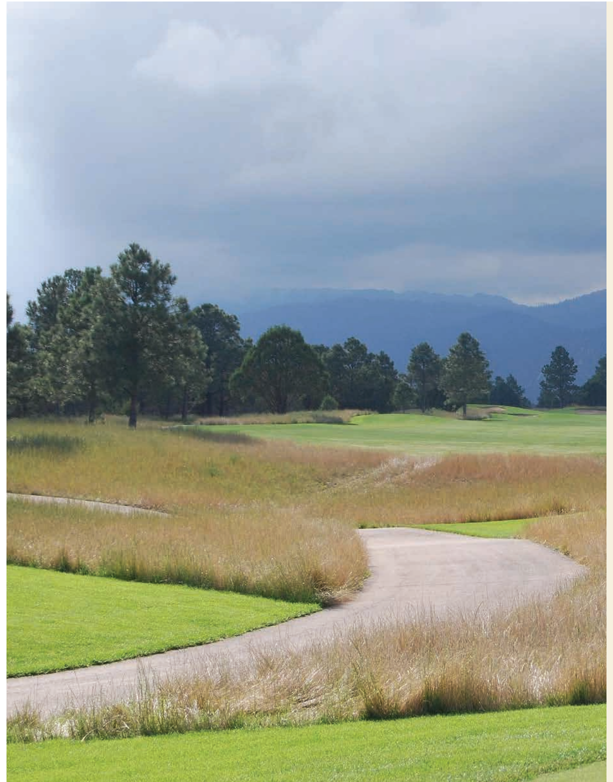
In the area on the outside of the outer rows, there are only one or two sprinklers (Single leg pattern) contributing to the coverage which results in less effective coverage, and in this case, a much lower Sc of 1.7. This difference in uniformity would require that in order to properly irrigate the turf between the outer row of sprinklers and the desired grassing line, the outer row of sprinklers must be irrigated approximately 40% more, compared to what is required to irrigate between the rows. (Sc 1.7 / Sc 1.2 = 42%)

While this change improves the irrigation of the outer grassing areas, it increases the wasted water in those over-throw areas by approximately 40%, and now is also over-watering the interior pattern areas by 40%.

The result of this is a combination of wet and dry turf across the hole between the grassing lines. In a simple example on an average par-4 hole where the required irrigation was 0.25 inches per day, almost 6000 gallons of water is wasted, as well as the electricity to pump it. (An 18-hole equivalent golf course using this example would waste over 100,000 gallons of water per day.)



OVERSPRAY AND WASTE



The Agronomic Impact

Being able to control irrigation inputs as finitely as possible offers many rewards associated with turf quality and budget savings beyond those related to water and electrical cost:

- Over-watering creates more compaction, which in turn requires more aeration and related additional labor expense.
- Disease pressures greatly increase as excess moisture is applied, resulting in additional fungicide applications (add cost of fungicide and labor to apply).
- Over-watering also creates the perfect environment for higher weed population, thus more herbicide cost and labor to apply.

The average American golfer is hooked on "wall-to-wall green," and golf course managers tend to buckle under the pressure to produce it. The gold standard for agronomic excellence is to produce uniform green color while maintaining the perfect agronomic balance for healthy turf growth, enhance the environment throughout the property, and improve playability throughout the golf course… all while managing water responsibly and staying on budget.

Here's a better design solution.

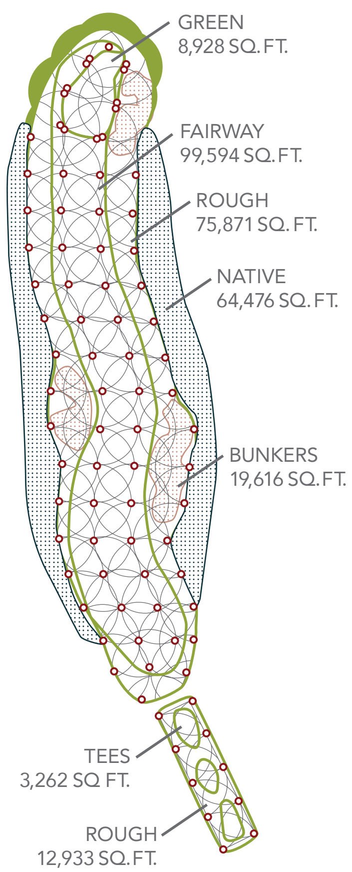
Using the same sample par-4 hole, this example shows two rows of full circles down the middle, but effectively provides for one extra row of sprinklers, which allows a row of part-circle sprinklers down each outer grassing line, throwing only inwards. (Going from three rows in total to four rows)

First, this has eliminated 100% of the over-throw area and thus all the wasted water in those areas.

Next, because the sprinkler coverage is evenly uniform across the entire width between grassing lines, the coverage efficiency is greatly improved, yielding a Sc of 1.2, and eliminating the need for over watering any area to make up for under watering another.

These two changes will save over 100,000 gallons each day this golf course needs to apply .25 inches of irrigation, plus the electricity to pump it. Using an annualizing factor for seasons, a course such as this in the central US might save more than 12 million gallons of water per year, and almost 20,000 kWh of electricity to pump it.

So what is the catch? Saving so much water and power must have a huge up-front initial cost. The actual cost in this example is the addition of 270 additional part-circle sprinklers. (The total sprinklers on the 18-hole plan would go from 1,242 to 1,512). The contractor bid includes a "per sprinkler added" total of $400 each (all-in), so the total additional cost during construction would be $108,000. However, this is immediately offset by the savings of water and electricity. Water in this example is from a city water supply at a cost of $4.85 per 1,000 gallons, and electricity cost is $0.11 per kWh.



4-ROW COVERAGE PAR - 4 SAMPLE

In 10 years, about 125 million gallons of water will have been saved.

Each year, these combined savings amount to $61,775, giving a total payback period on the extra sprinklers of only 1.75 years. In 10 years, the cumulative net savings would be over $500,000, and continue at almost $62,000 per year. The savings of resources is not trivial; in those 10 years, about 125 million gallons of water will have been saved as well as almost 200,000 kWh of electricity.

Maybe the best outcome for a club is that the uniform coverage across the entire grassing area will provide greatly-improved turf grass, both aesthetically and from a golfing playability standpoint, which are attributes which golfers will appreciate.

An experienced superintendent can explain why this will also help to better maintain the turf grass and increase plant health, thus reducing the other maintenance practices required. Every course's turf grass and budget would see a benefit from having higher uniformity irrigation coverage.

Each golf course has its own unique circumstances and situation, and while some may only see half or less of this amount of cost savings, many others could see two to three times this amount.

Owners tend to appreciate the extra savings and profitability as well, with all this coming from just a slight change in irrigation design style and technique.

The combination of technological advances, development of sophisticated and common sense approaches to design and superintendent management skills is leading many courses to realize the benefits of using less water and energy to give golfers healthy turf and great playing conditions.

Case Study Introduction

EXAMPLES OF WATER STEWARDSHIP THROUGH DESIGN

Golf course architects have embraced the challenge to positively affect water use through innovative design solutions. Following are case studies that demonstrate some of these innovations.

Ole Miss Golf Course

OXFORD, MISSISSIPPI | ARCHITECT: NATHAN CRACE, ASGCA ASSOCIATE

The Situation

A plan for renovation of the Ole Miss Golf Course, owned by the University of Mississippi, called for more efficient irrigation solutions. The source for irrigation was a small pond located on top of a hill fed only by a well, requiring nearly non-stop operation of a pump to draw water from it.

What's the best way to reduce energy consumption, practice water conservation and capture runoff while improving aesthetics for golfers at Ole Miss?

The Approach

The nearby Oxford Airport and six of the 18 holes of the golf course at Ole Miss were found to drain more than 100 acres of watershed runoff through a large ditch crossing the 4th fairway and through a culvert under the adjacent roadway with no detention capability. The hilltop irrigation pond measured only a quarter acre, and didn't have any source of water other than what was pumped from the well. The renovation plan looked for ways to redesign the course that would allow for capturing runoff from the course and the airport, moving the irrigation pond to a location that would serve a detention function and replacing the deep well pump with one that would take advantage of retained water.

The Solutions

The scope of the renovation of the golf course included drainage work throughout the course. Central to the drainage component was the creation of a new 3.85 acre lake in a large out-of-play area between the 2nd green, 3rd tee and 4th hole. This new lake area was also used to generate fill material for many of the new green complexes and bunkers included in the plan.

The objective for creating the new lake was threefold:

1. converting this large grassy area to water would no longer require mowing,
2. the new lake would serve as the new irrigation lake, and
3. the location of the new lake would allow the course to retain 100+ acres of watershed (including the Oxford Airport) runoff before it left the property and save that water to be re-used for irrigation—eliminating the need to use power running the existing well and reclaiming a great deal of irrigation runoff in addition to rainwater runoff.

The new lake would allow the course to retain 100+ acres of watershed runoff to be reused for irrigation.

The Takeaways

Taking advantage of existing topography, and enhancing its ability to drain water to a low spot and retain it for irrigation use, has resulted in saving between seven and eight million gallons of water each year since renovation, as well as lower energy costs for pumping. The resulting aesthetic quality of a large mid-course lake is a welcome bonus.

Olivas Links Golf Course

VENTURA, CALIFORNIA | ARCHITECT: FORREST RICHARDSON, ASGCA

The Situation

A popular municipal course, about 60 miles north of Los Angeles, was suffering the effects of deferred maintenance, turf that was not thriving, poor drainage through floodplain and the need to adapt turf and non-turf landscape to a shared irrigation source that was made up of 100 percent reclaimed water.

How can a municipal course reduce the amount of managed turf in areas of play, reduce the amount of water it uses for irrigation and introduce turf and out-of-play landscape plantings that will most effectively tolerate its reclaimed water source?

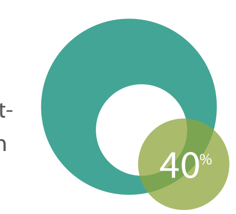
The Approach

The golf course architect looked for ways to reroute the golf course that would allow for more efficient management of the layout: relocate the clubhouse so it wasn't in the floodplain, and eliminate east-facing opening holes and westerly-facing finishing holes to improve pace of play. Since the irrigation source was reclaimed water, it was important to look for drought-tolerant grass varieties and to reduce the total turfgrass footprint while maintaining strategic intent.

The Solution

The course borders the Santa Clara River, and design established a connection between the course and the river and its estuary to the ocean by relying on native plants and ground cover to form new landscape between holes and in open areas. Plantings that replaced turf also included a creative use of Kikuyugrass, a mainstay of California's costal zones, which used as rough appears to drift off into the natural landscape as if there were no formal transition.

The course was also one of the first in the Western United States to be planted with salt-tolerant Paspalum, which thrives with higher salt content in irrigation water (which tends to be the case in reclaimed water). This species is also drought-tolerant. The re-routing resulted in a better diversity of holes of varying direction and nearly 40 percent less managed turf area. To accommodate future turf limit adjustments, several irrigation heads and lines that could be used if needed as the new course matured and areas of turf might be needed in lieu of the deeper natural areas. Pace of play was carefully weighed, with areas golfers would frequent being purposefully zoned with playable (and findable) roughs.



The re-routing resulted in nearly 40% less managed turf area.

The Takeaways

Olivas Links has returned to popularity and excellent conditions, and the targeted water reduction has been achieved year after year. Designing less turf area also requires careful selection of playable turf varieties that are drought-tolerant. Naturalized areas also benefit from planning for use of playable turf in roughs, and choosing other adaptable ground cover and drought-tolerant native plants. It is possible to design a course to use less water and to retain—or even improve—its pace of play.

Whistling Rock Country Club

CHUNCHEON, GANGWON PROVENCE, KOREA | ARCHITECT: TED ROBINSON, JR., ASGCA

The Situation

With all the focus on minimizing water use, one might wonder why lakes continue to appear on many new golf course projects. Often, the reason is the lakes are serving a function other than a strategic or decorative aspect relating to the golf course itself:

- Retention lakes are used to collect runoff from the fairways. Planted with vegetation that uses up the excess fertilizer, these lakes ensure the course remains environmentally neutral to surrounding areas while adding wetland habitat. In dry areas of the country, this habitat can prove especially valuable during periods of drought. These types of lakes can also be designed to retain storm water.
- Detention lakes are used to regulate rainwater from winter storms so as to reduce potential flooding through areas located downstream of the golf course. This use is especially valuable when the golf course is located between large watershed areas upstream and populated areas below. These lakes work by allowing excess flow to be held on the golf course so it can be discharged in a controlled fashion.

At Whistling Rock, located in the mountains just east of Seoul, Korea, the approving agencies required separate systems for both retention and detention serving three distinct drainage areas. A total of fourteen lakes were mandated, eight serving as retention ponds to insure the site remained environmentally neutral and six serving as added detention basins to control flooding during the monsoon season through the village located below the site. The challenge for the design team was to incorporate the lakes into golf course plan in the size and locations dictated by the agencies while fully integrating them into the site so as to appear entirely natural in a mountainous setting.

The Approach

Two entirely separate drainage systems were required: drainage on the fairways was to be provided by a underground piping system to static retention lakes; drainage of the natural areas and the surrounding watershed was to be provided by a series of surface streams to a second set of lakes designed as detention basins. These two systems had to be separate as one was not allowed to flow into the other; however with a series of visual tricks and well-disguised dams and barriers, the two systems were expected to appear as one and look entirely naturalized within the site.

The Solutions

The design solution controls over 14 million gallons of water during storm events

In the picture above, the lake is part of the central detention system for the site. The stream begins as a dry creek acting to convey storm water flow from the upper watershed. It appears to flow into an upper pond (not pictured) acting as a retention lake, but this lake is static and bypassed by the creek. At what appears to be the exit point on the upper lake, a recirculation pump from the lake below cascades the water during dry periods. A close look at the lower lake shows it to be depressed – there is a full meter of detention capacity, which is controlled by a weir hidden under a cart path bridge. The fairways are irrigated on the project using a modern state of the art irrigation system to minimize water use; however, drainage in these areas are picked up and directed to other static retention lakes. As static ponds, the retention lakes insure the site remains environmentally neutral by also detaining water from the fairways during storm conditions. While the site's detention system serves to retain six million gallons of water from the surrounding watershed, when combined with the retention system, the site regulates over 14 million gallons during a storm event.

The Takeaways

In many Asian countries, where flat arable land often cannot be used other than for food production, golf courses can be used to effectively control flood water in mountainous sites within major watersheds. The practices used to provide this control can be equally effective on many flatland golf courses in other areas of the world when potential downstream flooding can be an issue.

Abacoa Golf Course

JUPITER, FLORIDA | ARCHITECT JOE LEE, ASSISTED WITH TECHNICAL PLANNING BY JOHN SANFORD, ASGCA

The Takeaways

By utilizing 100 percent treated effluent to irrigate the golf course and 2000 acre community, ground water aquifers are preserved for use by the Town of Jupiter's potable water system

The Situation

Abacoa was developed in the late 1990s as a mixed-use development on 2000 acres on the western edge of Jupiter, Florida. Included in the development is a golf course, designed to retain effluent water in a reservoir located between the golf course and an "island" residential development.

How does a golf course designed as part of a planned community positively impact water usage in a mixed-used development?

The Approach

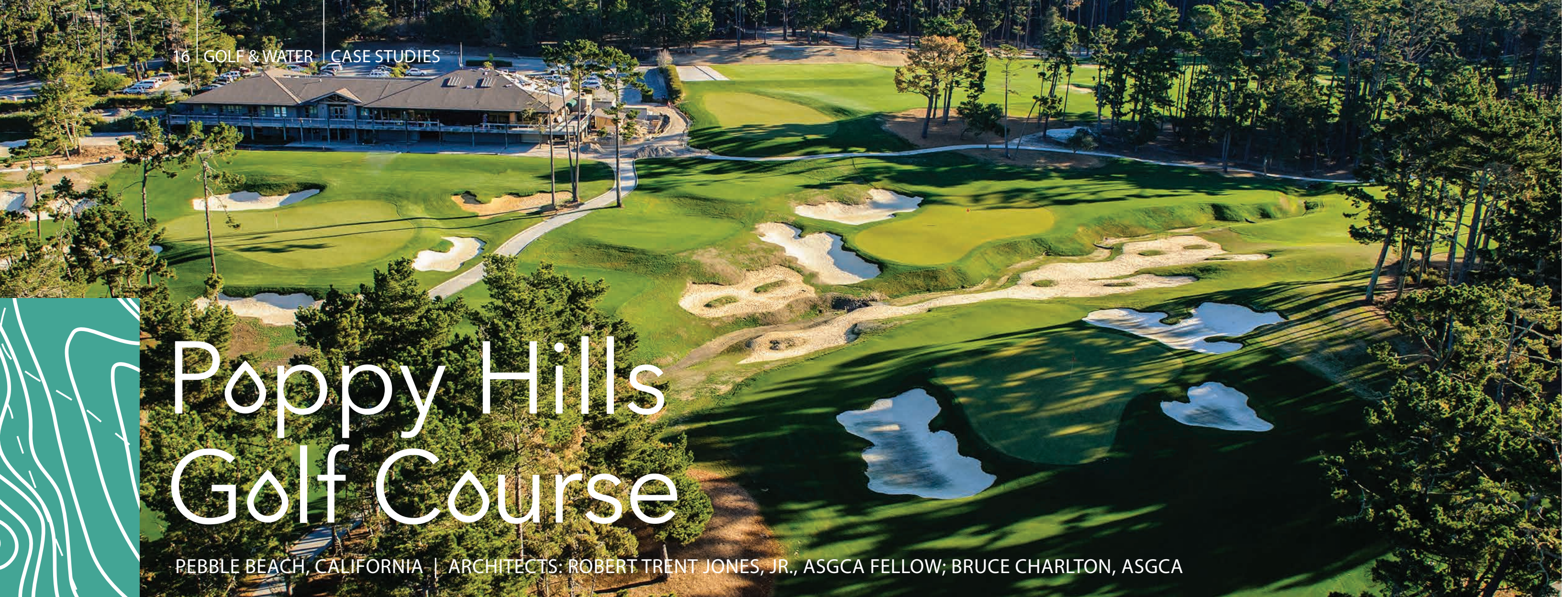
Treated effluent water is received from the Loxahatchee River District into one of the lake systems on the course. Excess storm water is controlled by a weir on the 13th hole and flows into a mitigated wetland "slough" before entering the community drainage system downstream. Approximately 20 acres of connected lakes are lined to function as a reservoir for the effluent. The pumping system for the community is located on the course.

The Solution

The retained effluent is tapped for irrigation water for the golf course and for all green space in the community, including the landscapes of the community's 2,500 homes, the town center, a university, common areas and a spring training baseball complex. The design helps to maintain consistent water levels in the lakes, providing an aesthetic benefit to surrounding residential development. 100 percent of the irrigation needs of the community are covered by the water retained in the reservoir.

100%

100% of the irrigation needs of the community are covered by the water retained in the reservoir.



Poppy Hills Golf Course

PEBBLE BEACH, CALIFORNIA | ARCHITECTS: ROBERT TRENT JONES, JR., ASGCA FELLOW; BRUCE CHARLTON, ASGCA

The Situation

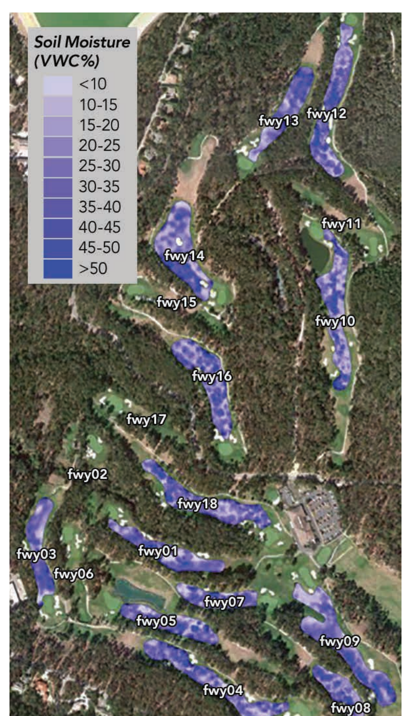
The Northern California Golf Association (NCGA) wanted to bring the 1986 Robert Trent Jones II design up to "modern standards," improve playability (potentially attracting the return of championship tournaments) and conserve resources. Water conservation was a particular focus, as the course was facing higher costs and less availability of water due to state mandates.

What can current technology lend to the renovation of a popular course faced with the higher cost and diminishing availability of water?

The Approach

Prior to renovation, a water audit was performed at Poppy Hills, looking to uncover ways to save water and use it more efficiently, while simultaneously improving the playing experience. "Water mapping" identified areas of the course that faced chronic problems (insufficient or inefficient irrigation, poor drainage, for example). Tree cover keeping nearby turf from thriving was also identified. In addition to turf that was stressed, turf that could be removed from selected playing areas (without compromising strategic intent) and from out-of-play areas was chosen for removal.

Tree cover keeping nearby turf from thriving was identified.



"Water mapping" identified areas of the course that faced chronic problems.

The Solutions

Water consumption was cut in a number of ways. The area of irrigated turf was reduced from 82 to 62 acres, while simultaneously lengthening the golf course from 6,875 to more than 7,000 yards—a modern standard for the championships the NCGA hopes to attract. The water mapping project identified areas to install sensors which measure current moisture content in the soil and provide information used in controlling individual sprinkler heads—which can adjust the degree of arc of water distribution—to ensure even, efficient irrigation only in the places where and when water is needed. This process also revealed that the mostly-clay soil profile of the layout was inhibiting drainage and keeping turf roots from penetrating deeper and, thus, surviving on less water. The entire course was sand-capped to address this issue.

The area of irrigated turf was reduced from 82 to 62 acres, while simultaneously lengthening the golf course.

The course was re-grassed with turf varieties including a mix of shade- and moisture-tolerant fescues, rye and others which can acclimate to all the variables in the Monterey Peninsula weather cycles. Grasses were also chosen based on their ability to be mowed at a single height according to a simplified open mowing pattern, saving time and energy. Out of play areas where turf was removed were seeded with grasses with a slightly higher, thinner wispier growth pattern to meet permitting requirements, and sandy areas were seeded with a drought-tolerant native mix including yarrow, poppy and several fescues which require no irrigation. Poppy Hills will be irrigated with tertiary sewage effluent water as part of a program that irrigates all seven Pebble Beach golf courses. Sand capping and drainage systems filter the water, which passes into naturally vegetated buffer zones that provide additional filtration.

The Takeaways

New technologies—water mapping, soil moisture sensors and controllers that take sensor data and in turn manage sprinkler head operation—are available to help courses use less water and energy to manage their layouts, while giving golfers more consistent and enjoyable playing conditions.

Bonita Bay Club

BONITA SPRINGS, FLORIDA

The Situation

Bonita Bay Club in Bonita Springs, Florida, a 54-hole facility, designed by Arthur Hills, ASGCA Fellow, in the 1990s, had achieved Audubon Cooperative Sanctuary Status in 1995. Recently it was looking to improve playability and extend its environmentally-sensitive practices to include water conservation by upgrading the irrigation system. The existing irrigation systems were based on older design practices with wider sprinkler spacing (80 feet, 24 m), square spacing, sprinklers paired together, and an old control system.

How can modern, high-tech irrigation systems provide more efficient water delivery, saving water and electricity consumption, while improving playability?

The Approach

The Director of Golf Course Operations looked for ways to more efficiently control the application of water and reduce water consumption. Additional goals included reducing irrigation repair costs and improving playing conditions. The first phase of the new irrigation system was installed on one eighteen (The Marsh Course) and included intelligent control modules located at each sprinkler, eliminating all the field satellites and 90 percent of wire typically used in a traditional satellite control system.

The upgraded system design used a larger number of new, high-efficiency sprinklers installed at closer spacing with single-head control, managed by state-of-the-art control software. With more sprinklers on the course, the superintendents can easily provide targeted irrigation and precision control to small areas when needed. Having more sprinklers enables the club to use less water.

The Solution

Fertilizer can be applied through the irrigation system, resulting in more effective response of fertilizer: better results with the same inputs. The IC System eliminated over 10 tons of copper by eliminating the field satellite controllers. Smaller, low-flow rotary sprinkler zones were installed on the tops of mounds in roughs. Since the tops of mounds tend to dry out first, using rotary spray nozzles saves water by reducing the need to turn on the larger sprinklers. Many times the superintendents don't turn on the large overhead sprinklers because the rotary nozzles apply a small amount of water every day to keep the turf looking good.

Rotary spray nozzles save water by reducing the need to turn on the larger sprinklers.

The Takeaways

After 14 months of operation with the new irrigation system at the Marsh Course, the results are very positive. Comparing the water use of the new system to the adjacent Creekside course (with the original irrigation system), the Marsh course used 32 percent less water on a per-acre basis.

Yintai Hongye Golf Club & The Yinhong #6 Golf Course

BEIJING, CHINA | ARCHITECT: RICK ROBBINS, ASGCA

The Situation

The golf development market is maturing in China; with fewer new courses, attention has turned to helping existing layouts run more effectively. In the case of Yintai Hongye Golf Club, the golf complex of 54 holes was developed specifically for the purpose of restoring a large tract of land that had been abandoned to a useful purpose. The site existed in a "feast or famine" water environment; a riverbed adjacent to the courses was generally dry due to its flow being diverted upstream for agricultural uses. The resulting dry surrounding areas, as well as the golf courses, were prone to flooding during significant rain events.

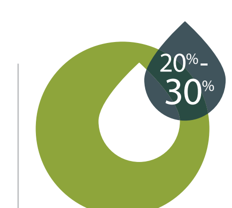
How can an existing 36-hole facility on the outskirts of Beijing adopt water usage BMPs, and develop its third 18-hole layout (which was constructed but not open) as a course that practices water conservation from Day One?

The Approach

The golf course architect looked for ways to alter the golf course design and topography to allow for detention of storm water and creation of wetlands for water retention. An evaluation was made of several related items that would help store enough storm water to eliminate the need for use of ground water and make actual reductions in the quantity of water used for course irrigation. The architect wanted to produce a coordinated effort to achieve water efficiency by managing the work of the irrigation designer, irrigation manufacturer, golf contractor and golf superintendent so the watering system was designed, installed and operated efficiently. The basic design theme was to be evaluated to see where irrigation use could be reduced or completely eliminated.

The Solution

The irrigation system on all three courses was audited for efficiency and proper sprinkler head placement and operation. Agronomic practices were altered to encourage a "firm and fast" style of play to allow for rolling balls onto most greens and reduce the amount of daily water use. The design of the course was changed to include areas of native grasses in non-play sections and irrigation was removed from mature landscaped areas. These factors helped reduce water use by about 20% -30% from before. Integration of wetland planting along lake and wetland edges improved water quality while the increase of wetland area helped increase storage.



These factors helped reduce water use by about 20%–30%

The Takeaways

Water conservation practices can be implemented at existing golf facilities through the introduction of native grass zones, water detention basins and wetland development into the golf landscape. Agronomic practices can be altered to encourage firm and fast playing conditions, which enhances enjoyment for players and inherently reduces water use.

Charleston Springs Golf Complex

MONMOUTH COUNTY, NEW JERSEY | ARCHITECT: MARK MUNGEAM, ASGCA

The Situation

The Monmouth County, New Jersey, Park System in the 1990s implemented a regional Open Space Plan, with the goal of incorporating ecological considerations into the development and management of recreational facilities. The system earmarked part of the 600 acres of the land for two golf courses and practice facilities. Much of the site for the golf courses was barren, and the development plan called for wildlife habitat, irrigation solutions and storm water management.

What is the best approach to designing championship golf layouts on land earmarked for cultivating endangered plant and wildlife habitats, and creating sustainable irrigation and storm water run-off systems to support recreation and habitat?

The Approach

The golf course architect scouted the land for a site with surface water, agricultural soils and minimal forest cover. These features made the land inherently conducive to golf design, and therefore more economical to develop. The golf course was also positioned to sit between sensitive habitat and other recreational amenities. The budget for water—and the ecological requirements of the facility—pushed the architect to find ways to collect, retain and filter water for irrigation use, so the design process took this into account as well.

The Solution

The team designed course grading, drainage and new pond configurations to collect and filter a large percentage of the course runoff. Intensive play areas flow into a series of created wetlands and water quality basins that treat the water prior to it being re-used for course irrigation. Irrigation swales were designed to handle runoff and allow percolation to recharge the groundwater. The architect selected drought-tolerant grass species and an efficient irrigation system to reduce water dependence.

Energy conservation was achieved through advances in geothermal heating and cooling

Energy conservation--one of the highest-cost aspects of the application of water—was achieved through use of a number of technological advances in geothermal heating and cooling. Water was conserved and protected through the use of low-maintenance grasses and a highly-efficient irrigation and fertigation system that minimizes the use of higher quality groundwater, reduces fertilization needs and minimizes runoff and leaching of potential pollutants.

The Takeaways

By embracing sustainability and ecological restoration strategies into the course design and operation, a process is initiated that will allow for the establishment of a variety of ecological functions in wetlands. Degraded land can be brought back to support wildlife, host recreational facilities and support water use and conservation in a number of ways. The way land is graded and treated can allow water to be detained, retained and filtered for groundwater recharging and use in irrigation systems, resulting in sustainable land for recreation and wildlife support.

Snapshots

The examples on the previous pages only begin to tell the story of how design is helping facilities manage water efficiently. Here are some more innovative design solutions to golf's water quantity and quality challenges.

1 Wilmette Golf Course

WILMETTE, IL | ARCHITECT: GREG MARTIN, ASGCA

To effectively manage the flood frequency from a nearby river, golf course ponds were expanded to accommodate storm surges. These ponds were connected with a bio-swale that slowed fast moving rain events. Wetlands were introduced to provide active buffer systems and improve water quality.

2 Reid Golf Course

APPLETON, WI | ARCHITECT: TODD QUITNO, ASGCA

The course helped the city meet new state and federal mandates for storm water ponds and flood control, and created a newly naturalized channel running through the course and four acres of new ponds. Reid became "a giant filtration system" that holds and cleans storm water before heading downstream.

3 The Outlaw at Alto Golf Estates

ALTO, NM | ARCHITECT: JOHN LAFOY, ASGCA

Where every drop of water makes a difference, skillful design takes on additional value. The design for a newly developed golf course in high desert included only 45 acres of drought-tolerant turf, a sophisticated triple-row irrigation system and the digging of two new wells.

4 Georgian Bay Club

ONTARIO, CANADA | ARCHITECT: JASON STRAKA, ASGCA

Can a well-designed golf course benefit salmon and trout spawning streams? It can when the goal is to protect the waters of Georgian Bay on Lake Huron. The project identified new irrigation sources and positively impacted water quality, erosion management and water retention.

5 Pelican's Nest Golf Club

BONITA SPRINGS, FL | ARCHITECT: JAN BEL JAN, ASGCA

More than a mile of directional boring and trenching brings reclaimed water directly to the pump station where it is blended with well water that now contains excessive salts and minerals. Salts are monitored in real time so the superintendent can dilute the well water as necessary.

6 Fazenda Boa Vista

PORTO FELIZ, BRAZIL | ARCHITECT: THAD LAYTON, ASGCA

Through a series of interconnected lakes built in strategic locations around the golf course, on- and off-site storm water runoff is captured and filtered before being reused as irrigation. Created wetlands within the lakes have filled in with native aquatics that capture contaminants and provide habitat and a food source for the native wading bird population.

7 Hunting Hawk Golf Club

GLEN ALLEN, VA| ARCHITECT: BILL LOVE, ASGCA

The golf course was designed to utilize existing topography and a system of both surface and sub-surface drainage to collect 95% of the rainwater that falls on the property. The collected rainwater is then stored in three man-made ponds incorporated into the design of the golf course as impoundments as well as buffers and habitat enhancement for a sensitive environmental area along an adjacent river. This drainage system and water resource management practices allow the golf course to be irrigated at up to 50% less than normal rates during periods of drought with rainwater supplying the only source for irrigation throughout the year.

8 Rock Manor Golf Club

WILMINGTON, DE | ARCHITECT: LESTER GEORGE, ASGCA

A municipal water plant housing the drinking water supply and development surrounded the course. Highway expansion significantly encroached on the course. Eventually, flooding of the Matson Run Watershed became a loss-of-life reality. The course was used to create new maintenance and floodwater attenuation, working around utilities and routing around a major interchange.

What's Next?

INNOVATIONS IN THE MAKING

Golf course architects have built a solid record of putting innovative solutions in place to help golf courses be good stewards of water. However, the issues with water quality and quantity, as well as the cost of energy needed to apply water to turfgrass, will only become more complex as time goes on. Here are some new approaches to the management of water resources in golf:

Water Collection/Retention

New golf courses, early in the design process, can be planned for the collection and retention of rain water for irrigation use. Development of this type of system to supplement a source of water or supply the entire source of water for irrigation is dependent upon determining whether the proposed site receives sufficient annual rainfall, understanding regional climactic conditions so appropriately-sized detention systems can be incorporated into the design of the golf course, and a thorough analysis of the surface drainage patterns of rainfall on the site and the design of a collection system to retain the majority of that surface drainage to make collection feasible. A system for the collection of water can lessen the need of more expensive/less sustainable water sources, and, through careful planning, can contribute significantly to meeting the water requirements for irrigation during times of drought, as well as during normal weather conditions.

Water Treatment Partnerships

Golf facilities can think beyond their property lines by addressing their water needs and providing benefit to their community at the same time. An historic golf club in California has purchased its irrigation water from the local water district for decades. However, due to years of drought and the ever increasing cost of procuring that water, an alternative source became a necessity. Effluent water was not a readily apparent solution due to the distance from the municipal treatment plant (more than eight miles) and the capacity of the plant itself. Instead, the club is proposing to install a small treatment plant on the golf course property, harvesting waste-water from a nearby sewer line, treating the water for use on the golf course and sending the remaining waste downstream to its original destination. This process will provide all of the necessary water for the golf course and reduce the load on the municipal plant to the point where a planned expansion will not be necessary.

Focus on Energy

According to the EPA, "The use of water and the use of energy are intricately intertwined. The extraction, treatment, distribution, and use of water followed by the collection and treatment of wastewater require a lot of energy; likewise, the production of energy—particularly hydroelectric and thermometric power generation— requires a lot of water." Conducting energy audits on the golf course—focusing on the irrigation pumping system and related wells and water services, and the irrigation system's central control computer and programming—is a new focus area for courses looking to conserve water.

Precision Turf Management

The Poppy Hills case in this book is a look at how technology has driven the development of tools to more precisely monitor soil conditions. As the technology advances, superintendents have to do less interpretation of outputs; the tools translate data to advice on how to more effectively manage resources like water and energy, leading to healthier turf and better playing conditions.

Irrigation Checklist

INSTALLING OR RENOVATING AN IRRIGATION SYSTEM? HERE'S HOW TO PROCEED.

Irrigation systems, whether being renovated or newly-installed, can help a golf facility realize significant water, energy, and labor savings. Just as every golf course is designed to fit the conditions of its setting, every irrigation system design is site-specific. Here's what you need to consider when investigating options:

- **A professional irrigation designer, golf course architect and/or an irrigation manufacturer** will provide guidance for a golf course looking to improve or replace an irrigation system.
- **Modern golf course irrigation systems include the following design criteria…;** make sure your project includes these items:
  - **Modern, high-efficiency golf-quality sprinklers** are designed and installed at the correct sprinkler spacing for the sprinkler's operating parameters. Depending on climatic conditions, sprinkler spacing of 60-65 feet (18-20m) provides the best Distribution Uniformity (a measure of sprinkler performance).
  - **Sufficient operating pressure,** both at the pump station and on all elevations of the course to ensure sprinklers are operating at their intended design pressure.
  - **Weather station**–an on-site weather station will measure climatic conditions and provide real time information to the central control computer. Each sprinkler head and irrigation program can then be set to provide only the water needed.
  - **Rain sensors and soil sensors** will enable the operator to know when and if to irrigate.
  - **A professionally-designed and sized pipe network** will ensure that the system operates efficiently during a watering cycle, minimizing pressure losses and maintaining safe flows (water velocity) which will result in a more efficient, longer lasting irrigation system.
- **Use individually controlled valve-in-head sprinklers.** With a valve-in-head system each sprinkler is operated only when required. By comparison, a "block" system has several sprinklers operating from a single remote valve. This wastes water because all the sprinklers in the block have to be operated for the same time and at the same time, even if only one small area of turf needs water.
- **Ensure proper irrigation coverage of the turf that matches the expectations of the owner or membership.** Through design, the layout of sprinklers should be such that spacing is uniform to maximize efficiency. Poor sprinkler spacing, and therefore coverage, results in wet and dry areas, and poor turf quality.
- **Automated computer-controlled irrigation software that communicates directly with each sprinkler should be used.** Each sprinkler can be automatically adjusted to match daily weather at your golf course.
- **Use reclaimed wastewater, RO water or other non-potable water sources when available.** Consider consulting a professional for assessing water quality and mitigation requirements.
- **Include a modern pump station if needed.** These are managed by computer PLC and variable frequency drives (VFD) on the motors and pumps for electrical efficiency. These stations also communicate with the irrigation system software to ensure that the irrigation system and pump station are operating efficiently in tandem. Include communication packages for monitoring at the control computer and online through the web.
- **Develop a regular sprinkler maintenance program.** A sprinkler that is tilted by over 5 degrees from its intended position can waste 15% or more water than designed. Routinely check and adjust your system to maximize results.
- **A "less expensive" irrigation system option will almost always sacrifice system efficiency and coverage on a per-acre basis.** Plan carefully and match your expectations and budget with your improvements. Your design professionals can help!

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For more background and research on water management on golf courses, please visit the following websites:

American Society of Golf Course Architects	**www.asgca.org**
American Society of Irrigation Consultants	**www.asic.org**
Golf Course Superintendents Association of America and the Environmental Institute for Golf	**www.gcsaa.org**
Irrigation Association	**www.irrigation.org**
United States Golf Association	**www.usga.org**

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