Golf and the Environment: Guidelines for the 21st Century

The United States Air Force Golf course Environmental Management (GEM) Handbook

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Water Resource Management Section

San Antonio, Texas

Combine the natural beauty of Kauai with Jack Nicklaus' design expertise and you get the awesome Kiele Course.

Environmental Compatibility Categories

Many diverse and complex aspects of golf course management have been revealed through the literature search conducted to compile this study. In order to simplify the process, these aspects have been summarized into eight main topics and incorporated into five distinct environmental compatibility categories.

- Planning & Compliance
- Operations & Maintenance
- Water Resource Management
- Conservation
- Pesticides & Pollution Prevention

The environmental compatibility quotient (ECQ) checklists have been compiled from several sources (Audubon International, 2000) (AFCEE, 2001) (Smart, et al, 1999). The ECQ checklists represent the best method currently available to determine the actual relative environmental compatibility of a golf course's management practices. The ECQ checklists can be completed through interviews with the golf manager and the golf course superintendent, a professional examination of the course's golf course management process, and review of the available environmental or planning documents.

Extraordinary efforts have been taken at Kiawah's Ocean Course to protect water quality and native plant and animal species.

Water Resource Management

Water is the primary limiting resource for life and golf. No other issue is as significant or as prevalent as those concerning water resources and their management. "Protecting ground and surface water from chemical pollutants is a national initiative. The Environmental Protection Agency (EPA) estimates that 1.2 billion pounds of pesticides are sold annually in the United States. About 70 percent of the pesticides applied are used for agricultural production of food and fiber. Only a small fraction is used on golf courses. Yet, increased public concern about chemicals has drawn attention to golf because of the perception that the intense maintenance on golf courses creates the potential for environmental contamination" (Kenna, 2000).

According to Balough and Walker (1992), "Prevention of adverse environmental impacts, such as surface water and groundwater contamination, by implementation of rational water, nutrient, and pesticide practices is a cost-effective measure. Avoidance or protection of wetlands prior to construction and continued protection during turfgrass maintenance will eliminate the need for expensive wetland mitigation or restoration. Avoiding protracted permit processes or litigation prevents losses of revenues and natural resources."

"Understanding on-site water resources, as well as local and regional influences affecting water quality, is the first step in developing a management plan that is right for your course" (Mackay, 2002). Several complex and diverse, yet intimately connected water resource issues command a dominant position on the list of environmental concerns for golf course managers to include water quality, watersheds, rivers and streams, lakes and ponds, wetlands, and recycled water.

Excessive nutrients from a sewage treatment plant just upstream of the golf course property enhance plant growth in this small stream.

Water quality

"Protection of both quantity and quality of drinking water supplies is a major environmental concern of the public, regulators, and ecosystem managers in the United States" (Balough and Walker, 1992). "Properly managed water resources provide good quality irrigation water, aesthetically pleasing ponds and streams, appropriate storm water treatment, and no offsite surface or groundwater pollution problems" (Mackay, 2002).

In the eyes of the public and some environmentalists, golf has long been associated with impacts to water quality. Since this is easily quantifiable through scientific experiment, many universities are actively testing and monitoring water quality near golf courses with interesting results. "Numerous studies and reviews have shown that fertilization of turfgrasses according to established practices presents negligible

potential for nutrient movement into groundwater or surface water because the dense turf canopy, thatch and root system, when properly managed, are an effective filter" (Georgia Golf Course Superintendents Association, Georgia State Golf Association). "Sound management of water, nutrients, and pests involves practices designed to retain the applied chemicals onsite and within the soil root zone" (Balough and Walker, 1992). Ultimately, it is either the Clean Water Act or the Safe Drinking Water Act that dictate the water quality standards in the United States. Each of these laws are complicated and armed with potent fines for violators.

The Clean Water Act

The Clean Water Act stated objective is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (33 U.S.C. § 1251(a)). In the past, the Clean Water Act has focused on end-of-the-pipe point sources through the National Pollutant Discharge Elimination System (NPDES) permits. Recently, the U. S. EPA has promulgated Phase II NPDES regulations that are beginning to focus on non-point pollution sources. General construction permits are now needed for projects that disturb an acre or more. In addition, these projects will also require a Storm-water Pollution Prevention Plan (SWP3) as part of the permitting process. Add to this the much tougher regulations for regulated small municipalities, Phase I medium and large cities, and discharges to designated non-attaining streams.

The Safe Drinking Water Act

Enacted in 1974, the primary objective of the Safe Drinking Water Act (40 CFR § 141-149) is to protect the public from risks posed by drinking water contamination. Although it is mainly aimed at public water systems and their operators, it does have its application to golf course management. Issues such as sole source aquifer protection, a major consideration in San Antonio, Texas, underground injection control (septic systems), and wellhead protection. Once again, great care must be taken when these types of issues are part of the golf course or adjoining property.

Watersheds

Watershed science is a rapidly growing and relatively new field of study. "A watershed is the entire area of land that drains into a specific river or river system" (Mackay, 2002). Knowing where in a particular watershed their golf course property lies is an invaluable piece of information that most golf course superintendents usually do not have at their fingertips. "To protect natural resources within a watershed, a threefold approach should be taken as follows: 1) preventative measures; 2) control measures; and 3) detection. This proactive approach stresses protecting water quality through removal, filtration, detention or rerouting potential contaminants before they enter surface waters; and developing strategies for protection of environmentally sensitive areas and guidelines for detection through an environmental monitoring program that provides feedback to the golf course superintendent as to conditions and movement of materials" (Peacock, et al, 1998).

Rivers and streams

Rivers and streams are intimately related to watersheds. These water features are the most dynamic and unpredictable on a golf course. "Because water is always

moving, what happens in one area can impact water quality in other parts of the watershed. Golf courses must be mindful of five primary impacts to water quality as a result of their operations:

- Discharges of chemical pollutants via leaching, drift, or runoff from chemical applications and storage, equipment maintenance, grass clippings, and parking areas;
- Sedimentation due to eroding shorelines;
- Thermal pollution-water temperature increases due to lack of shade when tree cover is removed along stream margins;
- Impacts associated with excessive water withdrawals; and
- Oxygen depletion due to excessive growth of algae, often caused by nutrient loading from spring fertilizer applications" (Mackay, 2002).

String trimming right to the edge of water features may not always be desirable.

Lakes and ponds

Lakes and ponds are used on golf courses "to add to the beauty of the setting and to enhance the playing experience. They are a dramatic and integral part of the landscape that superintendents are charged to manage" (McNabb, 2001). Maintenance of water features is one of the few tasks that does not focus on or relate to the quality of the golf course's turfgrass. Accordingly, superintendents oftentimes do not have the expertise to adequately maintain these water features,

potentially resulting in difficulties ranging from negative environmental impacts to customer or neighborhood complaints.

"Any evidence of unsightly aquatic plant growth can detract from that beauty, and this easily draws the attention of members or the playing public. Aquatic plant and algae growth can obscure balls that have been hit into the lake, adding to the stress of the players when they can't be found. Excessive aquatic plant growth can cause flow problems in the irrigation lakes because intakes can be plugged or holding capacity of the lake as a reservoir can be reduced by the volume of plant material. Poor water quality can increase the presence of insect vectors like mosquitoes and cause odor problems near the feature. As such, superintendents need to have a good understanding of the dynamics of these lake systems" (McNabb, 2001). Since every lake may require different management practices and the fact that they are a living, changing biological element that attract birds, animals, regulators, and environmentalists, the superintendent must be diligent, knowledgeable, and ready to take action when required. Although the design of a lake may be the most important issue for the ease of their long-term maintenance, superintendents need at least a basic understanding of lake chemistry and biology to ensure success. Fish kills, nitrification, foul odors, and potential pollution from inappropriate pesticide or fertilizer applications are among the most common incompatible results of poor water feature management on golf courses.

Wetlands

Wetlands cover about six percent of the earth's surface. In the lower 48 United States, wetlands cover about five percent. Unfortunately, "between 1930 and 1995 this country lost wetlands roughly equal to the size of the state of Oregon" (Sodikoff, 1996). "The current national trend regarding wetlands and land development is for no net loss of wetlands. Environmental legislation both at the state and federal level has been enacted to establish a comprehensive program to conserve and manage wetlands in the United States" (Balough and Walker, 1992). These "prime tracts of acreage may not be drained, filled or built upon because they gained legal protection in 1972 under the Clean Water Act" (Sodikoff, 1996). "The United States Environmental Protection Agency (EPA) and the United States Army Corps of Engineers (COE) produced a definition that has been incorporated into Section 404 of the 1979 Clean Water Act Amendments" (Balough and Walker, 1992). "The term 'wetlands' means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally included swamps, marshes, bogs and similar areas" (33 CFR 323.2(c); 1984). "Section 404 of the Clean Water Act has become the federal government's primary tool for protecting wetlands" (Salvesen, 1990). It gave "the Corps authority to establish a permit system designed to regulate the dredging and filling of materials into water of the United States" (Balough and Walker, 1992).

Storm water may not always be manageable.

Stormwater management

"In some cases, any earth disturbance activity could trigger regulation under state erosion and sedimentation control requirements" (White, 2005). Under Section 402 of the Clean Water Act, is Phase II of the National Pollutant Discharge Elimination Stormwater Program (NPDES) requires a permit and a Stormwater Pollution Prevention Plan (SWPPP) for any project that disturbs one acre or more of soil. Not only can projects be delayed when these regulations are not satisfied in writing or in practice on the site, but fines can be imposed that can severely impact budgets. "Erosion is a real environmental problem, and those who make their living moving earth have a responsibility to understand the science behind that problem and take steps to control erosion. At http://cfpub.epa.gov/npdes/stormwater/cgpfaqs.cfm, the EPA provides an online FAQ [frequently asked questions] resource that provides precise answers to many specific questions construction contractors have relating to NPDES permits" (White, 2005).

Although dry as a bone most of the year, this wash is classified as a "water of the United States" and is subject to regulation by the USACE.

Floodplains

Another environmental challenge faced by golf courses worldwide is their susceptibility to flooding by being constructed in low-lying, otherwise difficult to develop properties. Usually, in order to develop within the delineated 100-year floodplain, a finding of no practicable alternative (FONPA) is required. This process can be lengthy and potentially contentious in the eyes of the community and regulators.

Coastal zone management

With the promulgation of the Coastal Zone Management Act of 1972, the federal government established a comprehensive policy to "preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations" (Public Law, 104-150). Additionally, the Act strives to "manage coastal development to improve, safeguard, and restore the quality of coastal waters, and to protect natural resources and existing uses of these waters" (Public Law, 104-150).

Seaside golf offers some of the greatest challenges – both to the player and the superintendent.

Recycled water

"Water use and reuse are the most significant issues faced by superintendents worldwide. There are several reasons to use effluent, recycled, reclaimed, or wastewater including opportunity, need, conservation, reliability of supply, economics, and pollution abatement" (Crook, 1994). "Beginning in the mid-sixties, the use of effluent [recycled] or wastewater on golf courses was thought to be the answer to many developers' dilemmas in states with restrictive water use laws such as Arizona and California" (Gill and Rainville, 1994). It may be that the use of recycled water for irrigating golf courses is the only way the game will eventually survive.

Many states have promulgated their own regulations for the use of recycled water for golf course irrigation purposes. In 1992, the EPA released *Guidelines for Water Reuse*. Some of the issues raised by the document include "limits for fecal coliform organisms, recommendations that wastewater receive secondary treatment, filtration, and disinfection, setback distances between wastewater irrigated areas and potable water sources, and maintenance of minimum chlorine residual" (Crook, 1994).

Recycled water is golf's future lifeblood regardless of the location.

Obviously, most of these requirements indicate there may be a potential to harm human health through the use of recycled water. Public safety and protection are the primary considerations, but native vegetation and wildlife must also be monitored to ensure no adverse affects. In addition, none of the recycled water should be allowed to runoff either the property or into non-recycled water bodies such as natural streams, lakes, or ponds.

Untold acre-feet of recycled water are not reused. In many communities like Tucson, Arizona, recycled water is nearly the only source available for golf course irrigation use. Unfortunately, in other communities the public perception of this valuable resource is not favorable. Education is paramount for golf to survive by utilizing recycled water at every opportunity worldwide.

Keeping expensive equipment clean is an important golf course water use.

Water use

"In order to ensure adequate water supplies not only for irrigation, but also for the healthy ecological functioning of water bodies, such as rivers, streams, wetlands, lakes, and ponds, golf courses must conserve the earth's most precious natural resource" (Mackay, 2002). Jim Snow, national director of the United States Golf Association's Green Section, revealed that "a series of widespread droughts during the late 1970s and early 1980s, highlighted by a severe drought in California and other Western states, resulted in extreme restrictions on the use of potable water by homeowners and businesses in hundreds of communities" (Achenbach, 1996). "No other golf course impact garners more attention from the general public than water use. When entire regions are limited by law on how much they are able to water their own property's lawns, golf course irrigation systems continue to pump large quantities of precious water on their turfgrass" (Mackay, 2002). Snow adds, "Golf courses were among the first and most severely restricted operations in many areas, due in part to their visibility in their communities and because they were considered nonessential users of water" (Achenbach, 1996).

"Though water use on golf courses varies widely depending on climate and other factors, an average golf course may use 10 to 30 million gallons of water per year. Several simple, yet inter-related practices can help a superintendent ensure that their golf course uses only as much water as it needs. These practices include

identifying potential water sources and equipment, operational, and behavioral changes such as optimizing efficiency and keeping records" (Mackay, 2002). For example, "A water conservation practice could be as simple as matching the irrigation rate with the course's soils infiltration rate to properly schedule irrigation cycles that minimize runoff" (Georgia Golf Course Superintendents Association). Choice of turfgrass varieties, mowing heights, sharpness of a mower's blades, soil compaction, quality of the irrigation system design and installation, and water quality all play significant roles in the conservation of water on golf courses.

Water resource management action items

- Improve water hazard care to eliminate unwanted vegetation while improving aesthetics and habitat
- Closely monitor and manage water use to prevent unnecessary depletion of available company or local water resources
- Maintain a vegetative buffer around all water features to filter or trap potential pollutants
- Reduce offsite transport of sediment, nutrients, and pesticides
- Compile and utilize a Drought Management Plan for the entire golf course facility
- Reduce total chemical loads by use of Integrated Pest Management, economic thresholds, alternate pest control options, and fertility testing
- Employ appropriate water feature management techniques possibly including biological and mechanical controls prior to using chemicals
- Ensure there is never a violation of Section 404 of the Clean Water Act by increased employee training and awareness
- Eliminate the potential for fish kills in golf course ponds or lakes through intelligent, science-based management
- Never allow water use permit violation by maintaining good records
- Be prepared to minimize water use on the golf course facility grounds in case of extended regional drought
- Insist on proper application of pesticides and fertilizers along water feature banks to eliminate potential for spills or drift
- Avoid a buildup of heavy metals like mercury and cadmium in soils due to using poor quality recycled irrigation waters
- Ensure that a Stormwater Pollution Prevention Plan is submitted for all construction disturbances over one acre

Water Resource Management
Environmental Compatibility Quotient Checklist

Water Resource Management				
#	**Environmental Compatibility Indicator**	**Yes**	**Partial**	**No**
1	Are written records of water quality monitoring activities, results, and pollution control measures readily available?			
2	Where appropriate, are slow-release fertilizers and/or spoon-feeding techniques used to reduce the potential for runoff impacts and nutrient loading to water quality?			
3	Has the irrigation system been completely checked for proper water distribution in all irrigated areas and are water leaks fixed in a timely manner?			
4	Are outdoor irrigation of non-golf course areas and indoor plumbing regularly monitored and maintained for leaks?			
5	Have low-flow water saving devices been installed wherever possible?			
6	Are recycled or other non-potable water supplies being used to irrigate at least 65% of the golf course property?			
7	Are there projects planned that should eliminate or minimize a potential water quality or erosion problem?			
8	Are water features regularly monitored for algae, erosion, excessive aquatic plant growth, eutrophication, and sedimentation?			
9	Is runoff from parking lots cleansed by control measures such as vegetative or drainage filters prior to leaving the golf course property?			
10	Are there procedures for reporting water quality problems to supervisors (as required) for appropriate action?			

Water Resource Management Checklist (continued).

#	Environmental Compatibility Indicator	Yes	Partial	No
11	Is the irrigation pumping station and associated equipment regularly checked for proper operation and leaks?			
12	Has the irrigation system or its components recently been upgraded to reduce inefficiency, malfunction, and overall water use and are flow meters used to monitor water use and detect potential waste?			
13	Is there a map of the watershed in which the golf course property resides and location(s) of floodplains and stormwater drainage that exist on the property?			
14	Is the quality of the water entering and leaving the property tested regularly for contaminants, pH, dissolved oxygen, and nutrients?			
15	Is water quality data collected to establish baseline conditions for all water features on the property?			
16	Are settling ponds and/or detention ponds used to effectively remove sediments and pollutants from water features?			
17	Are biological processes such as the addition of grass carp or white amur used to control unwanted aquatic vegetation in water features?			
18	Is there a written Water Resources Management Plan that delineates the care of the course's water features?			
19	Has the property been examined for potentially significant wetlands or associated sensitive water-based habitats?			
20	Has the property's water features been studied to determine the aquatic and amphibious species population?			
	Totals			

Environmental Compatibility Quotient Summary & Scoring Scale

ENVIRONMENTAL COMPATIBILITY QUOTIENT SUMMARY			
Environmental Compatibility Category	**Yes**	**Partial**	**No**
Planning & Compliance			
Operations & Maintenance			
Water Resource Management			
Conservation			
Pesticides & Pollution Prevention			
Totals			

- Key to checklist responses
  - **Yes** = Practice is complete or ongoing and can be verified
  - **Partial** = Practice has been initiated but needs improvement or completion
  - **No** = Practice is not in place

ENVIRONMENTAL COMPATIBILITY QUOTIENT SCORING SCALE	
Total Yes or Partial Responses	**Environmental Compatibility Level**
86-100%	**Advanced (Green)**
70-85%	**Showing progress (Yellow)**
69% or less	**Just started (Red)**

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