

AQUIFER GOLF

Imagine a world where a golf course can coexist with a municipal water supply and not be the center of constant protest.

by FRANK A. RENDULIC, CGCS



A self-cleaning screen at the lake intake prevents large debris from entering the system.

THE KITTYHAWK Golf Course is an 800-acre, 54-hole golf complex owned and operated by the city of Dayton, Ohio. The golf course is unique in many ways. First, it is one of the largest municipally owned golf facilities in the country, and it is situated immediately above the Miami Aquifer, one of the largest bodies of underground water in the world and the water source for Dayton and the surrounding area. Second, the Kittyhawk Golf Course is a part of the city's Miami Well Field, which produces as much as 63 million gallons per day (MGD) of water for the residents and businesses of the greater Dayton area.

The concept of a golf course within the well field arose in 1956 when the city of Dayton acquired a large tract of land adjacent to the Great Miami River to act as a buffer zone for the existing Miami Well Field. The well field included a large lake and two recharge lagoons (long, narrow water channels intended to increase percolation into the aquifer). The lake and lagoons were filled naturally through a connection to the Great Miami River and could produce 2 to 4 MGD of recharge to the aquifer. City planners sought to make better use of the newly acquired land rather than allowing it to sit fallow.

The development of a golf facility was considered to be an appropriate dual use of the land. Robert Bruce Harris was contracted to design an 18-hole championship course (Hawk Course) and a par-3 beginner's course (Kitty Course). Construction on the golf courses began in 1960, and the two courses opened for play in 1961. With

increasing rounds of golf and additional land available at the Kittyhawk site, the city again hired Robert Bruce Harris to design the 18-hole Eagle Course. The Eagle Course opened for play in 1965, bringing the number of holes available for play to 54.

Time to Sell Water?

From 1965 to the early 1980s, the Kittyhawk Golf Course not only served as a fine test of golfers' abilities, but also fulfilled its role in buffering the well field operations from industrial development. Then, in 1982, the city of Dayton, along with Montgomery County, hired CH2M Hill to study the feasibility of the city of Dayton selling water to the southern suburbs. The results of this study concluded that the well field and treatment facilities were adequate to proceed with the project. The necessary interconnects were created, and the city began selling water to Montgomery County in the mid-1980s.

The added demand, coupled with back-to-back drought years in 1987 and 1988, caused the water table to drop dramatically during that period. The drought had the expected effect on the golf operation, leaving large areas of brown turf in the non-irrigated areas and showing clearly any weak areas in the irrigation system. More important, however, was the impact on the city's ability to provide water to area residents. Modifications to the existing recharge lake and lagoon system had allowed for a maximum aquifer recharge of approximately 29 MGD, but it was clear that additional recharge

was needed to insure that future demand could be met.

Enhancing Water Recharge

The services of Camp, Dresser and McKee were engaged to study the feasibility of adding recharge facilities to the Kittyhawk Golf Course. Three possible solutions were studied: horizontal collector injection wells; the typical long, narrow recharge lagoons already in use in the well field; and ponds strategically placed as water hazards on the golf courses. Each of the three solutions would require a pumping system to lift water from the recharge lake near the river to the golf courses' higher elevations.

Following several internal meetings, it was decided that golf water hazards were the most viable solution. Hank Chafin, CGCS, superintendent of the golf course at the time, worked with Abe Martin, well field supervisor, to select approximately 40 possible locations that would serve both the Water Department's and the golf courses' needs. Bowser-Morner, Inc., was contracted to take soil borings at each site to help determine the final locations for the ponds. This work was completed in 1988.

Woolpert LLP was hired to oversee the water hazard construction project. Six new ponds were placed on the Kitty Course, 13 new ponds were added to the Hawk Course, and 11 new ponds were added to the Eagle Course. In addition, one existing pond on the Hawk Course and two on the Eagle Course were reworked to be added to the recharge system. Following the excavation of the ponds, a connection to the aquifer was created by excavating a trench through any clay layers to facilitate movement of water into the aquifer. The resulting trenches were backfilled with clean #4 roofing gravel; #57 gravel and #8 pea gravel were then installed over the roofing gravel to act as a filter. The #8 gravel layer is removed and replaced periodically to ensure maximum recharge of the aquifer.

Water for the recharge system is pumped from the original recharge lake, which had been modified to act

as a stilling basin, allowing particulate matter to settle before being pumped into the ponds. The pump station is fitted with five 16"-diameter line shaft turbine pumps driven by 75 HP motors. The total output of the pump station is approximately 39 MGD. Water from the pump station is delivered to the ponds through a 30-inch main that branches out to each pond. The lateral lines servicing each pond range from 8 to 12 inches in diameter, based on the size of the pond being filled. Final output to the ponds ranges from 800 to 1,200 GPM (gallons per minute). Each pond is fitted with a water-level control that maintains preset levels once the ponds fill.

Concurrent with the installation of the recharge pipe network, a 60"-diameter potable water main was installed to deliver water from 14 new production wells located on the golf courses to the water supply and treatment facility. This pipe was installed in a trench alongside the 30" recharge main. The routing of the two mains bisected the Hawk and Eagle courses. (Note: The resulting trench was 20' wide and 20' deep and did have an impact on play.)

Filling freshly excavated ponds or ponds that have had the filter layer replaced is not an overnight process. The initial filling can take up to two months. During this time, the water delivered to the ponds simply flows into the gravel channel and disappears. As groundwater under each pond begins to mound, percolation rates drop to the design levels and the pond begins to retain water. The water-level control structures prevent overfilling of the ponds.

Several factors influence the pond cleaning schedule. Because the ponds are relatively shallow (8' maximum depth), and because the water supply comes through a predominantly agricultural area before reaching Dayton and may contain nutrients as a result of runoff, algae forms more rapidly. In addition, to help meet the needs of the golf operation, water has sometimes been pumped into the ponds when turbidity levels have been higher than planned. The Water Department installed aerators or air diffusers in 20 of the ponds, which helped with the algae problem, but the ponds must still be cleaned every two years. The cleaning involves the replacement of the gravel filter layer.

Replacing the filter layer is no small task. Excavators, loaders, and Terex-style, off-road dump trucks haul the

contaminated materials out and bring in fresh gravel. This process takes much of the winter to accomplish. The trucks and other equipment follow prescribed haul roads, but they must cross the playing areas at times. Haul roads have been laid out to minimize effects on golf play, the grounds, and underground facilities.

Ongoing Maintenance

Maintaining a golf course within an operating well field presents special challenges. We stay in almost constant contact with the city's Environmental Protection Office. A copy of our annual plant protection program is forwarded to that office for review every winter. Before and immediately after every application of fertilizer or pesticide, a record of the application is faxed to the Environmental Protection Office so that upcoming groundwater tests can be tailored to look for potential problems. In addition to 16 production wells located on the golf course, numerous monitoring wells dot the landscape. We can proudly say that no golf-course-related materials have ever been found in the groundwater or in soil samples taken around the course.

Also submitted is an annual Regulated Substance Activity Inventory Report (RSAIR) to the city's Environmental Protection Office. This report is required of any business located within the well field protection area. The report lists quantities of regulated substances that may be stored or used on the property during the course of the year. The golf courses store only dry formulation products on site for the plant protective program. All liquid materials are stored in a specifically designed facility at the Madden Golf Course. Liquids are brought on site within 24 hours of use.

The Plant Protective Program is developed as a guide for the golf course superintendent to follow and represents the maximum amount of product that may be applied. Phil Cline, CGCS, golf course superintendent at Kittyhawk, carefully monitors weather patterns and is free to back off the program to meet conditions. A comprehensive inventory is conducted every fall to ensure that excessive amounts of materials are not stored. The program is under constant review, and products are replaced as newer, more efficient, or lower toxicity products become available.

The use of Merit® for white grub control is a prime example of this review

process. Merit, which replaced organophosphate materials used in the past, has decreased the potential impact on the environment while providing much better grub control. All improvements in our environmental management program carry over to our other golf courses as well.

Application of materials is a special concern as well. In addition to the bermed pond edges to prevent runoff from adjacent areas, no applications are made within 30 feet of the top edge of any of the ponds to help ensure that materials do not run off. Maintenance of the pond edges is the responsibility of the Water Department well field managers, with many banks allowed to grow rank as a deterrent to Canada geese.

The Kittyhawk Golf Course (along with its sister courses Madden and Community Golf Courses) is a member of the Audubon Cooperative Sanctuary Program and is currently working toward certification. Communicating the purpose of the water features and the need for them to be dry at times is an ongoing process. The Water Department has placed signs at the first tee on each golf course to explain the overall operation of the recharge project. Much of the Water Department equipment on the course (freshwater pumps, lake level control structures, water purifying towers, etc.) has signage explaining how the equipment works.

The Kittyhawk Golf Course is a work in progress, with changes made to the recharge system from time to time. One recent change included the excavation of a creek across the third fairway on the Eagle Course to move water from a purifying tower into one of the lakes. The stream flows at 800 GPM and acts as a hazard on the hole. Work currently in progress includes the creation of a series of waterfalls and meandering streams to connect the ponds on the par-3 Kitty Course.

This project has demonstrated how the city has successfully worked with the community to meet their water needs and provide a recreational facility.

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