Desert Mountain: Built to Enhance *and* Preserve the Native Landscape

Renegade's 12th hole at sunset.

Of all the sports played on turf, golf brings the player into closest contact with some of nature's most spectacular scenery. From the sport's beginnings in Scotland, golf course architects and superintendents have sought to blend the acres of turf necessary for golf with the surrounding native landscape, regardless of the location. In doing so, they have helped preserve the relationship between man and this earth during a period of massive urbanization.

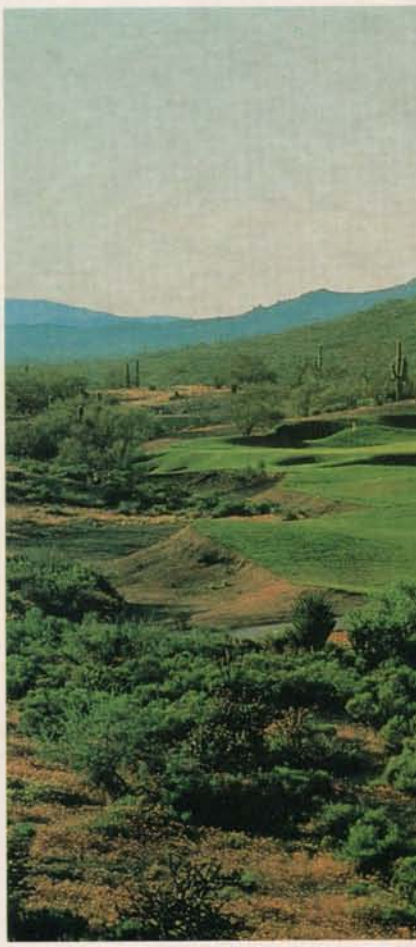
Creating and maintaining golf courses is a continuous process of give-and-take. In exchange for the plants, soil, and water that are taken from an area to build and maintain a course, golf courses can enhance the remaining native landscape and generate a greater public awareness and appreciation of it.

The Desert Mountain Development Company is keenly aware that it must take as little as possible from nature and return as much as possible. This responsiblity covers more than 8,000 delicate acres of the Sonoran Desert which lie within the city limits of Scottsdale, AZ.

As its name implies, Desert Mountain Development and its three golf courses are perched in mountainside canyons of granite ranging in elevation from 2,700 to 4,900 feet. Dramatic desert plants such as cactus, acacia, brittlebush, yucca and sage in the lower approaches yield to scattered juniper and pine at the higher elevations. To the south is a panoramic view of the Valley of the Sun.

More than 2,000 acres of the land will be left untouched. The remainder is master-planned and zoned for the golf courses, plus over 5,000 homes, resorts, offices, and commercial retail development.

Conservation is the key to the planning and development at Desert Mountain. The master plan, devised by Taliesin Associated Architects, an Arizona firm founded by pioneering modern architect Frank Lloyd Wright, seeks to preserve the beauty of the desert. No hill is flattened, no majestic saguaro cactus is disturbed, without careful consideration of the effects on aesthetics and ecology.



The two different pin positions are eviden

The landscaping of the community and golf courses is being designed to preserve the natural beauty of the desert terrain. Steve Martino and Associates, a Scottsdale-based landscape architecture firm specializing in native plants, has been hired to incorporate the existing vegetation into the project and to protect the native habitat.

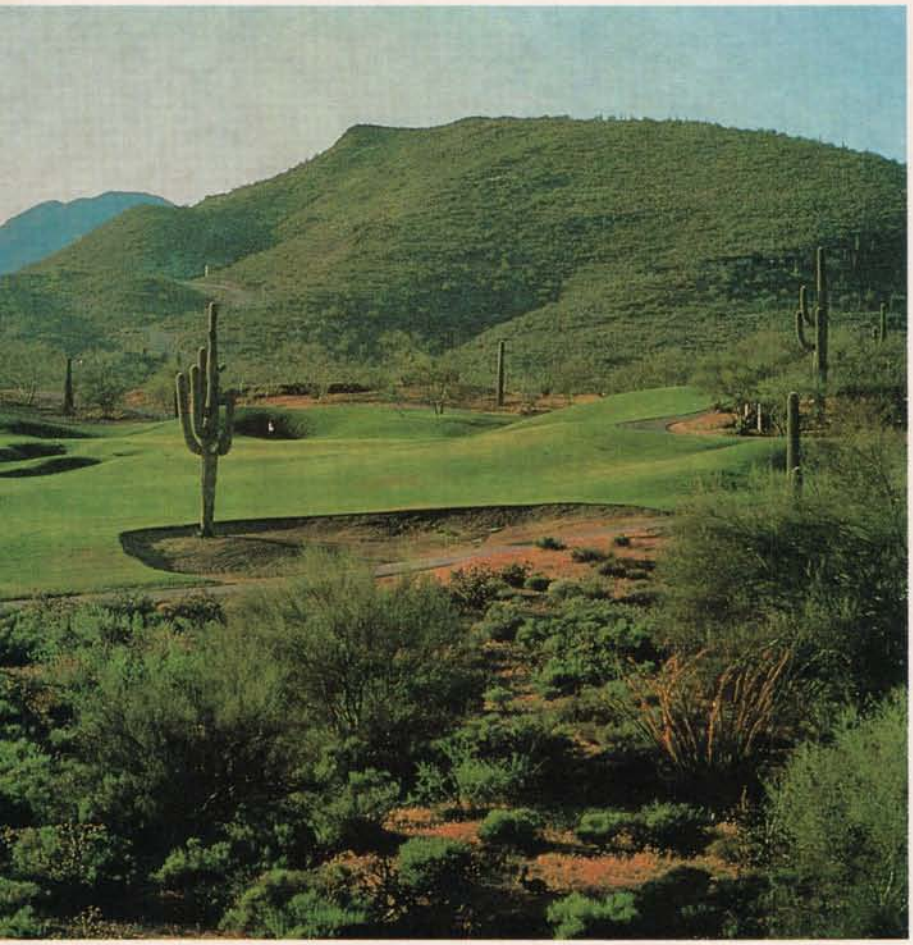
"Native landscaping has struck a chord with the people of Arizona," Martino enthuses. "They are finally starting to celebrate the desert rather than apologize

for it. They want this area to be part of the desert character instead of making it look like somewhere else. Desert Mountain Development is a fabulous example of this."

The community is planned around the three golf courses, appropriately given names reminiscent of Arizona's native American Indian heritage: Cochise, Geronimo and Renegade (warriors). Jack Nicklaus sought the challenge of designing the three courses and won the opportunity. The project began in 1985 with Renegade, located in the foothills, and now continues with the highest course, Geronimo.

Cochise has very soft, smooth slopes with dramatic elevation changes. For Geronimo, I'm planning the course to feature very severe, steep banks. There will be big elevation changes, deep ravines and plateaus."

His plan for Renegade was even more unique. "Renegade is like many courses in one," Nicklaus reveals. "You have a choice of two flags at every green—one with a demanding target area and the other considerably easier. The biggest advantage of this concept is that the average golfer and the good golfer can play together. . .yet be equally challenged. It's ideal for family play as well as a great competition course."



ge green divided by bunkers.

Cochise, which lies between the other two courses, was the site of the first Desert Scramble last April. The televised event matched Nicklaus and partner Lee Trevino against Greg Norman and Ian Woosman. The two teams played to a cliff-hanging tie. The tiebreaker was played on the completed 18th hole of Geronimo.

Describing the overall design concepts of the Cochise and Geronimo courses, Nicklaus explains, "It's my intention to create Geronimo as the strong-looking golf course, with Cochise being the soft-looking one.

Both the more difficult yellow flag course and the white flag course require good basic skills. On six holes the two flags are on separate greens, the yellow flag always further away and better guarded. On each of the other holes there is only one green, but it is large and irregularly shaped to provide room for the more difficult yellow flag pin placement.

Four tees on each hole, combined with two pin placements, provide eight separate course ratings. At 7,515 yards, the yellow flag course from the back tees is the longest in Arizona. The United States Golf Association has given it a handicap rating of 77.6, reportedly making it the toughest course in the country.

The white flag course is more forgiving with ratings ranging from 69.5 to 74.1 from the women's tees and 65 to 75.1 from the men's tees. Renegade carried more than 20,000 rounds in 1988.

Nicklaus brought out superintendent Phil Shoemaker from Muirfield Village Golf Club in Dublin, OH, to manage the courses during construction. Shoemaker didn't have to look far to find his assistant. Ron Ruppert, a fellow Rutgers graduate, was the assistant at Desert Highlands, four miles away.

Upon completion of Renegade, Ruppert took over as superintendent so Shoemaker could concentrate fully on Cochise and Geronimo.

"Renegade is like two golf courses in one," says Ruppert, "and it's spread out. You can't see one hole from another because the course is one big loop around the foothills." Mounds, huge outcroppings of rock, and hills make golfers feel they are alone in the desert. For the most part, the Renegade locale still looks just as it did when renegade warriors rode through more than a century ago.

The course is intermingled with the desert. "There is no out-of-bounds," explains Ruppert. "We have 4,500 sprinkler heads of just about every type Rain Bird makes, because the water needs of the turf are so different from the desert plants."

There are 108 Rain Bird SBM Field Satellites to control the multitude of heads, and these are linked to a MAXI System IV central computerized control system. "It would be impossible to irrigate this course without a computer and specialized software," says Ruppert.

The turf is separated from the desert with a transition zone that ranges in width from five to 40 feet. This area helps keep the desert out of the playing area and the golfers out of the desert.

A few desert plants are located within the transition zone to conceal equipment, but it is mainly decomposed granite, rock outcroppings or Caliche clay. "At first we spread sand over these areas, but the wind just blew it away," recalls Ruppert. "So now we keep it bare native soil. We treat them like bunkers, raking and using a harrow to get all the rocks out."

The transition zone also protects the desert plants from the more intensive irrigation of the turf. Provision had to be made when planning the irrigation system to provide the very small amounts of water required for some transition zone areas and replanted desert sites. These plants could be easily damaged or destroyed by overwatering.

Beyond the transition zone lies the native desert in all its awesome grandeur. Some areas were enhanced by relocating plants and rocks during construction. "Plants that

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had to be moved during construction were relocated rather than destroyed," Ruppert explains. "When we walk the course, we are checking the condition of the native plants at the same time we check the turf. They are equally important."

The challenge of maintaining turf in the relatively hostile environment is immense. "We have 301,000 square feet of Penncross (bentgrass) greens," states Ruppert. "That's nearly twice as much as some golf courses." Greens range in size from 5,500 to 26,000 square feet. Each one is constructed to USGA Green Section specifications. "We even have two large greens with bunkers in the middle!" Every foot is mowed at 1/8-inch with walk-behind greensmowers.

"It took me a month to figure out the best pin placements for the dual greens," says Ruppert. "The white flags have to be aligned differently from the yellow to maintain the right amount of difficulty for both levels of players. At the same time, we have to spread the wear out. Working the two things together was a challenge! Now we have the combination of positions for each green in an assigned rotation."

Renegade's multiple tees are Tifway 419 growing in sand atop of the native decomposed granite soil. Altogether, they cover four acres. The wear on every tee also has to be planned in advance so that the bermuda has time to fill in divots. Regularly topdressing with sand keeps the tees smooth and level. Ruppert's crew mows them with greensmowers at 1/4-inch.

The balance of Renegade's 90 acres of turf is Tifway 419 hybrid bermudagrass growing in decomposed granite. The fairways are mowed at 1/2-inch. Ruppert verticuts the fairways every two weeks during the summer with a Lely dethatcher or a Jacobsen HF-15 with verticut reels. "I subscribe to the 'light and often' theory of verticutting," he adds.

The 419 roughs, which range in width from 90 inches to 50 yards, are trimmed at 1½-inch year-round. Ruppert edges the bermuda where it meets the transition zone—both mechanically and chemically.

"The native soil has a percolation rate of 60 inches per hour," says Ruppert, "so drainage isn't a problem—but it packs down to become hard as a rock. The only aerifiers that will penetrate are the Aerway spiker and the Verti-Drain shatter aerifier. We've been trying a new prototype Toro fairway aerator that seems to work." He uses a Toro greens aerator on the greens and tees.

The course is closed for two weeks in October to overseed the tees, fairways and rough with a blend of perennial ryegrasses. "We keep the course green year-round except during overseeding," Ruppert explains. Two weeks prior to overseeding he verticuts heavily and does not apply either liquid or granular fertilizers.

While the course looks as natural as the surrounding desert, it depends greatly on technology that is completely man-made. This technology is largely the brainchild of an electrical engineer named Rene Evelyn-Veere in Glendora, CA. Thanks to him, Ruppert has a high degree of control over every one of the 4,500 sprinkler heads on the course, using only the water and energy necessary to keep the millions of plants as healthy as if they grew there naturally.

"Control is essential in the desert," states Ruppert. "The control I have over the irrigation system, whether I'm at home, 2,000 miles away, or in my office, is amazing. It's all computer-based, but I don't have to be a computer expert to run it."

Superintendent Ron Ruppert at keyboard of MAXI IV.

"The white flags are aligned differently from the yellow to maintain the right amount of difficulty for both levels of players."

That was Evelyn-Veere's intention when he first started to develop Rain Bird's MAXI System in 1976. "An irrigation computer has to be an extension of the irrigator," he says today. "The approach needs to be practical, not scientific. Once the basic concepts are built into a computer program, the irrigator must be able to refine them easily to meet his needs. Everything must work in harmony—the computer, the superintendent, the water delivery system, the water source and the plants. That was the ultimate goal."

He started by developing an "irrigation language" to instruct a computer what to do. Since there was no such thing as a personal computer at the time, Evelyn-Veere personally had to design a computer for Rain Bird.

The first MAXI was tested in Phoenix at Ahwatukee Golf Course in 1978. It consisted of a "blue box"(the computer) and operated the valves directly by using decoders, simple on/off switches controlled by electrical signals. The biggest problem was that it didn't allow for manual operation in the field.

By adding field satellites with memory, Evelyn-Veere was able to endow the irrigator with control over his system in the field as well as from a central computer. "If the wires between the computer and satellites were cut, the satellites would operate on a standby program stored in them," he explains.

At the same time, he gave the central the ability to accept a wider range of instructions based upon sensors for wind, rain, soil moisture and water pressure. For exam-

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ple, the computer could instruct the satellites to start or stop, based upon information from the sensors. Rain Bird called the new version MAXI II and installed the first systems in 1980.

When IBM introduced the PC (personal computer) in 1981, Rain Bird decided to concentrate on programming and leave the hardware up to computer experts. Evelyn-Veere took the irrigation language and converted it into English. This let the irrigator select from understandable options presented on the computer's screen. MAXI III was born.

As IBM graduated from the PC to the AT, considerably more memory was available for programming. Evelyn-Veere focused his attention on two areas, increasing the intelligence of field controllers and adjusting irrigation programs based upon the amount of water used by the turf and lost to the environment.

In 1987, Rain Bird introduced a solid-state field controller that had as much intelligence as early central computers. The superintendent could make many of the necessary adjustments in the field and the satellite would store these in memory.

The biggest challenge was to enable the computer to track weather and its effect on plant water use, not just for the general area, but for individual zones on the golf course. "The goal was to get the irrigation system in harmony with nature," explains Evelyn-Veere.

Agriculture had already developed a weather-based calculation to measure the amount of water that needed to be replaced by an irrigation system. It is called evapotranspiration (ET) and is measured in inches. A series of weather factors must be included to make the relatively complex calculation.

"A superintendent thinks in terms of the quality of each part of his course," Evelyn-Veere believes, "not in quantitative measurements. He needs a reference point to gauge the effect of weather without getting bogged down in complicated calculations for each different part of his course. We had to make it practical for him to utilize ET data. By using the superintendent's expertise in making qualitative judgments, the computer could determine the quantitative data."

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Since the primary controlling factor in irrigation schedules is time, not inches, Evelyn-Veere made time the basis for ET adjustments. By entering one number that represents all environmental factors, and making qualitative adjustments for separate zones within the course, the superintendent could concentrate on other important matters. This one number is called the ET adjust factor, and it is expressed as a percentage of the system ET.

The MAXI-ET, which utilized an IBM AT, was released in 1987. "The next job was to bring the computer and the superintendent into harmony with the supply and delivery systems," says Evelyn-Veere. "ET would instruct the system to apply a certain amount of water. Basically, the system would run wide open until it satisfied this amount. We were saving water by applying only what was needed, but we could save more by balancing the delivery system with the pump system."

By dividing the irrigation delivery system into "flow zones" based upon the capacities of pipe, heads and valves, the computer can balance flow. By juggling the demand of individual zones, the computer can also control the overall demand placed on the pump system to match the most efficient operation of the pump station.

"A pumping system is designed to maintain a certain pressure," Evelyn-Veere explains. "It turns on pump motors until it satisfies the pressure requirement. Anytime a motor has to start or increase its speed to meet demand, it consumes energy. Motors are designed to be most efficient at certain speeds. By regulating demand to keep pumps operating at peak efficiency, you save a considerable amount of energy."

By telling the computer to regulate demand to match the efficiency of the pumps, peaks and valleys in pressure are avoided and the cost of electricity is reduced. If one pump goes down, the computer can rejuggle the combination of flow zones to match the efficiency of the remaining pumps. Evelyn-Veere's software to accomplish this is called Flo-Manager™.

One problem remained to be solved. ET would determine what amount of water needed to be applied and would instruct valves to stay open until it was delivered. If the infiltration rate of the soil was not great enough to accept all the water at one time, water was lost as runoff. Some soils require extra time to let the water soak in.

By adding one more data base to the computer, Evelyn-Veere enabled the superintendent to set a maximum continuous water time before runoff for each valve zone. If this time was less than that needed to apply the necessary amount of water, the controller would have to reopen the valve to meet the ET requirement. If it opened before the water had a chance to soak into the soil, water would still be wasted. So the computer also needed to be given a minimum soak period.

Evelyn-Veere called this new function Cycle + Soak. "If ET says an area needs 18 minutes of run time, the computer will divide this time by the maximum continuous water time—six minutes, for example. It then knows it will have to cycle three times after waiting at least the minimum soak period. Finally, this adjusted schedule is figured into the demand of the flow zone."

Flo-Manager and Cycle + Soak are the primary features of the new MAXI System IV. "Upgrading a MAXI-ET is just a matter of installing another program," says Evelyn-Veere.

When Renegade was built, a MAXI-ET was installed. Ken Christley of Water Management Systems helped get Ruppert up to speed on the system and then encouraged him to add the new program to upgrade it to a MAXI IV. Last year, the course became one of the first to upgrade.

"Before Flo-Manager came along, we made the daily plan by working up a dry run on the computer, combining all the irrigation schedules throughout the course into a single schedule for the following night," Ruppert recalls. "When the computer plotted our schedule into a flow graph, it sometimes looked like the Grand Teton mountain range. This meant our pumps were coming on and off all night to deliver the widely varying flow rates. We were wasting energy!

"Combining all those hundreds of schedules into one was challenging and time-

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Transition area next to two-flag green.

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consuming; we spent anywhere from 45 minutes to two hours daily. Now we just punch in whatever adjustments we want based on field observation. The weather station provides the ET, and Flo-Manager works out the whole schedule in about 15 seconds. When we plot a flow graph, it looks like a plateau instead of a mountain range!" The result is a 23-percent energy savings.

Shortly after the program was installed, one of Renegade's pumps went down. The maximum efficient pumping capacity dropped from 2,000 gpm to 1,500 gpm. In 30 seconds, the irrigation for that night was revised. "When we lost that same pump once before," says Ruppert, "it took me four hours to revise it."

With the irrigation system under control, Ruppert has been able to devote the extra attention his desert course requires. His major concern is keeping the bentgrass greens healthy during the summer. "The toughest time is in May and June, when temperatures range in the 90s," he reveals. "For some reason, it's easier to manage the greens when temperatures get over 100 degrees. Fortunately, the temperature here drops as much as 40 degrees at night."

He keeps a close watch on the root depth of the Penncross. "When roots get shorter than six inches deep, we reevaluate all maintenance on that green," says Ruppert. "We'll raise the cutting height, change the pin placements, spoon-feed with micronutrients, and adjust the irrigation. I don't like to syringe unless I have to. A little stress forces the roots to look for water. When we syringe, we do it just for a couple of days."

Desert flows in and out of 18th fairway.

Keeping track of 4,500 sprinkler heads is a full-time job for two of Ruppert's crew. Instead of running to any one of 108 satellites to activate the valve-in-head sprinklers, they use hand-held radio valve controls. The units double as radios for the crew to communicate.

"We have to catch malfunctioning heads immediately," Ruppert adds. Each morning

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Native plants conceal irrigation satellites.

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he scans the flow charts for anything unusual. "My rule of thumb is—if there is a problem, check the field first. Is the nozzle damaged? Is the valve functioning right? If that's not it, check the satellite, then the pump station. You work your way back toward the computer. So far, we have always located and corrected the problem before we got to the computer."

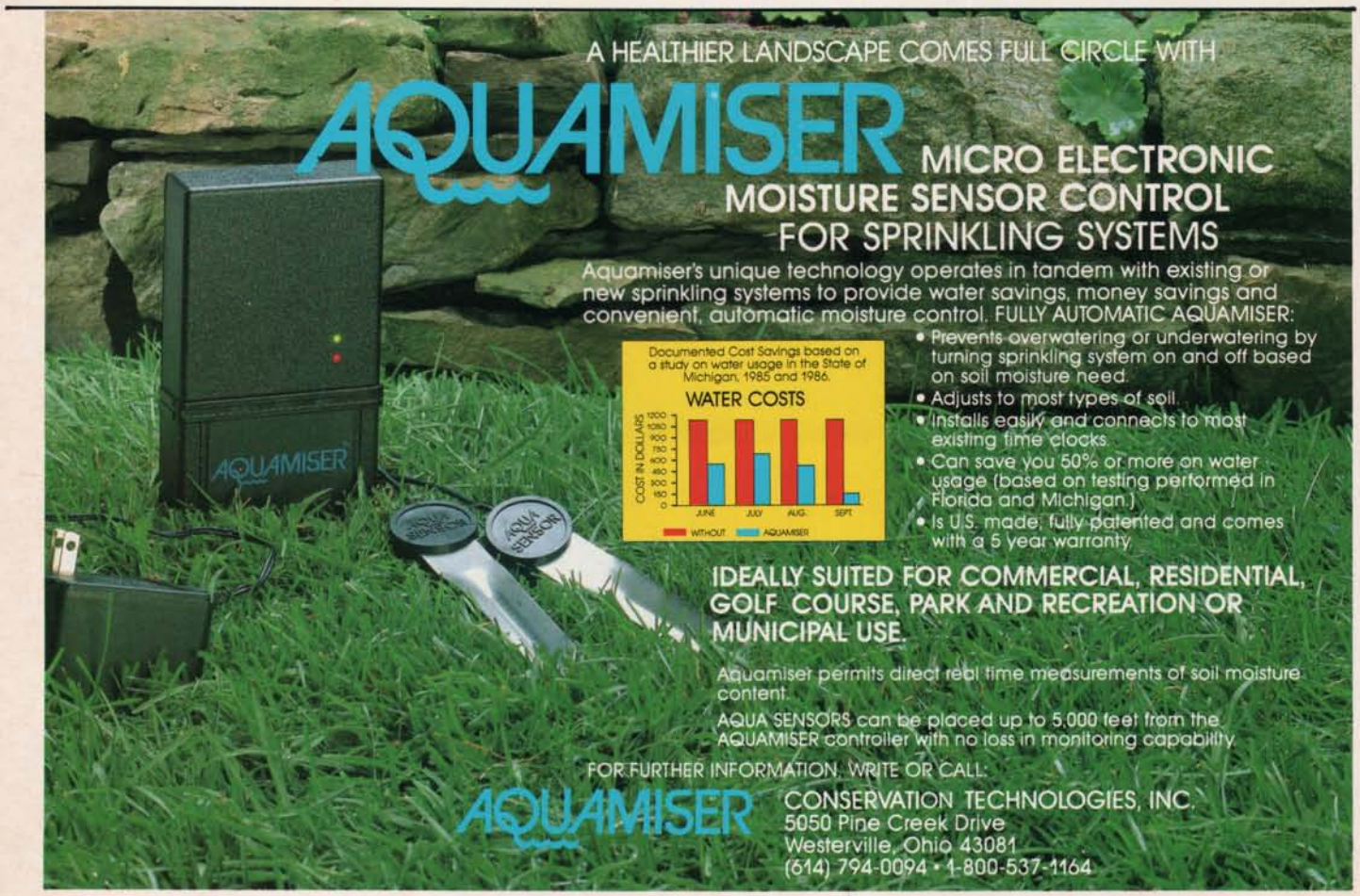
Ruppert's job is full of "musts." He must protect the native plants. He must keep the unique two-flag course in a condition which properly represents Mountain Desert and Jack Nicklaus. And he must conserve the precious water.

"We operate under the most stringent water conservation regulations in the U.S.," Ruppert declares. "The Arizona Department of Water Resources limits the acreage we can put in grass and the amount of water we can apply. Currently we are allowed 90 acres of turf for 18 holes and five acre feet of water per acre per year. That's a lot less than desert courses in other states." All water comes from two wells and is stored in lakes on the course.

Renegade is now past the grow-in phase, so Ruppert is continuously making adjustments to conserve water and energy. Initially he shared a weather station with Cochise, but Renegade is getting its own station this year. Every 1,000 feet of elevation represents a significant difference in both rainfall and temperature. "I want to track our local weather as closely as possible," he states.

When Geronimo is completed this year, it and Cochise will be restricted to members and their guests, while Renegade will be available to all owners in Desert Mountain and to certain permitted guest play. Ruppert expects play to rise dramatically in the next two years.

The first homes are rising from the desert floor around the courses. The Desert Mountain community is taking shape. Renegade, Cochise and Geromino are the center of attraction, exposing thousands of people to the beauty of the desert for the first time. Man and the desert are in harmony.



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