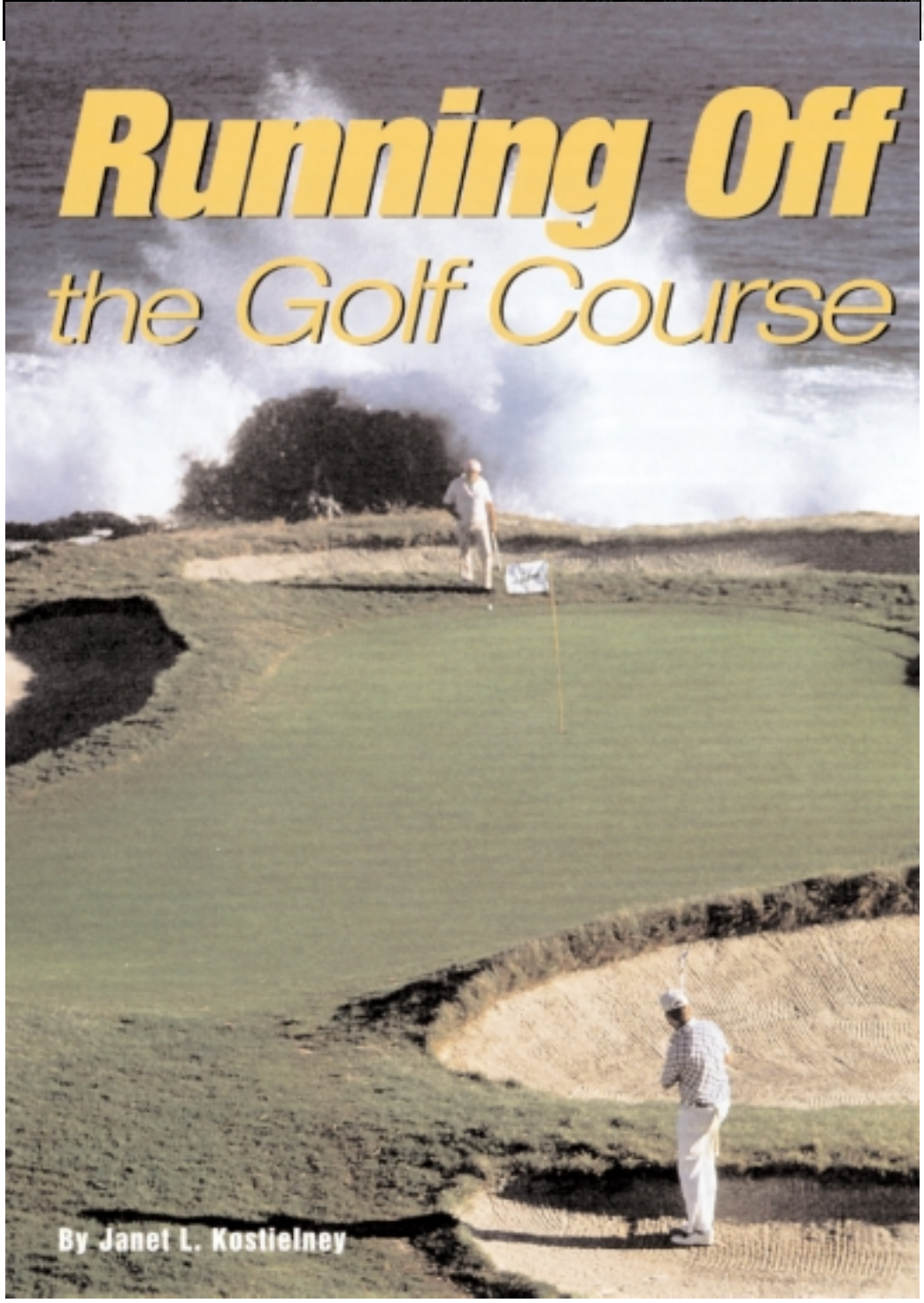
Running Off the Golf Course



By Janet L. Kostielney

Photo: Uniphoto

Rain and water from our lawns and gardens wash pollutants off streets, sidewalks, roofs, driveways, parking lots, and other surfaces and carry them into the storm-drain system. Storm drains are separate from the sanitary sewer system. Unlike the water that goes down the toilet or sink, water and pollution that enters the storm-drain system flows directly to our creeks, ponds, streams, lakes, and oceans with no treatment. Golf courses can be another source for this witch's brew of chemicals, fertilizers, and sediment.

Despite the fact that often they're the only green spot in a concrete and asphalt jungle, golf courses are still targeted as threats to the environment. Fair or not, designers, owners, and superintendents have learned that it's important to be purer than the driven snow to avoid destructive criticism.

Why is this a problem? This toxic mix degrades our lakes, rivers, wetlands, and ocean bays. Soil clouds and water degrades habitat for fish and water plants. Nutrients such as phosphorus promote the growth of algae, which crowds out other aquatic life. Chemicals such as antifreeze and oil from leaking cars, carelessly applied pesticides, and zinc from galvanized metal gutters and downspouts threaten the health of fish and other aquatic life.

On a global scale, runoff occurs because of the imbalance between evaporation and precipitation over the Earth's land and ocean surfaces. The distribution of runoff per continent shows some interesting patterns. Areas having the most runoff are those with high rates of precipitation and low rates of evaporation.

Continent	Runoff (mm/yr.)
South America	445
Europe	300
Asia	286
North and Central America	265
Australia, NZ, New Guinea	218
Antarctica and Greenland	164
Africa	139

This stormwater runoff concoction might not be so damaging if it didn't contain chemicals and fertilizers. According to *Grounds Maintenance* magazine, pesticides control weeds, insect pests, and fungal and other diseases. It seems reasonable to agree that some pesticides are beneficial. How can we abandon our homes to termites or roaches? Is it crucial to our well-being as a species to eradicate dandelions from our lawns and golf courses?

Golf Courses, Erosion, and Runoff

The booming golf trade in Asia creates a haven for golfers and a nightmare for environmentalists. Southeast Asia's golf courses offer greens carved out of paddy fields or virgin forest. Breathtaking views of the sea or mountains are the norm, and cable cars are often

Table 1. Erosion Control Materials for Channels and Streambanks

Typical Applications	Shear Stress lb/ft²	Longevity	Recommended Materials
Fairway swales	< 1.45	1 growing season	Loose mulch in quick-degrading net, quick-degrading erosion control mesh, quick-degrading single-net blanket
Out-of-bounds swales	< 1.45	1 growing season	Loose mulch netted, erosion control mesh, single-net erosion control blanket
Fairway swales	< 1.55	1 growing season	Quick-degrading, single-net blanket
Out-of-bounds swales	< 1.55	1 growing season	Single-net erosion control blanket
Fairway swales	< 1.65	1 growing season	Quick-degrading, double-net blanket
Out-of-bounds swales, streambanks	< 1.65	1 growing season	Double-net, erosion control blanket
Fairway, out-of-bounds swales, streambanks	< 2.25	1-3 growing season	Double-net, long-term blanket
Fairway, out-of-bounds swales, streambanks	2.25-8.00	Permanent	Permanent, turf-reinforcement mat, riprap
Fairway, out-of-bounds swales, streambanks	> 8.00	Permanent	Gabionized riprap, interlocking concrete blocks, poured concrete

Table 2. Erosion Control Materials for Various Slopes

Typical Applications	Slope Grade (H:V)	Required Longevity	Recommended Materials
Fairways, flat tee boxes	< 6:1	1 growing season	Loose mulch Loose mulch crimped or tacked Hydromulch
Sloping fairways, tee boxes	6:1-5:1	1 growing season	Loose mulch crimped or tacked Loose mulch with quick degrading net Hydromulch with bonding agent
Steep fairway slopes, tees, greens, bunkers	5:1-2:1	1 growing season	Quick-degrading erosion control mesh Quick-degrading, single-net erosion control blanket
Very steep fairway slopes, tees, greens, bunkers	2:1-1:1	1 growing season	Double-net erosion control blanket
Steep, out-of-bounds slopes	5:1-2:1	1 growing season	Erosion control mesh Single-net erosion control blanket
Very steep, out-of-bounds slopes	2:1-1:1	1 growing season	Double-net erosion control blanket
Very steep, out-of-bounds slopes	2:1-1:1	1-3 growing seasons	Double-net, long-term erosion control blanket
Severe, out-of-bounds slopes	> 1:1	1-3 growing seasons	Double-net, long-term erosion control blanket

Source: Golf Course Management magazine, February 1997, courtesy of North American Green

necessary to transport golfers from one hole to the next. However, the beauty found in the setting of a golf course can be a hiding place for environmental, social, and health problems that more than a few environmental activists call the steep price of the game.

On a global basis, conflicts often occur between farmers and the golf industry. Farmers find it profitable to sell their land to golf course investors, thus the fertile land used for farming becomes obsolete with the development of golf courses. The environmental costs vary but are generally worse in highland areas where the ecosystem is fragile. Along with the growth of golf courses, luxury hotels, condominiums, and chalets also continue to grow. The sport of golf has turned into a business with high-class stakes.

Before we all go off on a crusade to implement comedian George Carlin's suggestion to turn all golf courses into subdivisions for the homeless, we need to look at the other side of the story. According to the Society of Australian Golf Course Architects, well-designed golf courses can benefit the community and environment. It states that environmental awareness has significantly increased in recent years and today's society is far better informed and reacts more quickly to pressures on the environment and natural resources.

Let's look at some of the benefits of golf courses. They are contiguous with greenbelts and compatible land uses, such as sporting reserves, wildlife sanctuaries, wetlands, and forest. Golf courses serve as a buffer between sensitive natural environments, cities, and industrial areas. They play a significant role in the management of water, aiding in the conservation and preservation of water resources. They act as a natural filter of stormwater and runoff. Often, economic limitations make it difficult to rehabilitate scarred and degraded landscapes such as landfill, quarries, tip sites, and barren rural land. Golf courses provide a viable use of land degraded over time by intensive use or mismanagement. They can contribute to the reinstatement of the natural processes of a healthy environment by reconditioning degraded soils and restoring natural systems.

Turfgrass, together with the natural land-

Top: **The Deer Creek channel stabilization and floodway construction project illustrates the use of bioengineered bank construction techniques to produce a stream with a natural appearance.**

Bottom: **Prior to stabilization, Deer Creek flowed through 1,000 ft. of failing culvert, leading to significant sediment problems and hazards for golfers.**

scape, traps sediment and pollutants before they enter into common waterways. The containment of water on-site helps in flood control and filtration while contributing to the recharge of aquifers and groundwater that might otherwise pollute nearby waterways.

The reliance upon potable water to irrigate a golf course is an issue gaining attention. Golf courses must strive for sustainability while seeking alternate water sources and more effective water usage/managernent practices. Whenever possible, golf courses offset their potable-water usage by the use of alternative water sources. As the costs of potable water rise, there is an economic incentive to supplement potable water with effluent and/or stormwater. Filtering effluent and stormwater through a golf course lessens the pollution and sedimenta-\tion of our waterways. The use of secondary-treated effluent has the added advantage of supplying more than half the nutrients needed to maintain quality turfgrass and lessening the need for chemical support.

Of the stream and river miles that the states reported as "impaired" in EPAs *National Water Quality Inventory Report to Congress* (1992), siltation was to blame in 45% of the cases in which state officials could determine the cause. Silt and other suspended solids are easily washed from urban areas, logged hillsides, residential and commercial construction sites, plowed fields, strip mines, and eroded riverbanks and shorelines when heavy rainfall occurs. Golf courses are all too frequently a contributor of silt. These sediments might not seem harmful to the average person, but they can cause plenty of problems when they enter waterways and wetlands. Not only can silt carry potentially toxic compounds into waterways, it can directly interrupt essential biological processes-with devastating effects.

Silt can cause abrasions in gills, killing fish directly by interfering with their respiration; it can suffocate fish eggs and bottom-dwelling organisms; and it can destroy spawning beds when it settles to the bottom of rivers and streams. Siltation also creates turbid, murky water, decreasing photosynthesis and reducing the productivity of aquatic plants. A buildup of silt and other sediments can radically alter water depth and change an entire aquatic habitat over time.

An overabundance of nutrients, such as nitrogen and phosphorous, is another of the most serious problems facing the nation's lakes, estuaries, rivers, and streams. In 1992, more states reported lake and estuarine impairments due to nutrients than any other single pollutant. For rivers and streams, nutrients were second only to siltation as the most serious cause of harm. Research has shown that nutrients can come from point sources (sewage and wastewater treatment flows), nonpoint sources (agricultural and urban runoff, primarily from fertilizers and manure), and the atmosphere as well.

Runoff from feedlots, pastures, and suburban development can carry organic material in the form of grass clippings, leaves, and other debris into waterways; sewage often contains organic solids as well. While natural microorganisms in the water frequently break down these materials, the breakdown process uses up valuable dissolved oxygen, creating a biochemical oxygen demand (BOD). A lack of dissolved oxygen affects many aquatic organisms. And if a system's BOD is too high, other chemical and biological processes are also affected.

Case Studies

Many solutions to the problems of runoff and erosion control exist and are being used in golf course design, construction, and maintenance.

Minami Golf Course, HI On the Hawaiian island of Oahu, erosion control blankets (ECBs) by North American Green were used to establish grass cover on the Minami Golf Course designed by Dick Nugents Associates of Chicago and developed by Minami Group Inc.

Because it is perched on the windward side of the Koolau Mountain Range, warm, moist winds sweeping in off the ocean dump tremendous amounts of water in the Minarm area each season. From November through May, the 1989-1990 rainy season delivered 134 in. of precipitation, much at tremendous intensities. In a two-week period, over 20 in. of rain fell on the golf course site, 8 of those inches in a 24-hour period. Rainfall at this intensity causes severe erosion damage to unprotected, freshly excavated soil.

In late August 1990, with the threat of another severe rainy season, Project Architect Scott Fisette and Course Superintendent Sean Hoolehan realized that erosion protection would be necessary to establish grass on the newly prepared Minarm Course in the coming months. The 40-gpm sprinklers and heavy rains necessitated the use of ECBs to prevent rill and gully formation.

After an erosion control plan was developed in conjunction with ECB and vegetation recommendations from Gilbert Araki of Pacific Agricultural Sales and Services, course revegetation activities began.

Bermuda grass was handsprigged on fairways and hydromulched. Double-netted straw ECBs were then installed on steep undulation and bunker faces to control soil loss and hold sprigs in place. A heavy-duty blanket made from a combination of wheat straw and coconut fiber was used to line drainage swales and cover steep slopes. For those high-flow channels designed to carry runoff water from large drainage areas on the course, coconut and nylon channel liners provided maximum scour protection.

Undulations formed from erosive soils posed problems to superintendents who tried to stabilize them. The ECBs provided temporary stability until grass establishment, so undulations could challenge golfers, not the superintendent. The nylon channel lining was used to stabilize the ditch skirting a cart path. The nondegradable blanket will remain in place under the grass, increasing its resistance to damage from high-velocity flows and golf-cart tracking.

On the first fairway, where hydromulch provided the only protection, a 2- x 200-ft. gully requiring expensive rework and reshaping of the landscape was formed by rainfall and irrigation runoff. On the second fairway where ECBs were used, no significant erosion occurred. According to Hoolehan, "If we had not used blankets on the second fairway, the amount of finish work would have been a lot greater. Since the blankets effectively controlled the erosion, we can concentrate our efforts on fine-tuning the hole." The coconut fiber blanket used on the sideslopes of this high-flow drainage-way enabled vegetation establishment through heavy rains. This ECB is a slow-degrading blanket, providing extended erosion protection for gradually maturing vegetal stands.

The need for high-performance erosion control materials in golf course construction is obvious. With the newly successful establishment of vegetation on the Minami Course, Hoolehan and Fisette are firm believers in ECBs for the protection and revegetation of critical course areas. As Hoolehan concludes, "ECBs saved us a lot of repair work." ***Radnor Country Golf Course, PA.*** Tom Dale has struggled with Ithan Creek since he became superintendent of the Radnor Country Golf Course in Radnor, PA, over 13 years ago. He remembers how the creek-banks eroded and caved in, sometimes nearly filling the stream with soil: "This was not only unsightly and bad for us but for our neighbors downstream as well."

Today, however, the creek is under control and the Radnor Club problem is history. Commenting on the completed work, Dale says, "As a result of what we did here, the creekbanks are now tied down and have safely handled several 50-year rains." On top of that, he comments, "The area is much more attractive for our members." The Radnor Creek erosion problem was similar to those affecting many golf courses.

The "beginning of the end" of the creek erosion problem came when the board of directors of the club authorized its construction committee to find a solution. All County Engineers of Oley, PA, was employed to develop an engineering plan. A problem arose, however, when all construction bids for the plan exceeded the amount of money the club was willing to spend. This stumbling block was only temporary; ultimately it led to a unique cooperative effort by All County Engineers, The Dawson Corporation of Clarksburg, NJ, and Pinelands Nursery in Columbus, NJ. Pooling their expertise, this team developed a different plan to bring the wayward creek under control at a cost even lower than the club's construction money allotment. The plan and bid were accepted, and construction was done in mid-summer 1995.

Bob Swain, president of The Dawson Corporation, is a well-known East Coast landscape construction contractor with extensive experience in golf course construction and ecological restoration. Pinelands Nursery produces a wide variety of native plants for landscaping and erosion control. Don Knezick, president of the company, is also the master distributor of BonTerra America wetland products for the Mid-Atlarnic and New England states. The nursery and the Hackensack (NJ) Meadowlands Development Commission recently cosponsored the First Environmental Restoration Symposium at the Meadowlands Environmental Education Center.

Photo: Inter-Fluve

Top: **Construction of the bioengineered streambanks relied on the use of coir fabrics, soil, and sod.**

Bottom: **Designs for the completed streambanks and floodway included four new crossings for golf carts and mowing machines.**

The final plan developed by the team called for the use of biodegradable coir-fiber logs at the base of the streambanks and coconut ECBs and geotextile mats for rehabilitation of the sideslopes. The Dawson Corporation was the construction contractor, and Pinelands Nursery provided the native plants and erosion control materials. The primary objective of the team was to control the erosion on the creekbanks and sideslopes. Aesthetics was a secondary but important consideration. "The work had to solve the problem," explains Knezick, "but we also wanted the finished job to look nice. That's why we included a number of flowering plants and attractive grasses, sedges, and rushes in the plantings."

Since Ithan Creek runs through the center of the golf course, there were special constraints on the methods used to control the erosion. The vegetation selected could not be tall trees; rather, it had to be low-growing and heavy-rooting planting material that would be attractive to the golfers. Coir-fiber logs would provide a planting medium and several years' protection before they biodegraded. In the meantime, vegetation would be established to provide permanent cover. Since several fairways crossed the creek, construction activities were carried out with as little interference to golfers as possible.

About 4,000 ft. of the logs were installed-one of the largest installations ever done using this material. Construction was completed in increments, starting where the creek enters the course at the north end.

The following sequence of six steps was followed at a typical increment:

1. The silt fence was installed at the base of the bank.
2. The coir-fiber ECB was unrolled down the slope to the toe of the bank.
3. Logs were laid along the base of the bank cover and staked through the blanket. This helped to anchor the bottom end of the blanket. The coir-fiber logs were 12 in. thick and 25 ft. long. "Normally, they are 20 feet long, but because the distances there were greater than most installations, these were made longer to cut down the, number of splices," explains Knezick. "Anytime you splice two sections together, there is a possibility of water getting under the logs and causing washouts. So the less splices, the better." The logs are ideally placed at a level so that most of the time the bottom half will be underwater and the top half above water. Knezick states that the exposed portion gives better protection to the bank from the scouring action of the creek water. In addition, some plants grow better if their roots are not fully immersed in water.
4. The portion of the blanket on the slope was then rolled temporarily back downslope over the log to allow access to the slope for grading and shaping.
5. The slope was graded, shaped, raked, and seeded. Grading was done with the excavator using a 48-in.-wide bucket without teeth. A Dawson mechanic had customized the excavator using a Balderson Swinger so the bucket could be tilted and turned, enabling the operator to work across the slope instead of up and down. Seeding was done with a Cyclone hand seeder. The grass seed used was dwarf tall fescue. It grows about 12 in. high. "This seeded area will be treated as a 'rough' on the course and won't be mowed," says Dale.
6. The blanket was unrolled from the top of the log at the water's edge, placed back on the slope, and pinned in place. The upper end was anchored in a 6-in. deep trench at the top of the slope. The tilted excavator bucket dug the trench.

"The sedges, rushes, and rice cutgrass were our 'nuts and bolts' for controlling erosion," explains Knezick. "We added different herbaceous wetland plants with ornamental flowers for various colors at different seasons of the year. The blue flag iris, joe-pye weed, cardinal flower, blue lobelia, lizard's tail, New York ironweed, swamp milk weed, and swamp rose mallow were among those used." Adds Fred Rapp, project manager on the job, "We scattered the different plants along the banks using small-sized groupings. We want a variety of plant textures, heights, and colors instead of a manicured and monoculture look."

The logs, coconut fiber mats, and fabric are living up to all expectations. Having already successfully handled several heavy rains, the erosion control work will become more effective as the plantings become better established. Not only are the plants doing their intended erosion-controlling work, they will become increasingly attractive as they burst into bloom throughout the seasons. The plants work as filters, preventing much of the pesticides and fertilizers used on the course from entering the stream.

Dale, as the golf course superintendent, must keep the grounds in shape, including the once troublesome Ithan Creek. He's delighted with the restoration: "I spend a lot less time maintaining this creek. That time can be spent elsewhere on the grounds. And I don't have to worry any more about the cart path being washed away." He adds, "Instead of being an eyesore, this creek now is a part of the attractiveness of our course."

Michigan City, IN. Deer Creek meanders through the Michigan City Municipal Golf Course. Forty years ago, Deer Creek was put into culverts beneath the golf course. The 1,000-ft. culvert was overwhelmed by increased runoff from developments upstream, so the creek began to fail in several areas and the golf course was literally falling into the culverts. This presented some rather challenging holes for the course patrons. On Hole 5, the cart path disappeared, and the course staff had to design alternative routes for the golfers to follow in order to prevent further damage to the course. Suck holes, areas where the culvert collapsed and left a gaping hole in the ground, were flagged so golfers could see potentially dangerous areas from a distance. The last five sections of the culvert failed totally and washed away.

J.F. New & Associates of Walkerton, IN, was the prime contractor and handled all permits for the restoration project. It also designed the bridge and culverts and functioned as the project manager. Inter-Fluve of Bozeman, MT, provided all hydrology, stream-channel design, and drainage design for this project. E.F.M. Excavating of Mishawaka, IN, controlled all earth-moving operations. The goals of the team and the golf course superintendent were to remove all the culverts and replace all cart-path crossings and other stream crossings while designing the restored creek to be able to handle anticipated runoff and prevent future damage from erosion.

The watershed for this project encompasses 1.9 $mi.^2$. There were no hydroligic records, so the designers used regional regression method USGS WR-84-4134. The team designed the stream channel to contain bankful discharge of 109 $ft.^3$/sec. based on two-year return-interval flows.

The design is a compound channel—a channel within a channel within a channel. The smallest (low-flow) channel is 5 ft. across and 1 ft. deep; it will handle 20-to-30-$ft.^3$/sec. flows. The bankful channel (the middle channel) averages 20 ft. wide and 2.25 ft. deep and can handle 125-$ft.^3$/sec. flows. The largest channel, the floodway channel, is 50 ft. wide and 4.25 ft. deep and designed to handle 100-year discharge-event flows of 356 $ft.^3$/min.

The streambank-restoration design focused on soil-wrapped walls. The project built variability into the new design through sinuosity and a natural appearance. The channel originally had been approximately 800 ft. long; with the new design, the channel gained 200 ft. in sinuosity and is now 1,000 ft. long.

To begin the project, the contractor excavated the channel (a sandy clay mixture) down to solid clay. There was no rock foundation, as this is a very low-gradient stream. The topsoil, a good organic soil, was stockpiled. Three feet down, the contractor reached impervious clays, which presented standing-water problems. Lateral drainage lines were installed on either side of the new creekbed, and 200-ft.-long feeder lines were placed on each side. This system has worked very well.

There are three unique aspects to this project. The first is that the golf course remained in use during this major construction project. The project began downstream and involved only one hole at a time. Golfers were rerouted to keep them safely away from construction activities. Some holes that were shorter than normal, but there were no complaints.

The second aspect is that, rather than seeding the soil beneath the BonTerra CF7 coir-fiber netting used in the wrapped wall project, the design called for sod placement beneath the ECB. The project was installed in October 1997, and the growing season for northwest Indiana is long over at that time. Hard freezes, temperatures dipping to -60°F, and snow cover often topping 6 ft. make it difficult to predict that seeds will survive the winter and germinate in the spring. Sod seemed a better choice than seeds. Sod rolls, from a local grower, were 3 ft. wide and 8 ft. long, making the rolls too heavy to be moved by floodwaters. Two rows of sod were placed from the edge of the low-flow channel to the top of the bankful channel.

The coir-fiber ECB was buried in a key trench, wrapped over the rows of sod. Two additional rows of sod were added to the outside, for

a total of 12 ft. Silt fencing was trenched in at the edge of the flood channel. Jim Lovell, project construction supervisor and project designer with InterFluve, says, "We wanted something that was going to green up quickly. We didn't have much of a growing season, and the soil here wasn't the best for predicting good germination in the spring." Inter-Fluve's experience on a New Jersey project was that coir-fiber net could degrade in as little as two years in adverse conditions, so they wanted to be certain that strong vegetative cover was established long before the end of two years. Sod was the answer. Native sedges were also sprigged along the creek edge. "It worked great," says Lovell. "The sod grew right up through the CF7. At project end, the entire site was green. We haven't had any erosion on the site at all."

The third unique aspect of this project involved the old culverts. They were sold to a local scrapyard for recycling, and this money was used to pay hauling costs. The material didn't go to a landfill, and the contractor didn't incur fees for hauling or landfill use.

Brent Bachmann, clubhouse manager, states that he's extremely happy with the project. "We've eliminated flooding, and the two downstream ponds fill quickly with water, which we use for irrigation." Using this "free" water has considerably reduced the course's cost for watering the grounds. Lovell says that this was the only capital project the golf course had that came in on time and on budget. Total design and construction costs for this project were $250,000.

Bachmann voices concern about the enormous volumes of sediment that still come down the channel: "Our neighbors haven't dealt with their own erosion problems," he states, and the golf course is forced to handle the runoff and sediment that ends up on its property. As a result, the course maintenance supervisor anticipates that the upper pond must be dredged every one to two years.

Suggested Remedies

The Terrene Institute in Alexandria, VA, states, "Watersheds contain a mosaic of land uses that contribute to our vitality and enjoyment of life. Walk in any direction and you will see them: houses and neighborhoods and commercial districts; industrial developments and farms; and scattered here and there, the parks, golf courses, and other open spaces that provide refuge, recreation, and relaxation. Look closer, and you will see that these open spaces have been designed to protect and enhance the quality of life. Golf courses, like parks and riverine areas, are managed natural spaces that function best when managed naturally-when those who supervise and visit them know that only simple, nonintrusive actions are needed to preserve them. Properly managed golf courses are valuable community assets. From design to construction and on through long-term maintenance, the golf course is a model for ecosystem management and sustainable development."

EPA offers many excellent suggestions in its booklet, *Environmental Principles for Golf Courses in the United States:*

- Place buildings and fairways within landscapes to protect critical areas from offsite water-quality problems.
- Protect and enhance wetlands to increase their benefits to humans and wildlife.
- Establish or maintain buffer or riparian areas to protect the quality of small headwater streams.
- Reduce erosion through an erosion and sediment control plan that includes construction phasing.
- Manage runoff to prevent sediment from entering streams and wetlands.
- Golfers have many opportunities to limit their impact on natural resources while enjoying a round of golf. Place signs in clubhouses and near golf tees and greens to remind golfers about treading lightly on the earth.
- Timed irrigation, water reuse, and native plants help conserve water and reduce operating costs.
- Courses designed around natural features provide unique challenges and protect vital resources.
- Applying fertilizers only as needed and at appropriate times helps reduce nutrient loss to receiving waters.
- Conserving and reusing irrigation water helps maintain minimum instream flows for fish and other aquatic animals.

James Achenbach, senior editor of *GolfWeek* magazine, says, "What we have learned over the past several decades is this: We weren't put on this earth just to play golf. We were put here to care for the earth, to pass it on to new generations of people and golfers. Those who don't take environmental awareness seriously deserve our reproach. But they also deserve our help. The ecology of our world is nothing to scoff at. We cannot afford to be uneducated about it."

According to the Center for Resource Management, as golfers, we should:

- Recognize that golf courses are managed land areas that should complement the natural environment.
- Respect designated environmentally sensitive areas within the course.
- Accept the natural limitations and variations of turfgrass plants growing under conditions that protect environmental resources.
- Support golf course management decisions that protect or enhance the environment and encourage the development of environmental conservation plans.
- Support maintenance practices that protect wildlife and natural habitat.
- Encourage maintenance practices that promote the long-range health of the turf and support environmental objectives.
- Commit to long-range conservation efforts on the golf course and at home.
- Educate others about the benefits of environmentally responsible golf course management.
- Support research and education programs that expand our understanding of the relationship between golf and the environment.
- Take pride in our environmentally responsible courses.

References

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