value. By week 2 Mar Mound firmed dramatically, with the wear pattern going from a hole to merely large cleat indentations. By the final week Mar Mound was performing very well; it was extremely firm and finished with two straight weeks in which the wear per 100 pitches was below 2 inches. The wear became spread out, with very little product needed for re-working.

Turface: Turface, especially in week 1, performed very similar to Mar Mound, with a deep hole dug at the toe plate that continued into week 2.

By weeks 3 and 4 Turface showed significant improvement in terms of wear with an average displacement of 2.5 inches. The third day of week 4 (Apr 6) bumped this average up due to the wet conditions caused by rain the previous day. One of the most desirable attributes of Turface was its ability to give, yet remain firm. A number of the 14 pitchers commented on their comfort from this mound. One pitcher said, "The landing area was soft enough to land on and not feel stiff on your front leg. This helps me keep the ball down in the zone."

Diamond Pro: This product was one of the most consistent throughout the study, showing less displacement than the others, especially by week 4. The main difference between Diamond Pro and the others was in how it wore. When the area was a bit wet, as in week 1, it would deform, but at all other times cleat indentation was the only sign of wear. This firmness required very little product to be used for re-working. Often times scarifying and tamping the worn areas was sufficient. Many pitchers preferred Diamond Pro amongst the group, but the firmness caused some consistent complaints such as: "I don't feel comfortable pushing off and landing on this surface"; or "I feel restrained in the landing area which may affect my fielding ability; and, finally: "I can't get enough torque or spin off the toe plate because it is too firm".

Pro's Choice: This product took the most time to form and build the mound. Once built, the clay areas performed very well. During week 1 it was the material with the least wear. Pro's Choice wore differently than the others as it would chip off rather than leaving a hole (Mar Mound and Turface) or just cleat indentations (Diamond Pro). Some of the pitchers complained about this chipping leaving slick areas that restricted their torque. The landing area was extremely firm which was viewed as a plus or a minus depending on pitcher preference.

PITCHER PREFERENCES

At the end of the study each pitcher was asked to pick their favorite product. Many wanted a firm, strong product that would not give out when they landed. Others preferred something softer that could help them finish their motion and keep pitches down in the strike zone. The 14 votes were as follows: Mar Mound (2); Turface (3); Diamond Pro (6); and Pro's Choice (3).

FIELD MANAGER PERSPECTIVE

We put the four products into two categories, high and low initial input. The two products that were not as easy to use straight out of the bag we placed in the high initial input category: Diamond Pro and Pro's Choice. Mar Mound and Turface were very user-friendly so we describe them as low initial input. For those managing a larger facility with a lower budget and many fields to work on weekly, we would choose Mar Mound first and Turface a close second. For those managers on higher profile fields who may not mind the extra up-front time required to prepare their mound, we would recommend Diamond Pro first and Pro's Choice second. However, these are fine distinctions we have drawn and we would like to close with a quote from our primary author: "All four products were better than anything I have ever used or thrown from in my 17 years of playing baseball." ■

Gerald Henson is a former Virginia Tech turf student; Chad Kropff is sports turf & outdoor facilities manager; and Erik H. Ervin, PhD, is a professor, Turfgrass Culture & Physiology, at Virginia Tech.

Wear injury on sports fields: BMP approach

THE TERM "TRAFFIC STRESS" encompasses all types of stresses on sports turf resulting from both human and vehicle traffic. To develop sound management practices it is important to understand each individual type of traffic stress since they differ substantially as to mode of injury and management. The major types of traffic stresses are soil compaction and wear injury; but the focus of this article on wear injury.

Soil compaction, caused by traffic pressure on the soil matrix, results in a more compacted, dense soil mass, especially in the surface 3 inches, with few macropores for aeration, water infiltration, and root channels along with higher soil mechanical strength. These adverse soil physical conditions result in root and shoot deterioration over time.

Wear injury is the immediate, direct injury to shoot tissues by traffic action in the form of abrasion, pressure, scuffing, tearing, and/or divoting damage where pieces of turf and sod are displaced. Each sport imparts different mixes of these physical injuries. Moderate traffic may cause some discoloration and slight thinning of the turf over a period, while intensive traffic may result in immediate tearing of the sod and severe loss of stand density. Tissue damage from pressure, scuffing, or abrasion, may require one, or two, days to be apparent, while tearing and divoting actions result in immediate damage. Normally for pressure, scuffing, and abrasion wear, turfgrass takes a bruised (dark-green, moist) look, turning to blue-green wilted tissue before decreasing in greenness within 24-48 hours. Close leaf inspection may reveal shredding and/or wearing off of the leaves and even stems.

WHAT IS THE DOMINANT TRAFFIC STRESS?

Knowledge of the dominate traffic stress or stresses is important because practices to reduce direct physical injuries to plant shoot tissues (wear) will differ from addressing soil physical problems (soil compaction). For sports fields with fine-textured soils without a sand layer at the surface, soil compaction normally would be the dominant traffic stress, especially if clay/silt content is high, the clay type is shrink-swell clay, or surface and subsurface drainage is poor. However, wear stress will still be very evident on these fine-textured fields, so both stresses must be addressed in management protocols. On high sand-content (> 85 % sand), well-drained sports fields, wear injury are the most important traffic stress while soil compaction is of little importance. This would also be true for fine-textured soils that have received sufficient sand topdressing (usually 3.0 inches or more sand layer) and internal drainage to negate surface soil compaction.

BMPS TO PREVENT OR MINIMIZE WEAR INJURY

The best management practices (BMPs) term noted in the title highlights that management of wear stress, similar to other traffic, environmental, or pest stresses, requires a holistic, science-based approach where multiple management strategies must be combined together to achieve success. Essentially, a good BMPs wear management program will minimize the traffic factors, turfgrass characteristics, and soil conditions that favor a greater degree of wear injury with the turf manager selecting the "best" set of options that can be used for their specific site based on economic, field playability for the sport, environmental, and societal (i.e. player safety) considerations, i.e. a sustainable sports field management approach.

Traffic factors that increase wear are: a) repeated, concentrated traffic in an area; b) turning, twisting, or slipping traffic actions; and c) high pressure per unit area on the grass tissue and underlying soil. A well-designed traffic control plan supported by administrators, coaches, and field managers is essential to minimize unnecessary wear and soil compaction on athletic fields, i.e., to insure safe playing fields. Components of

Table. Traffic Control Measures to Reduce Wear on Sports Fields

- Develop a traffic control plan agreed to by administrators, coaches, and field managers. Determine who has authority to limit field use. Photos and documentation of traffic damage and stresses can aid in development and adjustments of plans.
- Games only fields – hold scrimmages and practices on practice fields
- Field rotation plan for practice fields
- Shift fields by > 100 feet from prior location
- Use N-S and E-W practice field layouts
- Use all field areas
- Consider spectator traffic patterns in the overall traffic plan
- Move goals weekly or as needed
- Coaches need to distribute drills as much as possible off of practice fields – this requires improved grass areas adjacent to fields
- Use different colored markings for different sports on multiuse fields
- Limit band practice on game fields to once per week and not when fields are too dry or too wet
- Develop yard lines for band practice in parking lots or improved grass areas other than practice and game fields
- Minimize extra-curricular use of fields – restrict use on dry of wet field conditions
- As much as possible limit traffic on excessively wet, dry, frozen or partially thawed turf – mowing should not be done on drought stressed grass
- Cover fields receiving short-term intensive traffic such as concerts
- Cover sideline area during games
- Allow only vehicles with of pneumatic "turf" tires will aid in reducing the pressure and tear components of wear

an overall plan are noted in the table.

The primary **turfgrass characteristics** that influence plant wear tolerance are: a) degree of living shoot biomass, i.e., verdure and shoot density; b) turfgrass growth rate; c) nature of the thatch or mat layer where both include living and dead organic matter; d) presence of high plant succulence or low cell turgidity; and e) nature of turfgrass rooting, stolon, and rhizome development. Turfgrass species and cultivars within a species that exhibit superior wear tolerance inherently have characteristics that foster better tolerance to wear.

Studies on turfgrass species or cultivar wear tolerance consistently demonstrate that greater wear tolerance is associated with high verdure and shoot density at the normal mowing height for a particular use. The first line of defense against wear injury is a dense, healthy turfgrass stand that provides a cushioning effect and ability to rapidly regenerate leaves and shoots. Attention should also be given to any factor that may limit growth rate or cause a decline in shoot density since slow growth and low density not only foster greater wear but delay recovery. Sometimes the active growing period can be extended somewhat in the fall or early spring by Fe and N applications.

Important factors affecting turfgrass growth rate are: a) nutrient limitations or deficiencies retarding growth—most common on sand-based fields would be low N, P, Mn and Mg (K will be discussed later), where soil tests and plant analysis will aid in determining needs; b) climatic conditions can limit growth and those that cannot be dealt with by direct management should be considered in traffic control measures (common are drought, cool/cold or excessively warm weather); c) saline conditions from saline irrigation water acts as a plant growth regulator; d) surface soil compaction inducing low soil oxygen and high mechanical strength can reduce shoot growth by 30-50 % which significantly increases potential for wear injury; e) sand fields where the organic matter accumulates to above approximately 4-5 % by dry weight in the surface 1-2 inches can result in low soil oxygen if the sod receives moisture daily by irrigation or rainy periods which in turn limits shoot and root growth; f) any pest limiting growth or reducing shoot density; g) scalping or mowing too close even if not a scalp condition; h) shaded grass has more fragile and spindly shoot tissues that are more susceptible to wear injury and the lower light limits recovery; and i) application of a PGR that excessively reduces plant growth rate during high traffic periods. PGRs often are used to "tightened up" the canopy which can aid in wear tolerance but delay recovery if wear injury occurs.

Thatch is a layer of live and dead plant tissues overlying the soil surface, while mat is a layer of living and dead organic matter with appreciable sand or soil intermixed. A "good" mat should have > 85 % sand by weight so as not to be dominated by the organic matter component. Mat layers that do not contain sufficient sand can result in a compacted organic layer that holds excessive moisture during wet periods and can result in poor rooting. Moderate thatch/mat (0.25

to 0.50 inch) reduces wear damage due to greater cushioning and provides better traction or footing compared to no thatch. Excessive thatch or mat without sufficient sand integrated into it greatly increases potential for tearing and divoting action and will have poor rooting stability. During dry periods on high-sand fields, excessive organic matter can also foster water repellant, hydrophobic areas where the grass is susceptible to greater wear damage and reduced root stability.

Excessive tissue succulence increases susceptibility to wear injury since tissues are more fragile due to less total cell solids (important factor in wear tolerance) but higher water content (by weight). Conditions fostering succulent grass are too high nitrogen, low light conditions, excessive irrigation, and poor surface or subsurface drainage where the grass is growing in excessive moisture.

Shoot tissue cells exhibiting low turgidity are much more susceptible to wear injury than plants under normal cell turgidity. Low cell turgidity results from lack of sufficient cell moisture to maintain a turgid cell wall that resists wear stresses where conditions contributing to low cell turgidity are: a) inadequate soil moisture; b) lack of a good root system to take up soil moisture during hot, low humidity periods; c) soil salinity from saline irrigation water inducing physiological drought stress on the plant; and d) inadequate potassium for osmotic adjustment of the plant to drought stress. Management practices to address situations that foster low cell turgidity are especially important during field use periods; and this includes avoiding mowing on a drought stressed field since this can cause considerable shoot tissue injury including death.

Adequate plant potassium deserves some attention since it contributes to total cell solids and maintenance of cell water for turgidity (rigid cells). For example, research on seashore paspalum under saline irrigation water has demonstrated that potassium is required for > 25% of cell turgidity (osmotic adjustment) and cannot be substituted for by another cation or organic osmolyte. Potassium deficiency also causes stomata to remain open in grasses with high water loss and reduction of cell turgidity. Typically, higher potassium rates are recommended for recreational sites compared to general turfgrass areas. On all but high sand-content, root-zone media, soil testing is the best method of determining potassium needs with a target range within the upper medium range for extractable potassium.

On irrigated sand fields, potassium can be easily leached making it difficult to maintain soil test values. Losses also occur if clippings are removed. However, too much potassium can increase soluble soil salt levels during prolonged dry periods without any leaching losses, and reduce water uptake. For high-sand, irrigated, recreational turfgrass sites, many research scientists (including the author) suggest that potassium fertilization rates be coupled with nitrogen application rates and timing with the following suggestions for recreational grasses when the irrigation water is not saline: a) < 6 lb N per 1000 ft2 per year, use a 1:1 N: K20 ratio; b) > 6 lb N, use a 1:0.75 N:K20 ratio. During rainy periods when soil K may leach, foliar application aids in maintaining adequate shoot tissue K and cell turgidity. If the irrigation water is saline, especially when sodium is moderate or higher, a higher N:K20 ratio such as 1:1.5 may be necessary along with periodic foliar K application. Applications of K based on N rates are *only* for heavily leached sand media. Unfortunately, many turf managers with K-retaining fine-textured soils have used the "ratio method" (ignoring soil tests) resulting in excessive K applications and promoting build-up of K (a salt) within the soil especially in prolonged dry periods.

The nature of the grass species and cultivars within a species influence the wear tolerance of the grass. Characteristics that enhance wear tolerance are: a) high inherent shoot density coupled with an adequate shoot growth rate; b) strong and deep rooting grasses that resist tearing actions; c) grasses with good lateral stolon/rhizome growth; and d) a grass that is adapted to the climatic and pest stresses and mowing regime at the site so that it can maintain good growth. Wear tolerance differs from soil compaction tolerance so results from studies should be evaluated for what mix of traffic stresses were actually present in the study. Over the past 10 years several research scientists have evaluated relative wear tolerance and mechanisms (physiological, morphological, and anatomical plant differences) that contribute to superior wear tolerance of a cultivar within a species, which can vary considerably from the general ranking for a species.

Turfgrass species and cultivars of a species vary not only in wear tolerance but also wear recovery. Plant aspects influencing rapid recuperative potential include: high inherent growth rates; presence of lateral stolons and/or rhizomes; and physiological health of the plant, especially carbohydrate reserve levels.

During the winter several types of wear injuries can occur: wear on dormant tissues; traffic on frosted green leaf tissues (disrupting brittle protoplasm); and traffic on thawed surfaces where the underlying soil remains frozen. Traffic on dormant tissues causes considerable wear since there are no live green leaves to cushion the pressure and no regrowth. Dormant warm-season grasses overseeded with a cool-season species can tolerate more traffic as the overseeded grass provides a protective cover and cushioning. However, the primary grass may decline over time from overseeding competition.

During the winter several types of wear injuries can occur: wear on dormant tissues; traffic on frosted green leaf tissues (disrupting brittle protoplasm); and traffic on thawed surfaces where the underlying soil remains frozen.

SOIL FACTORS

Soil texture has a strong influence on different types of wear as well as proneness to soil compaction. Sandy, well-drained soils, while resistant to soil compaction and less prone to water-logging than fine-textured soils, are more susceptible to being droughty that requires careful irrigation to avoid drought stress during field use. High-sand content fields at field capacity have better traction and stability to resist tearing action and divoting than when drier. If the irrigation water is saline, sandy soils compared to

fine-textured soils will exhibit: more rapid accumulation of total soluble salt; much less susceptibility to soil structure deterioration by sodium; and are much easier to leach salts. Sand provide greater friction, especially when wet, than a heavier soil; however, fine-textured soils provide more root stability against divoting or tearing. A mat layer of 0.25 to 0.50 inch on a sand field will aid root stability. Careful selection of the sand used for construction and topdressing is important so as not to use a well-rounded sand shape, especially if the particle size range in narrow, since the sand may not stabilize; thereby, resulting in susceptible to divoting and tearing. Whether a sand or fine-textured field, accumulation of excessive surface organic matter should be avoided to minimize divot, tear, and slippage actions—and on a sand field may enhance development of hydrophobic areas.

Any soil factor that leads to excessive soil moisture at the surface will increase wear injury and divoting. Common situations fostering excessive surface moisture are: a) low inherent water infiltration and percolation rates typical of many fine-textured soil types; b) compacted soil surface; c) poor surface drainage where water collects in depressions within field areas; d) any subsurface layer that impedes water drainage. These conditions are primarily on fine-textured soils and remediation practices include combinations of good surface and subsurface cultivation programs, surface drainage by proper contouring, tile drainage, sand-slitting, and sand-capping directly or over time by topdressing with sand.

Topdressing is important on both sand and fine-textured sports fields to enhance wear tolerance. On sand fields, topdressing can control the nature of the surface organic matter by producing a good mat that integrates into the underlying soil and is a good rooting media. For fine-textured soils, especially those prone to soil compaction and with poor drainage, topdressing is essential to build up a surface high-sand layer (ideally of > 3.0 inch) so that the surface does not compact nor easily waterlog. Heavy topdressing should be avoided during high use periods since it leaves considerable sand around the upper crown and stem tissues which, combined with the brushing and drag-matting needed for integration causes considerable abrasive wear. Fewer problems are apparent with lighter, more frequent dressings.

A key distinction of recreational turfgrasses compared to other turf sites is the traffic stresses on these living entities. Wear stress can be in various forms from abrasion, scuffing, tearing, pressure, and divoting depending on nature of the traffic. There is no silver bullet in management of wear stress, rather success depends on using a holistic, BMP approach that includes traffic control measures, fostering plant conditions to maximize wear tolerance and recovery, and addressing any soil factors that impact the degree of wear stress. Successful maintenance of traffic stresses (wear and soil compaction) ultimately impact the athlete's performance and safety via footing, traction, and stability.

Dr. Robert N. Carrow is with the Crop & Soil Sciences Department, University of Georgia/Griffin Campus.

>> WHEN CATTAILS GROW in water they take up mass amounts of nitrogen in the water. Here cattails are being planted in drainage areas of an athletic field.

>> Top Left: A BLUE HARING perch on tree that fell in the pond makes up part of our buffer zone.
>> Middle Left: ST. MARY'S of Maryland helps teach high school athletic directors and coaches correct ways to fertilizer their fields for grow in or regular maintenance.
>> Bottom Left: TEACHING COACHES how to mow sports turfgrass without causing injury to plants and avoiding weed encroachment and disease pressure.

SUSTAINABILITY:
it is not a small world after all

SPORTS TURF MANAGERS are not as few in numbers as you might think. The Sports Turf Managers Association (STMA) is more than 20 years old but we are still a fairly young national organization, although we have strengthened considerably under the leadership of president Troy Smith, CSFM and past presidents, educators, sports turf managers and CEO Kim Heck, along with her dedicated hard working staff who gave this organization its professional glow.

Valuable data can be gained from sports turf athletics fields, acreage and water sources and I would recommend the STMA try to inventory sports turf manager athletic fields/acreage/water sources, etc for important data that they can use for educational and lobbying aspects.

On a national scale, there are a lot of properties sports turf mangers care for and in fact, we are often overlooked as professionals because the general public associates or compares our trade with golf course superintendents. We all know it is two different worlds, but what have we done to highlight our properties, operational expenditures, investments and to protect our environment? We are all doing our part to stimulate the economy, promote safety on the field, and promote environmental awareness. Let's look at comparisons between golf courses and sports turfs from this recently documented survey.

Sports turf is growing consistently at a rate higher than golf courses, but let's look at the bigger picture. An 18-hole golf course averages 30,000 people a year and a sports turf professional football game can average 50,000 people per day/per game. That's a lot of folks for outreach and education; now imagine the amount of storm water that could be filtered and retained for irrigation.

Look at the acreage as a classroom through signage for millions of children and adults. Let's imagine we could preserve 5% for wildlife habitat from the total of 2,800,000 of sports turf and convert it into 140,000 acres of wildlife. That would equal a $455,000 fuel savings and consider the equipment hours and labor savings. Now, let's look at the ground work.

OUTREACH & EDUCATION

This should be the most important step a sports turf manager takes in their strategic environmental plan for their property. Educating the general public in your environmental maintenance plan does not only highlight your company images, but it also serves as a tool for the public to understand how and what we are doing to protect our environment.

- Composting for difficult soils
- Wildlife Habitats/ Biological control

The amount of athletic fields/sports turf is difficult to estimate due to there is no accurate records kept for acreage. However we can break it into the following categories of K-12, colleges, universities, and professional fields according to the Turf Industry /Fact Sheet Sports Turf Advantage Division of Plant Sciences-Turfgrass Research Center College of Agriculture, Food and Natural Resources University of Missouri. There is a total of 2.8 million acres of sports turfgrass fields nationally and broken into four groups:

Type of Facilities	Total number of Facilities
Park & Recreation	13,000
College & Universities	2,200
K-12	16,000
Professional Sports	800

Total National Average of sports turf acreage = 2,800,000

According to the National Golf Foundation, the leading golf courses in the United States are broken down into five different categories:

Type of Facilities	Total number of Facilities
Public	7,958
Resort	995
Private	4,256
Semi Private	3,541
Military	197

Total National Average of golf course acreage = 2,542,050

JOHN MASCARO'S PHOTO QUIZ

John Mascaro is President of Turf-Tec International

Can you identify this sports turf problem?

Problem: Brown turf across the end zones of four fields on a 25-field complex
Turfgrass area: College intramural practice fields
Location: Amherst, MA
Grass Variety: Kentucky bluegrass/perennial ryegrass mix

Answer to John Mascaro's Photo Quiz on Page 33

Background illustration courtesy of istockphoto.com

• Storm Water Runoff Management
• Responsible turfgrass maintenance
• Responsible water management for turfgrass
• Reducing your carbon foot print
• Recycling
• Energy Performance

STORM WATER MANAGEMENT TIPS

Storm water pollutants should be every sports turf managers concern to help protect their local watershed. There are many things we all can do and should do to reduce the storm water pollutant load that is harming our local watershed and our local wildlife, food production and quality of life. First let's look at the storm water it filters, typically non pervious surfaces, for example, roof tops, parking lots, sidewalks and roadways generate lot of storm water pollutants. These are measured in gallons. Look at the ratio chart below.

Many gallons are affecting aquatic life in our local watersheds from alga bloom to contamination poison from heavy metals. Stop and think about where the water goes when you wash your turf equipment daily or the storm water runoff from rain events within your sports facility.

There are many different types of storm water pollutants that can reach your tributaries associated with your sports complex. A list below indicates harmful side effects to our local watershed. Understanding some of terms associated with managing storm water is critical. Best Management Practices or (BMPs) is a term use for managing storm water. The basics is know how much you are generating or averaging through a typical rain storm of 1 inch.

Examples for reducing your nutrient load:

• Add rain gardens where storm water accumulates on your property.
• Use cattails along culverts and ditch lines.
• Plant several water lilies in storm water retention pond to block photosynthesis to prevent alga bloom.
• Mow different heights around your athletic fields to slow down sheet water movement with higher grasses mows around the field.
• Practice good housekeeping with all your fertilizer products. Clean up spills or shop areas that stores fertilizers. Do not let them go down the drain.
• Clean all sports facility drains and keeps them free of silt and other types of yard waste that can harm your local watershed.

Here are some watershed pollutants to think about:

Metals. There are more than 50 elements that can be classified as heavy metals, 17 of which are considered to be both very toxic and relatively accessible. Toxicity levels depend on the type of metal, its biological role, and the type of organisms that are exposed to it. Human and aquatic life is at-risk when these types of metals are introduced into our local watershed. My thought on this is simple: we use these chemicals for a purpose on our sports fields, but let's not stop reading the labels for directions. Let's put safeguards into place (please look at the solution list). We have to be responsible for applying these chemicals or for looking at safer alternatives for pest control on your sports turfgrass.

• Mercury is one of the common metal pollutants.
• Polychorinated biphenyis (PCB's)
• Polycyclic aromatic hydrocarbons (PAH)
• Organophosphate pesticides (herbicides and insecticides)
• Organochlorine pesticides DDT, chlordane and chlorothalonil
• Lead
• Arsenic
• Cadmium
• Copper
• Zinc
• Chromium

Nutrients. These chemicals affect plants and animals' survival rates in our local watershed. When too many nutrients make their way into local rivers, streams and the bay, they can create conditions that are harmful for blue crabs, bay grasses and other underwater life that might be harvested recreationally or commercially. Excess amounts of nitrogen and phosphorus, are two types of nutrients that are local and are a national reason for poor water quality in our watershed.

Nitrogen, broken down from activities listed below.

• Emission from vehicles, turf equipment, electric utilities, etc.
• Chemical fertilizers applied in aquaculture and suburbia settings
• Treated wastewater discharge from industrial facilities and municipal wastewater treatment plants
• Manure from aquaculture land
• Septic systems that leach into watershed

Phosphorus, broken down from activities listed below.

• Erosion sediment from stream banks in urban and suburban areas
• Manure from aquaculture land
• Treated wastewater released from municipal and industrial wastewater facilities
• Chemical fertilizers from aquaculture and suburbia land
• Natural sources and forest land

SOLUTIONS

• Incorporate cattails in swells or drainage areas on the sides of sports fields and other areas to absorb nitrogen and other harmful storm water pollutants.
• Wash off mowers on pervious surfaces like grassy areas.
• Provide secondary containment for all gas, oil, pesticides, fertilizers and spill kits.
• Provide rain gardens for sport fields, parking lots.
• Plant native trees and shrubs that can aid in filtering and reducing storm water pollutions.
• Incorporate buffer zone for rivers, lakes, ponds, streams, creeks, ditch lines, culverts and athletic fields.
• Naturalize areas within your complex.
• Patrol for recycling/litter.
• Feed the soil not the turf using 100% organic fertilizers that can stop volatilization and process a high WSN rate of 70% -80% for slow release feeding. Liquid fertilizer and synthetic fertilizers can break down fast, resulting in vitalization, rapid runoff and more high rates of WIN with 20-40 of product rapidly breaking down. These types of products break down very fast and which result in a flush of N at one time.
• Manage appropriated turfgrass for your climatic zone that can reduce your pesticide and fertilizer input.
• Add rain gardens where storm water accumulates and stands within your property.
• Plant several water lilies in storm water retention pond to block photosynthesis to prevent alga bloom.

One inch total rain fall non-pervious surface
Roof Top (1000) sq-ft 600 Gallons of storm water runoff
Sidewalk/Streets (237,600) sq ft- One Block 6,500 Gallons of storm water runoff
Parking Lot (43,560) sq ft 27,000 Gallons of storm water runoff
Tennis Court (7,200) sq-ft 4,100 Gallons of storm water runoff
Natural Turfgrass Athletic Field (80,000) sq-ft 20,000 Gallons of storm water (Depending on soil Structure)
Synthetic Turfgrass Athletic Field (80,000) sq-ft 27,154 Gallons of storm water run off

• Mow different heights around all your fields to slow down sheet water movement with higher grasses mows around the field.

• Practice good housekeeping with all your fertilizer products. Clean-up spills or shop areas that stores fertilizers. Do not let them go down the drain.

• Clean all sports facility drains and it keep them free of silt and other types of yard waste, that can harm your local watershed.

IMPROVING SOIL STRUCTURE IN A SUSTAINABLE WAY

Your soil profile can be a challenge to propagate turfgrass in athletic fields depending on your horizon zone. Soil textures can also be a challenge depending on the organics percentages in your sand, silt, or clay athletic fields. Applying compost can add beneficial fungi to fight certain turfgrass diseases and to help retain water, which in return reduce storm water runoff and provide much needed nutrients to turfgrass. Examples include: grass clippings, leaves, prunings, aeration cores, coffee grinds, annual flowers, shrub trimmings, shredded Christmas trees, and wood chips.

ENERGY PERFORMANCE

The Environmental Protection Agency along with Energy Star has developed a program called "The National Building Association for Professional Sports Stadiums and Athletic Facilities." The program is a competition among other professional sports facilities and arenas for energy performance. The EPA picks one facility that has managed to reduce and conserve the greatest amount of energy and gives them an award to showcase their success.

Here are some other outstanding organizations that help promote environmentally sound sports turf maintenance:

• Global Sports Alliance: Kevin Trotta, turfipmguy@aol.com

• Audubon International: Jim Sluiter, jsluiter@audubonintenational.org

• EPA-Energy Star: Laura Senchack, LSenchack@icfi.com

• National Watershed Coalition: Michael Hebert, mhebert@mckinneytexas.org

Get involved with your local watershed association. Lead by example within your community and offer your ideas to conserve or protect your local watershed.

As sports turf mangers, we should highlight and showcase our many different types of environmental stewardship to promote sports turf property for the general public. Together, we could reach over a million people a year through sporting events thorough outreach and education. We can filter over a billion gallons of storm water pollutants and conserve a million gallons of fuel and tons and tons food waste and yard waste through composting.

ST. Mary's College of Maryland's president, Dr. Joseph Urgo, is committed to protecting our natural resources. He stresses for all of us in every department on campus to be educators in everything we do regardless if we are faculty, staff or administration. His vision is for us to help him make our campus a learning environment and then it can become a positive one with endless possibilities.

Just like president Urgo goal if we work together through teamwork, then we can rally together to protect our nation's athletic fields and set example on to how to reduce are carbon footprint and storm water pollutants. ■

Kevin Mercer is superintendent of grounds at St. Mary's College of Maryland.

Athletic field cultivation & topdressing: How much field area does your program actually impact?

>> Amount of sand required and area impacted for various coring and topdressing programs.

Core space in.	Holes per sq. ft	Tine dia. in.	Tine depth in.	*sand needed to fill holes + leave some on surface (ton/1000sqft)			% area removed each pass	Number of passes with aerifier to impact a given area of the field		
				+1/8"	+1/4"	+1/2"		50% removed	25% removed	10% removed
2	36	.5	3	1.22	1.78	2.89	5.0	10	5	2
			8	1.76	2.87	4.00				
		.75	3	2.04	2.60	3.72	11	5	2	1
			8	4.51	5.08	6.19				
3	16	.5	3	.85	1.41	2.53	2.2	22	11	5
			8	1.34	1.9	2.93				
		.75	3	1.22	1.78	2.89	5	10	5	2
			8	2.32	2.87	4.00				
4	9	.5	3	.72	1.28	2.40	1.3	40	20	8
			8	.99	1.55	2.68				
		.75	3	.93	1.49	2.61	3	18	9	4
			8	1.55	2.10	3.22				
6	4	.5	3	.63	1.19	2.31	0.5	90	45	18
			8	.75	1.31	2.42				
		.75	3	.72	1.28	2.40	1.3	40	20	8
			8	.99	1.55	2.68				
8	2.25	.5	3	.60	1.16	2.28	.31	161	81	32
			8	.68	1.22	2.35				
		.75	3	.65	1.21	2.33	.69	72	36	15
			8	.81	1.36	2.48				
No coring topdress only				.56	1.12	2.24				

*Assume sand weighs 1.45 ton/cu.yd. and there is 100% efficiency on subsequent passes with aerifier.

>> Topdressing and amending sands for "native soil" athletic fields.

Size	Sieve Size (mesh)	Particle Diameter (mm)	Ideal % by wt.		Acceptable %by wt.
Gravel	10	2.0 -3.4			20% max, with 3% max from gravel
Very Coarse Sand	18	1.0 -2.0		90% min	
Coarse Sand	35	0.5 –1.0	80%min		60% min
Medium Sand	60	0.25 - 0.50			
Fine Sand	100	0.15 - 0.25	none		20% max
Very Fine Sand	270	0.05 - 0.15	none		5% max
Silt		0.002 - 0.05	none		5% max
Clay		<0.002	none		3% max

USE THE FOLLOWING tables to determine how much of the field area is actually being impacted by your coring program. Did you realize that using a 3/4-inch hollow tine more than doubles the area of the field that is impacted compared to a 1/2-inch tine?

Let's suppose that your goal is to remove 50% of the field area to a depth of your aerifier tine. The field is predominately clay that you want removed from the field and replaced with sand. Removing cores on 3-inch centers will require 22 passes over the field using 1/2-inch hollow tines in order to meet your goal of removing 50% of the clay soil. At two corings per year this would require 11 years and that might be too long to wait. By using 3/4-inch tines you can achieve the same goal in 10 passes over the field. If you increase your aerification and topdressing to three times per year you can achieve your goal of replacing 50% of the surface in nearly 3 years.

In the case of soil modification, the most effective modification, greatest change in physical properties with the least amount of added sand, has been obtained from sands in the very coarse to coarse size range. Rounded sands that are narrowly graded and have a coefficient of uniformity less than two are preferred. Select uniform coarse sand (80% of the particles between 1.0 and 0.5 mm and 90% between 2.0 and 0.5 mm) to maximize large pore space when modifying native soil fields high in silt and clay. Mixtures of predominately coarse and medium sand, with minimal fine sand, are best for amending native soils. Adding very fine sand or silt and clay does little to improve soils already high in silt, clay, and very fine sand. Golf course topdressing sands containing at least 60% in the

Mixtures of predominately coarse and medium sand, with minimal fine sand, are best for amending native soils.