## Improving native soil athletic field drainage

THE TYPICAL MICHIGAN HIGH SCHOOL ATHLETIC FIELD serves as a focal point for social gatherings and community pride. It is often one of the few fields in town with lights, making it host to a variety of after school and work events. Therefore, having an aesthetically pleasing and functional high school athletic field is





Sand-capped athletic field system schematic

often important to a variety of members in the average community.

High school athletic fields constructed on native soil relatively high in silt and clay are incapable of providing adequate drainage during periods of heavy rainfall. This in combination with heavy use will result in turfgrass failure, reduced traction and stability, and compaction, which will only worsen infiltration and future turfgrass health and vigor. Current solutions to this dilemma include complete field renovation. However, these processes are very costly and render the athletic surface temporarily unusable. For instance, renovation costs range from \$600,000 - 1,000,000 for a synthetic field; \$400,000 - 600,000 for a conventional sand-based athletic field with a 12-inch, sand-based rootzone over a 4inch gravel layer and a subsurface drain tile system; \$200,000 - 300,000 for a sandcapped system with a shallow (4 - 6 inch)sand-based rootzone directly over the underlying native soil and a subsurface drain tile system.

These staggering upfront prices are not an option for schools systems with minimal



budgets and high annual use requirements.

A possible alternative to complete renovation is the installation of a subsurface drain tile system and subsequent sand topdressing applications, providing a built-up sand-capped system over time. A built-up sand-capped system, which can be done in four simple steps for \$58,200 – 103,800 [price includes irrigation system installation (\$15,000), 6 - 20 foot drain tile spacing (\$60,000 – 14,400, respectively), and 2-inch sand layer depth (\$28,800)], would provide high schools and other municipalities with a cost effective solution to impeded field playability that does not interrupt field use for an extended period of time.

The concept behind the built-up sandcapped system is to combine the advantages of the sand cap system, rapid drainage and a sand-based rootzone, while providing almost uninterrupted availability. The idea is to cut drain lines in the existing field running lengthwise, put drain tile in the lines, back fill with pea stone and then sand, or coarse sand alone. Installation of an irrigation system, before drain tile installation, is necessary at this time if the existing field does not already have irrigation, because turfgrass grown on a sand-based system will require regular irrigation. At this time it is important to correct any low/wet spots in the existing slope by leveling them with topsoil; soil removed during drain line installation would be appropriate for this task. Repair to any irrigation line damage is necessary at this time.

Subsequently, an aggressive sand-based topdressing program would begin during the summer with a well-graded sand-based material, approximately 90% sand – 10% silt/clay. Sand topdressing would be coupled with an annual field renovation pro-

OKEMOS HIGH SCHOOL SOCCER FIELD, Okemos MI May 20, 2009. Drain tiles were installed at 8-foot spacing in May 2008 and 1 ½ inches of subsequent sand topdressing has been accumulated since.

gram, including inter-seeding and cultivation. During this period it is also important to regularly clean and maintain irrigation heads to prevent sand from damaging the system. The topdressing stops in early August to allow settling before use in the fall. During the first year the sand may not reach the level necessary to prevent saturated surface conditions from developing, particularly in low lying areas. However, the drain tiles will prevent standing water from developing, providing a system that is better than the original. The next spring the topdressing process would begin again to add the rest of the material, further increasing drainage capacity. The end result is a well drained, stable, sand-based field for a fraction of the cost required for other renovation processes.

The built-up sand-capped system will not only reduce the annual repair costs required for a native soil field, but also reduce the initial cost of field renovation. To install the drainage and backfill a field with 6-foot centers (would approximately have 30 400-foot x 4-inch drain lines @ \$4-5/linear foot) would cost \$48,000-60,000 installed, while a field with 13-foot centers would cost \$22,400-28,000, and 20-foot centers would cost \$14,400-18,000. Then topdressing would begin on the field during the summer with each inch of material costing about \$14,400 (300 tons of sand for \$8,400 and \$6,000 for labor). However, a number of concerns arise when considering the builtup sand-capped renovation procedure, such as what is the optimum topdressing regime capable of accumulating an adequate sand layer without being detrimental to turfgrass health, vigor or wear tolerance? Can athletic field use continue throughout the topdressing regime? What is the optimum drain tile spacing in combination with sand topdressing depth, accumulated over time, necessary to prevent prolonged saturated field conditions, which would otherwise compromise field playability?

A series of research projects were initiated in the spring of 2007 at the Hancock Turfgrass Research Center, Michigan State University, East Lansing, to explore the feasibility of a built-up sand-capped system. Objectives of this research were to evaluate the effects of cumulative sand topdressing rates on the fall wear tolerance of a cool-season turfgrass stand, determine the effects of traffic applied during the topdressing regime on the fall wear tolerance and establish drain tile spacing, in combination with sand topdressing, necessary to improve drainage characteristics, wear tolerance and surface stability.

All research was conducted on a 90% Kentucky bluegrass (*Poa pratensis*) – 10% perennial ryegrass (*Lolium perenne*) mixture established from seed on a compacted sandy loam soil with a 1% surface slope in relation to drain tiles. The turfgrass established for these





Irrigation&Drainage

WATER MANAGEMENT INC. cutting drain lines and installing drain tiles, Intramural Field,

WATER MANAGEMENT INC. backfilling lines with a sand-based rootzone material, University, July 2008.

being applied at the Haslett high school football field, Haslett,

research plots at the Hancock Turfgrass Research Center, University, July 27,

being applied with the Cady traffic simulator, Hancock Turfgrass Research Center, October 22, 2007.

ONE INCH OF SAND topdressing, 1/2 inch applied over a 5-week period in 2007 and 1/2 inch applied over a 5week period in 2008, Hancock Turfgrass Research Center, September 18, 2008.

projects received sand topdressing applications in the summer, applied over a 5-week period at a 1/4 inch per application, and simulated athletic field traffic, applied using the Cady traffic simulator.

Results obtained from this research regarding topdressing rates suggest that when topdressing is used to develop a sand layer over an existing native soil athletic field, a conservative topdressing regime, 1/2 inch applied over a 5-week period in the summer, will provide field managers the greatest results, wear tolerance and surface stability, in the subsequent fall. Results also suggest that if a spring re-establishment before the initiation of sand topdressing is required, restricting summer traffic will provide the best results in the subsequent fall. Findings from this research also indicate that if spring re-establishment is not required, effects of summer traffic will be inconsequential to turfgrass wear tolerance and surface stability characteristics in the ensuing fall. As little as 1/2 inch of sand topdressing (\$7,200) was shown to substantially reduce the surface moisture content of a native soil athletic field, implying that this cultural practice alone could substantially improve the drainage characteristics of a native soil athletic field.

Regarding drain tile spacing, in combination with sand topdressing, results suggest that as topdressing is being accumulated from a 0 to 1 inch depth in the first year, the 6-foot drain tile spacing will provide the greatest overall drainage, wear tolerance (ground cover) and surface stability (shear strength and surface hardness) characteristics.



Outstanding: Can play 40-50 events with minimal damage. All rain events should be mediated with minimal issues.

- Very Good: Can play 20-30 events with minimal damage.
- Average: Can play 10-20 events with minimal damage.
- Slightly Below Average: Can play 10-20 events with minimal damage. Heavy rain events will accelerate damage.



However, the 13-foot drain spacing will provide drainage and surface stability characteristics equivalent to the 6-foot drain spacing. These findings indicate that a drain tile spacing of 13 feet, which will substantially reduce installation costs (\$22,400-28,000), is adequate to provide sufficient drainage and stability when 1 inch of sand topdressing (\$14,400) has been applied.

As topdressing depths were accumulated from 1 to 2 inches in the second year, minimal wear tolerance and surface stability differences were observed, suggesting that the effects of drain tile spacing on wear tolerance and stability are minimal once 2 inches of topdressing has accumulated. These findings suggest that if 2 inches of sand topdressing (\$28,800) has been accumulated and an adequate surface slope is available  $(\geq 1\%)$ , drain tile spacing can be increased to distances of 20 feet or even greater. Drain tile installation at 20 foot spacing would cost approximately \$14,400-18,000. It is important to note that substantial surface runoff was still collected from the control treatment after 2 inches of sand topdressing was accumulated, suggesting that drain tiles are still required for the removal of surface runoff from low lying areas.

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