

SOLVING YOUR DRAINAGE PROBLEMS



SOLVING YOUR DRAINAGE PROBLEMS
By John Kelly and Steve Ami, Kelly Ami Inc.

In order to solve turf drainage problems, both the source of the water and the reasons why the excess water is not draining away naturally must be determined. Four different types of drainage problems are presented in this article along with their individual appropriate solutions. A major topic of discussion will be the use of a drainage technology called "slit trenching". Although lesser known than conventional drainage techniques, it has been very successfully used on relatively impermeable soils in Europe and North America for over 20 years.

The key to solving drainage problems is to understand that not all drainage problems are created equal and each drainage situation is a special case. The realization that the drainage of a golf course or sportsfield is special to that golf course or sportsfield will lead to making the desirable soil investigations and analyses to make drainage designs suited to solve that particular drainage problem.

The first step is to identify the nature (or cause) of a drainage problem by examining topography and subsoil conditions. Once identified, you can select the appropriate type of drainage system solution to effectively remedy your drainage problem.



Although there are many types of drainage problems, this article will discuss the 4 most commonly found on golf courses and sportsfields.

The Problems

Drainage Problem # 1: Impermeable Soils

Impermeable soils are characterized by a silty / clayey soil texture with flat topography and poor infiltration rates. These soils are also very susceptible to compaction from golf carts and maintenance machinery. A vicious circle starts with more compaction leading to lowering infiltration

rates which leads to more compaction and eventually a sealing at the surface.

To check for impermeable soil condition you should verify the soil texture and infiltration rates. Dig a 50 to 75 mm diameter auger hole near a group of pondings, wait several hours for the water table to stabilize in the hole and measure the depth of the water table and compare to the level of the water in the pondings. If the water table is more than 450 mm below the level of the water in the pondings then you have found an impermeable soil condition.

Installation of a conventional drain in the dry subsoil, backfilled with native soils (or with stone and then capped with soil and sod) will not remedy this type of drainage problem.

Drainage Problem # 2: Depressional Areas

Depressional areas can be defined as low wet areas where a significant amount of water ponds after rainfalls. There is no deep percolation available for the excess water. They are usually created during the golf course construction, but can develop over the years through soil settlement in swales without adequate slopes. If the water ponds greater than 3 metres in diameter or greater than 100 mm deep, then the problem should be treated as a depressional area.

Conventional subsurface drains are often installed through these depressional areas but generally do not work adequately because it is very difficult to get large amounts of water to infiltrate fast enough through the turf, soil and backfill material into a drain pipe.

Drainage Problem # 3: High Water Table

A high water table condition is identified when the level of free water in a test hole (auger hole) stays within 300 to 400 mm of the ground surface. The water table is too close to the surface and is a drainage problem. During rain storms this shallow water table can come to the surface very rapidly resulting in numerous small pondings.

These pondings can easily be confused with the impermeable soil condition discussed earlier. You can not tell what type of problem you have without digging test holes, analyzing the soils and studying the water table depths over time. The treatment for a high water table condition will be quite ineffective for an impermeable soil condition.

High water table conditions result when soils have reasonable infiltration rates but no natural outlet via deep percolation, usually due to the presence of a clay or stone barrier. There are also characterised by some type of waterweeds present either in shallow adjacent ditches or sometimes in the low areas of the fairway.

Drainage Problem # 4: Side Hill Seepage

Side hill seepage can occur where a relatively permeable soil (sandy) overlies a relatively impermeable soil (silt / clay) on a slope. Excess water infiltrates into the sand at higher elevations. It cannot continue downwards into the clay and is forced to move horizontally and "seep" out where the sand layer ends. It is usually along the toe of a slope or partially up the slope.

Side hill seepage can also occur where clay soils have been reworked into mounds or hills by machinery. There will be large voids left in the disturbed clay since it is virtually impossible to recompact it to its original state. These large voids will allow the water to move freely into the disturbed profile (mound). The native soils under the new mound will not permit the water to continue downwards. The result is the same as the first case - water moves horizontally and seeps out along the base of the new feature (mound or hill).

This problem is easily identified by digging a series of test auger holes 600 to 900 mm deep at the toe of and partially up the wet slope (but still in the wet zone). Observe the soils during the digging and observe the water level in the holes afterwards. This type of drainage problem can generate enough water to keep a wide flat fairway, adjacent to the slope, very wet. Installation of conventional drains in the wet fairway will not solve this drainage problem.

The Solutions

Drainage Solution # 1: Impermeable Soils = Slit Drainage

Slit drainage systems consist of an 80 mm wide trench, 250 to 550 mm deep, containing a 38 to 50 mm inside diameter drain pipe backfilled to the surface with a column of coarse sand aggregate. The sand trench is eventually grassed over at the surface by the natural growth of the turf from both sides during a season. Seeding of the sand slits can be done to increase the speed of recovery. The drains should be spaced between 1.5 and 2.5 m apart depending on the soil type, topography and severity of the problem.

Allowing the adjacent turf to root in the coarse aggregate without the addition of a finer top soil maintains a high infiltration rate into the slit trench which is required to remove the excess water. In the impermeable soil condition, the excess water is trapped in the top layer of the soil profile. The excess surface water can move directly into the columns of coarse aggregate and is carried away by the slit drain pipes. Selection of the proper coarse aggregate is critical to the success. Sands with permeabilities of 20 to 30 m/day (30 to 50 inches/hr) provide good results.

The principal of slit drainage is to remove excess surface water before it has a chance to pond, soften the ground surface and inhibit turf growth, cause rutting, diseases and other problems.

Each of the individual slit drains are connected to a larger diameter collector drain. This larger drain will carry the water to an outlet. A special wheel trencher is required for the installation of the slit drains. The specialized wheel trencher is capable of digging a trench on grade (automatically controlled using laser grade control), excavating the soil directly into a trailer, installing the slit drain pipe, and backfilling with a coarse aggregate all in a "ONE PASS" operation. Clean up is fast and easy and always done as you go. Entire fairways can be drained in 2 to 6 days depending on the intensity of drainage required. Golf play can usually continue uninterrupted with the use of temporary tee placements or temporary greens.

Although it is a relatively expensive drainage technique, it provides excellent results with dramatic improvements for large flat areas.

Drainage Solution # 2: Depressional Areas = Surface Inlets

Surface inlets should be installed in the lowest part of a depressional area where water naturally ponds. Surface inlets are required to allow large quantities of water to rapidly enter a pipe drainage system. A properly sized collector pipe is then required to be installed on grade to carry the excess water to an outlet.

Surface inlets come in many shapes and sizes. The size is selected based on the amount of excess water that ponds in the depressional area.

All inlets should feature sturdy construction with a metal or plastic grate at the surface with large enough openings to allow unrestricted water entry, a 300 to 450 mm deep sediment trap is recommended to prevent sediment or debris entering into the drainage system.

Drainage Solution # 3: High Water Table = Water Table Control Drains

Whereas a slit drainage system was proposed in item 1), above, for surface problems where the water cannot infiltrate deep into the soil profile; high water table conditions require a treatment to lower the water table by removing excess water that has already entered into the soil profile. This requires a system of parallel sub-surface drains used to lower the water table.

The main features of a good water table control drainage system include 100 mm diameter drain pipes installed at 750 to 1200 mm deep. They are backfilled with the native soils because we know water can adequately enter the soil. The drain spacings are determined based on the native soil's saturated hydraulic conductivity and the desired 'drawdown' on the water table. A good (sufficiently deep) outlet to allow free flow from the drainage collector pipe.

Drainage Solution # 4: Side Hill Seepage = Interceptor Drains

Wet spots due to side hill seepage can be drained by installing 100 mm diameter interceptor drains (also know as "curtain drains"), 750 to 1200 mm deep backfilled with a highly permeable drainage sand. The bottom of the trench should be placed just into the less permeable subsoil.

The exact positioning of the interceptor drains is crucial to the success of the project. The interceptor drain should be placed just above the wet spot (or just above the highest seepage point) along the contour. The seepage water will then be intercepted by the curtain of sand, which allows the water to flow freely downwards into the pipe drain, and then carried to outlet. The wet seepage area will not dry if the interceptor drains are installed either too far below or above the seepage zone on the hill. Often it will take more than one interceptor drain to solve the problem.

The selection of the sand is again critical to the success of the drainage system. The backfill must have a permeability at least 10 times greater than the native soils, otherwise the use of clear stone is recommended.

Planning

The importance of drainage planning must not be underestimated. Proper design, coordination and selection of the type of drainage system are essential for the effective treatment of each Club's individual drainage problems.

The Club de Golf Royal Québec, in Boischatel, QC, recently completed a complete Master Plan for drainage improvements for the golf course. Some of each of these four types of drainage problems were found and the Master Plan includes four different types of solutions to address each of the problems.

The advantage of looking at the whole course at one time is to avoid situations where different holes have to be drained together and larger (or deeper) collectors are required than what was designed when only one hole was investigated. Other advantages include the obvious long range planning and budgeting possibilities when the entire course requirements are known.