DRAINAGE IMPROVEMENT — Remedy Without Reconstruction in New Zealand

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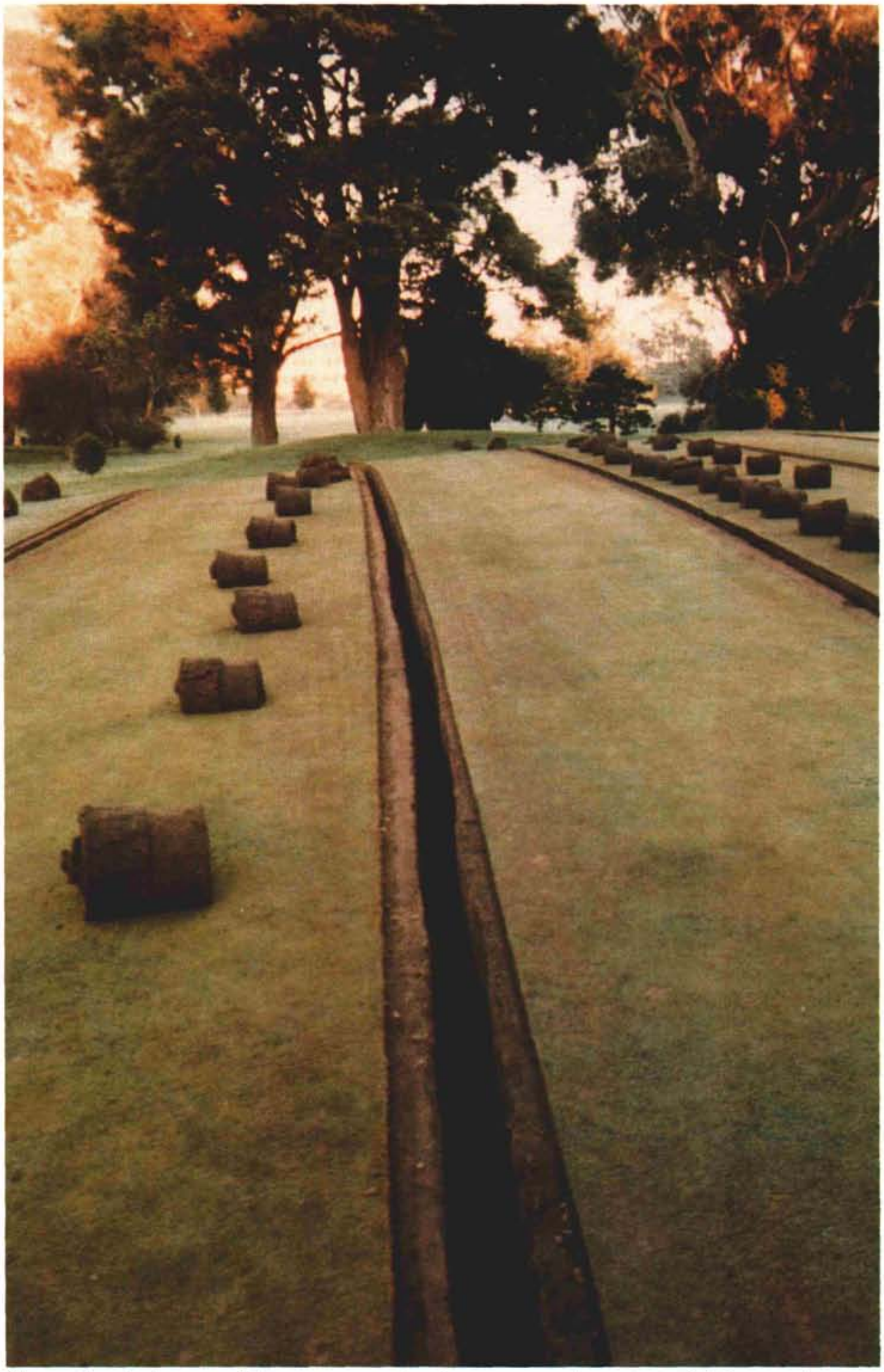


Correcting drainage problems on greens has become more important with increased playing pressures. Installing a trench and backfilling with materials that provide good water conductivity is one corrective technique used to improve drainage.

DO YOU HAVE a drainage problem with your greens? If your course is deemed to be satisfactorily drained, you don't need to read further; but if you have soft, spongy, or waterlogged greens or other wet spots around the course, then this article could be of some assistance. If your course is like most, you probably have at least one green you consider to be poorly drained.

Reconstruct or Recondition?

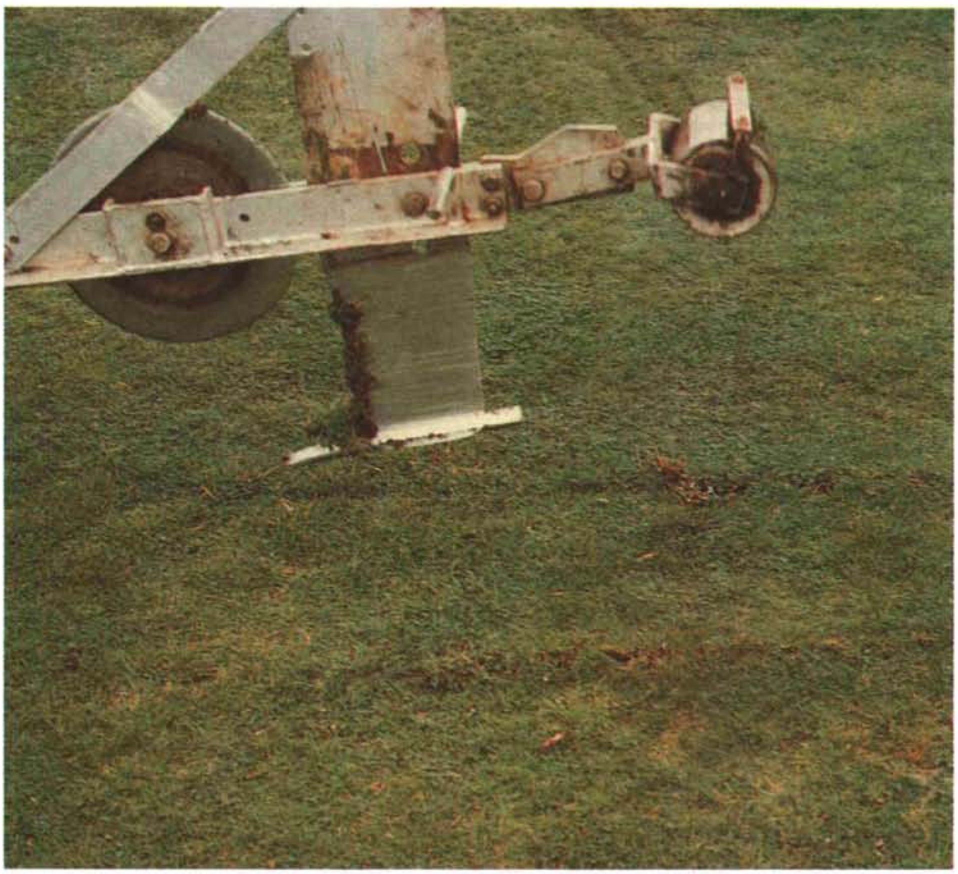
Reconstruction, using correct procedures and materials, is the method of preference when dealing with substandard soil performance on greens. It may not represent the most cost-effective option, however.

To reconstruct or recondition is an issue faced by many of New Zealand's golf course superintendents. Greens at most of our 390 golf clubs were constructed using local soil, generally silt loam material, at relatively low cost. Initially, these soil-based greens performed satisfactorily, but increasing playing pressures and high player expectations have brought about a growing requirement for consistently good year-round performance.

It is a fact that the majority of our clubs could not afford the costs of proper reconstruction, and most have been forced to try to recondition their troublesome greens to overcome drainage limitations. The spectacular response to low-cost physical treatments such as vibra-moling and mini-moling at many clubs is testimony to the fact that the reconditioning approach can work very well indeed.

The decision to reconstruct or recondition must involve a number of factors. Although it may ultimately boil down to economics, the first decision must be whether reconditioning could offer the desired level of improvement.

To answer this question, a scientific analysis of the following variables is needed:



(Top left and left) The oscillating mini-mole plow fractures the soil when a torpedo-shaped device is pulled through the soil. Fissures created by the oscillating mini-moling provide seepage planes for excess water to drain through.

(Above) Poor soil conditions result in soft, spongy, waterlogged greens or other wet spots around the golf course. In New Zealand, greens are often constructed using local soil, generally a silt loam material, which often exhibits black layer.

Figure 1.

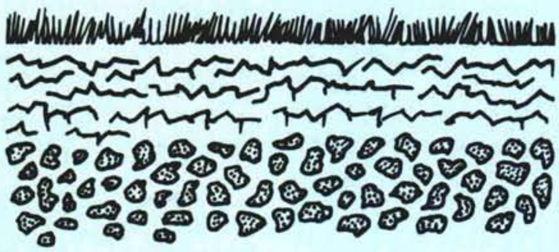


Figure 2.

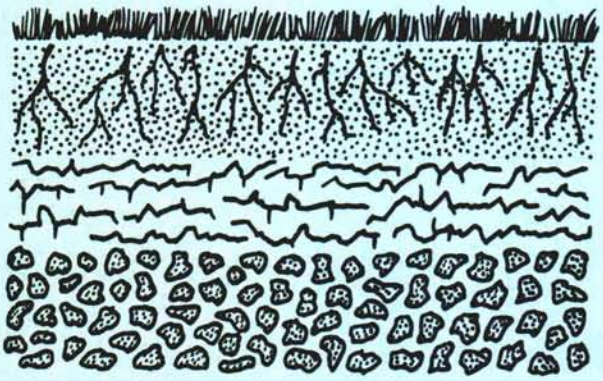
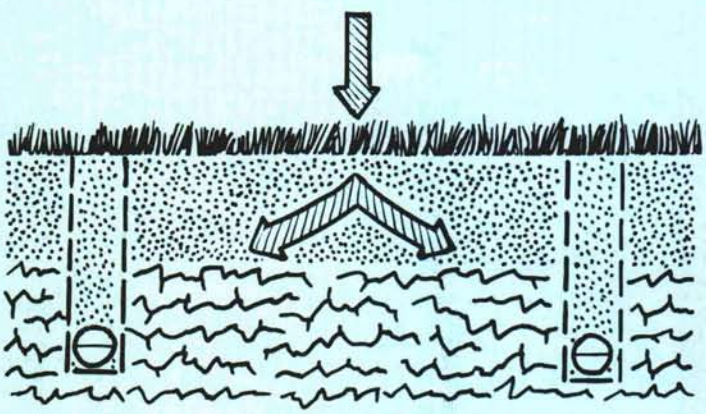


Figure 3.



Selection and use of proper cultivation equipment can help overcome drainage problems caused by compacted layers near the surface (Figure 1) or several inches deep in the profile (Figure 2), particularly when underlaid with a free-draining base. When the compacted zone is too deep to penetrate (Figure 3), another option is to install closely spaced collectors (drains) in the base which link with the permeable top layer.

- The sources of water loading (where is the excessive water coming from?).
- The present and potential flow paths for water movement through (and from) the green.

Identifying Sources of Excess Soil Water

An examination of the surrounding landscape, coupled with an intensive study of the soil profile, will point to the sources of waterlogging. The following matters need to be investigated:

- Is there any runoff or seepage of water from surrounding high zones?
- Is there an underlying spring or aquifer bringing water to the surface?
- Is the improper function or use of the irrigation system compounding the water loading?
- Are features such as trees accentuating the waterlogging by preventing sunlight penetration and blocking good air circulation?
- Is it conceivable that the wrong type (and depth) of sand or soil mix has been used to construct the green?
- Are there layers within the green profile which restrict water flow?

The Pathways for Water Flow

Having diagnosed the likely sources of excess water loading to our trouble spot, attention should be given to determining how surplus water is going to be removed from the soil (other than by evapotranspiration). This requires a close evaluation of the soil profile and an assessment of the permeability of the different soil horizons in both the vertical and horizontal directions.

Although there are techniques available to quantify soil permeability, we often rely on *subjective* means of assessment. For example, reference may be made to the soil texture, structure, hardness, color, root distribution, or number of visible pores to indicate soil permeability. If roots have difficulty moving through a soil layer, so too will water.

Using any or all of the above indicators, we can gauge which zones, if any, will freely conduct water through and away from the root zone. With this information at our fingertips, we are now in a position to assess drainage improvement options. Recall that drainage improvement involves a two-pronged attack: (1) minimizing excess water loading and (2) improving internal drainage.

Improving Drainage by Minimizing Water Loading

Strategies should be developed for dealing with diagnosed sources of excess soil water. For example:

- Seepage from high spots can be intercepted before it gets to the green. A cutoff drain running perpendicular to the flow (slope) and with the correct depth and backfill specification will overcome this problem.
- A spring or high ground water table will need to be intercepted and lowered. In most cases this requires the installation of a deep pipe drainage system.
- Irrigation practices need to be managed to achieve maximum water use efficiency. This point was dealt with admirably by James Snow in the January/February 1991 issue of the

GREEN SECTION RECORD. Points highlighted in this article included:

Controlling application rate to avoid ponding and runoff.

Ensuring uniform application through correct system design and maintenance.

Cultivating regularly to maintain good infiltration.

Adopting correct irrigation methods (e.g., hand watering) which consider site-specific features.

Drainage Improvement by Aiding Internal Drainage

From the soil permeability assessment, determine if there are any free draining layers in the soil profile. If the answer is yes, then aim to exploit them. Some examples:

Impermeable Surface with Free Draining Subsoil

Where the surface has become compacted or sealed through traffic, algae, or other problem (Figure 1), provide vertical water passageways down to the free-draining base. Options include slicing, coring, drilling, Verti-Draining, Hydro-Jecting, and oscillating mini-mole plowing (e.g., Jacobsen sub-air).

The choice of equipment would depend on the depth to the free-draining zone and would be site specific. In fact, using the wrong tool could worsen the condition.

In the longer term, we could also look to build up a more porous surface medium by topdressing with sand.

Relatively Free Draining Top Layer Over an Impermeable Base

This could occur when a sand layer has been created on a poorly drained base by topdressing with sand or a high-sand-content material (Figure 2).

If the poorly drained layer cannot be penetrated with conventional cultivation tools to reach a free-draining layer below, significant improvement in water clearance is not likely to be achieved. In fact, opening up a soil to aid water penetration can sometimes worsen the drainage problem if an outlet is not provided at the same time.

A better option in this instance could be to install close-spaced collectors (drains) in the base of the green that link up with the permeable top layer (Figure 3). Ideally, a collector pipe drain system for a green would have:

- A narrow trench width to minimize surface disturbance. Trench widths as narrow as 50mm (2″) are used.
- Pipes positioned well below any planned physical treatment. If the Verti-Drain or deep oscillating mini-mole plow will be used, there should be at least 350mm (14″) to the top of the pipe.
- Correctly selected permeable backfill specifications which provide good water conductivity yet do not affect surface play, either by subsidence or added droughtiness. A very coarse sand or fine pea metal is often preferred as backfill. Experience also has highlighted the need to firm the backfill thoroughly before replacing the turf slice.
- Drain lines installed perpendicular to the surface gradient to give maximum interception of flow.

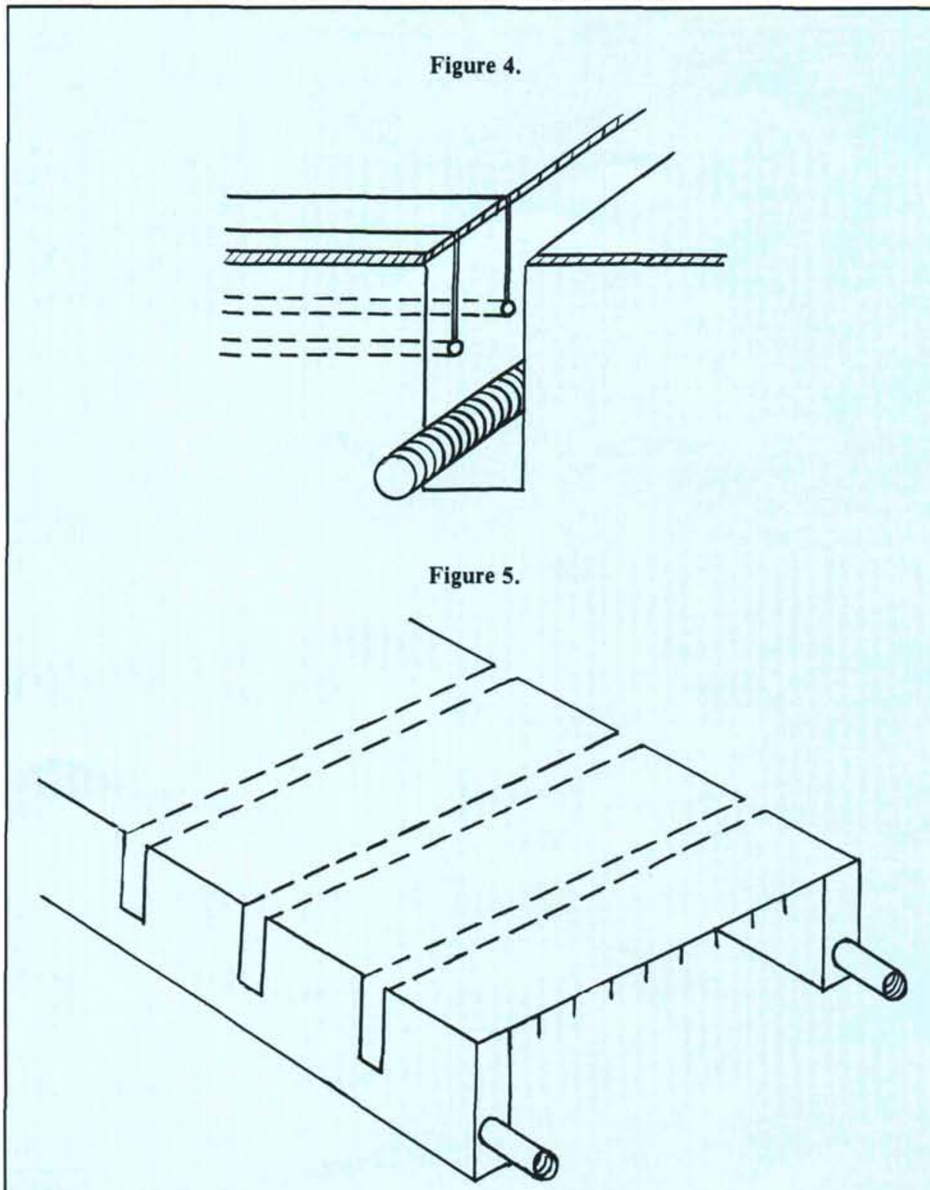
The Entire Profile has an Undesirably Low Permeability

One bypass technique commonly used in New Zealand (although less frequently in the USA) is "moling." This technique involves creating an unlined channel at a determined depth by pulling a torpedo-shaped device through the soil. Fissures created by moling (which will occur if the moling is carried out under relatively dry soil conditions) provide seepage planes for excess water

Figure 4: The temporary fissures and holes created by moling make pathways for surplus water to drain through to the underlying drain. Figure 5: Closely spaced, sand/gravel-backfilled slits divert surface water directly to the underlying drain.

Figure 4.

Figure 5.



to drain through to the underlying channel and then to an underlying pipe drain (Figure 4).

Note that there is a clear distinction between moling, where the goal is to form a stable channel, and oscillating mini-moling, where we aim to condition (fracture) the soil. Moling is not applicable to all soil types, such as stony soils, soils which crack excessively, or where excessive surface disruption occurs. Furthermore, moling is not a permanent remedy, and repeat treatments are needed. It can be an effective, low-cost method of improving drainage in fine-textured soils, though.

A second bypass option involves installing closely spaced, sand/gravel backfilled slits (often termed "sand slits") to direct surface water directly from the shallow cultivation treatment zone through to an underlying pipe drain. Sand slit spacing is typically 1-2m (3-6′).

As with the moling option, a base pipe drain system is installed perpendicular to the sand slits. The slits need to be sufficiently deep to intercept the permeable fill over the pipe drain.

In some instances, it is better to forget about transferring water through the profile and instead aim to encourage surface runoff. This situation often applies to sloping green surrounds, where we may prefer to leave the surface intact and collect runoff at the base of the slope. In this way a portion of rainfall (and irrigation) loading is diverted away from the trouble zone.

Of course, one option that remains is reconstruction. Maybe, when all is said and done, there is no other choice.

Summary

- Drainage problems are "site specific"; a single recipe for solving all drainage problems is meaningless. Good advice from a knowledgeable agronomist or drainage expert can save money and time and can prevent frustration.
- An intensive study of each site needs to be undertaken before the best improvement option can be determined. The study should seek to identify the ways of reducing water loading onto the problem site and the ways of speeding up the water removal rate.
- Lateral thinking can be of considerable benefit in deriving the best approach to the problem.
- A logical thought process for drainage problem-solving is presented in Table 1.

Table 1. The Thought Process for Drainage Improvement