In this instalment of Tech Talk AGCSATech agronomist John Geary looks at sand slit drainage systems and discusses the pros and cons of this cost-effective method of improving turf surface quality.

Surface water build-up between interceptor drains combined with intensive use during rainfall can led to significant damage to turf and underlying soil structure

Sand slit drainage – a cost-effective alternative to reconstruction

While discussion on climate change continues unabated, the facts are that weather patterns across Australia have changed dramatically over the past 10 years. Rainfall can be highly variable and national trends indicate that there has been a significant reduction in winter rainfall in south-west Western Australia since the 1970's, while rainfall on the east coast, particularly in southern and central Victoria, has experienced a sharp decline over the last decade.

Scientists also predict that climate change will lead to more frequent extreme weather events such as tropical cyclones, severe storms and bushfires, with rainfall modeling for northern NSW and Queensland indicating the likelihood of rainfall intensity increasing in the coming years. Tragically the events of February 2009 reinforce this with a number of catastrophic bushfires experienced in Victoria and severe flooding in Queensland.

From a soil perspective high rainfall (or for that matter over irrigating) expose a soil's ability or inability to shed excess water. This is especially true when heavier soils with low infiltration rates are used to construct a playing surface, be it a sports field, a golf course fairway, a tee or similar. The aim is to provide good growing conditions for the turf to thrive but this can be a challenge given these soils are prone to compact, especially when the fields are used during rainfall or when the soil is saturated. Significant damage to the turf and underlying soil structure can result, which can be directly attributed to the failure to remove excess surface water.

While turf managers may prefer to reconstruct surfaces using free-draining sands, the reality is this type of construction can be costly. An alternative is to install subsurface drains otherwise known as interceptor drains to capture any surface runoff.

INTERCEPTOR DRAINS

By way of definition, interceptor drains (Figure 1.) are subsurface drains with a permeable sand trench backfill designed to intercept water runoff as it moves across the surface. (P. Ford and G. Thomas 2003). Thus, for interceptor drains to be effective good surface falls are imperative – the greater the surface slope, the greater the removal of surface water will be. If the surface is relatively flat, the network of interceptor drains will be less effective.

A common mistake made by many is to assume that once water enters the soil profile it will drain laterally into the interceptor drains. While some water will move sideways though the topsoil, this water moves extremely slowly as the only force moving it is gravity. In many cases its contribution to drainage can be ignored, particularly when there are no drain pipes or where drains are spaced too far apart (McIntyre and Jakobsen et al., 1992).

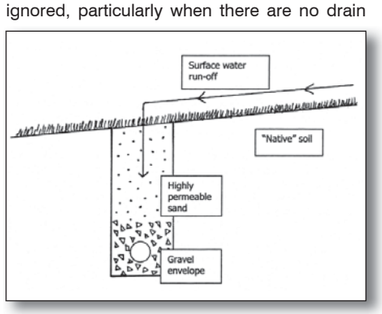


Figure 1. Interceptor drains are subsurface drains with a permeable sand trench backfill designed to intercept water runoff. Source: Ford and Thomas 2003

The aim of interceptor drains is to remove as much excess water before it has a chance to infiltrate into the native soils between the drains. If there is insufficient surface slope or the drains are spaced too far apart water will have to pass down through the profile which can often take weeks to dry out. So it is important to reinforce the message that for interceptor drains to be effective they rely on surface slope to move water across the native soil surface into the interceptor drains.

SAND SLIT DRAINAGE

So, how do you remove excess water off a surface with little or no surface fall? One method which has grown in popularity over the past 30 years is to install an intensive network of sand filled trenches.

Sand slitting, which is also known as sand grooving, sand banding or sand injection, is a term used to describe a "series of closely spaced, vertical channels of highly permeable material connecting with the surface and passing through the topsoil. The slits usually connect with gravel backfill overlying a system of lateral interceptor pipe drains situated deeper in the profile." (W.A. Adams and R.J. Gibbs, 2006).

The final component of a sand slitting programme is to heavily topdress the area with sand to a depth of 25mm which is aimed at protecting the integrity of the slit drains. This is sometimes referred to as sand carpeting and once this process has been undertaken an ongoing sand topdressing programme needs to be implemented to avoid any layering of the soil profile.

It is worth noting that sand slit drainage still relies on surface slope to move water sideways on the surface, but due to the sheer number of trenches combined with their close spacing, the bulk of the surface water should find its way into the network of drains.

Sand slit drainage comes in many variations but generally consists of:

- Major drainage lines (inceptor drains at 5-8m spacings);
- Secondary excavated sand trenches which have a large capacity to transmit water (e.g.: 50mm wide, 300mm deep trenches at 1-2m spacings backfilled with sand, gravel and small diameter drainage pipe at right angles to the interceptor drains);
- Sand grooves, which are often installed on a more intensive basis than excavated secondary trenches due to their lower cost per unit length (e.g.: 25mm wide, 100mm deep and at 0.2m spacings at right angles to the secondary sand trenches).

DESIGN CRITERIA AND INSTALLATION

Gibbs (2003) states that sand slit drainage systems can be thoroughly tested on paper using a modified form of Hooghoudt's steady rate drainage equation. This calculates the design drainage rate from variables such as the hydraulic conductivity and depth of the permeable backfill used, the lateral pipe drain spacing, and slit drain width and spacing, all of which are juggled to achieve the desired outcome.

McIntyre (1993) recommends installing sand slit drains at 2m spacings while Adams (1986) recommends that 50mm wide sand/gravel slit drains at 2m centres with lateral pipe drains at 15m centres seemed to be the minimum intensity worthy of installation.

PHOTO COURTESY OF TURF DRAIN

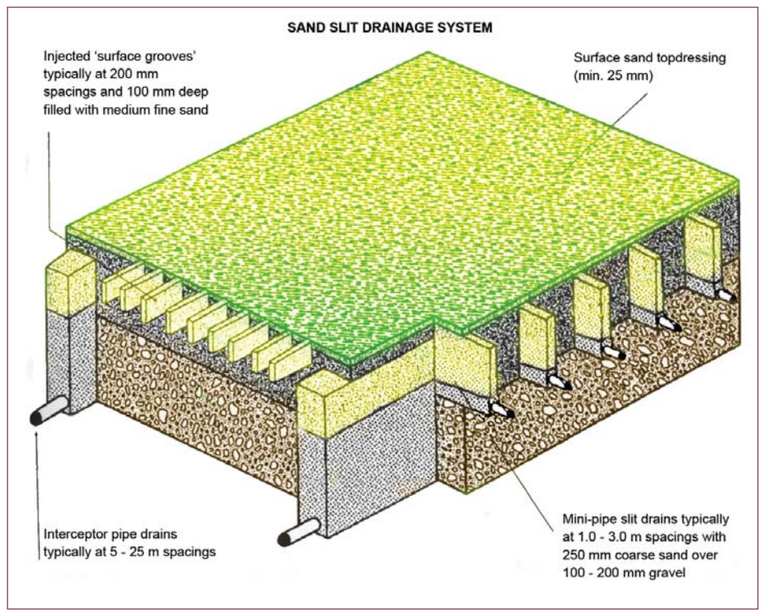
Sand slitting has become a popular method to remove excess water off surfaces with little or no fall

Given the number of variables which need to be taken into account at each site such as depth of drains, backfill material to be used, drain spacings as well as the existing soil and weather conditions, it is important not to forget how practical the system will be to install.

Like any renovation or construction project, quality control of the works is imperative. The selection of appropriate sands and gravel is critical. All sands and gravel intended for use should be tested for particle size analysis and hydraulic conductivity while the tests should be undertaken by an accredited laboratory.

Since the 1980s the majority of slit drainage works have been carried out by contractors with highly specialised equipment which removes the spoil and inserts the sand/gravel all in one pass.

This has revolutionised drainage installation allowing large areas to be drained in a short time frame as well as improving the overall quality of installation. But it is still important to closely project manage works to ensure standards are high.



THE PROS AND CONS

Before deciding on the installation of an interceptor and or a sand slit drainage system a number of limiting factors need to be taken into consideration. Possibly the most important factor to consider is that the efficiency of the drainage system will deteriorate over time. This is inevitable as the surface of the trenches seal over.

The timeframe can vary depending on what sport is played and depending on the quality of the installation but remedial works will need to be carried out every couple of years. Works aimed at improving the infiltration rate over the trench lines such as hollow tining or verti-draining need to be regularly scheduled. In relation to the interceptor drains, works may include removing the existing sod over the trench lines, removal of soil back to clean sand, topping up the sand and re-establishment with seed or washed sod.

Second, different management techniques need to be adopted for the two different soil types. This is especially so during grass establishment as the sands have little nutrient and water holding capacity requiring greater inputs. Seed or washed sod should only be used to establish a grass cover. If there is any soil on the sod the infiltration rates of the top of the trenches will be reduced dramatically.

Finally, it is critical to identify how much play is anticipated during periods of rainfall as high intensity use during these conditions can lead to slippery, muddy conditions which in turn can lead to the drainage lines being sealed off. This is particularly relevant for ovals which host activities such as football and soccer.

On the up side, Gibbs (2003) states that "the relative cost of installing a conventional slit drainage system into a existing poorly drained, soil-based field will vary, but is likely to be around 25 per cent of the cost of a complete profile reconstruction. Sand slit systems are an attractive option to total re-construction as they can be tailored to meet both budgetary constraints and site conditions.

REFERENCES

A full list of references can be obtained from the AGCSA ph (03) 9548 8600.

Figure 2. A typical sand slit drainage system. Figure adapted from Natural Turf for Sport & Amenity: Science & Practice.