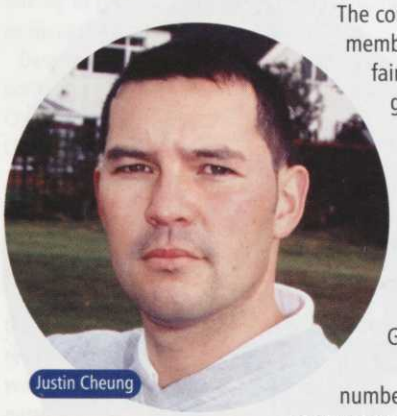
# DRAINAGE

## APPLIANCE OF SCIENCE PINPOINTS UPTON BY CHESTER GC DRAINAGE NEEDS

**Mike Saull looks at a new drainage scheme which was inspired by the January issue of this magazine**

**Upton by Chester Golf Club in Cheshire is a tight 5850-yard, Par 69 course, on just 68 acres of heavy soil.**

**So, while the summer sees it lush, with the verdant greens and tees nestling under the mature parkland trees, in a wet winter, things can be quite different.**


Justin Cheung

The combined weight of 700 plus members, trafficking certain narrow fairway areas, often renders the going tough and course closure is an occasional nightmare.

Not surprisingly, the club has a rolling programme of drainage activity, and last January they were just about to commence some new work when they opened their copy of Greenkeeper International.

"We were all set to drain a number of areas bounding some soggy tees and greens," recalls Club Manager/Secretary, Fred Hopley.

"Then Justin Cheung pictured above, our Head Greenkeeper, threw a copy of an article in your magazine on my desk."

As a result, eight months later the Club now has a much more accurate handle on its soil problems and has installed tailored schemes based on sound scientific investigation to meet a specific drainage need.

The new service, provided by TurfTrax Ground Management Systems, started with a complete site survey coupled with electromagnetic induction scanning of the top 200mm and then the complete soil profile to 1.2m depth.

This process, using a sophisticated scanner towed by a quad bike sends pulses down into the soil and measures differences in conductivity. The exact position of the scan result is pinpointed on a map using global positioning satellite technology, accurate to within a couple of cm.

In the hands of soil and water engineers, this data helped to highlight perched or deep water tables and target priority areas for attention. Subsequent soil sampling provided information on soil texture, moisture content and density as well as P, K, Mg and pH status.

Next step, recalled the company's Technical Director, Dr Richard Earl, was three days in the pouring rain in soil pits to confirm where existing drains were using tracer dyes to assess their condition.

"What we identified were three areas for immediate priority where surface water infiltration was the main problem on soils that had a large proportion of silt with a propensity to migrate down through the soil and block the macro pores needed for good natural drainage.

At one stage, Richard looked at the possibility of a drainage scheme that would drill holes down through the silt topsoil and into underlying sand, but this became a non-starter when the sand was discovered to be shifting quick sand containing a number of springs.

In the end the schemes adopted and installed at the Club used a revolutionary slit design, which turns current thinking on its head.

Instead of using relatively coarse material to within 100 mm of the surface topped off with a fine rootzone material above that, the slits were predominantly filled with fine material which was designed to create 'draw' to improve drainage efficiency. This ensureed water was able to flow into underlying 50mm gravel without being held by capillary action or needing a head of water to create the flow.

Top-dressing with a 6mm layer of the same material as that within the slits was critical in order to connect the water into the slit and remove it from the profile. Richard recommends that the greenkeeping team will need to build this layer up to 24mm over two years in order to maintain a good infiltration rate with rain being sucked sideways.

In order to ensure the materials would not silt up and continue to provide a good flow of drainage water, each of the three contractors who submitted tenders for the job also provided samples for testing in the laboratory.

"In the end, two were prepared to work with TurfTrax, the other gave us the impression that they thought the company were white-coated boffins who didn't know what they were talking about," said Fred.

"Appley Bridge, Wigan based, Duncan Ross Land Drainage won the contract based on price and their refreshingly open attitude to the project."

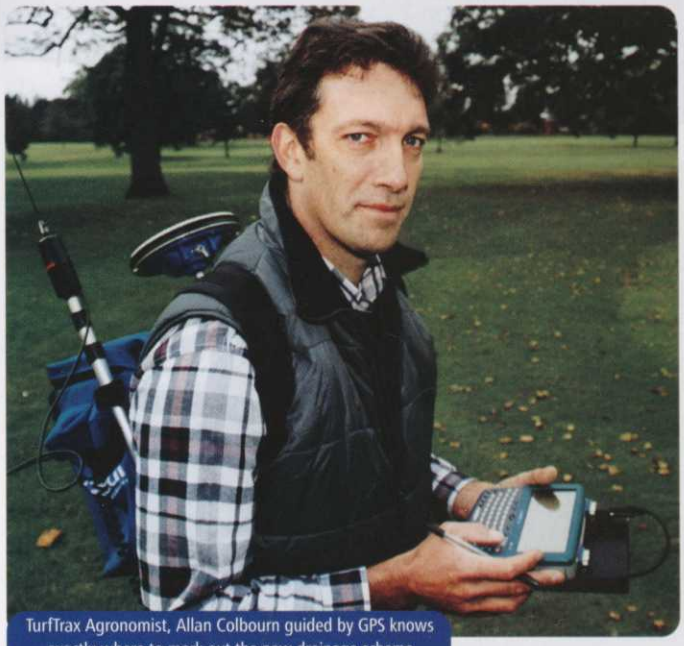
So what does the Club think of the TurfTrax approach?

"While we have paid more for the job, we now have an accurate picture of our soils across the whole course and a greater confidence that the drainage we put in will work," said Fred.

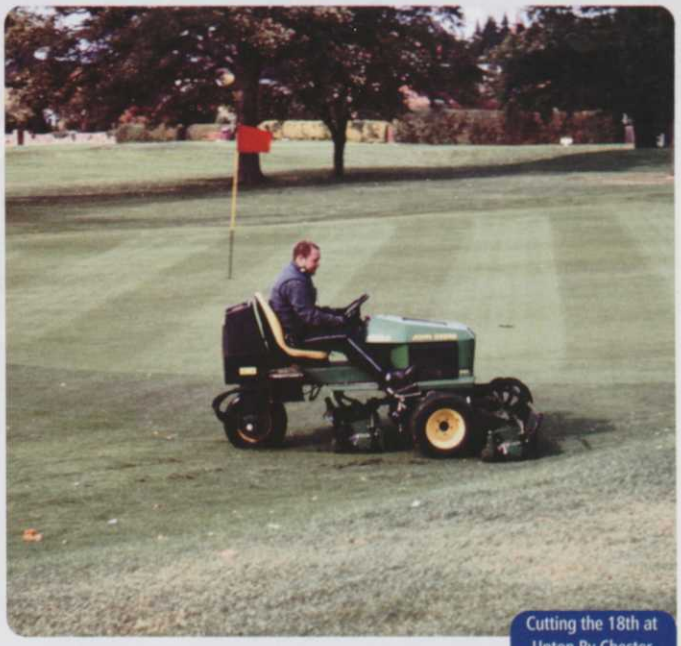
"For example, we now know where old drains are and which ones are working, and have detailed records of cables and utilities pipes that cross the course. And, because the scanning techniques are accurately plotted using global positioning systems, we can locate them much more easily.

"When Justin and I came to the club we found that records of previous drainage schemes were either non-existent or had been lost," he said.

"The information will also be important in the next phase of development at the club to bring all greens up to USGA standards. With so much information we'll be able to ensure what we do is compatible with the surrounding soils.



TurfTrax Agronomist, Allan Colbourn guided by GPS knows exactly where to mark out the new drainage scheme



Cutting the 18th at Upton By Chester

"As far as the immediate drainage problem is concerned, it became obvious that the problem was not due to water tables rising in the winter, but an inability of our soils to get rid of surface water.

"What we are now installing are six different schemes for six different areas on soils which were not clay as we had previously thought. We are also taking direct control of how our surface water passes through the soil and into tailored drainage material," says Fred.

Justin has also found that the accurate maps provided on CD have helped ensure better accuracy of chemical and fertiliser application.

His approach at Upton by Chester is to adopt traditional principles using fertilisers on a little and often basis to encourage bents and fescues and uses plenty of aeration to improve structure.

He adopts an 8-0-0 programme using iron where necessary and a mix of humic acids, seaweed extract and seaweed meal to build natural fertility and minimise thatch. Fungicides and herbicides are used sparingly.

With the seasons getting earlier, he recognised that his greens – being on cold soils – are slower to wake up. While they do last longer towards the winter, this does cause problems in the spring.

Duncan Ross Land Drainage laying a new main drain at Upton By Chester

As a result he regularly aerates the greens using a 70:30 medium coarse Whitemoss Amenity Mix, which is compatible with the sand now being used in new bunkers.

He admits that while the members are pretty good, the greenkeeper is the normal scapegoat when it comes to bad drainage. In the four years he has been at the club, he has drained the 2nd and 5th fairways using a standard system of 100mm diameter pipes at 5m spacings covered with 10mm gravel. These appear to have worked pretty well, but for how long?

"The approach we adopted is much more scientific with specific materials designed to do a specific job," he said.

"In much the same way we are putting in USGA specification greens, then why shouldn't we be as accurate with our selection of drainage systems."

Duncan Ross is also keen to monitor the scheme.

"Although the piped drainage system remains a similar design to our normal specification, the slitting that was advocated is quite different and we'll be keen to see how it performs," says Duncan.

## DESIGNER DRAINAGE

Dr Richard Earl reckons that many golf course drainage schemes are ill conceived and badly designed.

In his view, not enough preliminary spadework is carried out before pen is put to paper. Then, too many schemes are based on principles that work on agricultural land but fail on the golf course.

In addition, too little attention is still being paid to the physics of water movement through soil with the result that some scheme designers are using the wrong materials in the wrong place with no hope of success.

Basing his comments on 15 years of drainage and soil mechanics research at Cranfield University – Silsoe, he reckons that the industry needs to rethink how it approaches land drainage design.

So, what steps should be taken to ensure greenkeepers get the scheme they need to keep waterlogging at bay and courses open? Richard's advice is to:-

**1. Establish the cause**

Proper examination and confirmation of the cause of any problem is fundamental. Scheme design will be very different if you are dealing with a groundwater or a surface water problem.

Common practice is to adopt an off the shelf scheme based on agricultural practices. While this works well where you have deep-rooted crops and well structured soils with plenty of large pore spaces, golf courses are different.

**2. Ensure good porosity for grass growth**

Schemes have to be designed to satisfy the compromise between achieving adequate water storage while maintaining sufficient aeration (ie at least 10% air filled pores).

Without this level of aeration, you'll have pretty sick looking grass.

**3. Use coarser materials in the root zone**

Many slit drainage schemes use coarse gravel at depth topped by a fine root zone medium. However, fine pores retain water through surface tension and will only release this water into gravel when there is enough pressure from a surface head of water above it to force it down.

Slit drains installed in such a traditional manner require water on the surface before they will drain. This is exactly what the greenkeeper and the golfer don't want. Designs of this nature are fundamentally flawed.

**4. Use deeper slits and the right fill materials**

Use slits that are a lot deeper than those commonly employed and which are filled with materials that have hydraulic properties which are capable of creating "draw" to physically suck water towards the slit from up to one metre away.

To achieve this, the optimal dimensions of slits used in TurfTrax schemes are determined by the hydraulic properties of the materials intended for use within them. This can only be derived by conducting a suite of laboratory analyses.

Fred Hopley and Justin Cheung on the recently constructed USGA Spec 2nd Green

The deeper the sand slit, the wider the potential spacing of the laterals – but you need to take care that the domed water-table you create doesn't break the surface at the mid-point between laterals. Intensity of rainfall and catchment area on the course are critical in this respect.

It is a case of using materials that balance the need for quick drainage after intense rainfall with the need for water retention during the summer and which are not going to silt up.

The ultimate aim is to ensure there is sufficient available soil moisture, and at least 10% aeration, at 5cm depth throughout most of the year. While this may not always be possible, it is far easier to add water through irrigation than it is to get rid of it due to a poorly designed drainage scheme.

In trials on a number of UK golf courses, using the right material in slits has provided 500% increases in drainflow after controlled irrigation, compared to adjoining schemes using traditional slit designs.

**5. Aim to space slits 1m apart**

One metre spacing of sand slits works pretty well as long as the material specifications selected are correct and topdressings are hydraulically compatible with material in the slits.

**6. Orientate slits at 90 degrees across the slope**

If you are trying to remove water on a slope, then place the slit drains to intercept as much water as possible by running them across the slope.

Herringbone shaped schemes are often ineffective. Some soils only allow water to move 1mm a day, so use the slope to maximum effect to ensure you capture as much water in the sand slits as quickly as possible before it has a chance to infiltrate the soil.

**7. Don't drain uphill**

It may seem obvious, but we commonly find schemes that have mains and laterals that try to push water uphill. Check the levels.

**8. Minimise the risks of capping by using coarse top dressings**

Fines in materials used at the top of sand slits, as well as badly selected top-dressings can cap slits over creating a barrier to water flow.

Use coarser materials as top dressings and at the top layer of slits to ensure water flows quickly and effectively.

You have to be careful as grass growth could be affected by using too coarse and too uniform a grain size that won't retain sufficient moisture. However, it is easier to irrigate than it is to remove water and roots soon get down into slits and spread out into the surrounding original soil.

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