Cemetery Development Services

"Grey Water"... The law is Black and White

The environment is high on the agenda at all levels of government, industry and public opinion. Whether the issue is global warming, recycling or the protection of groundwater stocks, environmental legislation is impossible to avoid or ignore.

When it comes to protecting our groundwater, the Environment Agency is becoming far more vigilant. Authorities developing new cemeteries or extensions will encounter stringent rules and guidelines that have to be complied with before planning can proceed.

But many burial authorities, particularly if they have not undertaken any cemetery development work recently, are unaware of some of the groundwater and surface water protection directives they should be compliant with.

Whilst many millions of pounds are spent on memorial inspections and repairs as part of an overall health and safety policy, there is little consideration given to fulfilling the authorities' legal obligation to protect groundwater. However, groundwater protection is statutory under the Water Resources Act. Failure to comply can lead to prosecution if ground or surface water are subsequently polluted. The EA have laid down strict guidelines for the development of new cemeteries, which include but are not limited to the following:-

- Graves should not hold any standing water when dug
- There should be at least 1 metre between base of grave and water table; more if the soil has high infiltration rates
- Graves should be at least 250m away from wells and potable water supplies
- Pumping out of graves and discharging "grey" water directly or indirectly into surface or groundwater sources if found to be polluted is an offence under the Groundwater Regulations 1998
- No burials within 10 meters of land drains

During the winter months, many authorities pump water out of newly opened graves, often to within a few minutes of the cortege arriving, hoping that the burial ceremony takes less time to complete than the speed of the water to re-enter the grave!

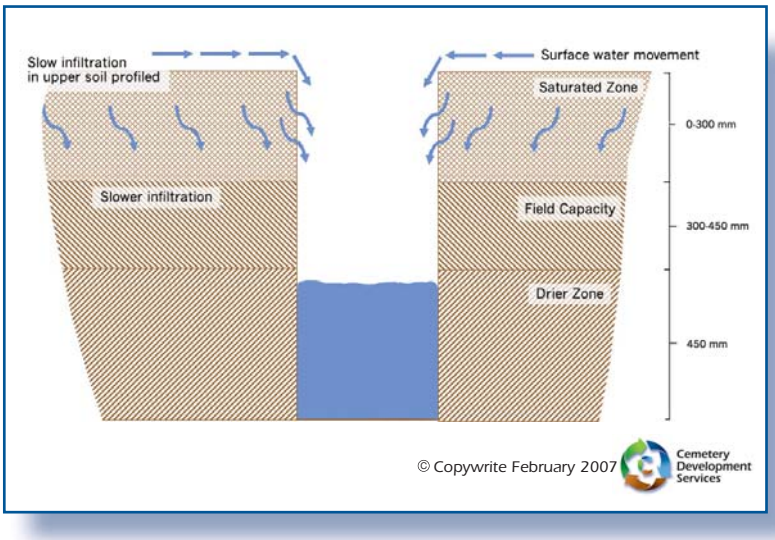
There are a number of reasons why water enters graves. If is not preventable it is a manageable problem - but it must be managed within the guidelines of the law.

It is important therefore, to determine where the water is coming from. There are usually three main sources:

- Surface water (surface run-off/perching)
- Ground water (rising water tables and suspended water tables).
- Inter grave seepage

Surface Water

In the winter, surface water from precpitation is likely to be the most common source of water seepage into graves particularly in clay or clayey soils. The upper profile soon becomes saturated and the soil exceeds field capacity, this means all the soil's pore spaces fill with water. The greater the water input, the deeper this waterlogged layer becomes. Clay soils may only allow infiltration rates of 2 or 3 mm per hour, however, if the soil is consolidated, then this could be less than 1 mm per day!



It is therefore not difficult to imagine what happens in high rainfall events (10-15 mm per hour). Water will run off or migrate to depressions, or into newly dug graves.

The diagram opposite illustrates a typical clay soil profile. The upper horizon (topsoil) soon becomes saturated as water movement downwards is impeded by the denser clay below. Eventually precipitation exceeds the speed of infiltration and water then moves over the surface.

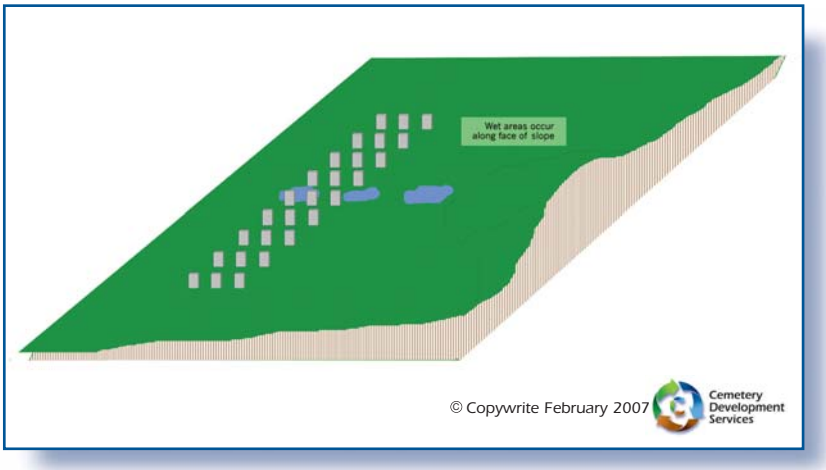
Excavating a grave will free water from the saturated zone as well as to allow infiltration from the surface. This water in most cases will be unpolluted, provided it is a new grave up-slope from existing graves. Pumping is an option and likely to pose little pollution risk if discharged to land and allowed to soak away, alternatively water can be discharged into the foul-water drainage system although permission from your water company will be required.

Ground Water

If when digging a grave, water appears to enter the pit at lower horizon levels it is almost certainly ground water. This may be the consequence of a spring, rising aquifers or a perched water table such as occurs when a sand or gravel overlies clay.

Often a site with a clay soil may contain pockets made up of sand and gravel known as "lenses". If a grave is dug into a lens, it will cause the water to drain from the lens into the grave. The size of the lens will determine the speed and quantity of water ingression into the grave. (See images left)

If other graves in the cemetery are at or above the level of these lenses, water entering graves below these lenses is likely to be contaminated. When considering pumping out, this water should be managed as part of a health and safety management approach (see later discussion).



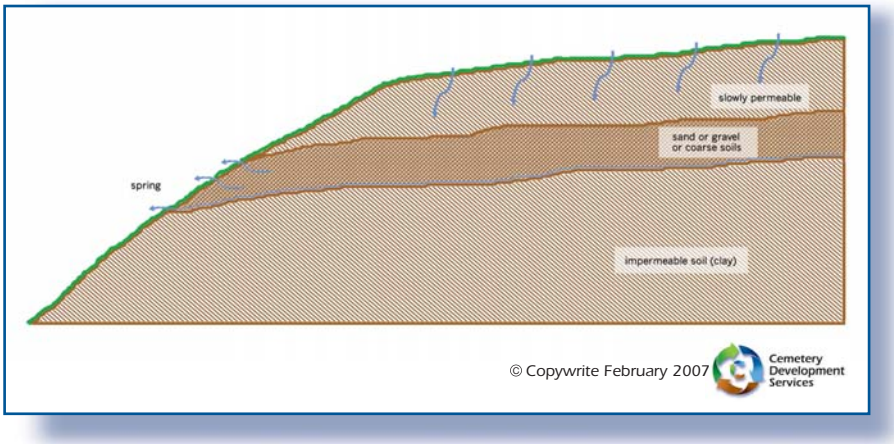
Spring Lines

Strata springs are common in areas where different soil types merge and usually appear on sloping ground.

Water migrates through a relatively permeable upper profile into a layer of coarser material usually overlying bedrock or clay that is very slowly permeable or impermeable. The pressure and volume of water likely to emerge at the spring point is dependent on the slope of the storage material and its textural make up.

A strata spring line is usually recognised by very saturated areas along the face of a slope and not just water accumulating at the slope base. (See diagram below)

Spring lines can be managed by deep cut off drains and by diverting water to alternative outfalls. Permission to do this must be obtained from the EA.



Minor Aquifer

In many cases water held in porous sandy soils is classed as a minor aquifer that may in turn be a direct feed for an underlying major aquifer. These areas are usually found in sandy soils overlying sandstone or silty soils overlying chalk.

If, when digging a grave, water enters from the sides and bottom and reaches a final rest level then it is almost certain your grave has been dug in a true water table, and possibly in an aquifer supply. In this case you are potentially polluting groundwater stocks. The only solution in this case is to lower the water table by deep drainage i.e. at least 3 metres to prevent coffins from sitting in the mobile water stocks. Pumping water may provide a cosmetic solution but you are likely to be in breach of EA guidelines and, if pollutant products such as formalin, ammonia and pathogenic organisms are at sufficiently high levels, you may be liable to prosecution under the Protection of Groundwater Act 1998.

Inter Grave Seepage

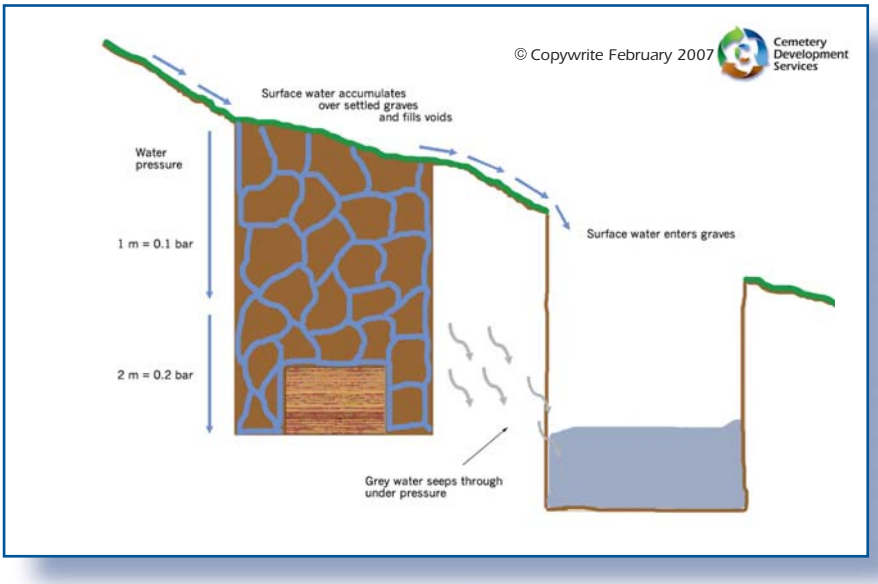
As discussed earlier, surface rain water falling over heavy or clay soils will migrate to depressions which in cemeteries are often associated with settlement of graves. The infill material of a grave is usually less consolidated than the surrounding undisturbed soil. If the surrounding matrix is less permeable, water will accumulate in the pore spaces and voids within the grave. This "free water is mobile and is under a "head" of pressure which increases with depth.

If a new grave is dug downslope and adjacent to any existing graves it is liable to seepage of "grey" water from these grave plots. (See diagram below)

This type of water is likely to be polluted. Recent evidence shows that the water may contain clostridium and streptococcal bacteria. Concern has now also been raised about the possible presence of the CJD vector.

Pumping "grey" water without adequate protection of water courses, staff and public is potentially extremely dangerous and irresponsible

Environment Agency representative advice as of January 2007 is as follows:



"Grey water" should be managed in the first instance by the prevention of surface water entering grave plots, old and new. This can be done by installing cut-off or surface management drainage systems. If water is subsequently pumped from the grave, the water must be stored and subsequently disposed of by a professional environmental waste management company.

Alternatively, the water can be treated on site by either mobile or permanent treatment systems prior to discharge or recycling. These systems will require EA approval."

By using slope and topography in the design of new cemeteries, water accumulation in grave plots can be reduced through grave layout and orientation, for example, starting burials from the bottom of a slope will reduce grey water seepage. Cemetery Development Services specialist drainage and soil water engineers can help to optimise drainage design and methodology.

Grey water and drainage problems can be avoided. Simple management techniques can save tens of thousands of pounds in engineering costs, and a well designed drainage scheme can be both functional and affordable.

Attenuation Products

In some cases where there is a risk of leaching especially in coarse or fractured soils such as sandy, stoney or chalk soil formations or where water tables are near to grave depth, the use of attenuation material can help reduce rapid leaching. Polluting compounds associated with decay process such as ammonium, formalin and other organic pollutants can be absorbed by attenuation compounds which provide a buffer protecting the groundwater below. Attenuation materials include smectite and zeolitic substrates or material of high carbon content such as certain organic composts.

These attenuation materials have very high Cation Exchange Capacity (up to 150 meq/100gms), for example just 1 gram smectic clay may have a reactive surface area of 80 square meters compared to a few square centimetres in a gram of sand. An equivalent 25 mm depth of smectite clay could equate to a depth 2000 mm of sand in terms of their comparative attenuation properties!

These materials can certainly help in situations where high leaching soils pose a potential threat. Smectite compounds have been advised by the EA for use as an attenuation medium in Southwick Cemetery in West Sussex where thin soils overly a chalk aquifer.

CDS have developed **"10u8 Z Plus"** for the attenuation and reduction of polluting decay compounds. CDS are further researching other materials that have these properties.

For more information on drainage and pollution management contact the countries leading specialist in cemetery enviromental management and design... Cemetery Development Services at:

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