Tech Note: Salt Barrier

The Problem of Salt

In areas close to the sea where water tables fluctuate due to tides and other ground conditions, a build-up of soluble salts in the soil can result, such as in Sabkha coastal areas of the Middle East where the groundwater will be saline. Capillary action within finer grades of soil causes saline moisture to rise to the surface through very small pores within the soils called capillaries.

Topsoil, salt is a major factor limiting plant growth, especially during germination and seedling stages. Areas within the soil of a high concentration of soluble salts draw moisture away from the roots of the plants, causing the plant cells to dry and roots to "burn" to the point of no recovery. Plants might absorb some of the excess salts, which results in salt stress (brown edges on older leaves). Salt also has corrosive action on almost all surface finishes, damaging paved as well as landscaped areas.

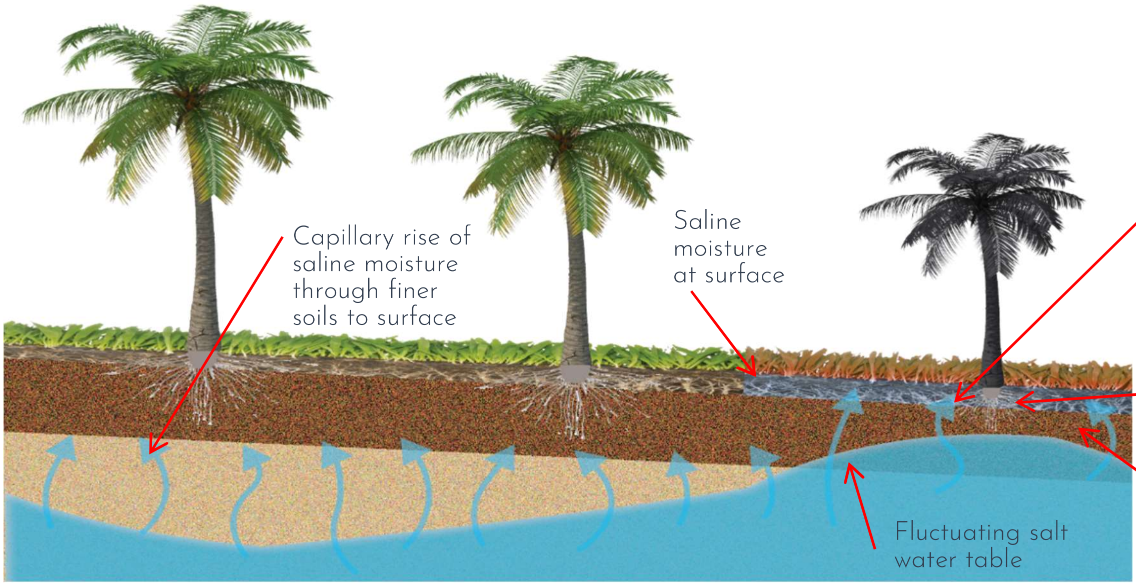

Figure 1: Capillary rise of salt water limiting plant growth

One way of dealing with excessive soluble salts is to "flush" and dissolve any salts in the subsoil. This is a standard method known as "leaching" of the soils and can be achieved by rain water and irrigation water.

Another way is to place a geomembrane liner below the root zone to form a barrier between the salty water and the "sweet" soil. However, such barriers can also prevent the natural escape of rain water and can lead to water logged soil or "ponding" which is also detrimental to healthy plant growth.

The most effective method is to install a capillary break layer. ABG Salt Barrier is a geocomposite capillary break which both prevents capillary rise but also allows rainwater to migrate to lower levels to prevent ponding.

Figure 1: Plant growth limited by salt

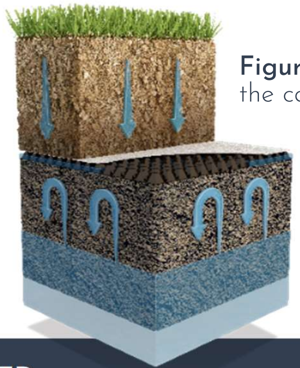

Figure 3. ABG Salt Barrier "cutting" the capillary route

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ABG Salt Barrier

The ABG Salt Barrier is a hybrid geocomposite capillary break system specifically designed to combine all the essential elements for an ideal salt barrier:

- A separation layer between the topsoil and the saline subsoil
- A physical air void core to cut off the capillary rise of saline moisture
- A high capacity open flow drainage core over the whole of the surface to rapidly remove excess sub-surface water, preventing ponding and flooding during high rainfall events
- A drainage system that allows for the flushing of lower capillary saline moisture back down to the water table
- Easy installation by simple overlapping – no specialist installation required
- An integral geomembrane barrier with one way outlets.

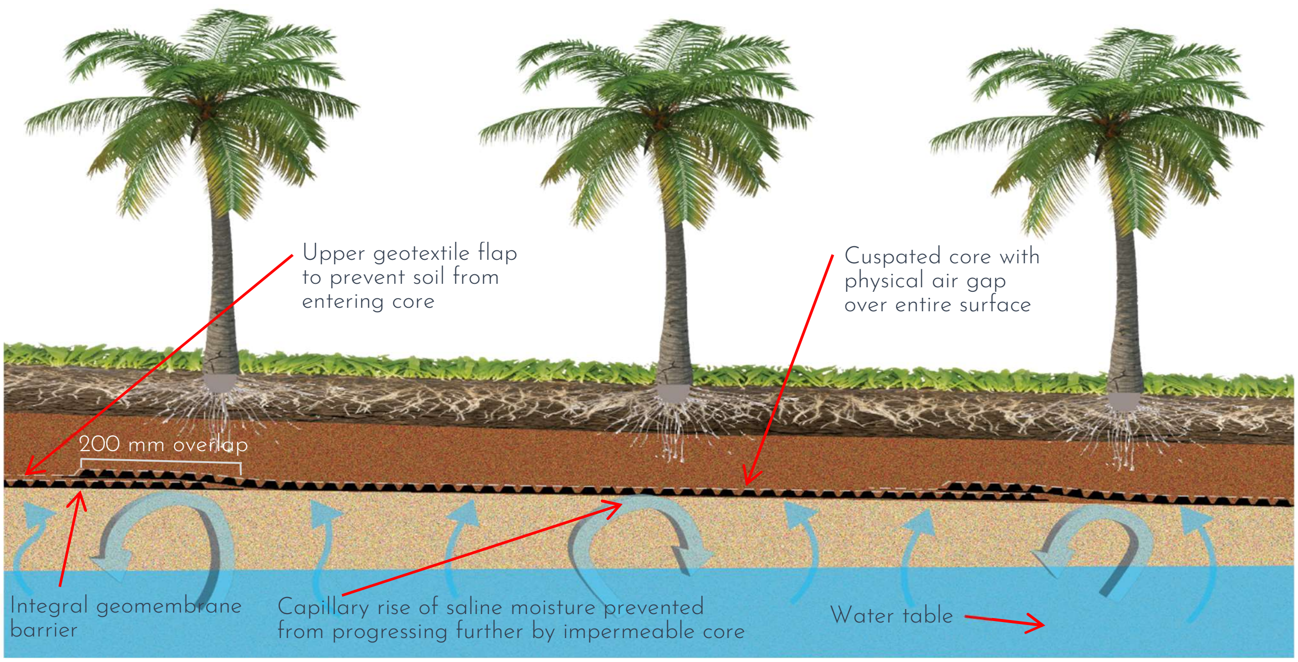

Figure 4: ABG Salt Barrier during dry conditions

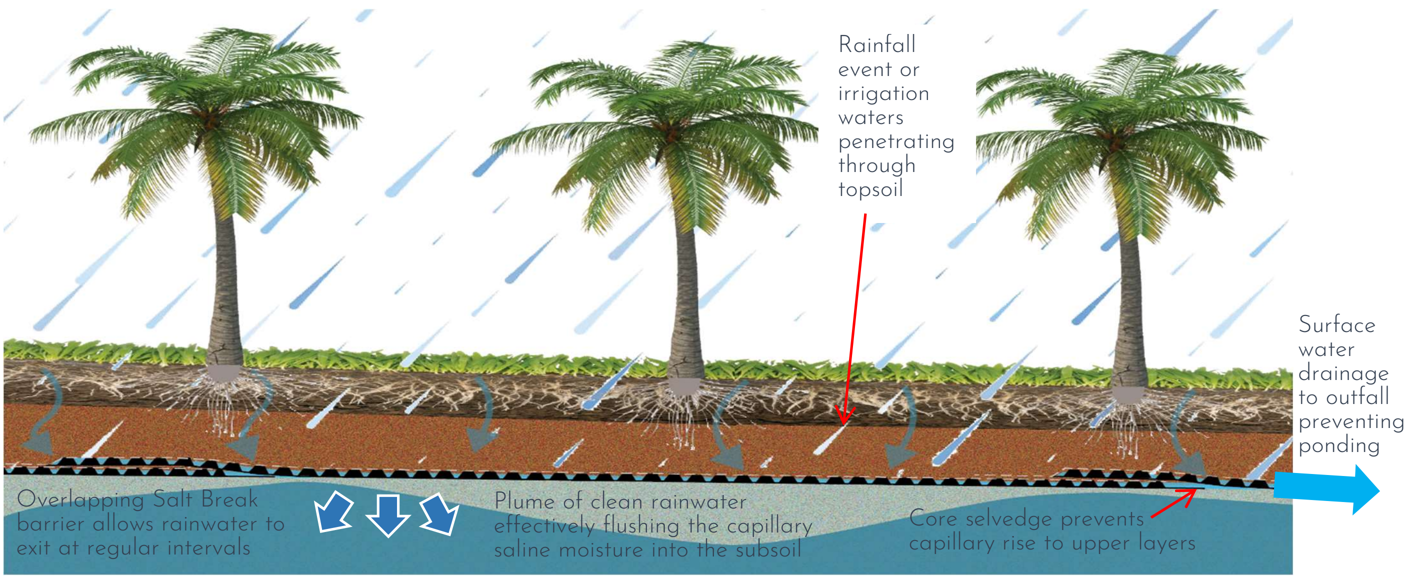

Figure 5: ABG Salt Barrier during rainfall or irrigation

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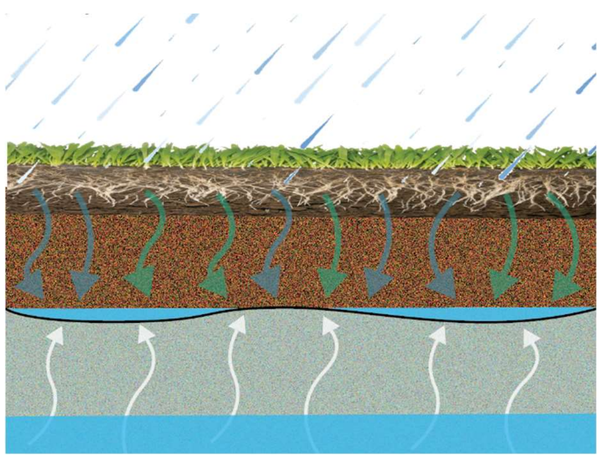
Salt Barrier Functions

Saline moisture rising through soil by capillary action will kill vegetation and damage hard landscaping by staining. A barrier placed below the growing soil (or "sweet" soil) but above the highest level of the water table will stop the capillary rise of saline moisture. The barrier can be a physical barrier (geomembrane) or an air void or both. Scientific research has shown that saline capillary rise cannot cross an air void, so providing a continuous air void is an accepted method of creating a capillary break. However, it is absolutely essential that the air void is not compromised. Gravel has traditionally been used as the air void but more recently geocomposites are being used. Geocomposites all comprise of a core bonded to a geotextile filter separator, but not all geocomposites are capable of maintaining an air void when buried in the ground. A good geocomposite must have sufficient core volume (under-ground pressure) not only to prevent the geotextiles from touching, but also remove collected rainwater or irrigation water whilst still maintaining an air void. The ideal solution is to have both a physical barrier and an air void and some geocomposites can achieve that.

Comparing Capillary Layer Solutions

The problem of salt can be overcome by stopping capillary rise with a capillary break layer. Existing methods to create a capillary break layer are compared below.

Method	How it works?	Functions
Geomembrane 	A totally impermeable barrier, such as a welded geomembrane, separates the saline soil completely from the cover soil. The geomembrane must be very robust to prevent installation damage when covering with soil or subsoil. With this method there is no provision for sub-surface water drainage which could result in ponding above the membrane. Furthermore, there would be no facility for the flushing of subsoils or drainage of excessive rainwater. 	✗ No capillary Air Gap - none exists and if the geomembrane is damaged salt can pass straight into the surface soil. ✔ Impermeable barrier – stops rise of saline moisture. ✗ No drainage of topsoil – method is liable to ponding and softening of surface soils. ✗ No flushing into sub-soil layers -no flushing possible. ✔ Costs - low material cost but high installation cost.

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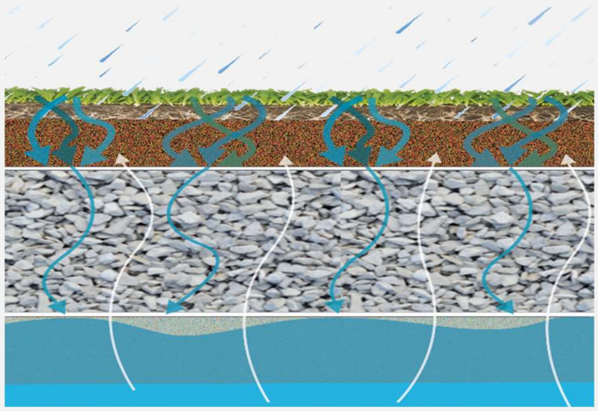
Granular Layer (plus geotextile filter top and bottom)

Placement of a free draining, clean stone as a break layer to prevent water from rising by capillary action.

Drainage stone allows for the drainage of sub-surface water to outlets. Subsoils can be flushed during rainfall events or with clean irrigation water. This can be an expensive method requiring installation of a relatively thick stone layer over large landscaped areas. A separator geotextile is required both above and below the stone break layer, incurring further costs. The same vertical flow path that allows "flushing" can work both ways.



✔ Capillary Air Gap - dependent on the quality assurance and placement of the free draining gravel.

✗ No impermeable barrier – may allow flow in either direction.

✔ Drainage of topsoil - slow flow rates through gravel so needs thick layer to be effective.

✔ Flushing into sub-soil layers - dilutes salt.

✗ Costs – high material, transport and installation cost of gravel plus two layers of geotextile.

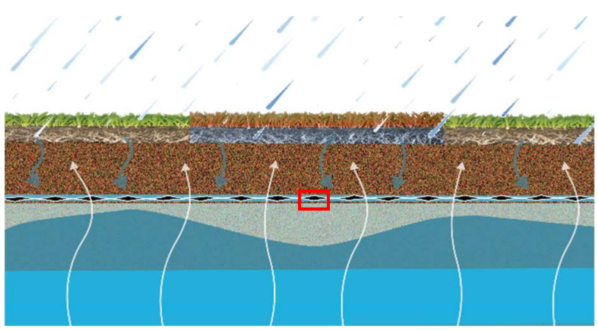
✗ Environmentally unfriendly

✗ Evapotranspiration of contaminated water

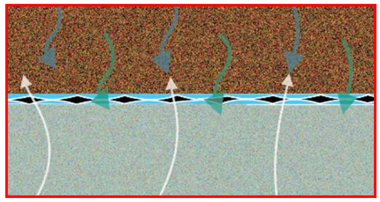
1st Generation Geocomposite (geonet)

Installation of a geocomposite (geonet) layer to separate the topsoil from the subsoils.

Many biplanar geonets, under the compression of overlying soils, do not provide an air gap or sufficient drainage capacity to act as a true capillary break layer – see below. Water can flow uninterrupted in the vertical plane through the products, so if the textiles touch under consolidation or long term pressure, the capillary break is breached allowing saline moisture to pass into the topsoil above.



Geonet textiles touching together, so no gap



✗ Capillary Air Gap – thin and vulnerable, even with a light load, soil may push the geotextiles together to bridge the capillary break.

✗ No Impermeable barrier - allows saline moisture to rise through composite.

✗ Drainage of topsoil - geotextile intrusion significantly reduces sub-surface water drainage.

✔ Flushing into sub-soil layers - dilutes salt but doesn't prevent it from rising back up.

✔ Costs – low cost with high risk of being inefficient

✗ Evapotranspiration of contaminated water

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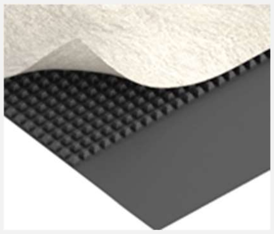
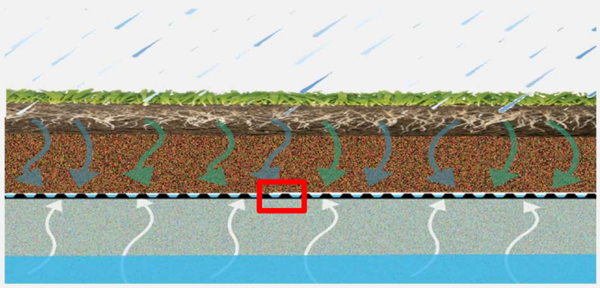
Hybrid Geocomposite Capillary Break (Geocuspate)

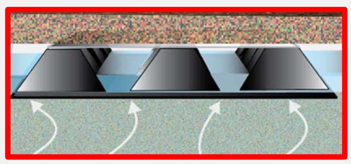


Installation of the ABG Salt Barrier geocomposite to separate the topsoils from the subsoils.

The latest generation of capillary break layer features a one-way drainage mechanism such that water can flush downwards but saline moisture cannot rise through capillary action. The geotextile laminated to the cuspated core provides the filtration and separation function for draining the overlying soils as well as creating an air gap for the capillary break within the layer.



Cuspate textile is well supported so good air gap



✓ Capillary Air Gap - sustained air gap prevents saline moisture ingress to topsoil even if core is punctured.

✓ Impermeable barrier –stops rise of saline moisture.

✓bDrainage of topsoil– substantial drainage capacity allows rapid drainage during rainfall events.

✓ Flushing into sub-soil layers – achieved at every necessary joint through one-way overlap.

✓ Costs - cost effective as a geocomposite.

Specification and Testing

It is important to specify a salt barrier layer by function. Ref: ABG Salt Barrier Break Layer SPEC CLAUSE.pdf

- The critical feature of the salt barrier is the sustained and optimised Capillary Air Gap. The ability of a geocomposite's geotextile to resist pressure and span the core node points dictates the size of the air gap. This is measured and named as the Capillary Void Capacity (CVC - test ref GEOSPEC SS036: 2016) Probes pressing on either side of the geocomposite to simulate soil intrusion determine the thickness between the two sides of the geocomposite. Other key clauses include:
- In plane water flow under SOFT FOAM platens in both directions of flow (machine direction and cross machine – MD & CMD)
- SIM Compressive creep strain to ensure sustained loads do not cause the core and textile to strain and compromise the capillary break in the long-term
- Geotextile breakthrough head is zero which ensures that no standing water occurs in surface soil before water passes into the drainage layer.
- Impermeable cuspated core with selvedge for one-way direction of sub-surface water.

Notes

- Geocomposite break layers must be laid onto a prepared formation at the required gradient
- The air gap is a critical feature and should remain even at the design rainfall/irrigation rate
- The flushing/overlap joints can be arranged to coincide with the low points in the prepared formation

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