

EPIC CASE STUDY

# THE SEAWATER PLOT

## YAS LINKS, ABU DHABI · THE DESALINATION-BY-CAPILLARY-RISE TRIAL

A plot built to test whether sand itself can take the salt out of seawater on the way up. The physics had already been demonstrated in the laboratory.

**91%**
TDS REDUCTION
Over the first capillary transfer

**32,000 → 3,000**
PPM TDS
Laboratory, January 2009

**110 cm**
LONGEST CAPILLARY PATH
Built in the companion cell

EVIDENCE LEVEL
DESIGNED & BUILT · Laboratory result, 2009 · field plot built and planted, 2012

Seawater plot at Yas Links, Abu Dhabi, 18 January 2012, 14 days after planting.

PROJECT RECORD

| | |
|---|---|
| LOCATION | Yas Links, Abu Dhabi, UAE |
| PLANTED | 4 January 2012 |
| ESTABLISHMENT | Watered with fresh water for the first two weeks, then hardened on a combination of TSE and sea water. The plan recorded on 29 January 2012: “Over the next 4 weeks the TSE water will be reduced and the cell will be maintained with sea water only.” |
| CONFIGURATION | Sea water introduced into the EPIC cell, looped through the chambers and returned to the sea, creating a 75 mm deep saturated zone |
| TRAVEL DISTANCE | 50 cm to the surface above the sea water section; up to 110 cm in the companion cell, up a 40 cm barrier wall, down the other side and up to the surface |
| PLANTED WITH | Sesuvium Portulacastrum, Atriplex Nummularia, Conocarpus, Atriplex Semibaccata, Pennisetum and Fountain Grass, Paspalum turf, Date Palm |
| PUMP | Solar operated |

## THE QUESTION

“The test plots were designed to determine if capillary salt water flow through sand has an influence on dissolved ion segregation.” If sand has a segregating influence, it may be related to travel distance, which is why the plot was built as two linked cells with very different path lengths.

The mechanism, as described by the system’s inventor: separation may occur in the capillary zone, where the water film is very tight in physical structure and squeezes out the larger molecules like a reverse-osmosis membrane. It may also be density stratification, sea water being heavier than fresh, with the slow movement EPIC provides working first with the lighter surface water at the source.

The laboratory work had already been done in 2009, and the result was substantial but bounded. That is why the field trial mattered.

## WHAT EPIC BUILT

Sea water is introduced into the EPIC cell, loops through the chambers and returns to the sea, leaving a 75 mm deep saturated zone. Above it, water can only reach the surface by capillary rise through sand.

In the first cell, that rise is 50 cm. In the adjacent companion cell, the water must climb a 40 cm barrier wall, travel down the other side and then rise to the surface: a total travel distance of up to 110 cm.

A full sampling protocol was written for the plot: dry-sand and saturated-sand weight references, damp sand sampled 10 cm below the surface, three samples in the centre of the seawater cell and three in the “fresh” cell at 15 cm depth, extraction into 500 ml distilled water, and laboratory analysis for TDS, sodium, calcium, magnesium, chloride and potassium; to be repeated a month later 30 cm north of the original points, and south, east and west on the following three-month intervals.



The seawater cell at Yas Links, January 2012.



The cells beside the Gulf, as built.

**91%**
TDS REDUCTION OVER THE FIRST CAPILLARY TRANSFER

**32,000 → 3,000**
PPM TDS, LABORATORY JANUARY 2009

**110 cm**
LONGEST CAPILLARY PATH BUILT

# THE LABORATORY RECORD

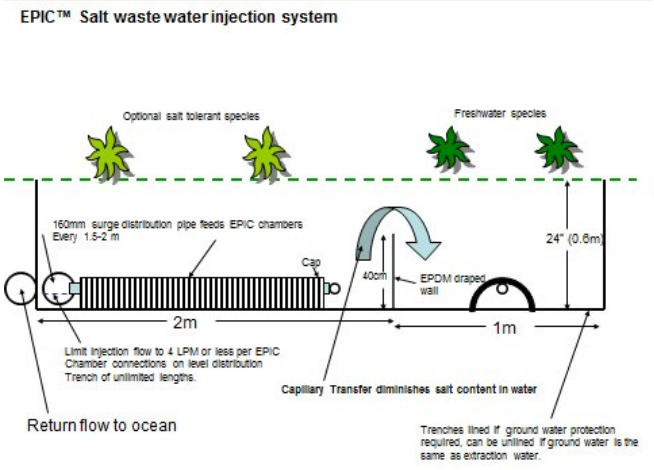
Anion and cation extraction levels in the root zone after capillary salt water movement. Values in ppm (mg/L).

| | SALT WATER SOLUTION | SAND CONTROL | B · 17 TO 20 IN | C · 28 TO 31 IN | D · 57 TO 60 IN |
|---|---|---|---|---|---|
| **TDS** | 32,000 | 81 | 3,000 | 3,800 | 3,300 |
| **Sodium** | 12,000 | 5.4 | 390 | 330 | 100 |
| **Chloride** | 20,000 | 2.4 | 2,200 | 2,400 | 2,200 |
| **Magnesium** | 1,400 | 8.7 | 210 | 250 | 270 |
| **Calcium** | 380 | 7.3 | 540 | 630 | 700 |
| **Potassium** | 340 | 3.0 | 7.4 | 7.6 | 7.0 |

Table 1 of the January 2009 laboratory paper on salt water irrigation with EPIC systems by Jonas Z. Sipaila, Director of Innovation, Rehbein Environmental Solutions Inc. Columns B, C and D are distances from the source, in inches. These are laboratory results, not Yas Island field results.



The seawater test plots on the Yas Links shoreline, as built.




The salt waste water injection schematic: limited injection flow, capillary transfer, return flow to ocean.

# WHAT THIS MEANS

- **The bound matters as much as the result.** TDS falls from 32,000 to 3,000 ppm over the first transfer, a 91% reduction, and then does not fall further across the next two columns (3,800 and 3,300 ppm). A 97% reduction, to below 1,000 ppm, was not achieved. This is why the application is specified for salt-tolerant species and not for fresh-water species.
- **Laboratory, not field.** The 91% reduction is a January 2009 laboratory finding, over the first capillary transfer only, with no significant further change over subsequent transfers. It is not a Yas Island result.
- **The field plot.** The Yas Links plot was built, planted on 4 January 2012 and given a full sampling protocol. The salt water sample locations were recorded on 3 April 2012.



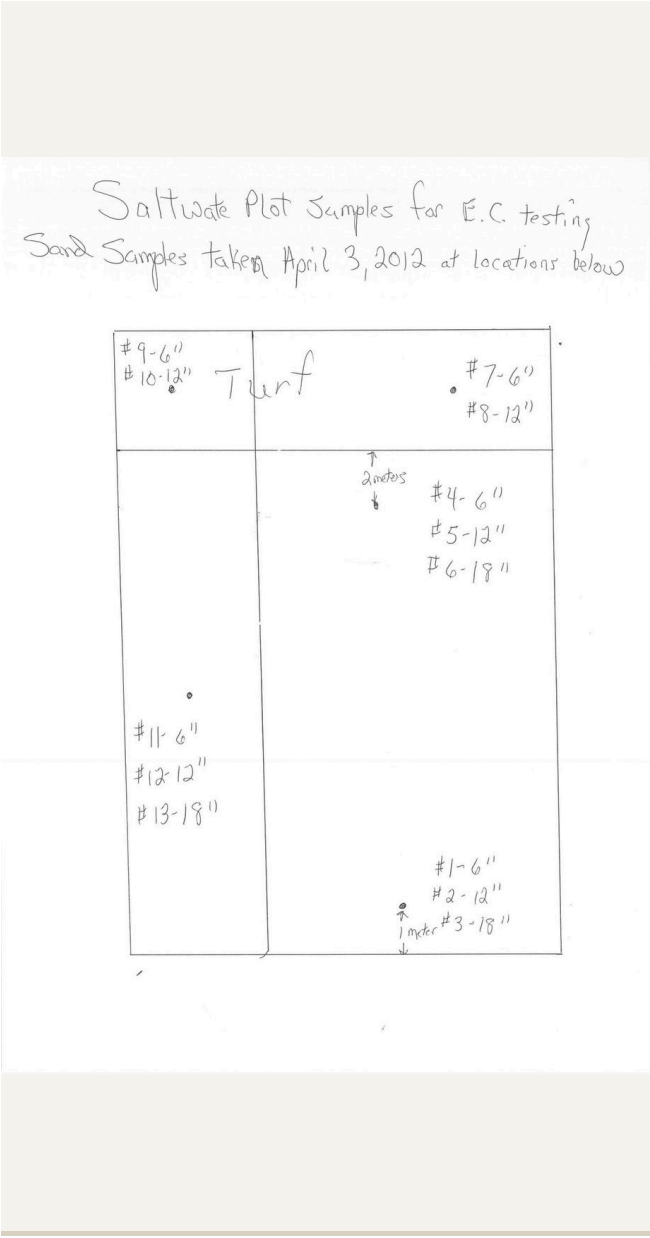
Salt-tolerant planting established in the cells.



The linked cells: the second carries the longer capillary path.



The seawater test plots as built at Yas Links.




**3 Apr 2012** Sketch of the salt water sample locations.

**RECORDS** Laboratory paper on salt water irrigation with EPIC systems, January 2009; evaluation of the EPIC System for desalination and subsurface irrigation with seawater; Yas Island salt water sampling procedure; sketch of the salt water sample locations, 3 April 2012; records of the salt water plants, including as built; EPIC installation record for Yas Island; summary of water consumption at Yas Island.