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Freshman to aid aquifer recharge

Dutch utility Dunea has begun piloting a new concept that integrates its use of different coastal groundwater sources. **By Jac van Tuijn.**

Dunea supplies drinking water to 1.3 million customers in The Hague and surrounding areas in the Netherlands. Its main freshwater resource is a managed aquifer recharge (MAR) system, which has been operating in coastal dunes since the 1950s. Pre-treated river water is infiltrated in the coastal dunes to replenish the natural freshwater lens and balance the freshwater extraction for the production of drinking water.

The presence of brackish groundwater below the lens restricts expansion of this approach. Facing increased demand for water as a result of population growth, and recognising the risk of extreme drought and low river discharges, Dunea is piloting the extraction of brackish water as an option for increasing its supply capacity.

The Freshman project

Dunea's Freshman project aims to increase the utility's supply capacity with treated brackish groundwater and, at the same time, potentially increase the volume of available fresh groundwater. The pilot involves a 110 metre-deep extraction well with filter screens and a reverse osmosis (RO) plant. Additional monitoring equipment has been put in place to closely follow groundwater salinity at different depths.

The data gathered will provide a better understanding of interactions between fresh, brackish and saline groundwater. It will also be used to validate model results and to gain operational experience of the potential for brackish water desalination as an alternative to seawater desalination in coastal

Left. Dunea chief executive officer Wim Drossaert initiates the pump to officially start the extraction of brackish water

areas. The pilot will test the Freshman concept for three years.

Switching on the extraction pump at the official opening of the project on 31 January, Wim Drossaert, chief executive officer of Dunea, said: "We have a production process that is becoming increasingly vulnerable to climate change, pollution and construction ambitions that affect our vital infrastructure. A multi-source strategy is our answer: more local sources, using different purification techniques. In this way, we can continue to supply sufficient drinking water under all circumstances, thereby increasing the robustness of our water supply."

Managed aquifer

The presence of saline and fresh groundwater is very common in coastal zones. The classic opinion is not to extract fresh groundwater as this increases salt intrusion. Many coastal cities turn to desalination technologies, such as seawater reverse osmosis (SWRO). The Freshman concept offers an alternative, as it uses brackish groundwater for desalination purposes while, at the same time, protecting fresh groundwater reserves from salt intrusion.

For the pilot in The Hague, a multi-screened abstraction well has been installed, with three screens at a depth range of 90-110 metres, just below the freshwater lens that floats on the brackish zone. An additional well is installed with two screens, between 60- and 85-metres depth, to extract fresh groundwater. Eight observation wells allow for accurate monitoring of changes in the distribution of fresh, brackish and saline groundwater. One of the techniques used is cross-hole electrical resistivity tomography (ERT), a geophysical technique that provides a three-dimensional image of different salinities around the extraction well.

The main well has three screens that reach to the brackish zone at a depth of 90-110 metres under the dunes

"The potential to increase the aquifer recharge and the dense 3D monitoring network make this Freshman pilot very special

Above ground, near the well field, is a treatment facility where the brackish groundwater is collected and converted to freshwater by RO and mixed with the regular drinking water supply. The remaining concentrate is discharged to the sewer system during the pilot. In the case of a full-scale application, concentrate is expected to be disposed directly to the North Sea.

First results

According to project leader Gertjan Zwolsman, senior strategist, policy advisor and researcher at Dunea, the design of the wells and screens meets expectations. The first results already show a lowering of the fresh-brackish interface, increasing the volume of fresh water. This means that more fresh water can be recharged, thereby increasing the volume of the aquifer.

"The use of brackish water for drinking water production is not new," admits Zwolsman. "But the extraction from the deep subsurface, the potential to increase the aquifer recharge, and the dense 3D →

monitoring network make this Freshman pilot very special. Hopefully, this pilot will stimulate the use of brackish groundwater for drinking water production in coastal areas worldwide."

The pilot in The Hague has been co-financed by the EU Life Programme for Environment and Climate Action, and includes a technical replication along the coast of Belgium. Next year, Flemish water supply companies Aquaduin and De Watergroep will start infiltrating fresh water from a drainage canal into a creek ridge. The groundwater surrounding the creek ridge is saline, resulting in a mixing zone with brackish groundwater. Brackish groundwater will be extracted at a depth of 10 metres and desalinated.

Market opportunities

Both pilots are supported by the KWR Water Research Institute. If they show good results, KWR will help to facilitate the market opportunities for the Freshman concept.

At KRW's spin-off company, Allied Waters, director Jos Boere sees many applications for MAR technology, beyond its benefits for coastal zones. Allied Waters has been involved in development of new MAR applications before, including a project in Abu Dhabi, where an inland aquifer was created to store freshwater in times of abundant rainfall, for use in times of drought.

Boere explains: "The managed aquifer recharge concept can be applied for various reasons, ranging from freshwater storage in the desert to storage of irrigation water underneath a greenhouse, as well as storage of post-treated effluent from a local wastewater plant."

Boere is conscious of the strong position of high-tech desalination technologies and the complexity of groundwater management in coastal zones. However, he is also aware of the growing interest in nature-based solutions. "MAR technologies are tailor-made solutions, based on a smart collaboration between Mother Nature and technology," he says. "It demands a combination of expertise, such as hydrogeology, groundwater chemistry, sensor technology, and process control. In that sense, it is easier to call in a water technology company and order a SWRO plant."

With MAR technologies, more project partners have a role to play. Boere concludes: "The fine-tuning and monitoring of the two Freshman pilots will teach us a lot, and I am convinced that water utilities will be interested in adopting the concept as a more natural and less energy consuming alternative." ●

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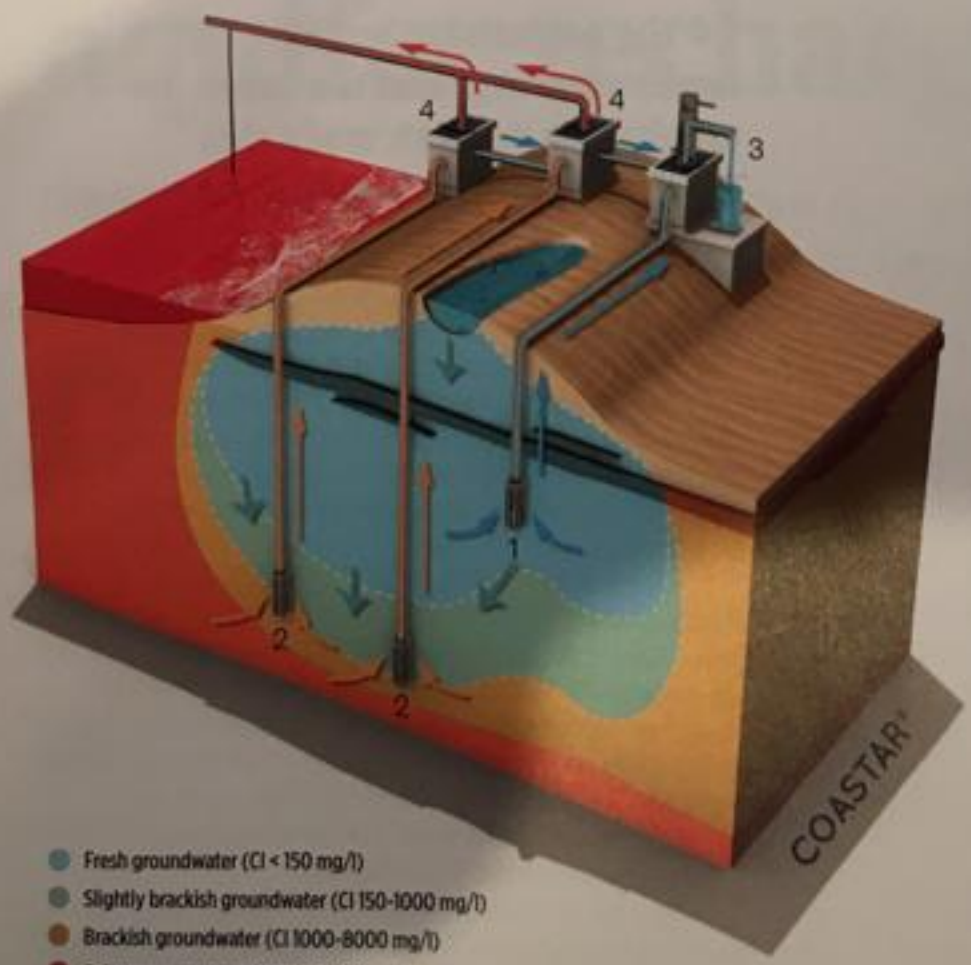
Figure 1. Full scheme of the Freshman concept with the brackish zone and the extraction screens (2) at the bottom of the fresh groundwater aquifer.

1 = Fresh water abstraction
2 = Brackish water abstraction
3 = Purification fresh groundwater
4 = Purification brackish groundwater



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