Webinar Q&A – Desalinating brackish water– Thursday 3rd October 2024

#	Question	Answer
Beneficial reuse of brine		
1	What are unique challenges or solutions that are associated with managing brine from brackish groundwater desalination compared to seawater desalination, particularly in inland or agricultural settings? Are there any emerging methods for beneficial reuse of brine in agriculture or industry that could turn this byproduct into a resource?	The big challenge with beneficial reuse of the salt is that the concentrated salt stream (brine) is a mixed salt. Purification of this brine to generate a resource that is commercially viable is more expensive than traditional methods of salt production.
2	Could the brine potentially support salt-tolerant macroinvertebrates and/or small-bodied fish in captive breeding situations?	For the scale of this project, we have not pursued the investigation of beneficial reuse of brine, such as you describe.
Brine disposal		
3	Is there any other method for brine disposal?	In addition to evaporation basins and aquifer disposal, ocean discharge is the other main disposal pathway for brine. Ocean discharge is not available in inland regions, such as the Murray Darling Basin.
4	What are the potential alternatives for brine disposal in inland desalination plants where ocean discharge is not feasible?	Evaporation basins, reinjection and techniques to minimise liquid discharge are the primary options for inland desalination plants.
5	What are the survey methods required to identify groundwater extraction and brine discharge ideal location?	State governments tend to hold publicly accessible hydrogeological information which can aid in the decision-making process. For instance, Flinders University hydrogeologists used information from the SA Government's Water Connect portal to identify where brackish groundwater is located and overlay this with the location of suitable aquifers for brine disposal. This gave us an initial impression of whether identified sites would be potentially suitable, and further water sampling was then undertaken to refine site suitability.
6	Has fouling been an issue in the injection well?	Not at the moment, but this could be a potential challenge in the future. We are monitoring to see whether fouling occurs.
7	How is the water discharged underground? Is it like a trunk or a network of reticulation pipes over a large area?	The water is discharged under gravity through the screened section of a PVC-cased bore, into the target aquifer. Two discharge bores are used

		at the site to provide some additional redundancy.
8	I'm interested in hearing how the team is monitoring clogging of the injection well (level transducer & specific capacity, camera, purging?), and how monitoring results compare with PHREEQ C results. Perhaps the low pH of injectate is impacting the aquifer.	Clogging is not being directly monitored but is being indirectly monitored by observing how effectively the discharge wells accept brine from the desalination plant. Greater investigation of the extent of clogging will be undertaken at the conclusion of the project and compared with the initial modelling results. pH has not been identified as a factor that could impact the aquifer.
Desalination technology and energy		
9	What is the typical energy consumption for the low-recovery vs a high recovery desalination plant?	This depends on factors such as water quality, energy recovery device and size. High recovery has a much higher load and power requirement than low recovery.
10	For irrigation purposes, do you need pretreatment?	The objective of pretreatment typically is to prevent fouling of the RO membranes. Thus, pre-treatment depends on the feed water quality rather than the water use.
11	What is the volume of treated water in this setup? Is the treated water output also seasonal, or rather stable across the year?	Please refer to the table provided on slide 18. This is an average of 30 kL per day from August to May.
12	How much water can be treated per day?	This plant has a maximum capacity of 100 kL per day.
13	Is solar farm an option for supplementing power requirements – ie., approximately 200 panels would do it! :)	Yes, this could be a next step of a project, and this is being investigated for a potential future project.
14	Reinjection is not listed in energy usage table. Is this included in 'bore pump'?	No, the reinjection is by gravity only.
15	What are the total approximate costs- including mobilisation, labour, treatment (including power), etc.	This is a complex question to answer, as there are a number of local factors that need to be considered. A cost calculator is currently under development as part of this project which will have the capacity to provide such estimates. Please keep in touch by subscribing to our newsletter to be alerted when this becomes available for public use.
16	For the summertime, cost is higher. Most of electricity is used by the desalination unit. Does the system have more freshwater output or higher recovery during summer? Thank you.	During summer almonds reach their peak water requirement - hence the need for the desalination plant to produce more water and run for a longer period.
17	Was low-pressure RO ruled out due to the high salinity of GW	Yes, it was.

18	Do you have a low-cost desalination technology that is more beneficial in terms of capex and opex?	No. Reverse osmosis is the most widely used and cost-effective technology at present.
19	How does percent recovery and power consumption vary with the TDS of the feed water (between ~1,500 mg/L on up to 40,000 mg/L)?	Power consumption is normally measured as energy intensity (kWh/kL) and is dependent on overcoming osmotic pressure which is roughly proportional to TDS. Water with 1500 mg/L TDS would typically require less than 0.5 kWh/kL whereas seawater (35,000 mg/L) typically requires 2.5 kWh/kL. Recovery depends on the ionic species in the feed water, their tendency to scale and use of antiscalants. Brackish water at 1500 mg/L TDS might operate at up to 85% recovery whereas seawater typically operates at 40-50% recovery.
20	Are any standby modes being trialled? Eg., if Century Orchard can get plenty of water during periods of full allocation then desalination plant is not needed for long periods of time	This trial and desalination plant will continue to run regardless of whether we have 100% allocation or not - we are fully committed to our trials and obtaining results which are important for growth and understanding across industries. If we were to have a full scale desalination plant for our orchard it is likely that the desalination plant would not run in periods where allocation is 100% - we would extract from the river as normal during these years.
21	Your commitment to innovation and best practice is pretty clear, my question relates to issue of components of desal plants can be impacted when not utilised so curious if there are trials to understand impact of having the plant idle for different periods of time e.g., we have had several years at 100% allocation so presumably the desal is not needed for that period???	There are not currently plans to conduct an investigation such as the one you describe. There are well established processes to enable RO membranes to be 'mothballed' for extended periods. One irrigator that does use desalination as part of their water mix does just this, based on water price. When the water price drops below a certain threshold, they mothball their system, so that it can be preserved and switched back on when it makes economic sense to do so.
22	What level of pressure is required for RO? Could it be feasible to use pressurised water directly e.g. from an elevated reservoir source?	16 bar is the projected pressure required for the feedwater to our desalination unit. While an elevated reservoir could theoretically be used,

		it is likely that this would not be energy efficient.
23	Julien - For this project, are you using full flow RO or partial RO with a blending bypass? If full flow, what if any post treatment is used?	Full flow RO is used in this project with no post treatment
24	'@Osmoflo - Do you have Packaged plant product to meet drinking water quality from brackish groundwater?	Yes we have, this is our bread and butter :-)
25	Is antiscalant used and is this an issue re: toxicity? Or is antiscalant not used?	No antiscalant is used. This is a benefit of low recovery RO.
Economics		
26a	Using a low recovery method for brine disposal requires a high yield source, did you investigate a high recovery method and complete a cost/benefit of the two options??	This low recovery method is chemical free, hence we didn't choose high recovery method. A cost calculator is being developed.
26b	I understand that but it comes at a cost to the water source ultimate volumes. Was this considered??	Yes. In terms of our demonstration site, all relevant permits were sought to extract groundwater to ensure sustainability. The costs associated with extracting a larger total volume of water under a low recovery scenario will be considered in cost-benefit analyses.
27	Do you have a draft of the budget calculator. We are working on a project testing 30 RO units on dryland farms, comparing systems and also reject options. be interested to collaborate. See https://www.agric.wa.gov.au/watersmart-farms	Yes, a draft calculator is being developed. Thank you for this information.
27	Could you talk more about the cost/benefit calculator? What level of detail are you looking at? How do you see it being used/applied (ideally). My interest is testing feasibility at larger scale for almond orchards, >3-5 ML/day	The cost calculator is being developed to have two interfaces: one for coarse analysis using minimal information, and one for 'power-users', who want to undertake a more in-depth analysis. The intention is for this tool to be used as a first pass to help potential desalination end-users decide whether this technology could be applicable to them.
Environment		
28	How much does the recharge to the Loxton Sands influence the movement of groundwater (e.g. towards the Murray River) or regional discharges (e.g. salinisation)	The Loxton Sands aquifer contains naturally saline groundwater, and this groundwater flows towards the River Murray, increasing its salinity. Salt interception schemes were set up to intercept and divert this saline groundwater before it reaches the river.

		In the case of the current project, the volume of water being recharged to the Loxton Sands aquifer is small in comparison to the volume of water in the aquifer, meaning the influence on the movement of water in the aquifer towards the River Murray is negligible.
29	What are the long-term ecological effects of increasing salinity in water bodies due to brine disposal from brackish water desalination?	Salinity, in terms of concentration, would not be increased by the brine disposal undertaken in this project, as the concentration of salt in the desalination brine is lower than the concentration of salt in the receiving aquifer. It is true, however, that salt is being added to the receiving aquifer that was not previously there. If larger scale projects were to be undertaken, attention would need to be paid to ensure that the increased recharge to the aquifer would not have unintended deleterious consequences.
30	From a hydrological and environmental engineering perspective, what are some of the long-term risks associated with brine disposal, especially when it's used near sensitive ecosystems? Are there emerging methods or technologies that could help minimize the environmental impact of brine, particularly in arid agricultural regions like South Australia?	Determining potential environmental risks associated with brine discharge near sensitive ecosystems needs to be considered on a case-by-case basis. The potential impact of brine is largely managed through appropriate planning and approval processes. One increasingly applied technique in desalination is to minimise brine discharge. For example, Osmoflo has developed its 'Osmoflo Brine Squeezer' technology to achieve high recovery.
Hydrogeology and water quality		
31a	Has there been any hydrochemical modelling to understand the response? (rock-water interactions, precipitation, etc)	Yes, modelling using PHREEQ-C was undertaken to better understand the potential for ions such as Ca and Fe to precipitate during aquifer disposal. This is indeed an important consideration.
31b	What were some of the key findings from that?	There is a risk of clogging in the injection wells, especially from Iron. We are monitoring this during the demonstration period.
32	Was there any groundwater modelling (additional to the maps shown at the beginning that covered the whole basin) done before choosing the site and doing the pilot?	Please see the responses above to questions, 31a and b.

33	Julien, has iron and iron bacteria been a challenge requiring pretreatment? Other challenges with WQ?	We only started last month, so far no bacteria issue. We did minimise air entrance in the system, but yes iron in general is a risk that we are monitoring
34	What range of TDS is considered to be brackish?	1,000-15,000 mg/L total dissolved solids is generally considered brackish.
Irrigated agriculture		
35	What are the water requirements for almonds and pistachios? Are they particularly thirsty crops? How sensitive are they to salinity?	Water requirements in Australia for almonds on average vary from 12 ML/ha/yr – 15 ML/Ha/yr. Water requirements for pistachios are slightly lower. In Australia 99% of almond orchards use drip irrigation systems designed to match the soil water-holding capacity. Many growers use sophisticated technology to measure and control water stress in almond trees, with climate data analysis coupled with plant and soil-based sensors, used to plan, monitor and adapt irrigation scheduling to meet tree requirements and minimise unnecessary water use. Almonds are more sensitive to salinity than pistachios with yield decline occurring from 1.5 dS/m and higher. The unit has been designed to desalinate the brackish ground water to below this limit.
36	at 185g CO2 eq/kWh in SA, the water extracted is about 2g CO2 eq/L (if my calculations are correct). How will this impact the carbon footprint of the crops?	While the current demonstration project is powered by a diesel generator, an alternative power source or sources would be required for larger scale implementations. For instance, connection to the electricity grid, or solar with battery storage, would lower the carbon footprint of the produced water. Such energy connections are being investigated for future projects and as part of cost benefit analyses.
37	If the trial is successful, what are the plans for the future with this project? Would Centuries Orchards look into supplying water permanently from this source?	Century Orchards will evaluate the outputs of this project at its conclusion and decide how to proceed at that point. The project team is actively investigating potential future projects.

38	Gemma, what sorts of demand management is employed on site. Do you drip irrigate?	Century Orchards is fully drip irrigated.
Regulatory requirements		
39	What planning, environmental or other regulatory approvals were required for this project?	For this project specifically, we needed well construction permits for the bores (production and discharge), and a permit to drain or discharge water into a well, both from the South Australian Department for Environment and Water (DEW). If the project was operating at a larger scale, additional permits would need to be sought from the Environment Protection Authority (EPA).
40	Does the EPA get involved in the recharge side of things?	In South Australia, when a desalination plant produces greater than 50 kL/day, or if the water has undergone chemical treatment, a permit to dispose brine to an aquifer is required from the EPA. See below for more information.
41	What licences are required in South Australia for pumping the groundwater and injecting water into a receiving aquifer? Do you require an EPA licence?	Extracting groundwater from a well requires a licence from DEW if the water resource is prescribed. A water allocation plan (WAP) will define how that resource may be used. Extracting groundwater from a well in a non-prescribed area does not require a licence, but the resources are regulated through statutory regional landscape plans and water affecting activities control policies (WAACP). If the water to be drained or discharged (injected) into a receiving aquifer is sourced from a surface water capture area greater than one hectare within the Adelaide metropolitan area or specified areas of the City of Mount Gambier, or the water has undergone antibiotic or chemical water treatment with a discharge volume greater than 50kL/day, an authorisation issued by the EPA is required. Otherwise, a drainage or discharge permit from DEW is required. The DEW assessment of the D or D permit is either under a WAP (prescribed) or WAACP (non-prescribed).

42	What did the regulatory pathway entail and how long did approval take? How supportive were regulators of the project?	Please see the response to the above question 41for details on the regulatory approval process. The approvals for this project took approximately three months to complete. The SA Department for Environment and Water is a partner of this project and as such are supportive of the project.
43	How does flood influence the operations? I am thinking about after a flood when groundwater levels may be elevated. Are there conditions on any of your DEW approvals?	The approvals did not specifically consider the risk of flood and how this could impact water table levels. It is important to note that the brine being discharged has a lower salinity than the receiving aquifer. To obtain a DEW drainage or discharge permit, you must demonstrate that the water being drained or discharged (injected) is equal to or better in quality than the ambient (receiving) groundwater. This is to provide evidence that the injection will not have a detrimental impact on the aquifer, ecosystems or neighbouring groundwater users. Flood risk is an important consideration when determining the location of evaporation basins and flood risk would usually be considered as part of the approval process.