ERAMURRA SALT - JULY 2024 GROUNDWATER MONITORING EVENT AND LOGGER DATA COLLECTION: REVIEW.

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Proprietary Information Statement

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Introduction and Aim

Leichhardt Salt Pty Ltd is an independent, majority-Australian owned Solar Salt Project headquartered in Perth, Western Australia, with operations 55 kilometres (km) outside Karratha, Western Australia. The project occurs from the Cape Preston East Multi-Commodity Port, between Eramurra Creek along the western edge and Devil Creek on the eastern edge. The project area will contain 90km^2 of concentrator area, 20km^2 of crystalliser area and 2km^2 bitterns in addition to the plant processing area. This will alter existing the surface water flows from waterways as well as tidal flooding of the project land parcels. There is also potential for groundwater impact from a number of project activities. As part of the project, a surface and groundwater monitoring network has been established to collect appropriate baseline data prior to construction and operations. The network will also inform ongoing monitoring assessments during future operations. These data are being collected and collated by Land and Water Consulting (LWC).

The aim of this memo is to review:

- LWC QI-01 -July 2024 Groundwater Monitoring Event and Logger Data Collection (December 2024)

The review focuses on the adequacy of the monitoring network (including the data collected thus far) to establish a robust baseline dataset for future groundwater impact assessments. The project site is located in a hydrodynamic coastal zone and therefore water chemistry and water levels can vary in response to many factors (e.g. tides, rainfall, floods). This makes establishing a robust predevelopment baseline dataset, that captures the natural environmental fluctuations, even more important.

Following the review summary and recommendations there are specific comments (by PDF page number, not the page numbers in the footer of the document) presented for consideration.

Review Summary

The December 2024 report details methods and presents results of the July 2024 monitoring events. These monitoring events are listed in the table below:

Monitoring Type	Sites Sampled
July 2024 Monitoring Event	
GW bore elevation survey	21 GW bores
GW sampling (lab analysis)	21 GW bores
GW and SW data logger download	19 GW sites, 18 SW sites, 1 barometric site
SW sampling (lab analysis)	Accessible sites on route to SW data logger location and at which water was present

NB: GW = Groundwater, SW = surface water

As of January 2024, an additional 10 groundwater monitoring wells were installed across the site, providing a total of 21 groundwater wells within the monitoring well network. The current well network is considered predominantly suitable to establish both a baseline understanding of the system and ongoing monitoring assessments during operations. The network would benefit from several additional groundwater monitoring bore sites; these were recommended previously (HGE 2023) and are also discussed herein. We acknowledge that our suggestions for additional sites may not be suitable based on land tenure or ground conditions etc. and are happy to discuss a compromise as required by Leichhardt.

The fieldwork carried out over these monitoring events appears to be of high quality. The major exception to this is the discrepancies between the logger data and the manual groundwater levels. This needs to be rectified in future monitoring events and commentary is provided herein regarding these measurements and addressing the issues. Groundwater and surface water levels measured look reasonable in the context of the levels measured during infrastructure installation and previous monitoring events.

Water quality sampling has also been completed and again follows the relevant guidelines and standards. The relevant chain of custody processes for laboratory analysis have been followed as much as is possible given the field site's location which will inevitably cause issues with sample holding times. As in previous sampling events, numerous water samples breach the appropriately quoted water quality guidelines. These data are important documentation of the fact that the baseline data in parts of the site are breaching water quality guideline values, and how this baseline varies seasonally. Important context for future monitoring events and impact attribution once the project enters construction and production phases.

Significant updates have been made to the July 2024 monitoring events, as per our previous recommendations (HGE 2024). Examples include drilling additional groundwater sites, manual water levels collected when loggers are downloaded, revision and inclusion of additional figures/hydrographs/WQ graphs, and the presentation and analysis of laboratory ionic balance.

We also note that while many of our recommendations have been addressed, some of the comments on related documents (HydroGeoEnviro GW modelling and previous monitoring event reviews) are again not reflected as addressed in the December 2024 report. Examples include revising the filtering regime of water sampling and quarterly manual groundwater measurements and logger downloads. Revisiting previous reviews and incorporating the recommendations is encouraged.

In summary the monitoring event data are generally fit for purpose and are working towards providing a suitable baseline to which future impacts can be compared. The addition of 10 newly installed groundwater bores and 22 additional data loggers around the site will greatly assist in collecting a suitable baseline dataset. As noted in previous reviews, the large number of dry surface water monitoring sites may present some issues and at least some event-based sampling will provide a better dataset for future impact identification by ensuring that samples are collectable at all locations.

Recommendations

In terms of suggested changes, we provide discussion and recommend the following:

1. Increased accuracy of manual groundwater level measurements – The matches between logger data and manual water level measurements are often poor. This needs to be rectified for future monitoring periods and commentary on individual groundwater monitoring bore hydrographs is provided at the end of this document.
   Deploying loggers on marine grade stainless steel wires (316SS) and attaching wires to the inner PVC of bores is recommended. Manual groundwater levels should be recorded along with a date and time. This time should be synchronised to the time on the corresponding data logger. Whenever a data logger is removed for download a manual level should be taken before, and again after the logger has been redeployed. Removing data loggers

before any sampling occurs is also recommended to prevent various field equipment getting entangled downhole and to remove any possible sample pumping interference. HydroGeoEnviro has extensive field experience with installation and conducting monitoring using dataloggers in similar settings and can provide further advice if requested.

2. Increased frequency of manual water level monitoring and logger downloads - Groundwater levels should be manually monitored more frequently than biannually, especially given the issues which are occurring. Quarterly manual groundwater level monitoring and logger downloads are recommended for at least the first 5 years of the project. A more regular logger download schedule will:
   - minimise the impact of any equipment failure (or equipment loss);
   - allow manual measurements at the logger sites to be collected to help with correcting any instrument/measurement drift; and
   - ensure the data from these sites is as continuous and accurate as possible.

   This will ensure suitable data are captured to provide an understanding of groundwater level fluctuations that are important for groundwater recharge and discharge dynamics, and groundwater model calibration. Detailed water quality (laboratory analysis) biannually is appropriate and basic field water quality parameters should be collected as frequently as is feasible (i.e. during manual water level measurements).

3. Visit all surface water sites in sampling event – The July 2024 sampling event visited only accessible sites on route to surface water data logger locations. All sites should be visited (where accessible), and accessibility should be considered when planning fieldwork to maximise the number of sites able to be visited.
4. Include rainfall event-based sampling - A number of the surface water sampling sites have been predominately (in some cases always) dry. There could be some consideration of some rainfall event-based sampling (where mobilisation for sampling only occurs when a rainfall event sufficient to cause runoff is forecasted). This would improve the quality and baseline functionality of data collected. There could also be some consideration of using stage auto surface water samplers to collect rainfall event-based samples.
5. Installation of additional monitoring bores - The previous HydroGeoEnviro review of the GMMP (HGE 2023) recommended gathering greater information regarding groundwater inputs into McKay Creek, and Devils Creek/Pool. Little is known about the current connection to groundwater at Devils Pool. The newly installed groundwater monitoring bores (drilled Jan 2024) have filled some of these knowledge gaps (e.g. MB33S and D adjacent to McKay Creek) but several recommended sites from the HydroGeoEnviro GMMP review have not been addressed:
   - *2 additional shallow bores upgradient of the concentrators, 1 near SW09 and one west of SW03 to help define inflowing groundwater quality and water table elevation.*
   - *Shallow bore/s downstream of the crystalliser and recovery areas immediately north of SW12. It is likely that the site conditions here are challenging for drilling so possibly a shallow hand auger installed bore may be the best installation method.*
6. Data inclusion and presentation of figures - Suggested inclusions for subsequent reporting periods include:
   - A figure/s with the project's infrastructure and monitoring site locations (e.g. add sites on Figure 3 to Figure 1 and include as an additional figure).
   - In Appendix E it is recommended rainfall be displayed as a bar graph (not as a line).

Specific Comments

Page 19, Table 4-3:

> Comment - It is suggested rinsate screening samples have anions and cations included as metals are very low concentrations so cross contamination will be hard to detect based on metals alone.
>
> And
>
> The trip blank should be analysed for the entire analytical suite to ensure that any compounds detected in the sample were not the result of contamination during the handling/sampling process used for the samples prior to analysis. Both these updates were recommended in our previous review (HGE 2024).

Page 20 – "Note that during the July 2024 monitoring event only surface water monitoring locations that were enroute to data logger locations were inspected/ sampled. Of these locations, surface water was only present at two locations (SW01 and SW14)."

> Comment – Why were all SW monitoring locations not visited in July 2024? Recommendations regarding event-based sampling have been included herein.

Page 23 – "…1 dedicated barometric pressure logger were accessed and data downloaded."

> Comment – Table 4-7 shows two barometric sites that were accessed, both of these dataloggers were full and reset. Data is missing from Dec 2023 – July 2024. It appears two additional barometric loggers were installed (Table 4-8 and 4-9) but no installation data are listed in the table. These tables should be updated in future monitoring events and more details around barometric data compensation methods should be provided. It would be helpful to keep a record of when large low-pressure systems (e.g. cyclones) are present as this would provide a crude quality assurance check on the barometric logger dataset.

Page 23 – "The difference or drift between the logger data water level and gauged water level upon retrieval was calculated. The difference between the two values was generally less than 0.5 m with the exception of MB33S, MB33D and MB35S."

> Comment – This drift needs to be reduced. Half a metre drift does meet industry expectation of the accuracy necessary for this monitoring in our opinion. This will hamper the utility of these data to be used for modelling or impact attribution. The position of the logger within the bore (e.g. reinstalled at a different depth) should be investigated to explore these drifts, this has been suggested for MB33D.
>
> A practical way to overcome this could be to attach a weight to the logger during installation to prevent the loggers line 'sticking' to the sides of the bore. It is also recommended loggers are deployed on marine grade stainless steel cable (and u-bolts) to prevent sticking. Also, groundwater elevation should be corrected for salinity. It may be that the best way forward is to engage a hydrographer to assist for some monitoring rounds to help address these issues and improve field standard operating procedures.

Page 23 – "It is noted that salinity corrected groundwater elevation has not been considered and may contribute to the observed differences in water level, principally for wells with elevated salinity"

Comment – as noted in the previous comment, data should be corrected for salinity but we acknowledge the best way to do this is via a groundwater model. Some sites are highly saline and this correction may account for some of the large drifts in the hydrograph dataset but we believe that other factors as described herein are the dominant causes of this issue.

Page 23 – "In some instances, the cord may 'stick' to the well casing (predominantly in deep wells). The data logger cord could be replaced with dedicated, low stretch cord during the next GME."

Comment – See recommendation above regarding deploying logger on marine grade stainless steel cable (with u-bolts) and/or adding a weight to prevent sticking.

Page 23 – "To facilitate Leichhardt's interim retrieval of data logger data (in between GMEs), following sampling, the dedicated well tubing could be removed from each well (and stored in dedicated containers to prevent cross contamination of tubing). This may reduce the occurrence of loggers becoming caught on tubing during retrieval and subsequent redeployment."

Comment – We currently understand that the tubing that is used to pump the groundwater sample is left within the bore. If this is correct, then yes it is a good idea to remove between sampling events. An alternative option, if practical, could be to have a decontaminant in the field (such as Decon-90) to use on tubing between individual bores to prevent contamination. The same reel of tubing could then be used for all samples, if decontaminated correctly between each site. This would require stringent decontamination procedures and we acknowledge that the use of individual tubes may be the most practical way to minimise cross contamination.

Page 23 – "LOG_MC03 is the only barometric logger installed at the Site (central portion of the Project Area, adjacent McKay Creek). Additional barometric loggers could be installed across the Project Area for improved accuracy and redundancy (e.g. in monitoring wells MBH20 in the northeastern portion of the project area and MBH10 in the western portion of the project area). Currently all loggers have been compensated with a single barometric logger and barometric pressure is likely to fluctuate across the Site,"

Comment – A backup barometric logger is suggested in case the first barometric logger fails. In our opinion two barometric loggers are sufficient. The barometric pressure fluctuations across site are most likely negligible but this would be worth investigating.

Page 33 – "Based on review of the logger data within Appendix E, possible tidal fluctuation in groundwater elevation is apparent at monitoring locations MBH01, MBH03, MBH10, MBH19, MB26D and MB40D….. Clear tidal influence was not observed for MBH03 and MBH08 which are also located in close proximity to the coast."

Comment – It is agreed there is a tidal influence in some bores however this paragraph contradicts itself. Initially it comments tidal fluctuation is apparent in MBH03 but later comments no clear influence was observed in the same bore. Typo? Check data.

Page 33, Figure 5-1:

Comment – Data points are not yet frequent enough for establishing baseline trends.

Page 34 – Table 5-1 and Figure 5-3:

Comment - A groundwater pH above 10 is considered high and is typically not found naturally, indicating a potential contamination issue or unusual geological/hydrogeochemical conditions. A normal groundwater pH usually falls between 6 and 8.5. This provides good data for establishing baseline pH values and ranges across the site. Further investigation to identify the cause of this highly alkaline chemistry is recommended. Some suggestions are it could relate to the development and/or dissolution of alkaline evaporite minerals, or the presence of urban waste water which can be high in alkalinity due to the presence of domestic bicarbonate chemicals.

Page 34 – Table 5-1: "Converting these values to the Standard Hydrogen Electrode (e.g., addition of 199 mV), positive oxidation-reduction potentials (oxidising conditions) were observed at all locations. Refer to Figure 5-8."

Comment –Figure 5-8 shows numerous bores with negative redox potentials, these haven't been converted as described above. Commenting that oxidising conditions were observed at all locations appears incorrect and needs confirmation.

Page 35 – Table 5-2:

Comment – MBH06 and MBH20 have large rises in pH in the June 2023 sampling event. Any explanation as to why? Typically other bores experience a fall in pH for the same monitoring event. Probe calibration error? Bad buffer solution?

Page 36 – Figures 5-4 to 5-7:

Comment – It is advised the Y-axis units are changed to TDS (mg/L) to coincide with the title. If EC is quoted, then a temperature should also be noted e.g. EC (µs/cm) @ 25°C.

Page 38 – Figure 5-8:

Comment – The negative redox potentials in bores MBH08, MBH12 and MBH20 seem to correlate with the alkaline pH values. These relationships should be further investigated.

Page 39 – "It is noted that alkalinity at MBH12, MB33D and MB40D is present as carbonate and hydroxide alkalinity as opposed to bicarbonate alkalinity (as reported elsewhere on Site)."

Comment – These differences in chemistry need to be further explored as the baseline dataset becomes better established.

Page 39 – "it is unclear if the elevated pH is associated with damage to the internal well casings. Inspection of the internal condition of the wells with a down hole camera would assist in confirming the internal condition of the wells (i.e. to assess if the screen has been impacted by bentonite plug/ grout from above)."

Comment – In our opinion, based on our experience, elevated pH are unlikely caused by deteriorating bore integrity. A down-hole camera survey is highly supported to investigate the condition of the bores. Further investigations into this chemical phenomenon are suggested and some suggestions have been made herein.

Page 40 – "The difference observed for MB33D (3,900 mg/L in July 2024 compared to 17,000 mg/L in February 2024) is considered to be associated with the development of the well. Levels at this location appear to have stabilised following well installation and this will be confirmed at the time of the next monitoring event. The variation observed for MB26D is not well understood at this time (noting that well development at this location was noted to be adequate) and will be further explored with future monitoring."

> Comment – Exploring the chemistry differences in coming monitoring events is highly supported. These natural fluctuations in groundwater chemistry need to be established in the baseline data prior to project commencement.

Page 41 – Section 5.3.3 Major Cation and Anions Alkalinity

> Comment - Major ion analysis is also important in understanding the mineralogy of the system however the halite/evaporite mineral precipitation dissolution will be more important for this site in the context of anion cation data. The balance of rainfall recharge/dilution, marine water recharge during high sea levels verses evaporation/concentration should also be explored during baseline studies. This work was recommended in our previous review (HE 2024); this should be investigated during the next review period. Some XRD data at key sites for surface sediments (crusts) to measure mineralogy may assist.

Page 42 – Figures 5-10 and 5-11:

> Comment – It is recommended each piper plot be enlarged to an A4 size. This would help increase the clarity as the symbols for individual bores are hard to pick out at the current size.

Page 42 and 43 – Figure 5-10 to 5-14:

> Comment – The piper plots exhibit some water chemistry relationships that could use further analyses. For example, Figure 5-13 shows three bores (MBH012, MB33D and MB40D) that all have no carbonate or bicarbonate, but they have differing calcium concentrations. Carbonate chemistry and its implications on the source/origin of groundwater and water chemistry/mineralogy dynamics warrants more work as this baseline dataset is developed.

Page 50 – "The following should be noted for future consideration: Filtering of samples with a finer filter (0.22 µm, for example) might address the concentrations of dissolved aluminium in groundwater where exceedance of guideline criteria may be due to the presence of colloids (the larger filter size adopted as standard practice for field filtration does not remove colloids). This may also address concentrations of other analytes for which dissolved concentrations were in exceedance of guideline criteria for example zinc."

> Comment - This was noted in the previous two sampling event reports. As stated in our previous reviews; although the data is being used for a baseline it still warrants an investigation with some duplicate samples (using 0.22 micron filters) to confirm if this is colloidal aluminium. After this filtering procedures may need to be slightly revised.

Page 52 – "If TRH is identified at this location in future, TRH with silica gel cleanup analysis should be undertaken to determine if the identified TRH is biogenic in nature rather than petrogenic."

> Comment - This work is supported.

Page 59 – "Recommendations have been made regarding the following…"

Comments – All these recommendations are supported.

Appendix E – Hydrographs (starts on page 262)

General Hydrograph Comments – It is recommended rainfall be displayed as a bar as opposed to a line graph. Manual water level measurements often poorly align with logger data. This needs to be rectified so datasets (manual and logger data) match more closely. The reasons for downward spikes that coincide with rainfall events in May 22 and Feb 23 needs further exploration. The following comments are made for each corresponding bore hydrograph:

- MBH01 – One of the manual groundwater levels is a poor match with logger data, water level dips in Feb 2023 should be investigated (i.e. look at the field data sheets)
- MBH03 & MBH08 – Poor match between one manual measurement with logger data
- MBH09 - Two of the manual groundwater levels are a poor match with logger data, water level dips in Feb 2023 should be investigated
- MBH10 - Several of the manual groundwater levels are a poor match with logger data, water level dips in May 2022 and Feb 2023 should be investigated
- MBH12 - Two of the manual groundwater levels are a poor match with logger data, water level dips in Feb 2023 and May 2024? should be investigated
- MBH13 - One of the manual groundwater levels are a poor match with logger data, water level dips in Feb 2023 should be investigated
- MBH19 – Manual groundwater levels provide a good match with logger data, water level dips in May 2022 and Feb 2023 should be investigated
- MBH20 - Three of the manual groundwater levels are a poor match with logger data, water level dips in Feb 2023 should be investigated. The interference from April to May 2024 should also be investigated. Inaccurate barometric compensation or nearby aquifer testing could explain data from this period. This interference inhibits the ability to process and analyse the dataset.
- MB21S – One of the manual groundwater levels is just an ok match with logger data
- MB26D - One of the manual groundwater levels is a poor match with logger data
- MB33S – One of the manual groundwater levels is just an ok match with logger data
- MB33D - One of the manual groundwater levels is a very poor match with logger data, water level trend for this bore should be watched closely in future monitoring periods. The lack of development post bore construction could mean the bore is not connected adequately to the aquifer or it could be a very slow bore to receive recharge post construction/drilling. These factors should be considered for future monitoring periods
- MB35S - One of the manual groundwater levels is a poor match with logger data
- MB37D – Manual water levels match well with logger data, the spike in May 2024 should be investigated as the seems to correspond with the second rain event around April but not the first.
- MB38D – One of the manual groundwater levels is just an ok match with logger data
- MB39D - Manual water levels match well with logger data
- MB40D - Manual water levels match well with logger data, the rapid rise in water level initially should be kept in mind for future monitoring periods.

References

HydroGeoEnviro (HGE), 2023, Review of Eramurra Solar Salt Project – Groundwater Monitoring and Management Plan., Prepared for Leichhardt Salt Pty Ltd, December 2023.

HydroGeoEnviro (HGE), 2024, Eramurra Salt – November 2023 and February 2024 Groundwater and Surface Water Monitoring Event and Logger Install: Review., Prepared for Leichhardt Salt Pty Ltd, June 2024.