

Investigating the Impact of Recycled Water Use on Soil, Groundwater and Vegetation at Isaac Region, Qld

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Abstract

This study examines the impact of recycled water use on soil, groundwater, and vegetation at Moranbah in the Isaac Regional Council (IRC), Queensland. Wastewater recycling is common across Queensland, though reuse rates remain low as effluent discharge into waterways is often more cost-effective. At Moranbah, recycled water is primarily used for irrigation, serving both beneficial reuse (supporting vegetation and landscapes) and disposal (managing effluent volumes).

Monitoring under a Receiving Environment Monitoring Plan (REMP) included monthly site inspections, six-monthly groundwater analysis, and annual soil assessments. Effluent monitoring showed compliance with Environmental Authority (EA) requirements for residual chlorine, pH, nutrients, suspended solids, and BOD. Vegetation inspections showed grasses thrived under irrigation but declined when irrigation ceased. Soil analysis indicated neutral to slightly acidic pH, low conductivity, nitrogen levels typical of duplex soils, and no heavy metal accumulation. Exchangeable sodium levels were below sodic thresholds except at one site (MBH3), likely due to natural soil variation. Groundwater results showed no contamination.

Overall, recycled water use at Moranbah WWTP is environmentally sustainable, with no observed adverse impacts on soil, groundwater, or vegetation.

Introduction

Recycled wastewater use is common in Queensland but limited in scale, as EA conditions often allow cost-effective effluent discharge to waterways. Within IRC, recycled water serves two purposes:

- **Beneficial use** – irrigation to improve vegetation and community landscapes.
- **Disposal** – irrigation to manage excess water and minimise uncontrolled discharge.

IRC operates recycled water facilities in six towns: Nebo, Clermont, Glenden, Middelmount, Dysart, and Moranbah. Plants provide up to tertiary treatment, including solids removal, nutrient reduction, disinfection, and lagoon storage.

The Moranbah WWTP, 2 km northeast of the township, services sewered areas with a peak design capacity of 10,000–50,000 EP. The 1.6 ha site is bordered by playing fields, a golf course, residential areas, and Mining Lease (rural land). Overland flow drains west to the Isaac River (1.3 km away), and an outfall pipe discharges to Grosvenor Creek (2.5 km away).

Methodology

The REMP included:

1. Monthly site inspections with photographic records.
2. Annual soil profile analysis
3. Six-monthly groundwater laboratory analysis (bores being established).

EA conditions allow irrigation of 97 KL/day. Six soil sample locations were visually monitored monthly.

Fig 1.1 Moranbah – Soil Sampling Points (Bio-Track) (Bligh Tanner REMP, 2022)



Results

Results for recycled water quality, soil analysis and visual monitoring is presented below:

Treated Effluent Quality (Recycled water)

Monitoring followed EA frequency requirements. Results are summarised below. All averages met EA limits.

Table 1.1 Effluent Characteristics Summary 2022–2023

Parameter	EA Limit	Mean	Min	Max
Residual chlorine (mg/L)	0.5–3.0	1.76	0.09* / 0.72	2.91
pH	6.0–8.5	6.84	6.26	7.27
E. coli (MPN/100mL)	10	1	<1	1
Total suspended solids (mg/L)	30	4	1	8
Total Nitrogen (mg/L)	30	4.31	0.50	6.4
Total Phosphorus (mg/L)	15	4.13	2.51	7.03
Conductivity (µS/cm)	1600	620	514	848
BOD5 (mg/L)	20	<5	<5	<5

*Result outside holding time; IRC sample confirmed 0.72 mg/L.

Monthly Visual Monitoring

Fig 1.3 Moranbah Site 2, On going Visual inspection monitoring the impact of Recycle water use on vegetation and soil over time.

Feb 2024



July 2024



July 2024



December 2024



Soil Analysis

Soil samples were collected per EA requirements. Results are summarised below.

Table 1.2 Moranbah – Soil Analytical Results

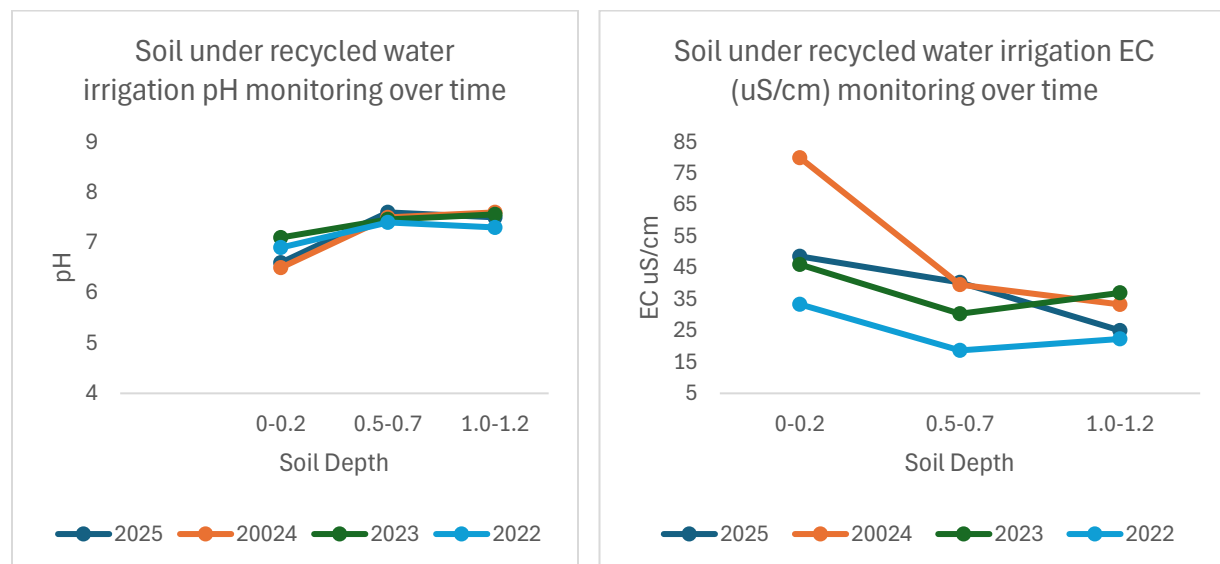
(pH, EC, Moisture, Exchangeable Cations, Total Nitrogen)

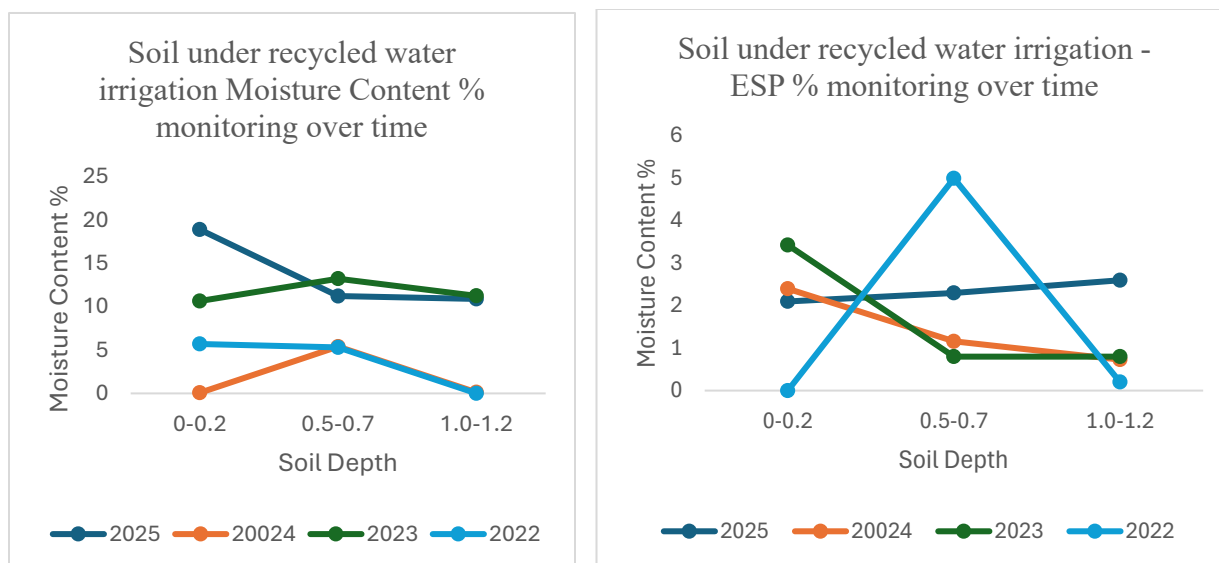
	pH value	EC @ 25 C	Moistu re	EX. Na	ESP	Ex. K	Ec.Mg	Ex. Ca	T. Nitrog en
Units	pH Unit	µS/cm	%	meq/100 g	%	meq/100 g	meq/100 g	meq/100 g	mg/kg
LOR	0.1	1	1.0	0.2	0.2	0.2	0.2	0.2	20
ID									
MBH1 0.0-0.2	6.7	31	17.2	0.1	2.9	0.2	0.9	2.4	800
MBH1 0.5-0.7	8.0	38	8.8	<0.2	<0.2	0.3	0.8	1.5	140
MBH1 1.0-1.2	7.9	23	7.2	<0.2	<0.2	<0.2	<0.2	0.5	90
MBH2 0.0-0.2	6.6	50	13.8	<0.1	0.7	0.5	2.3	6.3	810
MBH2 0.5-0.7	8.0	60	10.3	<0.2	<0.2	<0.2	<0.2	1.7	390
MBH2 1.0-1.2	7.7	28	9.7	<0.2	<0.2	0.2	<0.2	2.0	300
MBH3 0.0-0.2	6.6	65	25.7	0.3	2.7	0.3	2.8	6.9	2,560
MBH3 0.5-0.7	6.8	23	14.6	0.1	6.5	0.2	0.4	1.1	150
MBH3 1.0-1.2	6.9	24	15.9	0.1	7.6	0.2	0.4	1.0	170

Results from April 2025 soil sampling indicated a moist topsoil layer (7.2 to 25.7%), with neutral or slightly acidic pH, increasing at depth. The exchangeable sodium percentage (ESP) is predominantly less than the limit of reporting (LOR), or just above the sodic soil threshold of 6%

(Northcote and Skene 1972) in MBH1 and MBH2, indicating a lack of, or minimally sodic soils in these boreholes. However, MBH3 showed 6.5% ESP at 0.5 – 0.7 m below ground level (BGL) and 7.6% at 1.0 – 1.2 m BGL. These results are higher than in previous monitoring rounds; for example, in April 2024 ESP ranged from 1.8 to 4.0% at MB3. However, it is considered that these elevated results are more likely due to the natural heterogeneity of soil than from the irrigation. EC in both the surface soils and the subsurface soils was quite low ranging between 23 $\mu\text{S}/\text{cm}$ and 65 $\mu\text{S}/\text{cm}$. The nitrogen concentrations are of typical value for duplex soils. The nitrogen concentrations decrease as depth increases across the site. The subsoil's total nitrogen concentrations have not approached the topsoil concentrations, suggesting that at all sites the grass is assimilating the majority of the nitrogen. Topsoil values are expected to be significantly higher than subsoils owing to the higher quantities of organic matter in topsoil, and the values are expected to vary widely owing to the uneven nature of organic matter, as well as animal droppings. No heavy metal guideline exceedances were observed.

Fig 2 Soil pH, EC, Moisture Content and ESP comparison over time at Moranbah WWTP, using recycled water for irrigation.





Conclusion

Effluent parameters met EA limits. Vegetation monitoring showed no negative effects; grasses thrived under irrigation and showed wilting symptoms when irrigation ceased. No surface salt accumulation was observed. Soil properties have remained stable for several years. groundwater data is still awaited. However, based on available data it is safe to claim that recycled water use at Moranbah WWTP is environmentally sustainable.

References

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- Stantec (2024). *Moranbah Land-Based Effluent Disposal – Impact & Conceptual Model*, June 2024.
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