sunwater

Water Quality (Nitrogen) Offset Report Year 1 and Water Quality (Nitrogen) Offset Report 2025.

For Rookwood Weir under EPBC 2009/5173

Executive summary

Sunwater Limited is Government Owned Corporation and operates Rookwood Weir for the Queensland Government. This report addresses approval conditions for a report on nitrogen offsets investigations undertaken in the first year of operation of the weir. Nitrogen offset requirements are set out in approval conditions and an approved Water Quality (Nitrogen) Offset Management Plan (Rev2 Table 29 and text). Offset requirements were based on modelled assumptions that vegetation flooded by the weir would release nitrogen into the Great Barrier Reef, with most of this nitrogen being released in the first 12 months of inundation.

Water quality monitoring was undertaken prior to construction, during construction and after construction. Analysis of the monitoring data demonstrates that there is no increase in nitrogen levels in the impoundment or released water when compared to baseline conditions (SLR, 2025). As there is no increase in nitrogen release, no on-ground nitrogen offsets are currently proposed, although investigation of offsets has been undertaken. Investigation of scalable offsets will continue. Offsets based on research are continuing.

Sunwater is required to offset nitrogen impacts from inundation of vegetation in the Rookwood Weir impoundment. The water quality in and around the impoundment is being monitored and compared to preconstruction baseline levels to quantify impacts and offsets requirements under an approved Water Quality (Nitrogen) Offsets Management Plan. A number of nitrogen offset projects have been investigated. Two academic research projects are proceeding. Soil sampling, LIDAR data capture, remodelling and design has been undertaken at one stream bank project at Foleyvale (Alluvium 2024). Stream bank projects have been investigated in the Burnett and Fitzroy catchments including soil sampling (Butler and Partners, 2025; Alluvium 2025) but will not be pursued due to additionality concerns and low N yield.

Monitoring of water quality at Rookwood Weir indicates no increase in nitrogen release after 12 months of inundation compared to preconstruction levels (SLR, 2025). There is a strong possibility that no additional nitrogen will be released.

This report is the Water quality offsets review report that is required to be submitted between years 1 and 2 of operation of Rookwood Weir and the first years Water Quality (Nitrogen) Offsets Report 2025. It outlines Sunwater's approach to providing offsets in the context of water quality monitoring results received to date show no impact. Delays in identifying viable N offsets has not resulted in any new or increased impact to the Great Barrier Reef as monitoring demonstrates no additional nitrogen has been released.

Sunwater will continue to monitor water quality and provide a report on the second anniversary of operation as required under approval conditions.

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1. Introduction

Sunwater operates Rookwood Weir under EPBC approval *Lower Fitzroy River Infrastructure Project, Queensland -(EPBC 2009/5173)* including variations of conditions dated 27 July 2021. A Water quality monitoring program was designed and approved to allow monitoring of baseline and post construction water quality including nitrogen. A water quality offset strategy and Water Quality (Nitrogen) Offset Management Plan (WQOP) were developed that are subject to the approval conditions 1b and 4 (table 1).

The majority of the modelled nitrogen impact in the approval conditions was predicted to occur in the first 12 months of inundation. There has been no demonstrable increase in nitrogen levels relative to baseline levels in the first 12 months of monitoring post inundation. This suggests no nitrogen offsets will be required. The level of nitrogen impact will be determined in the Nitrogen Assessment Report of water quality data from the first two years of weir operation. This Water Quality Offset Review Report will be adjusted depending on those future findings.

Table 1 Extract of nitrogen offset approval conditions relevant to Rookwood Weir (Extracted from EPBC 2009/5173 variation of conditions)

1 Water quality monitoring program a) the program for Rookwood Weir must specify the monitoring activities and procedures capable of predicting potential, and detecting actual, impacts form the action…on the Great Barrier Reed World Heritage Area and National heritage place that may result from; i) changes in nutrient concentrations and oxygen levels due to decaying vegetation; and ii) agricultural development facilitated but the action in respect of the Rookwood Weir	
4 Offset strategy Impact vii) any increase in nitrogen due to decaying vegetation in the inundation area	Indicative impact area/quantity 645 tonnes initially predicted/modelled, later reduced to 194 tonnes under the plan **Unless the monitoring required at condition 1b) conclusively determines the impact is less than predicted**

2. Water quality results

Water quality monitoring results from before and after construction were analysed by independent suitably qualified experts. Concentrations and load were compared (SLR Figures 6 and Figure 9 extracted below). Results indicate that the anticipated release of nitrogen from rotting vegetation has not occurred.

> "At all sites, and most notably at the weir location, there was a trend of reduced peak nitrogen concentrations in the operations phase compared to the pre-operations phase " (SLR, 2025).

Figure 1 – Nitrogen concentration has not increased in the 12 months of weir inundation (source SLRa)

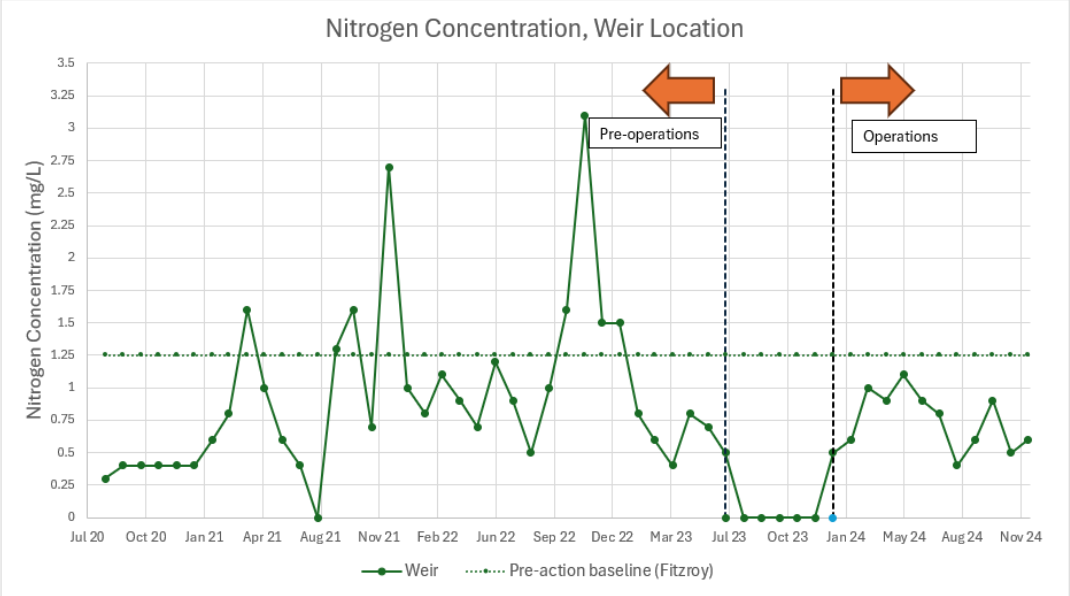


Figure 6: Monthly nitrogen concentrations at the weir location between July 2020 and November 2024.

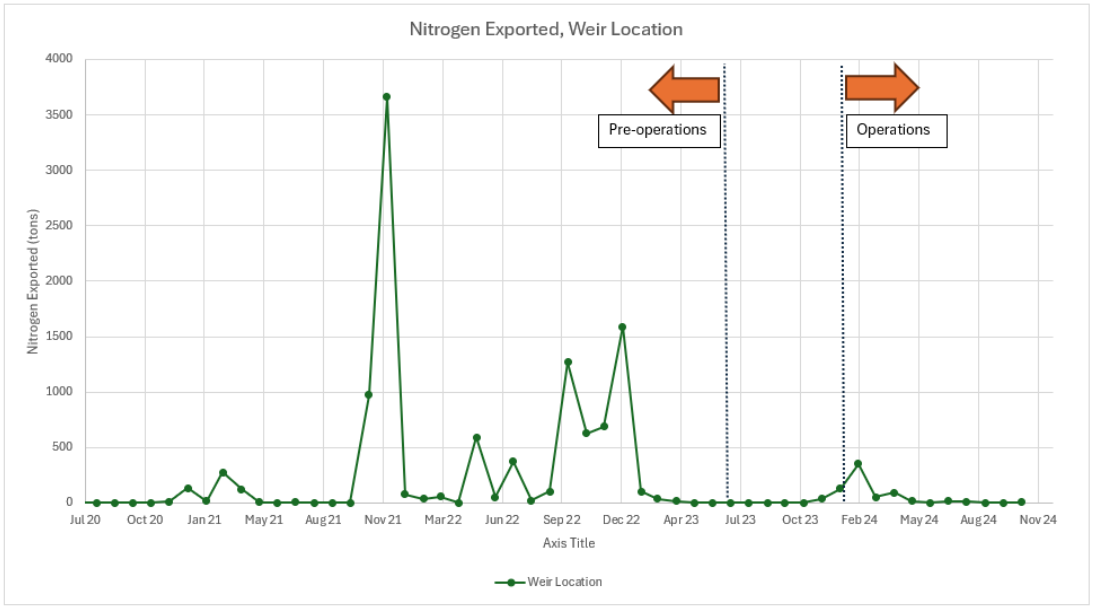


Figure 9: Monthly nitrogen loads at the weir location between July 2020 and November 2024.

An Annual Water Quality Monitoring Report (AWQMR) was prepared for the reporting period (i.e. 17 July 2024 to 16 July 2025) in accordance with the WQMRP. The AWQMR has concluded, upon assessment of the water quality monitoring data, that overall:

- There was no evidence that operation of the Rookwood Weir has influenced water quality of the Lower Fitzroy River.
- There is no evidence indicating that operation of Rookwood Weir has influenced water quality risks for the Great Barrier Reef.

Minor excedences of the 75th percale were detected in upstream, in weir and below weir locations (SLRb). An extract is provided below including monitoring data for the weir.

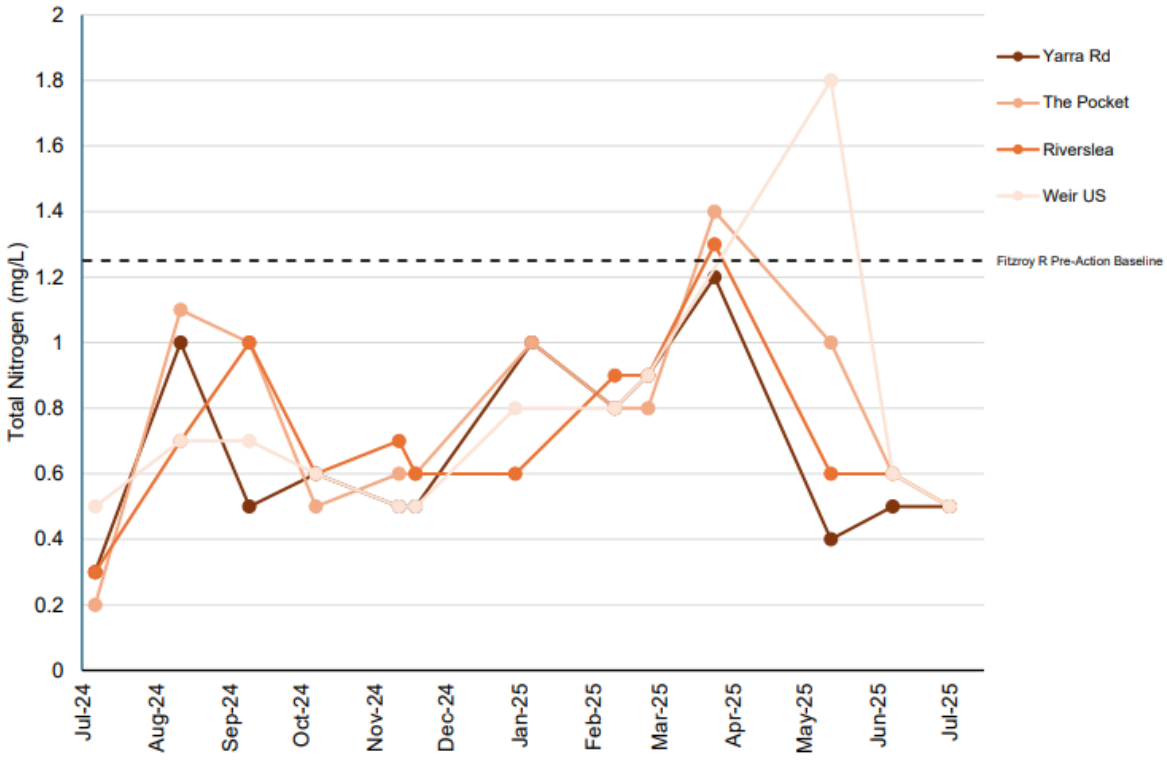
"Monthly nitrogen concentrations were generally similar across upstream, within impoundment and downstream sites and less than the applicable 75th percentile pre-action baseline except for

• Lower Dawson River upstream sites Beckers (October 2024; 1.5 mg/L) and Boolburra (July 2024; 5.3 mg/L), which exceeded the pre-action baseline of 1.4 mg/L

• Fitzroy River within impoundment sites The Pocket (April 2025; 1.4 mg/L), Riverslea (April 2025; 1.3 mg/L) and Weir-US (May 2025; 1.8 mg/L), which exceeded the pre action baseline of 1.25 mg/L (figure 2 below)

• Fitzroy River downstream sites Weir-DS (April 2025; 1.5 mg/L), Hanrahan (April 2025; 1.3 mg/L) and Glenroy Rd (January 2025; 1.4 mg/L), which exceeded the pre action baseline of 1.25 mg/L. The higher concentration of nitrogen at the Fitzroy River sites in April 2025 is likely the result of the high flow recorded during that month (see Section 3.2.1), with correlation analysis identifying a significant correlation between flow and the concentration of nitrogen for most Fitzroy River sites Figure 22 – Monthly nitrogen concentrations for sites within the impoundment during the reporting period (source SLRb) "

Figure 2 – Monthly nitrogen concentrations in the weir impoundment remain low relative to preconstruction levels (source SLRb)



The AWQMR was submitted to DCCEEW on 17 October 2025, and is publicly available at Sunwater website – Rookwood Weir Scheme.

These monitoring results are consistent with Griffith University studies on 6,000 ha of predicted flooding from a 2m raise at Burdekin Falls Dam, North Queensland. These studies measured high denitrification rates in shallow water with high organic carbon sources. Modelling suggested a net loss of 300tN/y from flooding vegetated areas, rather than any net increase in nitrogen release from rotting vegetation (Man, Burford and Hamilton, 2025 in prep.; Burford and Faggotter, 2025in prep). The Rookwood Weir inundation area is relatively shallow and contained substantial vegetation at the time of inundation. Denitrification is a probable alternative N export pathway to dissolved inorganic nitrogen.

3. Nitrogen offset projects assessments

Sunwater prepared tender documentation to secure nitrogen offsets using stream bank stabilisation projects with BMRG and FBA between 2022 and 2024. A range of potential projects were identified, modelled and ranked that Sunwater could fund for design and construction.

Testing of nitrogen levels throughout the soil profile was commissioned prior to financial commitment to the design and construction of three project locations. Using site soil testing results in the relevant model yielded a fraction of that initially modelled (Alluvium 2023; Alluvium, 2025). The level of nitrogen secured using the improved model is low relative to the financial commitment required. Stream stabilisation costs estimates from Alluvium 2023 indicate that securing nitrogen offsets for the maximum possible impacts from inundation of 18 t N would cost between $49M and $156M (Table 2).

The lead stream stabilisation site on the Burnett River at Bingara was also considered but was ruled out after consultation with DCCEEW due to additionality concerns. Some of the site works were funded by the Commonwealth through a separate environmental improvement scheme making it uncertain if nitrogen offsets could be claimed.

Table 2. Nitrogen reduction at the coast modelled with and without site nitrogen data.

Site	Costs (2023)	Modelled N retained (Alluvium 2023)	Revised modelling with site sampling of N (Alluvium 2025)	Initial estimate $/Kg N (Alluvium 2023)	Second estimate $/ kg N
Calliope	$1.3 - $1.6M	3.3 tN/y	0.279 tN/y	$737	$8,686
Styx	$1.3-1.6M	1.8 tN/y	0.527 tN/y	$805	$2,749
MacField	$5 - $7M	3.3 tN/y	1.47 tN/y	$1799	$4,038

Streambank projects were also considered to have additional risks including:

- possible failure under extreme runoff events
- high ongoing monitoring and reporting costs
- unknown maintenance costs.

Other offset projects in the WQOP were investigated and are set out in Table 3.

Table 3: Feasibility assessment of nitrogen offset projects in the WQOP

Offset Project	WQOP section	Descriptions of actions
Foleyvale / Stoney Creek streambank rehabilitation	5.1	**1. Review of overall strategy (Foleyvale and Stony Creek Streambank Rehabilitation)** The Foleyvale and Stoney Creek Streambank Rehabilitation nitrogen offset was reviewed by suitably qualified consultants (Alluvium,2024) including LIDAR and soil sampling to remodel nitrogen retention. The report was provided to DCCEEW June 2025. The yield of nitrogen was much lower than that predicted in the preconstruction Soil Horizon report making the cost per unit nitrogen very high. Estimation of nitrogen offset gains from land use change and gully rehabilitation on Foleyvale also indicated a very high cost per kg of N and risks of poor or negative delivery due to extreme weather events. Water quality monitoring at the weir indicates the anticipated N impact has not occurred so there is no clear trigger for providing offsets under condition 4 vi). **Sunwater is still considering this project in case nitrogen impacts from inundation are demonstrated during the required monitoring up to 2 years from inundation. This project is still feasible but with substantially reduced Nitrogen yield. It may be undertaken in the black Ironbox offset area.** **2. Field investigations and LIDAR capture** Alluvium undertook a site assessment including LIDAR data and soil sampling to remodel nitrogen retention rates at Foleyvale and Stoney Creek Stream bank Rehabilitation and adjoining gully systems. This report was provided to DCCEEW. This site may still be used if nitrogen offsets are required and the landholder is agreeable and Deed of Grant In Trust land can be used
Water quality research projects	5.2	Furthermore, Sunwater have established arrangements for the funding of two water quality research offset projects with Central Queensland University (CQU), comprising: ▪ PhD: Efficient nutrient monitoring framework for tropical impoundments, commencing early 2026 and concluding end 2029 (commencement date was rescheduled due to an unanticipated delay). ▪ Masters: Taxonomic composition of microalgae following freshwater impoundment and identification of cost-effective monitoring options. The masters commenced in August 2024 as scheduled and is due to be completed by August 2026. These projects are worth approximately 18 t of nitrogen offset under the approved WQOP
Streambank rehabilitation	5.3	Communications and meetings held with Fitzroy Basin Association and the Burnett Mary Regional Group regarding project planning and delivery arrangements for the four prospective sites. Multiple river restoration sites were prioritised (Alluvium 2023) and investigated with Fitzroy Basin Association (FBA) and the Burnett Mary Regional Group (BMRG). Contracts to design streambank repair were prepared and at the point of signing with BMRG and FBA. In discussion with DCCEEW the main nitrogen offset site (Burnett River) was then excluding due to unclear additionality due to Federal funding of tree planting for sediment retention at the same location.

		Sunwater prepared contractual documentations for the detailed design of streambank stabilisation at multiple sites via FBA. Soil testing and nitrogen level verification was undertaken prior to signing design contracts at multiple Fitzroy River catchment sites (Butler and Partners, 2025, Alluvium 2025). Sunwater funded this soil testing as part of due diligence assessment prior to committing to a multi-million-dollar design process, rather than trust modelled solutions to demonstrate an offset was achieved. Nitrogen levels were very low compared to the models used in site prioritisation and selection. The very low soil nitrogen levels and hence retention rates at site made the riverbank stabilisation projects questionable and cost per unit nitrogen very high. In addition, the risk of bank and pile field stabilisation projects failing catastrophically during severe runoff events has been recently demonstrated in the Burdekin Catchment, making this approach technically questionable and financially risky for securing nitrogen. Nitrogen yield was low, making it high-cost nitrogen if real nitrogen concentrations are used, rather than assumed values (Table 5.3). Streambank projects were also considered to have additional risks including: • possible failure under extreme runoff events • high ongoing monitoring and reporting costs • unknown maintenance costs. Streambank stabilisation project development is paused.
Weed harvesting	5.4	Communications and meetings held with Advance Rockhampton (the economic development unit of Rockhampton Regional Council) and James Cook University indicate this is an expensive option due to the lack of local water weed harvesting contractors and equipment. Investigation of harvesting water weed at Rookwood Weir show the site is difficult to access with the heavy and slow-moving machinery required. This project shows some feasibility with existing challenges being the high cost of mobilising contractors and suitable equipment from Brisbane (Costs around $300,000 per trip with limited weed harvesting achieved). There is potential for Sunwater to fund construction or design of a water weed harvesting unit plus truck to be housed in Rockhampton in return for claiming some of the nitrogen credits each year. RRC or other local body could own, maintain and run the harvesting gear. This project is potentially feasible but has challenges around safety, maintenance, housing, insurance and operating costs.
Landcare Projects	5.5	5.5.1 Landcare projects Landcare projects have not been pursued apart from preliminary discussions with Advance Rockhampton, VerTerra and Reef Catchments. Large scale agronomic change in grazing systems could provide nitrogen offsets. 5.5.2 Gully restoration Gully restoration projects have not been pursued as they mainly retain subsoil and very little nitrogen rich topsoil. Gully restoration on Foleyvale and Stoney Creek Stations were investigated as part of LIDAR survey and soil testing (Alluvium, 2024). The gullies were low yielding for nitrogen in terms of totals and $/kg. 5.5.3 Legume planting

<table>
<tr><td></td><td></td><td>This project proposal scope increases nitrogen levels in soils. Sunwater has not progressed this option. It may reduce surface erosion through increased ground cover however verbal advice from VerTerra indicates it is unlikely to reduce nitrogen export unless very large areas are involved.</td></tr>
<tr><td>In stream structure dredging</td><td>5.6</td><td>These projects have not been progressed due to potential increases in turbidity from dredging and low nitrogen levels in measured sediment at other tropical impoundments. Soil removal during periods where weirs dry out may still be considered. This project is feasible subject to cost and operational access. It would be safest to carry out when structures have complexly dried out so that truck and shovel operations can be used rather than dredging. Sediment sampling could be undertaken in years 2-3 of operation

Sampling results from Burdekin Dam extracted below (table 7) indicate that total nitrogen yield may be low based on sediment sampling at Burdekin Dam (Burford and Faggotter, 2025 in Prep) (results are means with standard deviation in brackets).

Table 7: Background sediment nutrient concentrations (g/kg) across all sites sampled during November 2023, March 2024 and July 2024. Data from April 2025 not yet available (na).
<table>
<tr><th>Date</th><th>Location</th><th>Total nitrogen (g/kg)</th><th>Total phosphorus (g/kg)</th><th>Total organic carbon (g/kg)</th><th>Sediment chlorophyll a (mg/m2)</th></tr>
<tr><td>28 Nov. 2023</td><td>Deeper reservoir</td><td>0.108 (0.067)</td><td>0.027 (0.004)</td><td>0.947 (0.088)</td><td>nd</td></tr>
<tr><td>18 Mar. 2024</td><td>Shallow littoral</td><td>0.230 (0.096)</td><td>0.024 (0.008)</td><td>2.840 (0.930)</td><td>nd</td></tr>
<tr><td>8 July 2024</td><td>Shallow littoral</td><td>0.121 (0.074)</td><td>0.021 (0.014)</td><td>1.230 (0.269)</td><td>146.07 (60.00)</td></tr>
<tr><td>8 July 2024</td><td>Deeper reservoir</td><td>0.108 (0.010)</td><td>0.027 (0.002)</td><td>0.959 (0.046)</td><td>nd</td></tr>
<tr><td>22 April 2025</td><td>Shallow littoral</td><td>na</td><td>na</td><td>na</td><td>5.78 (1.78)</td></tr>
</table>
</td></tr>
<tr><td>Financial offsets</td><td>5.7</td><td>Ecomarkets have been contacted and submissions made on water quality projects that Sunwater could participate in. Ecomarkets nitrogen credit producers have been met with (Green collar, Aquaregen). No commercial solution has been identified. This option remains very high cost ($35-50 M) so a clear requirement for offsets is needed before proceeding with investing public funds. Final investment decisions will be made after the Nitrogen Assessment Report at the end of Year 2. It is increasingly likely that there will be no nitrogen impact.</td></tr>
<tr><td>Other activities undertaken</td><td></td><td>Sunwater also investigated the following alternatives:

Woodchip bioreactors
Review of State government literature and interview of specialist academic researchers involved with bioreactor installation in the Burdekin cane production area. This demonstrated that installation was relatively low cost but monitoring and maintenance were expensive. N retention was erratic and relatively low. Sunwater operational staff will have difficulty installing on the existing network. This technology is not being pursued by Sunwater due to high maintenance commitments, impacts to the irrigation network and erratic N retention requiring expensive monitoring.</td></tr>
</table>

		Artificial wetlands These have high installation costs, high monitoring and maintenance costs for erratic nitrogen retention. Sites in the Burdekin were identified but the work Is not being pursued due to costs and hydrological effects disrupting established irrigation areas. **Aquatic vegetation installation in cane drains.** Sunwater hosted a Queensland government trial on nitrogen removal in vegetated irrigation drains in the Burdekin Haughton Water Supply Scheme. Results of the study have not been received. **Manipulation or alteration of drain vegetation remains a possible project option.** **Elevating water tables by holding water in drains.** This approach is used in the USA Mississippi Delta to denitrify cropping soils through intentional waterlogging of adjoining soil profiles. Internal consultation in Sunwater determined it is not suitable for Queensland cane production areas due to potential impacts on crop yields, soil trafficability, increased runoff and applied fertiliser loss.

Sunwater has investigated a number of offset projects All of the nitrogen offset projects investigated to date represent substantial investment of public money and many demonstrate low nitrogen benefit. Some certainty of offsets being required is needed before investment are made.

Variation from the plan for implementing viable N offsets has not resulted in any new or increased impact to the Great Barrier Reef as monitoring demonstrates no additional nitrogen has been released. The predicted nitrogen release reflected in the approval conditions (194t) cannot be identified by 12 months of site monitoring data collected under the approved Water quality monitoring program (approval condition 1b) (SLR, 2025). The first twelve months data was expected to show the highest nitrogen release. The current conclusion is there has been no increase in nitrogen levels, not the predicted increase (SLR, 2025).

4. Conclusions and recommendations

Monitoring of water quality indicates there is no impact on nitrogen levels from weir installation 12 months after inundation. It is likely that this trend will continue until the two-year nitrogen assessment report is prepared.

It is recommended that Sunwater:

- Continue nitrogen offset feasibility investigations but don't invest excessive public funds until nitrogen impacts from vegetation rotting in the weir pool are demonstrated.
- Consider desilting options for nitrogen removal if weirs dry out (instead of dredging).
- Consult with Woorabinda Pastoral Company and Woorabinda Aboriginal Shire Council about implementation of the Foleyvale Station Streambank rehabilitation if nitrogen offsets are needed.
- Pursue the two academic research projects regardless of the outcome of the two-year nitrogen assessment report.
- Continue water quality monitoring to allow determination if impacts are less than predicted.

If the two-year monitoring assessment report concludes there is no nitrogen impact then Sunwater will consult with DCCEEW to vary the WQOP to remove the need for nitrogen offsets.

5. Bibliography

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Alluvium 2024, Rookwood Weir nitrogen offset strategy- Foleyvale and Stoney Creek offset review, Report to Sunwater 2024.

Alluvium 2025 Sunwater offset calculations: Rookwood Weir Nitrogen Offset Sites, Report to FBA for Sunwater, 21 February 2025.

Burford M., Faggotter, S. 2025. Burdekin Falls Dam project final report – Part 1: Denitrification measurements. Australian Rivers Institute Report No. 2025/005, Griffith University, Brisbane.
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Butler Partners 2025. Soil Characterisation – Nitrogen in Soil Riverbank Restoration: Ogmore, Calliope and South Yamba, Report prepared for Fitzroy Basin Association, Project number RE24-1803A, funded by Sunwater, March 2025.

Man X., Burford, M. A., Hamilton, D. P. 2025. Burdekin Falls Dam project final report – Part 2: Denitrification modelling. Australian Rivers Institute Report No. 2025/006, Griffith University, Brisbane.

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SLRb 2025b Lower Fitzroy River Infrastructure, Queensland EPBC 2009/5173: Lower Fitzroy Water Quality Monitoring and Reporting Program 17 July to 16 July 2025, Report to Sunwater.