VISY PULP & PAPER TUMUT NSW

FARM AND ENVIRONMENTAL MONITORING REPORT

2023/2024

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1.0 Introduction

DM McMahon Pty Ltd have prepared this report on behalf of Visy Pulp & Paper Pty Ltd (Visy). The report presents a summary and analysis of environmental monitoring conducted at Gadara Park. Gadara Park is an approximately 2,124-hectare farm that surrounds the Visy mill. The Visy mill footprint on the farm is approximately 60 hectares.

The environmental monitoring program is conducted as specified in the Visy mill's Site Development Application, and in line with the Visy mill's NSW Environment Protection Authority (EPA) Environmental Protection Licence.

Gadara Park is an established cattle and sheep enterprise focused on prime beef and lamb production. Visy have a grazing rights agreement with JR Farming and Management Solutions, who presently run approximately 1,000 head of cattle and approximately 5,000 ewes and lambs. Gadara Park utilises the treated wastewater from the mill to irrigate 110 hectares using five centre pivot irrigators and a soft hose travelling irrigator. The irrigation areas produce hay, silage and fodder crops that are fed to the cattle and lambs, as part of Gadara Park's commercial prime beef and lamb production enterprise. Mill by-products have also been used as soil ameliorants in previous years for improved agricultural production as part of a Soil Amendment Trial.

The monitoring assesses the potential impacts of plant, farm, and irrigation operations on the environment. This report was commissioned by Visy as part of their annual Compliance and Monitoring report.

Limits for water quality have been drawn from the Visy EPA Licence No. 10232. Where no limit has been given in the licence, the Australian and New Zealand Guidelines (ANZG) for Fresh and Marine Water Quality (2018) or other relevant guidelines have been used.

Various sources have been used for establishing desirable ranges for soil analysis. The sources are mainly from published CSIRO and NSW Agriculture literature. Due to the wide range of test parameters, a single source could not be found that covered all analyses.

This report is a collation and interpretation of all monitoring activities and provides an annual summary of mill and farm activities.

2.0 Monitoring program 2023/24

Since November 2003, DM McMahon Pty Ltd has conducted monitoring at Gadara Park as specified in the Visy EPA Licence No. 10232. This includes, but is not limited to, groundwater, surface waters, irrigation water, sludge, and soils.

The monitoring program includes:

Groundwater
Quarterly groundwater level monitoring
Quarterly groundwater sampling and analysis

Surface water
Monthly surface water sampling and analysis (during irrigation season)

Wastewater and sludge
Wastewater sampling and analysis six times per year
Monthly sludge sampling and monitoring

Soil under irrigation
Biannual soil sampling and analysis
Nutrient balance and forward management plan

By-product application
Monthly sampling and analysis
Ongoing beneficial re-use assessment

Farm assessment
Farm agronomy
Crop planning for irrigation
Pasture improvement
Soil analysis
Nutrient budgeting

The following Table 1 shows the monitoring schedule of 2023/24 including sampling activity and frequency. Monitoring of sludge from the wastewater treatment plant, wastewater from the decant line, and mill by-products is undertaken monthly, while activities such as surface water testing are undertaken during the summer irrigation season. Groundwater sampling and analysis is undertaken quarterly. Soil sampling is undertaken biannually to coincide with the start of the winter and summer cropping programs. Soil sampling is used as a farm management tool as well as for environmental monitoring.

Table 1: *Monitoring program for all waters, soils, by-products and pasture at Gadara Park 2022/23*

Date	Activity
JULY 2023	
5.7.2023	By-products
5.7.2023	Storm waters
5.7.2023	WWTP-sludge from SBT
5.7.2023	Decant Point 10
4.7.2023	Groundwater quality
AUGUST 2023	
2.8.2023	By-products
2.8.2023	Storm waters
2.8.2023	WWTP-Sludge from SBT
2.8.2023	Decant Point 10
SEPTEMBER 2023	
1.9.2023	By-products
1.9.2023	Storm waters
1.9.2023	WWTP-sludge from SBT
1.9.2023	Decant Point 10
OCTOBER 2023	
3.10.2023	By-products
3.10.2023	Storm waters
3.10.2023	WWTP sludge from SBT
3.10.2023	Decant Point 10
3.10.2023	Surface waters
10.10.2023	Groundwater quality
9.10.2023	Soil monitoring sites
NOVEMBER 2023	
1.11.2023	By-products
1.11.2023	Storm waters
1.11.2023	WWTP-sludge from SBT
1.11.2023	Decant Point 10
1.11.2023	Surface waters
DECEMBER 2023	
1.12.2023	By-products
1.12.2023	Storm waters
1.12.2023	WWTP-sludge from SBT
1.12.2023	Decant Point 10
1.12.2023	Surface waters
JANUARY 2024	
9.1.2024	By-products
9.1.2024	Storm waters
9.1.2024	WWTP-sludge from SBT
9.1.2024	Decant Point 10
9.1.2024	Surface waters
10.1.2024	Groundwater Quality
FEBRUARY 2024	
1.2.2024	By-products
1.2.2024	Storm waters
1.2.2024	WWTP sludge from SBT
1.2.2024	Decant Point 10
1.2.2024	Surface waters
MARCH 2024	
1.3.2024	By-products
1.3.2024	Storm waters
1.3.2024	WWTP sludge from SBT
1.3.2024	Decant Point 10
	Surface waters

APRIL 2024	
2.4.2024	By-products
2.4.2024	Storm waters
2.4.2024	WWTP sludge from SBT
2.4.2024	Decant Point 10
3.4.2024	Surface waters
3.4.2024	Groundwater quality
4.4.2024	Soil monitoring sites
MAY 2024	
1.5.2024	By products
1.5.2024	Storm waters
1.5.2024	WWTP sludge from SBT
1.5.2024	Decant Point 10
1.5.2024	Surface waters
JUNE 2024	
3.6.2024	By products
3.6.2024	Storm waters
3.6.2024	WWTP sludge from SBT
3.6.2024	Decant Point 10

2.1 Monitoring suites

Table 2 shows the parameters that are tested for each monitoring activity. The parameters tested in the monitoring suites are dictated by the Environment Protection Licence No. 10232, although some additional monitoring is undertaken to aid farm management. Soil monitoring, for example, has additional nutrient analysis conducted to assist in nutrient budgeting for the cropping program. From the additional testing, nutrient budgets are calculated and reviewed every season to ensure maximum sustainable crop production.

A glossary with all abbreviations of chemical parameters can be seen in Sections 16 and 17.

Table 2: *Suite details – Testing suites for sampling schedule*

Monitoring activity	Frequency	Parameters
By-product monitoring	Monthly	As, Cd, Cr, Cu, Hg, Ni, Pb, Zn, Na, Bo, EC, Mo, pH, Se & moisture
Soil monitoring environmental	Annually	AS, Al, P (Available) EC, Ex Al, Ex Ca Ex Mg, Ex K, Ex Na, Nitrate, N (Total), OC, pH, PBI
Soil monitoring agriculture	Biannually	P(Bray), PBI, Ammonia, Ca, Mg, Na, K, Al, S, Cl, Boron
Hay / silage	As required	ME, Moisture, DM, CP, NDF, DMD, As, Cd, Cr, Cu, Hg, Ni, Pb, Zn
Groundwater monitoring	Quarterly	Depth, pH
Groundwater monitoring	Biannually	Depth, pH, EC, Nitrate
Decant Point 10	Six times per year	BOD, N, O & G, pH, P (Total) SAR, TDS, TSS, Zn
Sludge monitoring	Monthly during application	Mn, TSS, BOD, SAR, N (Total), P (Total), TDS, pH, EC, Cl, O & G
Surface water monitoring	Monthly during application	pH, TDS. BOD, TSS, Zn, P (Total), N (Total), Mn, EC, FC, O & G

3.0 Seasonal conditions 2023/24

Rainfall, temperature, and precipitation data was obtained through SILO (QLD Govt., 2024) with the data being interpolated from a point on the subject site. The SILO database has information on temperature, rainfall, and evaporation date from 1889 to the current day. The seasonal conditions compared to the long-term averages from 1889 can be seen in Figures 1 to 4.

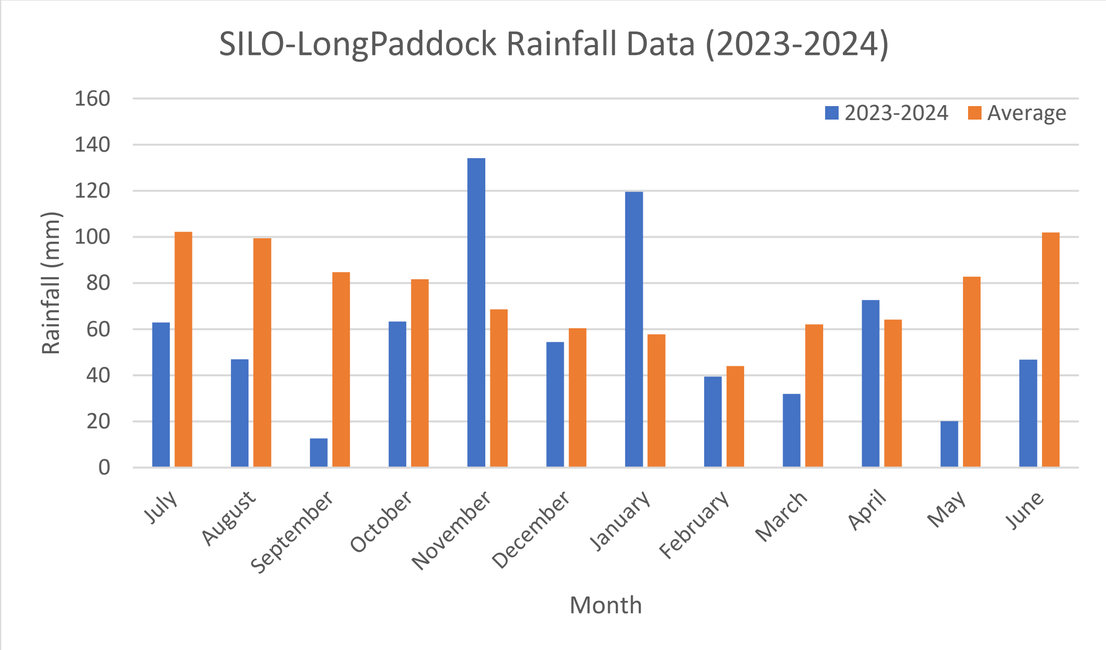


Figure 1: *Monthly rainfall 2023 to 2024 compared to long term average.*

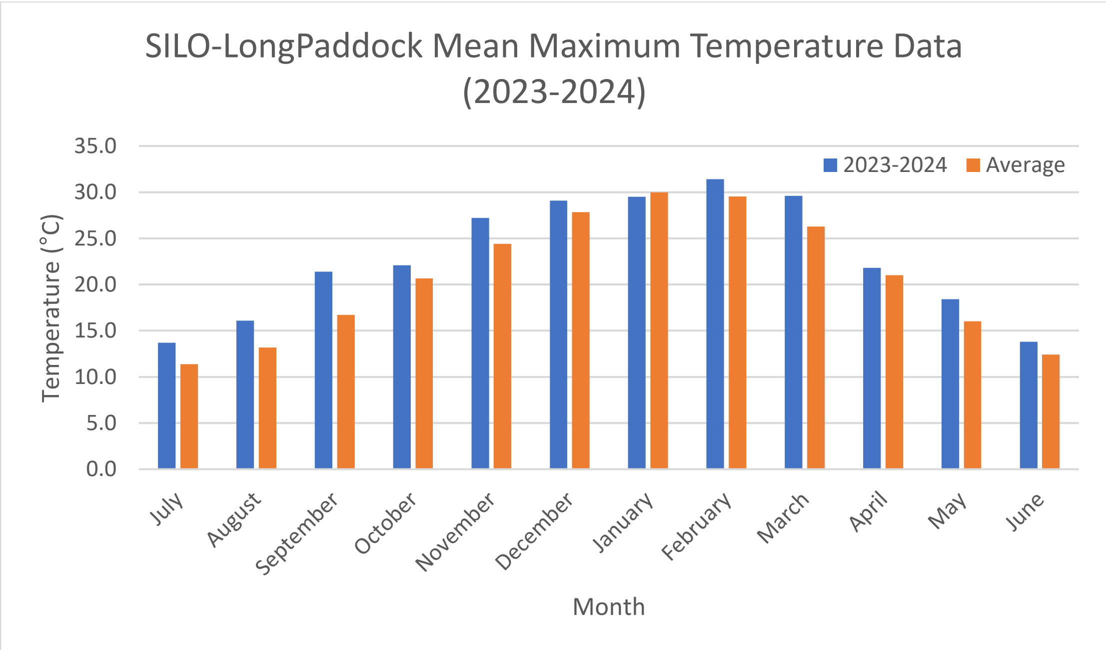


Figure 2: *Monthly maximum temperatures 2023 to 2024 compared to long term average.*

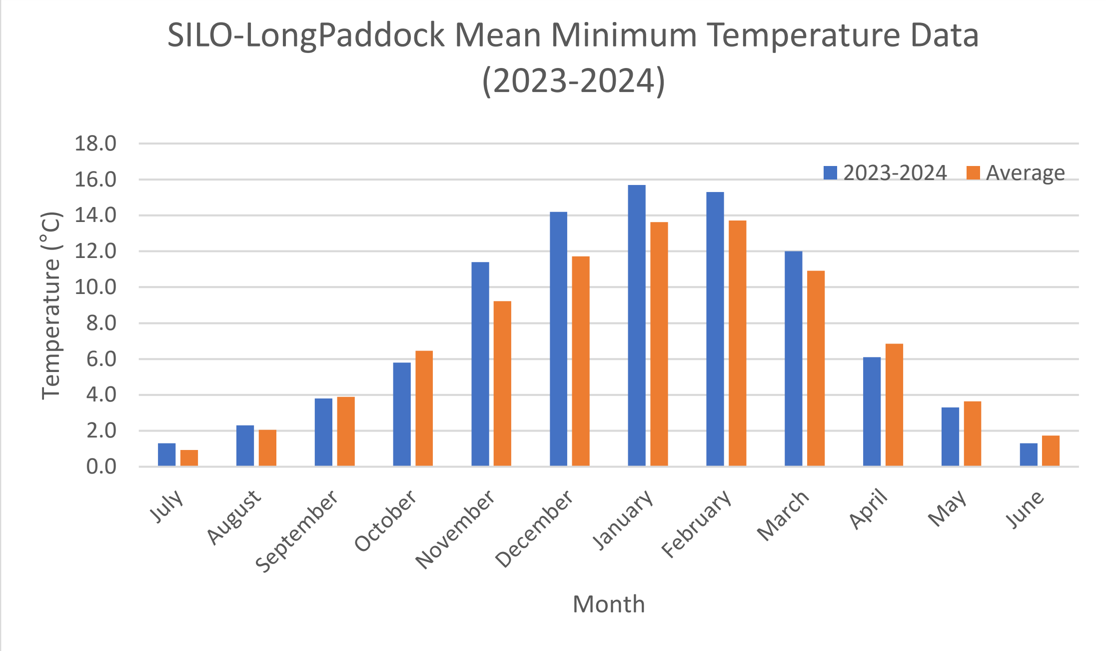


Figure 3: *Monthly minimum temperatures 2023 to 2024 compared to long term average.*

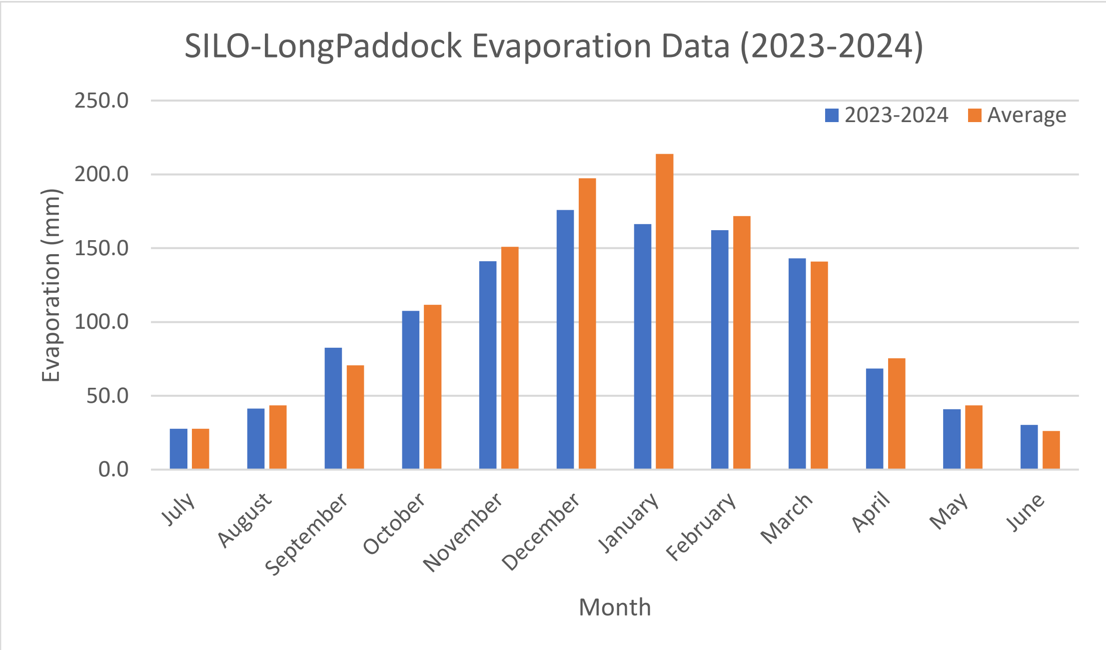


Figure 4: *Monthly evaporation 2023 to 2024 compared to long term average.*

Total rainfall for 2023/24 was 704.6mm which is lower than the annual average of 909.8mm. Monthly rainfall was above the average in November, January and April

Maximum and minimum temperatures in 2023/24 were similar to the long-term average.

Evaporation in 2023/24 was generally similar to the average.

4.0 Groundwater assessment

4.1 Groundwater bores introduction

At Gadara Park, 18 groundwater bores are monitored as specified in the EPA Licence conditions. Depth to piezometric surface and groundwater quality are monitored to ascertain if the mill and irrigation operations have any impact on local groundwater conditions.

Chemical analysis is carried out on a quarterly basis with the following parameters tested:

- Depth and pH (quarterly).
- Electrical conductivity (EC) and nitrate (every 6 months).

Depth to piezometric surface is assessed manually each quarter, with a water level indicator and tape measure. Automated depth monitoring has been installed in two bores as an ongoing improvement to the monitoring program.

The monitoring bores are classified in three main groups used for comparing quality:

- Bores BH1, BH2, BH3, BH4, BH7S, BH7D, BH11S and BH11D are background monitoring bores, and are located upstream of irrigation and mill activities.
- Bores BH8S, BH8D, BH9, BH10, BH15S and BH15D are located downstream and in areas of irrigation and potentially impacting activities.
- Bores BH13, BH14, BH16, and BH17 are located immediately below the winter storage to assess any impacts of the dam on shallow groundwater.

Thirty new groundwater monitoring bores were installed in 2005/06 to gain a better understanding of the groundwater characteristics upstream of, and within the irrigation area. The piezometric surface depth of the new bores in the irrigation and winter storage area is monitored quarterly in conjunction with the existing 18 bores but most of these bores were destroyed in 2023/2024 when the pivots and paddocks were cultivated.

- Bores BH27S, BH27D, BH28S and BH28D are located on either side of the winter storage to assess any impacts of the dam on shallow groundwater.
- Bores BH21S, BH21D, BH22S, BH22D, BH23S, BH23D, BH24S, BH24D, BH25S, BH25D, BH26S and BH26D are located within the irrigation area.
- Bores BH29S, BH29D, BH30S, BH30D, BH31S, BH31D, BH32S, BH32D, BH33S, BH33D, BH34S, BH34D, BH35S and BH35D are located upstream of the irrigation and mill activities and are classified as background bores.

The following map, Figure 5 shows the location of all the monitoring bores. At some sites, shallow (S) and deep (D) bores are located alongside each other. These have been represented as a single monitoring bore site in Figure 5.

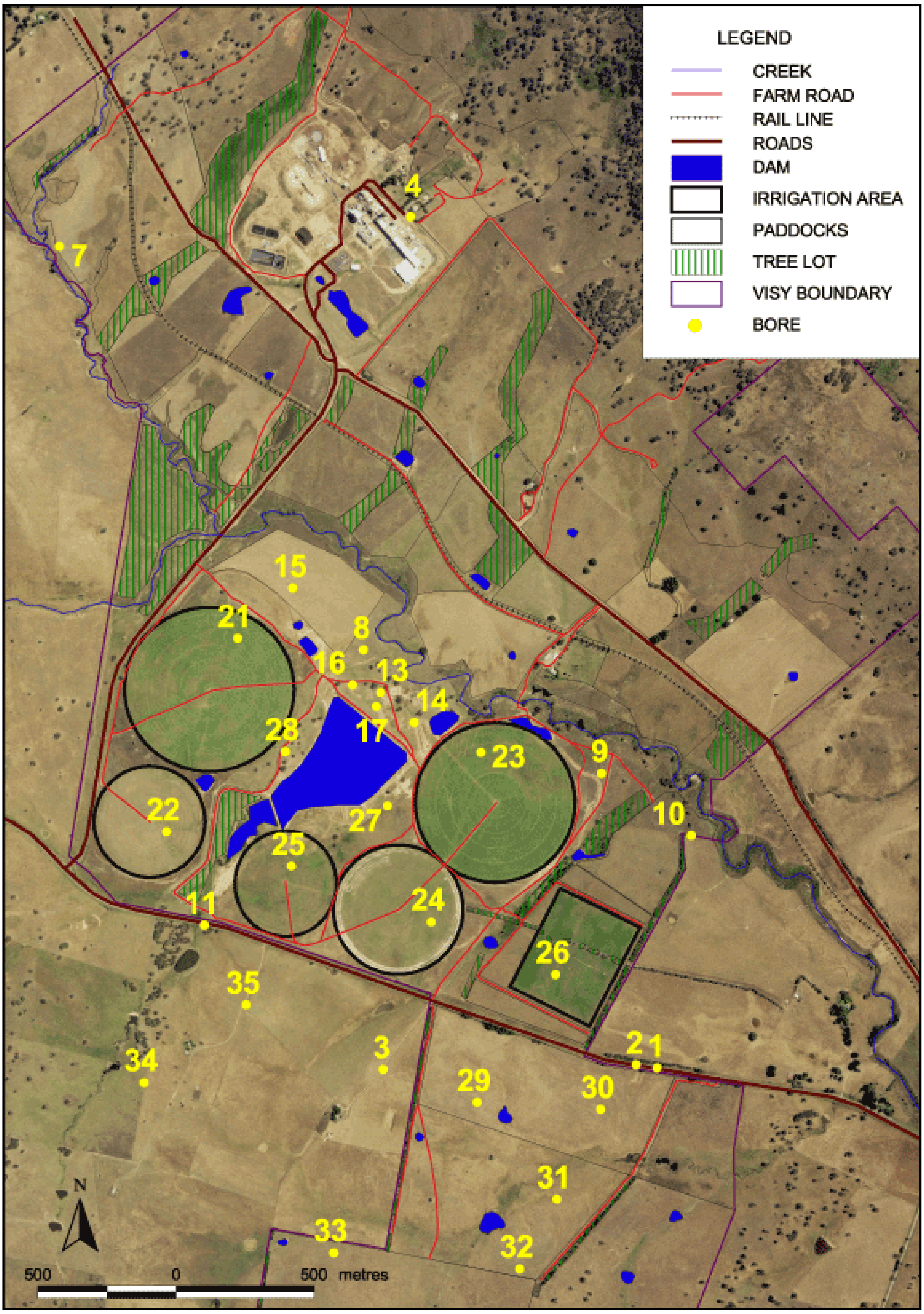


Figure 5: *Bore locations around Gadara Park and the Visy mill.*

4.2 Background bores monitoring

Bores: BH1, BH2, BH3, BH4, BH7S, BH7D, BH11S and BH11D

Bores BH1, BH2, BH3 and BH4 are large diameter bores (75mm to 100mm casing), ranging in depth from 10m to 30m. Bores BH1, BH2 and BH3 are located on the southern boundary of the farm and are higher in elevation compared to the irrigation area. Bore BH4 was located north of the mill site and is higher in elevation than all irrigation and mill activities. It was the deepest bore (30m) and had the highest elevation. In December 2007, Bore BH4 was destroyed during the mill expansion construction process and has not been replaced.

Bores BH7S and BH7D are located on the western margin of the Gadara Park property before the junction of Sandy Creek and Deep Creek. These bores are upstream of all mill and irrigation activities. Bores BH7S and BH7D have respective depths of approximately 7m and 14m.

Bores BH11S and BH11D are located on the Snowy Mountains Highway, at the southern boundary of Gadara Park and upstream of all irrigation and farm activities. These bores have respective depths of approximately 6m and 13m.

4.2.1. Chemical analysis

All results are provided in Attachment A.

pH

All background bores are slightly acidic to slightly alkaline (5.6 – 7.4) with most sitting within the neutral range. Overall, groundwater pH has been variable since monitoring commenced. Since 2013 however, pH is becoming more neutral and stable with a gradual increase noted over time in BH1, BH2 and BH3. When compared to the 2022/23 monitoring period, pH has remained stable.

Electrical Conductivity

EC ranged from 135µS/cm (BH2, July 2023) to 898µS/cm (BH11S, January 2024). EC values have remained relatively stable with a slightly decreasing trend noted since 2001.

Nitrate

Background bores generally exhibited low and stable levels of nitrate. Levels encountered in these bores are classed as low strength for agricultural use, compared against the Australian & New Zealand Guidelines for Fresh & Marine Water Quality (2018) critical values. Nitrate levels were highest at BH2 (5.5ppm in January 2024) which is typical for this monitoring bore.

4.3 Irrigation bores monitoring

Bores: BH8S, BH8D, BH9, BH10, BH15S and BH15D

BH8S and BH8D are located to the north-east (down-slope) of the western irrigation area slightly above the creek flats. They are 6m and 10m deep respectively.

BH9 is located to the north-east (down-slope) of the eastern irrigation area and Centre Pivot 3. BH9 is 16m deep.

BH10 is located on the eastern edge of the farm, and of all the bores is the furthest downstream of all irrigation activities. BH10 is 14m deep.

BH15S and BH15D are located to the north of Centre Pivot 1 on the creek flats. They are 6m and 17.5m deep respectively.

4.3.1. Chemical analysis
pH
All irrigation bores were typically slightly acidic to neutral across all bores (6.5 – 7.7). The irrigation bores have remained relatively stable since monitoring began.

Electrical Conductivity
EC ranged from 317µS/cm (BH15D, January 2024) to 860µS/cm (BH15S, July 2023). EC in the irrigation bores has remained relatively stable since monitoring began in 2001 with some seasonal variation.

Nitrate
Nitrate levels in the irrigation bores are variable ranging from <1mg/L (BH15S & BH15D July 2023) to 15.8mg/L (BH9 July 2023) which is consistent with the 2022/23 monitoring for these bores. Nitrate levels at BH8S and BH8D have been declining gradually since 2004 but have remained relatively stable for the last two monitoring periods.

4.4 Winter storage bores monitoring
Bores: BH13, BH14, BH16 and BH17

All bores are located to the immediate north of the winter storage dam wall. They are all shallow bores, ranging in depth from 3m to 7.5m. These bores are all shallow in depth compared to the background and irrigation monitoring bores and are measuring shallow aquifers or moisture in colluvial layers only.

4.4.1 Chemical analysis
pH
Winter storage bores were typically neutral to alkaline (6.7 – 8.0) which is typical compared to historical data.

Electrical Conductivity
EC in the winter storage bores ranged from 749µS/cm (BH14, January 2024) to 1540µS/cm (BH16, July 2023). BH16 has remained relatively stable with a slight decrease since July 2021, with all other winter bores having remained relatively stable.

Nitrate

Nitrate values ranged from <0.1mg/L to 0.8mg/L (BH14, July 2023). All winter storage bores exhibited low to very low levels of nitrate which is a continuing trend over the last five years.

4.5 Groundwater depth monitoring

Groundwater piezometric depth monitoring takes place on a quarterly basis. All depths are measured from the top of the bore casing which ranges from 200mm to 1000mm above ground level.

Monitoring commenced with the installation of four bores in 1997 and a further 14 bores followed in 2001 to coincide with the commencement of mill operations. In 2006, 30 new groundwater monitoring bores were installed to gain a better understanding of the groundwater characteristics up-gradient of, and within the irrigation area. Historically the background, winter storage and irrigation bores all exhibit similar trends, consistent with peaks and troughs that coincide with recharge from winter and spring rainfall.

Background, irrigation, and winter storage bore groundwater piezometric depths had progressively declined in the 2023/24 monitoring period after a slight increase between 2020 and 2023. Above average monthly rainfall from November 2023 to January 2024 led to increases in groundwater depths for most bores, indicating that groundwater recharge through rainfall is taking place. Subsequent low rainfall between February 2024 and April 2024 led to all monitoring bores greatly declining in groundwater depth during this period, apart from BH11D which remained relatively stable.

A graphical view of groundwater depths from during the 2023/24 monitoring period is provided in Figures 6, 7 and 8.

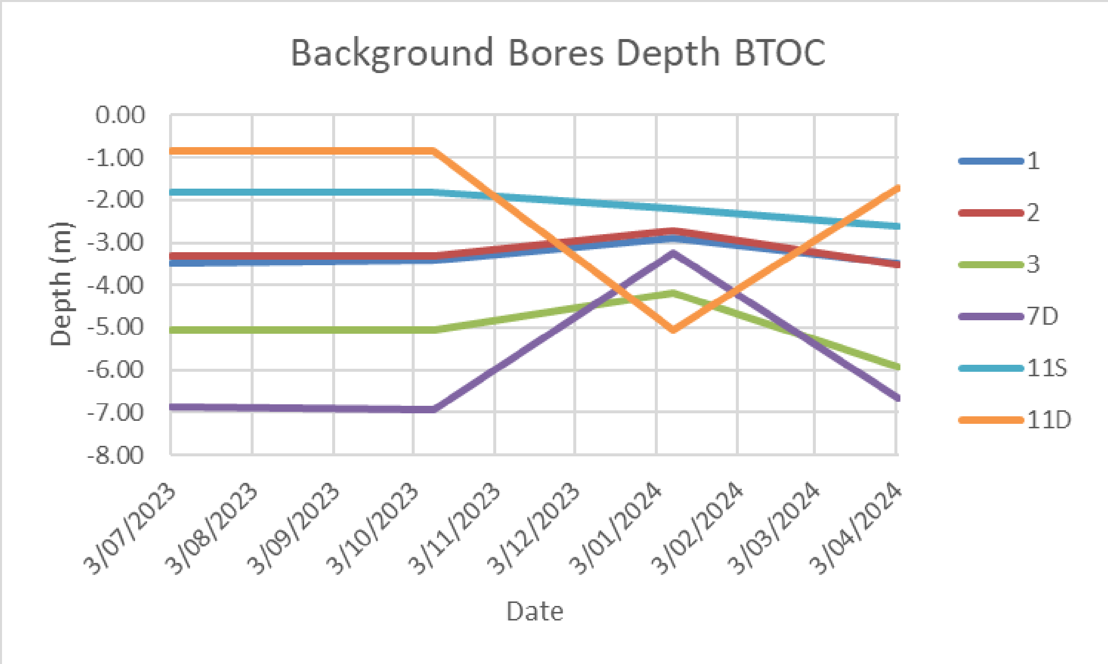


Figure 6: *Depth of background (non-irrigation) bores at Gadara Park in metres below top of casing (BTOC)*

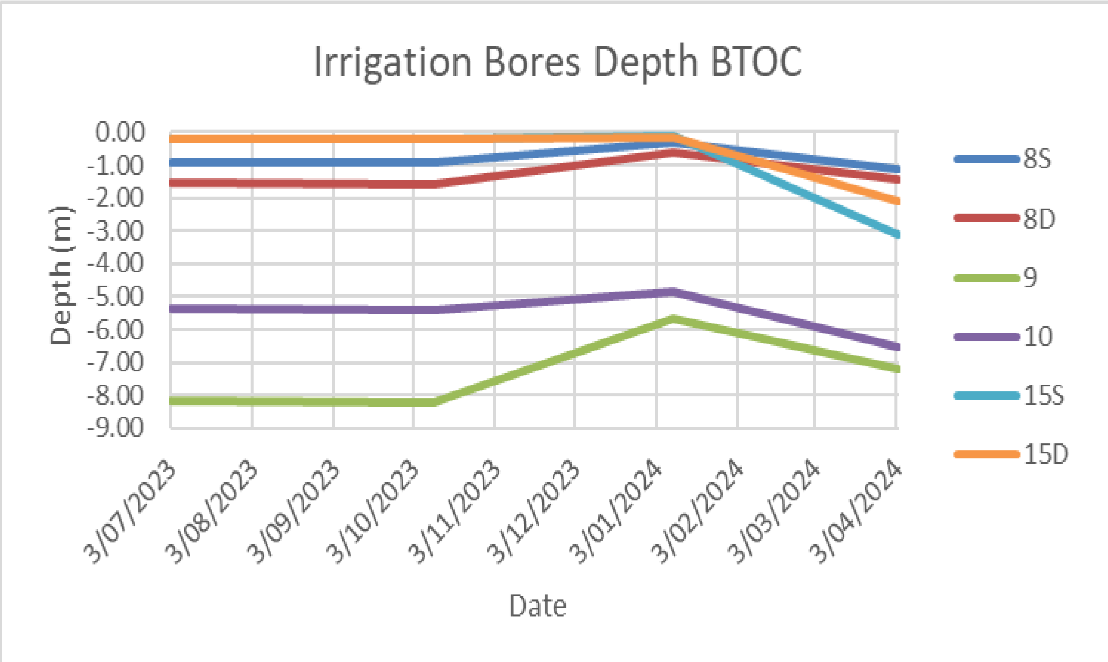


Figure 7: *Depth of irrigation bores at Gadara Park in meters below top of casing (BTOC)*

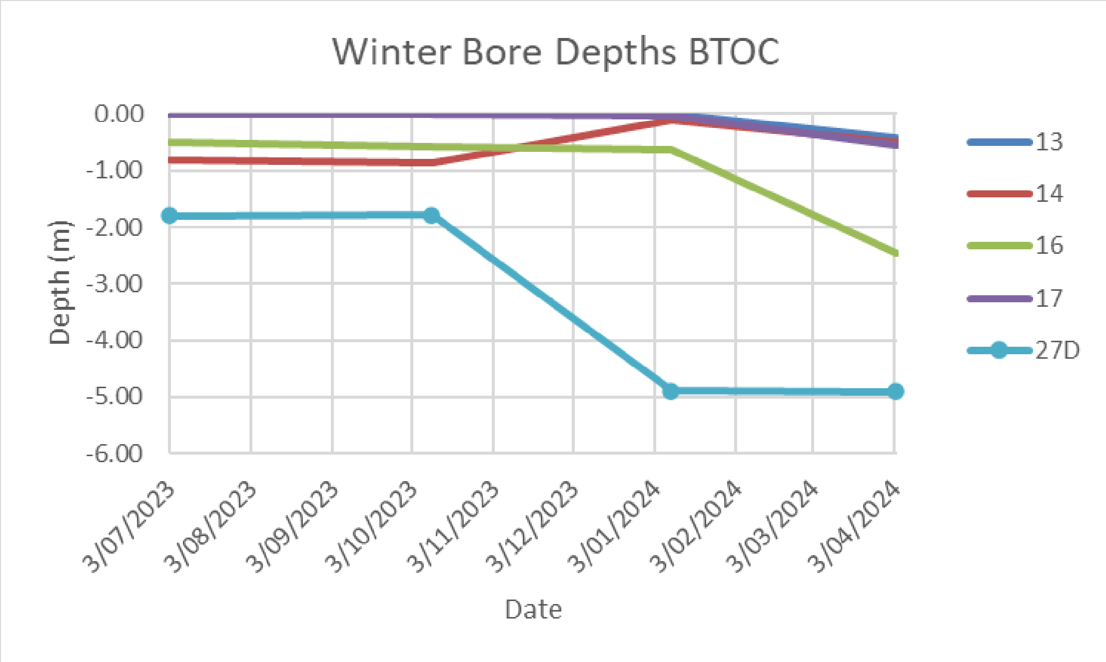


Figure 8: *Depth of winter storage bores at Gadara Park in meters below top of casing (BTOC)*

4.6 Groundwater conclusions

The groundwater piezometric levels in 2023/24 were similar to the trends monitored in the 2022/23 period. Historically, the groundwater piezometric levels are quite dynamic with a peak in October to January following recharge from winter and spring rains. Above average rainfall in November and January of the 2023/24 monitoring period saw this trend continue with most bores experiencing peak levels in January 2024. The majority of bores declined in levels during the July 2024 monitoring round which follows historical trends of the site. The shallow alluvial aquifers at Gadara Park rely heavily on recharge from rainfall to maintain a constant level. The cyclic trend of groundwater piezometric levels corresponding with rainfall as explained by Coffey is apparent from the historical monitoring data (Coffey, 2003).

Background bores exhibit low levels of EC and nitrate.

The irrigation bores exhibit elevated levels of nitrate compared to the background and winter storage bores. The irrigation bores exhibit steady levels of EC typical of alluvial aquifers. The levels of EC in the irrigation bores are slightly higher than in the background bores as a historical comparison. This same comparative trend was noted by Coffey (Coffey, 2003).

Winter storage bores exhibit elevated levels of pH and EC compared to the background and irrigation bores, especially in bores 16 and 17. Levels have remained relatively stable since 2003, with some minor seasonal fluctuations consistent with the background and irrigation monitoring bores.

Overall, the bores have remained relatively stable (with some seasonal fluctuations) in piezometric depth and chemical composition since monitoring commenced, pre-mill construction.

5.0 Surface water assessment

5.1 Surface water monitoring sites

The surface water monitoring sites are outlined in the following map of the Visy mill and Gadara Park farm site, Figure 9. Three of the monitoring sites are upstream (SW1, SW3 and SW4) of all mill and irrigation activities and the other two sites are downstream (SW2 and SW5).

The monitoring results from sites upstream of the mill are compared against downstream results to determine if the mill and irrigation activities are having an effect on water quality.

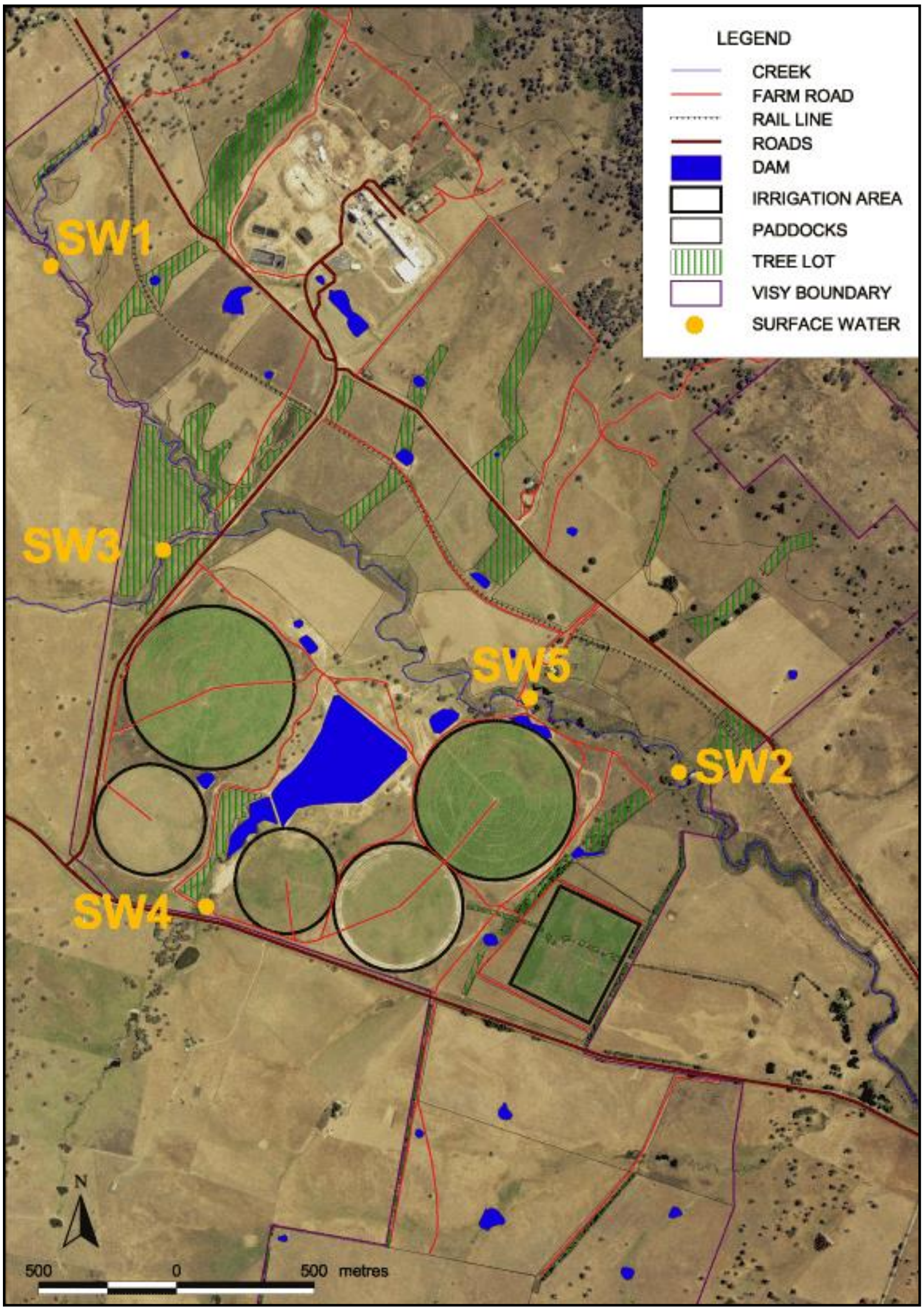


Figure 9: *Surface water monitoring points at Gadara Park*

5.1.1 Surface water site 1 (SW1)

SW1 (surface water monitoring north) is located on the upstream boundary of the Visy mill site. The monitoring site is in an incised creek line (around three metres deep), see Figure 10. Cattle can access the site from the neighbouring farm. There has always been some evidence of cattle around the monitoring site in the form of manure and tracks. The water is mostly running, albeit in limited amounts and water quality has generally been good.

This sampling location monitors water quality offsite and upstream of the mill site (Visy 2003).

Figure 10: *Surface water monitoring point number 1*

5.1.2 Surface water site 2 (SW2)

SW2 (surface water monitoring south) is located downstream of the Visy mill site and is the widest stretch of the creek. There has always been running water at this site and it is on the bend of the creek with a small sandy beach, see Figure 11.

This sampling location monitors water quality downstream as it departs the mill site (Visy 2003).

Figure 11: *Surface water monitoring point number 2*

5.1.3 Surface water site 3 (SW3)

SW3 (surface water monitoring deep creek) is located on Deep Creek upstream of the Visy mill site. The site is a widened pool within an incised creek line, see Figure 12. Water quality has generally been fair to good. There has consistently been particulate matter in the form of algae observed in the water column during sampling. This area is surrounded by a tree lot that is infrequently grazed.

This sampling location monitors water quality in Deep Creek before it joins Sandy Creek (Visy 2003).

Figure 12: *Surface water monitoring point number 3*

5.1.4 Surface water site 4 (SW4)

SW4 (surface water monitoring Snowy Mountains Highway) is located on the Snowy Mountains Highway and is down stream of the Visy mill site and farm. Water analysis usually returns high rates of suspended solids and TDS. The site is at the plateau of an extremely large catchment that has had only intermittent low flows since monitoring commenced in November 2003. With sufficient rainfall, the monitoring site receives high flows of water from the catchment which improves chemical quality.

SW4 is aesthetically the poorest surface water monitoring site because of the usually stagnant and discolored water, see Figure 13. Although this site is considered aesthetically poor, there is an abundance of macro invertebrates and aquatic fauna, indicating reasonable water quality.

This sampling location monitors water quality from upstream of the mill and irrigation areas, (Visy 2003).

Figure 13*:* *Surface water monitoring point number 4*

5.1.5 Surface water site 5 (SW5)

SW5 (surface water monitoring Sandy Creek) is located on the Visy farm at the creek crossing in the center of the farm, see Figure 14. The water quality has generally been fair to good with constant running water.

This sampling location monitors water quality in Sandy Creek as it passes beside the irrigation areas, (Visy 2003).

Figure 14: *Surface water monitoring point number 5*

5.2 Chemical analysis

All results are provided in Attachment B

Total Dissolved Solids

All sites exhibit low levels (<600mg/L) of TDS. The results ranged from 210mg/L (SW1, December 2023) to 563mg/L (SW4, March 2024). There are no significant long-term trends developing other than seasonal peaks in summer and autumn, consistent with lower surface water flows.

Electrical Conductivity

All sites exhibited relatively stable EC readings for all sites over the 2023/24 monitoring period, with values ranging from 328µS/cm (SW1, February 2024) to 880µS/cm (SW4, March 2024).

Biochemical Oxygen Demand

All BOD readings met the (ANZG, 2018) criteria of 15mg/L except for two occurrences in January 2024 at SW2 (52mg/L) and March 2024 at SW1 (19mg/L).

pH

The surface water pH for all sites ranged from 6.5 (SW1, April 2024) to 8.6 (SW3 November 2023). The recommended pH range for upland streams is between 6.0 and 7.5 (ANZG, 2018). Although the surface water pH is sometimes above the upper guideline value, pH results are consistent between all upstream and downstream monitoring sites suggesting this is inherent to the locale, (ANZG, 2018). Historical data shows similar pH levels since monitoring commenced in 2003.

Faecal coliforms
All surface water monitoring sites exhibit generally low to moderate levels of faecal coliforms with a range between <1fcu/100mL (SW3 February 2024) and 1600fcu/100mL (SW4, May 2024). The mean level of faecal coliforms across all sites for the 2023/24 monitoring period was 433fcu/100mL per month, which was lower than the historical mean of 1784fcu/100mL.

Nitrogen and phosphorus
Nitrogen levels for all sites ranged from below detectable levels, <2mg/L (multiple readings) to 4mg/L (SW4, Oct, Mar, Apr, May 23/24). Phosphorus ranged from <0.01mg/L (multiple readings) to 0.44mg/L (SW4, October 2023) and was consistent across all sites. The nitrogen and phosphorus levels are consistent with historical data.

Oil and grease
Oil and grease readings ranged from <1mg/L (multiple sites) to 4mg/L (multiple sites). The mean oil & grease level across all sites was 2.1mg/L which is lower than the historical mean of 3.5mg/L. Some higher readings have been recorded at all sites since 2003 when monitoring commenced although all sites have been below the (ANZG, 2018) recommended level of 5mg/L for the 2023/24 monitoring period.

The Hexane Extractable Matter (HEM) APHA 5520 D EPA method was used to test oil and grease. This test detects non-volatile hydrocarbons, chlorophyll, animal fats, vegetable oils, waxes, soaps, greases etc. The HEM method is not designed specifically to detect fuel or fuel oil. The results that are above detectable levels could be due to the detection of any of the above material and are likely to be from a natural source. No known fuel-related, grease-related, or oil-related contaminating activities take place at or upstream of the surface water sites.

6.0 Wastewater assessment

6.1 Wastewater monitoring site

Treated wastewater was sampled from a tap on the decant line (Point 10) that runs from the 2.5ML decant storage dam to the winter storage dam until December 2021, after unusually high readings (8 December 2021) were observed owing to alterations to pipework in the system. Since December 2021, the treated wastewater sample has been taken directly from the 2.5ML decant storage dam at the direction of Visy for a more representative sample of the wastewater that runs to the winter storage dam. In total, six samples were collected in 2023/24.

6.2 Chemical analysis

All results are provided in Attachment C.

BOD

BOD levels ranged from 3mg/L to 19mg/L with a mean of 8.4mg/L, which is classed as low strength effluent (<40mg/L) for irrigation (DEC 2004) and below the licence limit of 40mg/L.

TDS

TDS ranged from 136mg/L to 250mg/L. All results are classed as a low strength effluent (<600mg/L) for irrigation, (DEC 2004).

SAR

SAR ranged from 3 to 7. The mean SAR of 4.3 is similar to the readings from the previous five monitoring periods.

Nitrogen and phosphorus

The levels of total nitrogen range from 2mg/L to 43mg/L with a mean of 6.8mg/L, which is classed as a low strength effluent (<50mg/L) for irrigation, (DEC 2004) and below the licence limit of 20 mg/L.

Phosphorus levels range from below detectable limits <0.01mg/L to 1.44mg/L. All results are below the licence limit of 5mg/L. The mean of 0.9mg/L is classed as a low strength effluent (<10mg/L) for irrigation, (DEC 2004).

pH

The pH of the wastewater samples ranged from neutral to alkaline with a range of 7.0 to 7.9. The 7.4 average of the 2023/24 data is inside the suitable range of 6.0 to 8.5 for irrigation, (ANZG, 2018).

Suspended solids

The suspended solids readings ranged from <2mg/L to 18mg/L. Results were below the EPA licence limit of 45mg/L.

Zinc

Low levels of zinc were found in all samples with the highest of these concentrations being 0.050mg/L. The results were under the guidelines for irrigation of 2mg/L, (ANZG, 2018).

Oil and Grease

Oil and grease levels ranged from <1mg/L to 4mg/L. All results are below the EPA licence limit of 5mg/L.

The Hexane Extractable Matter (HEM) APHA 5520 D EPA method was used to test oil and grease. This test detects non-volatile hydrocarbons, chlorophyll, animal fats, vegetable oils, waxes, soaps, greases etc. The HEM method is not designed specifically to detect fuel or fuel oil. The results that are above detectable levels could be due to the detection of any of the above material and is likely to be from a natural source. No known fuel-related, grease-related or oil-related contaminating activities take place at or upstream of the surface water sites.

7.0 Irrigation assessment

A total volume of 830.24 megaliters (ML) of water was land applied during the 2023/24 irrigation season. Of the 830.24ML irrigated, most of the source is treated wastewater, the remaining volume being direct runoff from rainfall into the winter storage dam, runoff pumped from the irrigation run off dams and backwash water from the irrigation filters.

The amount of wastewater irrigated in 2023/24 is 354.24ML higher than the long-term average of 476ML per annum, and just below the irrigation amount for 2022/23, Table 3. The highest monthly irrigation amounts occurred from November 2023 until March 2024. Irrigation was reduced from 2007 to 2009 owing to the mill conducting water re-use trials in the production cycle and less rainfall runoff into the winter storage dam due to the drought conditions but has increased significantly in the last three years.

Table 3: *Historical irrigation amounts*

Season	Irrigation area (ha)	Volume irrigated	
		Total (ML)	ML/ha
2003-2004	110.86	568	5.12
2004-2005	110.86	615	5.55
2005-2006	110.86	512	4.62
2006-2007	110.86	258	2.33
2007-2008	110.86	233	2.10
2008-2009	110.86	153	1.38
2009-2010	110.86	74	0.67
2010-2011	110.86	368	3.32
2011-2012	110.86	428	3.86
2012-2013	110.86	762	6.91
2013-2014	110.86	261	2.35
2014-2015	110.86	644	5.81
2015-2016	110.86	617	5.57
2016-2017	110.86	500	4.53
2017-2018	110.86	545	4.92
2018-2019	110.86	372	3.35
2019-2020	110.86	368	3.33
2020-2021	110.86	513	4.63
2021-2022	110.86	852	7.68
2022-2023	110.86	894	8.06
2023-2024	110.86	830	7.49

Table 4 presents the breakdown of the volume of water applied to the five Centre Pivot (CP) irrigators (CP1 to CP5) and a soft hose travelling (SHT) irrigator.

Table 4: *Amount of water irrigated to land 2022/23*

Month	CP1	CP2	CP3	CP4	CP5	SHT	Total
July 2023	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
August 2023	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
September 2023	24.69	5.59	18.57	7.67	5.59	0.00	**62.11**
October 2023	25.40	10.57	18.06	14.51	10.57	0.00	**79.11**
November 2023	36.46	12.70	33.14	17.43	12.70	0.00	**112.43**
December 2023	33.63	14.40	30.57	19.77	14.40	0.00	**112.75**
January 2024	36.61	13.49	17.54	16.18	11.78	0.00	**95.60**
February 2024	35.90	15.55	31.73	20.52	14.76	0.00	**118.45**
March 2024	39.30	16.83	35.72	23.10	16.83	0.00	**131.78**
April 2024	15.47	6.62	14.06	9.09	6.62	0.00	**51.86**
May 2024	23.27	6.44	21.15	8.84	6.44	0.00	**66.14**
June 2024	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Total ML	**270.72**	**102.17**	**220.54**	**137.13**	**99.68**	**0.00**	**830.24**
Area ha	28.27	12.06	25.70	16.60	11.15	17.50	110.3
ML/ha	**9.58**	**8.47**	**8.58**	**8.26**	**8.94**	**0.00**	**7.49**

7.1 Irrigation scheduling

Wastewater application rates aim to match crop types to ensure sustainable and efficient plant water use. The amount of water irrigated in 2023/24 (depending on water availability) is closely matched with anticipated crop water demand. Over the 2023/24 summer irrigation season CP2, CP4 and CP5 were sown to lucerne & white clover, CP1 and CP3 to hogan rye & white clover and SHT to hogan rye.

When irrigation is taking place, scheduling is reviewed daily considering weather conditions, soil moisture, crop performance and the available irrigation resource. Gadara Park has excellent irrigation monitoring resources including:

- Soil moisture probes installed in each irrigation field with sensors located at 10cm, 30cm and 50cm;
- Evapotranspiration (ET_o) data available from interpolated dataset;
- Accurate irrigation application scheduling through the centre pivots;
- Annual soil analysis; and
- Accurate winter storage capacity data.

The correlation between crop daily water requirements, based on ET_o, and actual water use are demonstrated in Table 5. The ET_o value is from the SILO Data Drill for Lat, Long: -35.30S 148.15E (decimal degrees). This value is interpolated from surrounding Bureau of Meteorology weather stations with adjustments made for elevation. Wind speed is capped at two metres per second, which would exclude the extremely high ET_o days from the data. Potential ET_o is calculated as per FAO Irrigation and Drainage Paper 56. Effective rainfall has been calculated on the assumption that rainfalls of <5mm during the irrigation period are non-significant. In winter, all the rainfall is assumed to be effective (Qassim and Ashcroft, 2001).

At Gadara Park, water balances are regularly calculated to ensure irrigation supply is matched to crop demands. The water balance for CP3 has been supplied to demonstrate that sustainable irrigation is taking place, with applications on par with crop water demand, Table 5. Irrigation efficiency is commonly 85 to 90%, therefore the amount irrigated will sometimes be slightly more than the plants water requirement. Water losses include drift, evaporation, runoff, and deep drainage. The actual amount of water irrigated is aimed to match the daily crop water requirements, Table 5. The irrigation of CP3 in February 2024 was typical of irrigation scheduling throughout 2023/24 where irrigation occurred on an establishment or production-oriented basis favouring the planted crops used for grazing and/or hay production.

By irrigating smaller amounts more frequently, the risk of surface runoff or through drainage occurring is greatly minimised, therefore reducing potential environmental impacts. Runoff is monitored by a visual inspection of the irrigation areas while through drainage can be assessed by reviewing the real time soil moisture probes and the piezometers installed in the irrigation areas. Runoff and through drainage can occur when irrigation is scheduled in larger amounts of water at a lesser interval. The centre pivot irrigation system at Gadara Park is extremely versatile in the amount of water able to be irrigated by altering the speed of the rotation and droplet size with the use of adjustable nozzles.

Table 5: *Irrigation scheduling and ETo data, February 2024 CP3*

Date	Temp. Min °C	Temp. Max °C	Rain mm	ETo mm	Crop factor	Water requirement mm	Actual irrigation mm
01/02/24	15.7	32.7	0.0	6.6	1.2	7.9	12.1
02/02/24	12.3	31.7	0.0	6.5	1.2	7.8	12.1
03/02/24	12.3	34.1	0.0	6.5	1.2	7.8	8.5
04/02/24	14.6	36.2	0.0	6.3	1.2	7.6	0.0
05/02/24	20.2	23.1	1.6	1.8	1.2	2.2	0.0
06/02/24	19.5	30.5	19.0	5.0	1.2	6.0	0.0
07/02/24	11.4	28.5	0.1	6.1	1.2	7.3	0.0
08/02/24	13.7	27.1	0.0	5.7	1.2	6.8	0.0
09/02/24	11.3	31.8	0.0	6.2	1.2	7.4	0.0
10/02/24	15.4	28.2	0.0	5.8	1.2	7.0	0.0
11/02/24	13.6	30.0	0.0	6.0	1.2	7.2	0.0
12/02/24	14.0	33.8	0.0	6.3	1.2	7.6	0.0
13/02/24	16.3	34.7	0.0	6.0	1.2	7.2	0.0
14/02/24	17.3	27.1	13.1	5.1	1.2	6.1	0.0
15/02/24	12.5	27.8	0.0	5.1	1.2	6.1	0.0
16/02/24	16.9	30.6	0.0	4.5	1.2	5.4	5.5
17/02/24	17.5	33.9	0.2	5.7	1.2	6.8	12.1
18/02/24	17.3	33.8	0.1	5.8	1.2	7.0	7.0
19/02/24	15.2	32.7	0.0	5.9	1.2	7.1	0.0
20/02/24	16.4	30.7	2.5	5.4	1.2	6.5	0.0
21/02/24	15.9	30.4	0.3	5.2	1.2	6.2	8.5
22/02/24	16.0	33.6	0.0	5.9	1.2	7.1	12.1
23/02/24	18.4	30.0	0.7	4.9	1.2	5.9	12.1
24/02/24	10.7	29.5	1.7	5.2	1.2	6.2	9.5
25/02/24	12.2	31.4	0.0	5.6	1.2	6.7	0.0
26/02/24	14.3	33.0	0.0	5.5	1.2	6.6	0.0
27/02/24	15.9	32.1	0.0	5.8	1.2	7.0	8.5
28/02/24	17.1	35.9	0.0	6.0	1.2	7.2	12.1
29/02/24	19.1	35.8	0.1	4.4	1.2	5.3	3.5
TOTALS			**39.4**	**160.8**	**-**	**193.0**	**123.6**

8.0 Irrigated crop assessment

8.1 Crops grown and yields

In June 2023, CP1 and CP4 are currently sown to hogan rye & white clover and CP2, CP4 and CP5 are all currently sown to lucerne and white clover.

8.2. Irrigation cropping program

Details of the crops currently grown at Gadara Park and what is planned to be grown in the following seasons are given in Tables 6 to 10. The amount and type of crop grown is dependent on available water, seasonal conditions and crop rotations.

Presently the cropping program revolves around having a perennial crop of lucerne planted in irrigation areas for a period of around five years then rotated with cereal crops for two to three years for a weed and disease break. Having this cropping rotation in the irrigation areas ensures flexibility of irrigation management and grazing regarding timing and amount of irrigation.

Table 6: *Irrigated summer/autumn cropping for season 2023/24*

Field	Crop	Growing season	Irrigation period
CP1 – 28.3 ha	Hogan Rye & White Clover	Spring Summer Autumn	Spring Summer Autumn
CP2 – 12.1 ha	Lucerne & White Clover	Spring Summer Autumn	Spring Summer Autumn
CP3 – 25.7ha	Hogan Rye & White Clover	Spring Summer Autumn	Spring Summer Autumn
CP4 – 16.6ha	Lucerne & White Clover	Spring Summer Autumn	Spring Summer Autumn
CP5 – 10.2ha	Lucerne & White Clover	Spring Summer Autumn	Spring Summer Autumn
SHT – 17.5ha	Hogan Rye Grass	Autumn Winter Spring	Spring Summer Autumn

Table 7: *Irrigated winter/spring cropping for season 2024*

Field	Crop	Growing season	Irrigation period
CP1 – 28.3 ha	Hogan Rye & White Clover	Autumn Winter Spring	Spring Summer Autumn
CP2 – 12.1 ha	Lucerne & White Clover	Autumn Winter Spring	Spring Summer Autumn
CP3 – 25.7ha	Hogan Rye & White Clover	Autumn Winter Spring	Spring Summer Autumn
CP4 – 16.6ha	Lucerne & White Clover	Autumn Winter Spring	Spring Summer Autumn
CP5 – 10.2ha	Lucerne & White Clover	Autumn Winter Spring	Spring Summer Autumn
SHT – 17.5ha	Shirohie Millet & Brassica	Autumn Winter Spring	Spring Summer Autumn

Table 8: Irrigated summer/autumn cropping for season 2024/25

Field	Crop	Growing season	Irrigation period
CP1 – 28.3 ha	Rye, Clover & Millet	Spring Summer Autumn	Spring Summer Autumn
CP2 – 12.1 ha	Lucerne & White Clover	Spring Summer Autumn	Spring Summer Autumn
CP3 – 25.7ha	Rye, Clover & Millet	Spring Summer Autumn	Spring Summer Autumn
CP4 – 16.6ha	Lucerne & White Clover	Spring Summer Autumn	Spring Summer Autumn
CP5 – 10.2ha	Lucerne & White Clover	Spring Summer Autumn	Spring Summer Autumn
SHT – 17.5ha	Shirohie Millet	Spring Summer Autumn	Spring Summer Autumn

Table 9: Irrigated winter cropping for season 2025

Field	Crop	Growing season	Irrigation period
CP1 – 28.3 ha	Lucerne & White Clover	Autumn Winter Spring	Spring Summer Autumn
CP2 – 12.1 ha	Lucerne, Clover & Rye	Autumn Winter Spring	Spring Summer Autumn
CP3 – 25.7ha	Lucerne & White Clover	Autumn Winter Spring	Spring Summer Autumn
CP4 – 16.6ha	Lucerne, Clover & Rye	Autumn Winter Spring	Spring Summer Autumn
CP5 – 10.2ha	Lucerne, Clover & Rye	Autumn Winter Spring	Spring Summer Autumn
SHT – 17.5ha	Oats	Autumn Winter Spring	Spring Summer Autumn

Table 10: Irrigated summer/autumn cropping for season 2025/26

Field	Crop	Growing season	Irrigation period
CP1 – 28.3 ha	Lucerne & White Clover	Summer active	Spring Summer Autumn
CP2 – 12.1 ha	Lucerne, Clover & Millet	Summer active	Spring Summer Autumn
CP3 – 25.7ha	Lucerne & White Clover	Summer active	Spring Summer Autumn
CP4 – 16.6ha	Lucerne, Clover & Millet	Summer active	Spring Summer Autumn
CP5 – 10.2ha	Lucerne, Clover & Millet	Summer active	Spring Summer Autumn
SHT – 17.5ha	Brassica	Autumn Winter Spring	Spring Summer Autumn

9.0 Soil under irrigation assessment

9.1. Soils introduction

The soil monitoring program is conducted in accordance with the Visy EPA Licence 10232. The licence stipulates topsoil monitoring annually and subsoil every three years. This monitoring forms an integral part of crop nutrient budgeting and management. Results are provided in Attachment D.

In addition to the test parameters stipulated in the licence, other nutrients are tested as part of the monitoring program to aid the farm manager in decision making for fertiliser application.

9.2. Soil monitoring sites

There are seven soil monitoring sites at Gadara Park, Figure 15. These seven soil monitoring sites are split into three sample areas:

- West of the winter storage.
- East and south of the winter storage.
- South-east corner.

9.2.1. West of the winter storage

There are three soil monitoring sites in this area. There are two located in CP1 (SMS1, SMS2), and one under CP2 (SMS3) (Visy, 2003).

9.2.2. East and south of the winter storage

There are three soil monitoring sites in this area. There is one soil monitoring site located under CP3, CP4 and CP5 respectively. SMS4 is in CP3, SMS5 is in CP4 and SMS6 is in CP5, (Visy, 2003).

9.2.3. South-east corner

The only soil monitoring site in this region is SMS7 located in the SHT paddock along the eastern boundary of the Gadara Park property, (Visy, 2003).

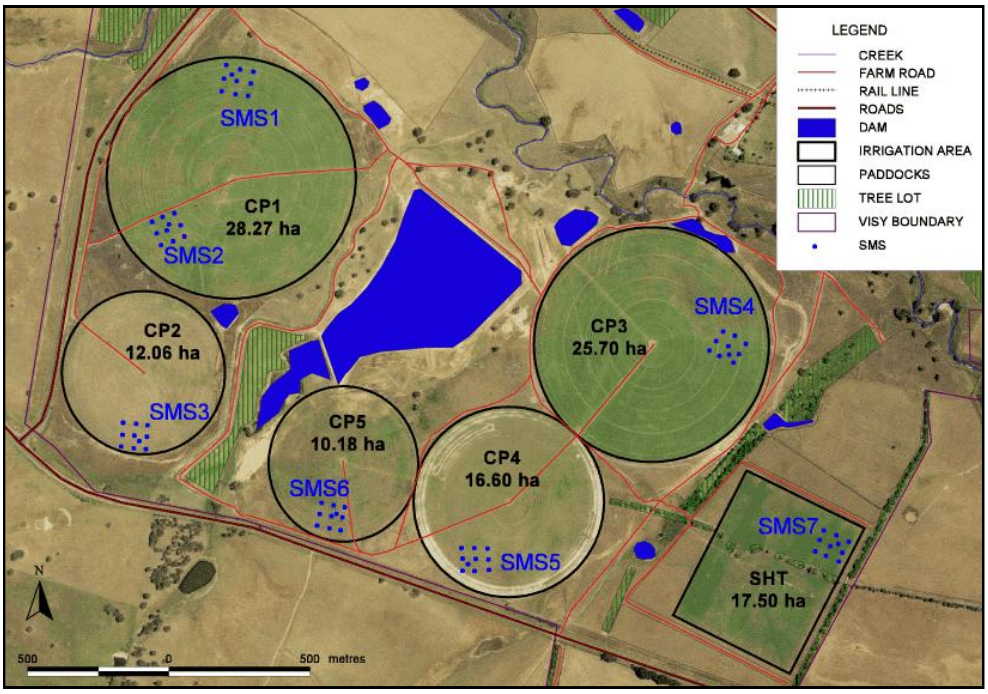


Figure 15: *Centre pivots at Gadara Park showing soil monitoring sites*

9.3 Methodology

Currently there is one soil monitoring site (SMS) per 15.7ha of irrigation area. Recommended soil sampling locations are to be distributed at one per 2 to 20ha, depending on the geological complexity of the site, use of effluent by irrigation (DEC, 2004). The SMSs were established in 2000 and have been navigated to using Global Positioning System (GPS) since 2003.

From a monitoring perspective, the SMSs are an accurate gauge of temporal changes in soil parameters at each location. Friesen and Blair (1984) detail that cluster sampling is the most appropriate procedure for estimating the nutrient status of pastures. This sampling method enables more reasonable estimates to be made of the temporal variations in soil tests.

Both surface and sub-surface samples are taken at each site. Approximately 40 topsoil sub samples are collected for compositing within each SMS. Ten subsoil samples are bulked together for analysis within each SMS.

This is in line with the EPL 10232 Condition M2.4 methodology. Special methods 1 and 2. These are as follows:

- Special Method 1: At each soil sampling site, 10 representative samples shall be taken on a 30 meter by 30 metre grid.
- Special Method 2: Sample to be collected in accordance with the current edition of “A Practical Guide for Groundwater Sampling, NSW Department of Land and Water Conservation”.

9.4 Electromagnetic surveying

The DEC recommends that an electromagnetic (EM) survey be used to identify soil sampling sites (DEC, 2004). An EM survey was carried out in 2001 and again in 2003. Ground truthing of the EM survey was carried out with soil cores in 2003 and soil pits have also been investigated in the irrigation areas in 2005.

The EM-38 survey measures the apparent electrical conductivity of the soil profile to a depth of 1.5m, which is the effective root-zone of most irrigated crops.

The main purpose of the EM-38 is to aid in the identification of different soil types that may influence soil analysis and crop performance so that management can be tailored to soil type. The EM-38 survey demonstrated a basic correlation between EM-38 readings and soil types. Low EM-38 readings were measured in the high elevation areas, characterised by a deep well drained soil with a substrate of coarse fragments and decomposed rock. High EM-38 readings were measured in the low-lying areas of the paddocks, characterised by poorly drained alluvium overlying clay subsoils. The EM-38 survey and SMS can be seen in Figure 16.

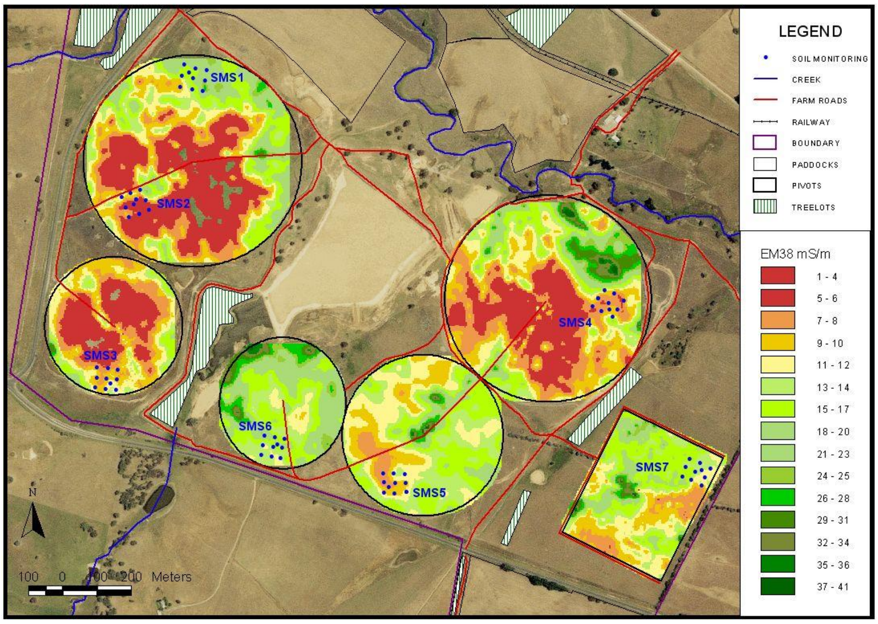


Figure 16: *Location of soil monitoring sites in relation to EM-38 survey*

9.5 Analysis

Topsoil sampling and analysis was undertaken in October 2023 and April 2024. Subsoil sampling and analysis was also undertaken as part of Visy's Environment Protection Licence which stipulates it is carried out every three years. McMahon conducts subsoil testing every year to gain better understanding on the sustainable assimilation of nutrients and provide management recommendations based on the results, Attachment D.

Overall soil health appears to be good with adequate humus levels and an abundance of earthworms in the topsoil. Topsoil organic carbon levels (as an average across the 7 SMS) have risen from 2.0% in 2003 to 2.4% in April 2024 due to the introduction of perennial crops such as lucerne into the cropping program.

Over the last 20 years, macro nutrients have improved to more desirable levels due to a comprehensive fertiliser program and topsoil pH has risen with the application of soil ameliorants.

9.5.1. Monitoring October 2023

Topsoil (0-10cm) analysis was undertaken in October 2023 to coincide with the start of the spring/summer irrigation season. Fertiliser recommendations for the crops were made based on the nutrient budget.

pH

Soil pH is slightly acidic to neutral with results ranging from 4.9 pH($CaCl_2$) (SMS7) to 7.5pH($CaCl_2$) (SMS5) . Typically, the application of alkaline soil ameliorants has been highly successful with an improvement in topsoil pH to within the desirable range of 5.5 to 7pH($CaCl_2$), (NSW Agriculture, 1998). However, SMS7 is below the desirable range. A neutral soil pH will improve nutrient and water availability for plants.

Cations

Calcium and magnesium ratios are typical for soils of the local area. Potassium % levels range from 3.3 to 17 with the higher percentage being SMS1, although this is considered typical for soils of the local area. Sodium levels average 1.3% which is at a suitably low level (NSW Agriculture, 1998).

Aggregate stability

Emerson Aggregate Tests were performed by reference to AS1289.3.8.1 and soils were categorised as class number 7 (SMS3, SMS4, SMS5 & SMS6) and class number 8 (SMS1, SMS2 & SMS7). A class 7 soil will not undergo mechanical slaking but will swell when immersed in water while class 8 does not swell under the same conditions.

Organic carbon

Organic carbon levels average 1.73% across all sites, these being lower than normal owing to most of the sites being cultivated at the time of sampling. This is desirable and indicative of soils with good structural condition, high structural stability, pH buffering capacity, soil nutrient levels and water holding capacity (NSW Agriculture, 1998). These organic carbon levels are slightly lower compared to the 2022/23 monitoring period.

Salinity

The salinity indicator (electrical conductivity) were very low indicating nil short-term salinity risk. Sodium as a percentage of cations is also low ranging from 0.9% (SMS5) to 2.4% (SMS2). Excessive sodium can cause the soil structure to deteriorate.

Chloride

Chloride levels in October 2022 were low with readings ranging from below the detectable limit of <10ppm (multiple readings) to 18ppm (SMS4), which is slightly lower than the 2022/23 monitoring period.

Nitrogen

Nitrogen and nitrate levels are generally satisfactory for agricultural production and can be improved by the addition of fertiliser if required.

Phosphorus

Phosphorus levels are generally satisfactory for agricultural production and can be improved by the addition of fertiliser if required.

9.5.2. Monitoring April 2024

Topsoil (0-10cm) analysis was undertaken in April 2024 to coincide with the start of the autumn/winter cropping season. Fertiliser recommendations for the crops were made based on analysis of soil fertility.

pH

Soil pH is at a desirable level for all the sampling points except for SMS1 and SMS7 (5.3 pH($CaCl_2$) and 5.0 pH($CaCl_2$)). Typically, the application of alkaline soil ameliorants has been highly successful with an improvement in topsoil pH to within the desirable range of 5.5 to 7($CaCl_2$), (NSW Agriculture, 1998). A neutral soil pH will improve nutrient and water availability for plants.

Cations

Calcium and magnesium ratios are typical for soils of the local area. Potassium levels range from 2.3% to 6.0% which at the higher end is above the 1-5% desirable range (NSW Agriculture, 1998). Sodium levels are averaging 4.98% across all sites which is at a suitably low level (NSW Agriculture, 1998).

Aggregate stability

Emerson Aggregate Tests were performed by reference to AS1289.3.8.1 and soils were categorised as class number 7 (SMS1, SMS2, SMS3, SMS5 & SMS6), class number 8 (SMS7) and class number 5 (SMS4). A class 7 soil will not undergo mechanical slaking but will swell when immersed in water while class 8 does not swell under the same conditions.

Organic carbon

Organic carbon levels are averaging 2.38%, this is considered to be desirable and is indicative of soils with very good soil structure and high buffering capacity with sufficient organic matter to decrease bulk density and improve water holding capacity (NSW Agriculture, 1998). This is a return to more normal levels from the October 2023 results.

Salinity
The salinity indicator (electrical conductivity) was very low indicating nil short-term salinity risk. The average sodium as a percentage of cations is also low. Excessive sodium can cause the soil structure to deteriorate.

Chloride
Chloride levels in April were low with readings ranging from 16ppm (SMS7) to 50ppm (SMS4). This is higher than the readings for October 2022.

Nitrogen
Nitrogen and Nitrate levels are generally satisfactory for agricultural production and can be improved by the addition of fertiliser if required.

Phosphorus
Phosphorus levels are generally satisfactory for agricultural production and can be improved by the addition of fertiliser if required.

10.0 Nutrient balance and forward management plan

The farm nutrient balance forms part of the forward management plan for the wastewater irrigation at Gadara Park, it also satisfies the load-based protocol for the Visy Environment Protection Licence. The nutrient balance and forward management plan are reviewed annually as part of irrigated cropping management. The review ensures maximum nutrient uptake for optimal crop production.

At the commencement of the Visy operations at Gadara Park, the soil nutrient status was poor with below desirable levels for all macronutrients and a very low pH. The macronutrient status and pH at Gadara Park since, has improved due to a strategic fertiliser and amelioration program, and improved cropping management.

Fertiliser is the main source of nutrient supply and application amounts are matched to anticipated crop removal. Nutrients are present in the wastewater but are at insignificant levels to make a marked impact on nutrient availability.

At present, soil testing is carried out bi-annually to coincide with the start of the winter and summer cropping programs. Nutrient budgets are calculated with current soil nutrient status for the crops to be grown, with likely nutrient efficiency and removal. Factors such as anticipated yield, irrigation amounts, rainfall, weed burden, crop variety and seeding rate are taken into account when budgeting actual nutrient removal and supply.

The aim for future nutrient application is to maintain a sustainable macro nutrient bank in the soil that will boost crop production for more efficient water use and crop production.

10.1 Nutrient balance management

The NSW EPA load based licensing protocol details that the following conditions be carried out for licensees to obtain the full fee discount for effluent irrigation.

Condition 1: Have developed a 15 year forward management plan that shows how proposed annual nutrient application rate compares with the annual amounts to be taken up by the biological or physical processes of the crop-soil system. This should be done before the construction of the effluent reuse scheme. Nutrient application rates must be based on the sustainable assimilation of nutrients over a rolling 15 year period.

The nutrient balance outlines the nutrient status from the soil testing carried out in April 2024. Nutrient removal has been calculated from the ranges outlined in Table 11 and efficiency factors have been determined from historical seasonal conditions encountered. The nutrient balance table outlines crop species, seeding rate and an estimated sowing date. The sowing date will change from year to year to suit the cropping programs and seasonal conditions. Perennial crops such as lucerne and ryegrass for example are only sown every five years or so. The table also outlines estimated fertiliser application and nutrient addition from wastewater and biological processes. The areas for which the nutrient balance has been calculated are the centre pivots and soft hose traveller paddock, Figure 15. The 15 year rolling nutrient balance can be seen in Attachment E.

10.2 Nutrient supply

Nutrients are supplied in the form of fertiliser and wastewater. Nitrogen is also supplied by soil biological processes of mineralisation and fixation.

10.2.1 Fertiliser

Fertiliser is the main source of nutrients at Gadara Park. A starter fertiliser (Nitrogen (N) Phosphorus (P) Potassium (K) Sulphur (S) at a ratio of 18.22.0.1) is used at sowing to supply the crops with the season's phosphorus supply and some nitrogen. Crops are usually top dressed with granular urea (NPKS 42.0.0.0) or with liquid nitrogen through the centre pivot or boom spray. Legumes will generally be top dressed with single super (NPKS 0.9.0.11) to supply adequate phosphorus and sulphur. Additional nutrients and trace elements can be added when suitable.

10.2.2 Waste water

A volume of approximately 830 megalitres of wastewater was applied in 2023/24 to approximately 110 hectares of farmland at Gadara Park via existing centre pivots (five of them) and the soft hose traveler irrigator. The irrigation of the wastewater is controlled by Visy's wastewater management plan and the EPA licence conditions. The amounts of nitrogen and phosphorus in the wastewater are very low and are the lowest contributors of nitrogen and phosphorus to the nutrient balance.

10.2.3 Mineralisation

Mineralisation is a process that releases nitrogen from soil organic matter while the temperature and moisture conditions are suitable for the soil microbes to function effectively. As a general rule, mineralisation rarely exceeds 80kg nitrogen per hectare per year. A rate of 40kg nitrogen per hectare per season has been used to approximate mineralisation.

10.2.4 Fixation

Further nitrogen addition is present in the form of fixation from legume crops. The principal annual legume crop grown will be a high density legume consisting of a clover mix. The principal perennial legume crop grown will be lucerne. It is estimated that the high density legume will add approximately 100kg nitrogen per hectare per year (Tisdale et al, 1998). Legumes fix around 20kg nitrogen per tonne dry matter per year - but most of this goes into the organic nitrogen pool. However, the amount of mineral nitrogen available to plants in autumn and early winter will increase in proportion to kilograms per hectare of legume dry matter grown the previous spring. The conversion of atmospheric nitrogen to organic nitrogen is called fixation (Agricultural Bureau of South Australia, 1997).

Experimental estimates of the total annual inputs of fixed nitrogen by grazed lucerne-based pastures range from 80-190kg nitrogen per hectare per year in a Mediterranean-type climate (Peoples et al, 1998).

10.3 Nutrient removal

Nutrient removal will be influenced by the type of crops grown, seasonal weather, sowing rate and general plant health. The following Table 11 has been used as a general guide for nutrient removal ranges, (Reuter and Robinson, 1997).

Table 11: *Nutrient removal ranges for crops grown at Gadara Park*

Crop	Normal nutrient removal range (kg/ha)		
	Nitrogen	**Phosphorus**	**Potassium**
Irrigated pasture (cut)	160-400	24-60	120-300
Lucerne hay (cut)	155-465	15-45	125-375
Maize silage	220-550	50-125	200-500
Forage sorghum	220-440	30-60	240-480
Winter cereal hay	200-400	30-60	160-320
Seed barley	38-95	6-15	8-20
Seed wheat	38-95	8-20	10-25
Triticale	29-57	6-12	9-18
Seed oats	15-75	3-15	4-20
Chickpeas	20-80	2-8	2-8
Cowpeas	15-60	2-8	10-40
Faba beans	40-120	4-12	12-36
Lupins	22-90	1-6	4-16

10.3.1 Seasonal influence

Nutrient uptake is heavily influenced by seasonal conditions:

Winter season

The winter growing season at Gadara Park is considered extended because of an early sowing date made possible by irrigation. This gives the winter crops a high nutrient removal rate. Another factor influencing a long growing season is the cool spring climate which aids a long stage of plant development which in turn means a late harvest.

Summer season
The summer growing season at Gadara Park is considered short with a low to medium level of nutrient removal. The rationale for this is the comparatively cooler climate at Gadara Park and cooler temperatures which will influence nutrient removal.

10.4 Depth of nutrient removal

Phosphorus removal has been calculated to 10cm depth. The majority of phosphorus is placed as fertiliser at sowing which is normally to a depth of between 5cm and 7.5cm.

Nitrogen removal has been calculated to a depth of 10cm which is the effective zone of the majority of nitrogen supply and mineralisation at Gadara Park. Mineralisation has been assumed to be 40kg per hectare for the winter cropping period.

The irrigation paddocks at Gadara Park are sampled to a depth of 60cm to assess root zone nitrogen status for the summer crops. Summer crops such as maize will have an effective root zone depth of approximately 60cm and are therefore tested accordingly. The nitrogen fertiliser rate is usually determined by considering the cropping history of the field in conjunction with a soil test for mineral nitrogen (Hocking, Norton and Good, 1999). Growers are advised to use a deep (60cm) soil test for mineral N for calculating N fertiliser requirements. The deep soil test can detect any nitrate-N accumulated at depth. Values for mineral N in soils are typically 30-140kg nitrogen per hectare.

Condition 2: Review the plan every 3 years to ensure that future planned application rates will continue to achieve sustainable assimilation over a rolling 15 year period.

The current management at Gadara Park is to assess the nutrient status at the start of every summer and winter cropping program. From the soil analysis, nutrient budgets are calculated and matched to crop type and efficiency. This will ensure the maximum amount of production from the irrigation area.

Soil testing is undertaken at the start of the summer and winter cropping seasons to determine current nutrient status and budget requirements. Soil testing locations have been GPS located so the same sample sites are visited every time.

The plan will be reviewed formally every 3 years as per EPA recommendations to achieve sustainable nutrient assimilation.

Condition 3: Prepare annual nutrient balances showing nutrient application rates and the results of soil monitoring done as set out in the management plan, and how these outcomes compare with those anticipated in the management plan. Documentation of plan and annual balances must be kept for at least four years.

In October 2023 and April 2024 most soil nutrient levels are at desirable levels for agricultural production. The phosphorus levels have always been very low and targeted application of fertiliser has seen a slow build-up of levels to boost soil fertility and agricultural production.

Nitrogen levels at Gadara Park have been low but are building to more favourable conditions for agriculture after adopting a fertiliser program. Soil nitrogen has been identified as the single biggest crop nutrient limiting factor. Nitrogen can be applied to the crops at Gadara Park in the form of granular urea, and liquid fertiliser which can be center pivot applied or boom spray applied. The introduction of legumes to the cropping rotation will help fix nitrogen in the soil for subsequent crops.

11.0 Whole farm management

11.1 Pasture improvement

As an ongoing pasture improvement program, paddocks are developed and renovated on a rotational basis every 5 to 10 years. Perennial pasture species are introduced to suitable paddocks to maximise production over the summer months. In some paddocks where weed burden is high, annual crops are grown for two to three years to prepare them for a wider range of crop and perennial pasture options.

The pasture improvement includes many management facets that are integral to the successful development program. They include:

- Soil testing and analysis;
- Regular paddock inspections;
- Weed monitoring and control programs;
- Insect monitoring and control programs;
- A pasture variety rotation assessment;
- Seasonal assessment and outlook considerations; and
- Budgetary assessment.

11.2 Tree management

In total, Gadara Park currently has 73 hectares of planted native tree lots in riparian zones and along drainage lines. The tree lots have been established and maintained over the last 16 years as part of a riparian/drainage line stabilisation and habitat improvement program that links the creek flats to the timbered hills.

The areas of tree plantings can be seen in Figure 17.

11.3 Weed management

The Weed Management Plan for Gadara Park was completed and approved as part of the Landscape and Native Vegetation Management Plan in the Operational Environmental Management Plan (OEMP). Two further properties were acquired in 2007 and 2008, “Havilah” and “Woomera” respectively. Weed management has also been undertaken on these properties as discussed for Gadara Park below. A range of weed control methods are employed as part of the land management on land owned by the company including spraying, insect control and “crash grazing” on the centre pivots where the sheep flock or cattle are put on in larger numbers and left for 2 to 3 weeks. This means that the pasture and weeds are grazed, the pasture recovers and continues to grow but the weed growth is checked.

Comments and observations for 2023/24 are as follows:

- Bathurst Burr has been controlled to a point with ongoing inspection and edification of any new germination. This is a summer weed and has required some spraying and chipping for control;
- Bracken Fern - an ongoing reduction program exists, and the fern is mainly occurring in the more inaccessible areas;

- Blackberry – ongoing maintenance program of spraying and treatment of any re-infestations continues;
- Paterson's curse is subject to ongoing management. Visy began working with the CSIRO and the Department of Primary Industries (DPI) on a biological control program using four types of insect for the control of Paterson's curse, in 2007 initially within the vegetation corridors, where spraying was unable to be undertaken. The insects however have now spread throughout the property and results have been outstanding. The DPI conducted an Open Day in September 2008 to monitor insect numbers and results and discuss with other landholders the use of these insects, which attracted over 40 people. Overall the insect control has been very successful. Some spraying has been undertaken on thicker areas away from the tree lines.
- Cape Weed - a pasture weed that has been subject to an ongoing spraying program with a good kill rate.
- Saffron Thistle - Spraying programs have been undertaken for this weed in the past. It is a difficult weed to control, occurring on the lower slopes with a late germination period.

The requirements of the Weed Management Plan will continue to be implemented.

11.4 Feral animal management

At Gadara Park there are three main feral animals controlled being: rabbits; foxes; and pigs. Each animal is assessed on a routine basis and baiting, trapping or shooting programs are implemented accordingly. Baiting of foxes using 1080 can be implemented on an individual farm or regional basis which is run by the Livestock Health and Pest Authorities. Rabbits are controlled by shooting, baiting, using 1080 and harbour destruction. Wild pigs are sometimes present at Gadara Park and are controlled by shooting and trapping.

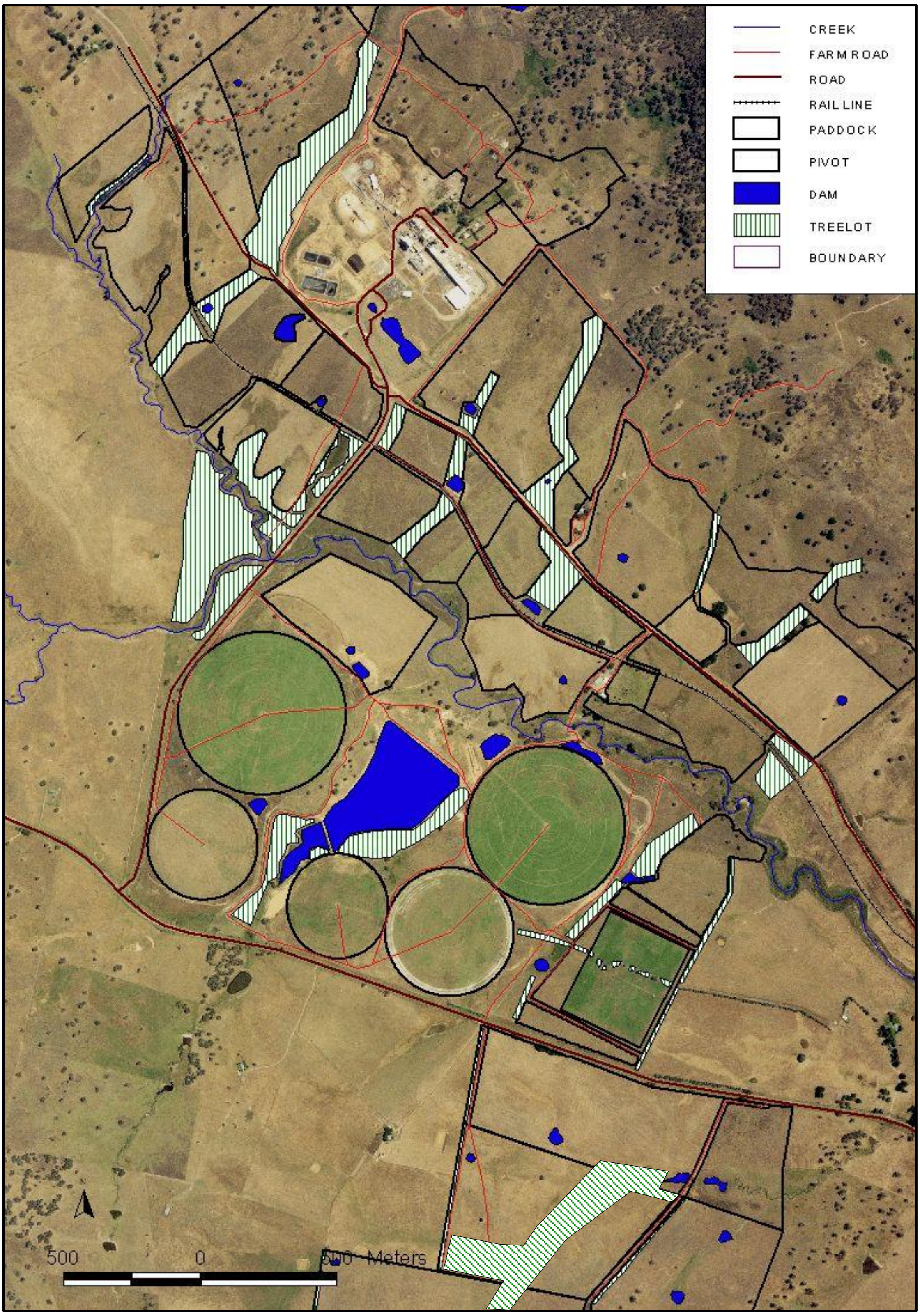


Figure 17: *Tree planting*

12.0 By-products and the soil amendment trial

The Soil Amendment Trial (SAT), for evaluating Visy mill by-products as soil ameliorants was completed in 2006 after the compilation and review of four years of soil testing, hay and silage analysis, animal tissue testing and by-product analysis.

The results show a marked increase in topsoil pH, after being measured as highly acidic pre-trial. Increased agricultural production has been a result of the correction in soil acidity, with improved nutrient availability and a greater variety of crops able to be grown.

Soil heavy metal levels have shown no significant increasing trends since the baseline testing was undertaken in 2001. Hay and silage analysis show heavy metals are not bio-accumulating in the plant tissue. Animal tissue testing indicates there are no food safety concerns, or any other concerns related to the heavy metals of interest.

Up until 30 June 2005, the criteria for the application of by-products was the Environmental Guidelines Use and Disposal of Biosolids Products, (NSW EPA, 1997). As of 1 July 2005, the EPA developed new draft guidelines in the “Land Protection Proposal” under the NSW Residue Waste Regulation. On 1 December 2005, amendments to the Protection of the Environment Operations (Waste) Regulation came into effect. The Regulation prohibited the use of the Visy by-products at Gadara Park, or otherwise, until a specific exemption is granted by the EPA.

After consultation with the EPA, Visy resumed the application of dregs & grits and lime mud in 2010 as the by-products satisfied the parameters as set out in the NSW Fertilisers Act, 1985.

300 tonnes of dregs & grits was land applied to 60 hectares of pasture in 2012 at a rate of 5 tonnes per hectare and 1,520 tonnes was applied to 600 hectares of pasture at a rate of 2.5 tonnes per hectare in January 2013. These applications were approved as one-off exemptions by the NSW EPA.

12.2 Summary of by-products at Visy

Three by-products from the paper making process were used at Gadara Park as soil ameliorants to improve agricultural production. These by-products are green liquor dregs, lime mud and fly ash. A fourth by-product (bottom sand) is inert sand which was previously used to line the roads around the farm, making the roads more readily accessible in wet weather. By-product testing results are provided in Attachment F.

12.2.1 Dregs and Grits

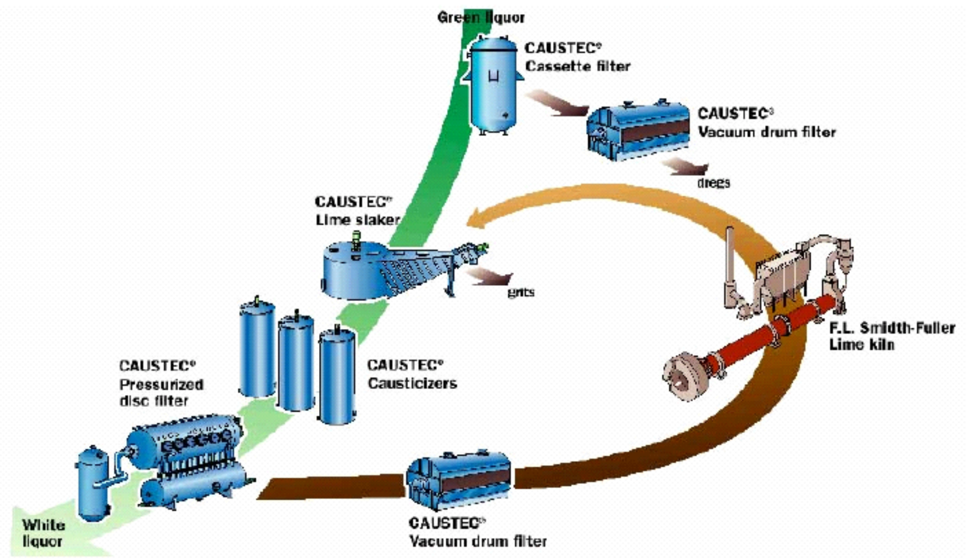
Green liquor dregs (process sediment) are a stabilised alkaline by-product. The source is un-burnt carbon and inorganics (calcium and iron compounds) from the green liquor smelt removed through clarification prior to re-causticising. Insoluble materials within the lime are separated and washed after slaking/causticising. The main components of the dregs and grits are calcium carbonate, unburnt carbon, and some sodium compounds. The benefits of the dregs and grits are the good liming characteristics that raise soil pH and subsequently improve fertility. The drawback of the dregs and grits is the presence of low-level contaminants in chromium, lead, nickel, zinc, and copper.

12.2.2 Lime mud

Lime mud is a stabilised alkaline product. It is obtained after decanting the white liquor following re-causticising. The lime mud is not returned to the lime kiln but is purged out of the system. The main compound of the lime mud is calcium carbonate. A greater amount of lime mud is produced, but the mill reuses the lime mud in the paper making process.

The benefit of the lime mud is its similarity to superfine agricultural lime. The lime mud has a neutralising value of around 95% which is classified as the highest grade agricultural lime. The drawback of the lime mud is low level contamination with lead.

The origin of the dregs, grits and lime mud can be identified below in Figure 18.



The Recausticising process

Figure 18: *Figure of the origins of the lime mud and dregs and grits by-products*

13.0 Sludge assessment

13.1. Sludge monitoring site

Twelve samples of sludge were collected in 2023/24 from the Sludge tank discharge line (3 samples) and the treated sludge line running into the storage dam (9 samples). The sampling location was changed from the Sludge Balancing Tank in July 2023 and again from the Sludge discharge line in October 2023. Sampling from July 2023 until September 2023 returned unusually high results for multiple parameters. It was also noted that during the sampling event, the sample was visibly darker, had a strong odour and had a substantial amount of particulate matter. The results returned to normal after the sampling location was again changed to the treated sludge line. All results can be seen in Attachment G. The sludge is transferred from the Sludge Balancing Tank to a trailer-mounted applicator from which the sludge is sprayed onto the paddocks. Approximately 472 kilolitres of sludge were land applied in 2023/24. The sludge applicator can be seen in Figure 19.

Up until 30 June 2005, the criteria for the application of by-products (including sludge) were the NSW EPA Environmental Guidelines Use and Disposal of Biosolids Products. As of 1 July 2005, the EPA developed new draft guidelines in the "Land Protection Proposal" under the NSW Residue Waste Regulation. On 1 December 2005 amendments to the Protection of the Environment Operations (Waste) Regulation came into effect. The Regulation prohibited the use of the Visy by-products (including sludge) at Gadara Park, or otherwise, until liaison and subsequent approval by EPA.

After consultation with EPA, sludge application resumed in May 2008. The application rates and paddock suitability on Gadara Park is determined by following the NSW Environmental Guidelines, Use and Disposal of Biosolids Products (NSW EPA, 1997).

Figure 19: *Sludge being applied to land (Colson 2002)*

13.2 Chemical analysis

BOD

The BOD of the sludge ranged from 22mg/L (January 2024) to 6550mg/L (August 2023). The average BOD result was 1171.3mg/L which is higher than the previous monitoring period's average of 123mg/L and the highest average for the last five years.

TDS

The TDS values of the sludge ranged from 162mg/L (November 2023) to 348mg/L (September 2023). The average TDS result was 227mg/L which is higher than the 2022/23 monitoring period average result of 177mg/L.

EC

The EC values ranged from 269µS/cm (November 2023) to 1690µS/cm (August 2023).

Nitrogen and phosphorus

Total nitrogen levels ranged from 5mg/L (May 2024) to 3880mg/L (August 2023). Phosphorus levels range from 1.69mg/L (April 2024) to 220mg/L (August 2023). Both total nitrogen and phosphorus results are similar to results from the previous five years.

pH

The pH of sludge is slightly acidic to slightly alkaline ranging from 6.2 to 8.1 and is generally in the desirable range for agricultural purposes (ANZG, 2018).

Suspended solids

The suspended solids ranged from 28mg/L (March 2023) to 19900mg/L (August 2023), elevated readings began in June 2023 but have since returned to normal levels. A visual inspection of the soil where the sludge has been applied indicates free draining topsoil with good porosity, therefore the presence of suspended solids in the sludge appears to have not adversely affected the drainage by blocking soil pores.

Oil and grease

Oil and grease levels ranged from <1mg/L (November 2023) to 316mg/L (September 2023).

14.0 Recommendations summary

The following improvements to the monitoring program are recommended:

- Most of the thirty additional groundwater monitoring bores that were installed in 2005/06 have been damaged or destroyed in 2022/23 and 2023/24 monitoring periods when the pivots and paddocks were cultivated. An audit of the condition of these bores is recommended and bores that can glean useful information are recommended to be repaired or replaced.
- Soil moisture probes located in the pivots alongside the groundwater monitoring bores were also damaged or destroyed in the 2022/2023 period. An audit of the condition of these probes is recommended and probes that can glean useful information are recommended to be repaired or replaced.
- The decant (point 10) sample point is recommended to be signposted for a consistent sampling location.
- The sludge sample location has recently been moved (October 2023) from the SBR to the treated sludge discharge line for improved safety. It is recommended this new sampling location be signposted for a consistent sampling location.
- Access to some of the groundwater monitoring locations on the farm is limited owing to gullies and rutted roads and improvement around this is recommended.
- Access to some of the surface water monitoring locations on the farm is limited due to high grass and weeds, improvement around this is recommended.

15.0 References

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16.0 General glossary

ANZECC	Australia and New Zealand Environment and Conservation Council
BTOC	Below Top of Casing
DEC	NSW Department of Environment and Conservation
DECCW	Department of Environment and Climate Change and Water NSW
DPI	Department of Primary Industries
EPA	Environment Protection Authority (NSW)
ET_c	Crop Evapotranspiration (ET_o multiplied by a Crop Factor)
ET_{pan}	Evaporation measured from a Standard Class A pan (in mm)
K_c	Crop Factor
ET_o	Potential Evapotranspiration calculated using the FAO Penman-Monteith formula (in mm)
NEPC	National Environment Protection Council
SAT	Soil Amendment Trial
TSC	Tumut Shire Council
WWTP	Waste Water Treatment Plant

17.0 Chemical glossary

Alkalinity	The capacity of water to neutralise acid
Al	Aluminium
AS	Aggregate Stability (using Emerson Aggregate Test)
BOD	Biological Oxygen Demand
Ca	Calcium
CEC	Cation Exchange Capacity
Cl	Chloride
EC	Electrical Conductivity
FC	Faecal Coliforms
K	Potassium
Mg	Magnesium
Mn	Manganese
N	Nitrogen
Na	Sodium
OC	Organic Carbon
OCP	Organochlorine Pesticides
P	Phosphorus
PBI	Phosphorus Buffer Index
Na	Sodium
S	Sulphur
SAR	Sodium Adsorption Ratio
SS	Suspended Solids
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
NV	Neutralising Value
ENV	Effective Neutralising Value
As	Arsenic
Cd	Cadmium
Cr	Chromium
Cu	Copper
Hg	Mercury
Ni	Nickel
Pb	Lead
Zn	Zinc
CP	Crude Protein
DM	Dry Matter
DMD	Digestibility
ME	Metabolisable Energy
NDF	Neutral Detergent Fibre
SolCHO	Water Soluble Carbohydrate

18.0 Attachments

Attachment	Details
A. Groundwater 2023-2024	3 pages
B. Surface water 2023-2024	1 page
C. Point 10 2023-2024	1 page
D. SMS October 2023 and April 2024	4 pages
E. Nutrient budget 2023-2024	9 pages
F. By-products 2023-2024	4 pages
G. Sludge 2024-2024	1 page

McMahon EARTH SCIENCE

DOCUMENT ATTACHMENTS

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Attachment A : *Groundwater 2023-2024*

Test Identity	Unit of measure	Critical Range	BH1 July 2023	BH1 Oct 2023	BH1 Jan 2024	BH1 Apr 2024	BH2 July 2023	BH2 Oct 2023	BH2 Jan 2024	BH2 Apr 2024	BH3 July 2023	BH3 Oct 2023	BH3 Jan 2024	BH3 Apr 2024
Conductivity	µS/cm	*350* [1]	362	-	351	-	135	-	147	-	156	-	171	-
Nitrate	ppm	*0.7* [1]	3.3	-	2.3	-	4.9	-	5.5	-	0.2	-	1.1	-
pH	pH units	*6.5-7.5* [1]	5.7	7.3	7.1	5.8	5.9	7.3	6.6	5.6	5.8	6.8	6.4	6.5

Test Identity	Unit of measure	Critical Range	BH7S July 2023	BH7S Oct 2023	BH7S Jan 2024	BH7S Apr 2024	BH7D July 2023	BH7D Oct 2023	BH7D Jan 2024	BH7D Apr 2024	BH11S July 2023	BH11S Oct 2023	BH11S Jan 2024	BH11S Apr 2024
Conductivity	µS/cm	*350* [1]	137	-	Dry	-	443	-	485	-	860	-	898	-
Nitrate	ppm	*0.7* [1]	0.5	-	Dry	-	2.6	-	0.1	-	<0.1	-	0.1	-
pH	pH units	*6.5-7.5* [1]	5.8	6.7	Dry	Dry	6.2	6.8	6.3	6.7	6.6	7.1	7.4	6.8

Test Identity	Unit of measure	Critical Range	BH11D July 2023	BH11D Oct 2023	BH11D Jan 2024	BH11D Apr 2024
Conductivity	µS/cm	*350* [1]	807	-	818	-
Nitrate	ppm	*0.7* [1]	<0.1	-	<0.1	-
pH	pH units	*6.5-7.5* [1]	6.8	6.8	7.2	6.8

1. ANZG (2018) Australian & New Zealand Guidelines for Fresh & Marine Water Quality.

Bore Reference	Location
BH1	Onsite upstream of irrigated and by-product areas
BH2	Onsite upstream of irrigated and by-product areas
BH3	Deep bore off site to monitor upstream groundwater quality and any mounding as a result of the Winter storage
BH4	Deep bore to monitor groundwater quality upstream of irrigation areas, and downstream of Power Boiler Ash applied area
BH7S	Shallow bore to monitor groundwater quality upstream of irrigation areas and downstream of Power Boiler Ash and Lime Mud applied areas
BH7D	Deep bore to monitor groundwater quality upstream of irrigation areas and downstream of Power Boiler Ash and Lime Mud applied areas
BH11S	Shallow bore to monitor groundwater quality off site and upstream of irrigation and By-product applied areas
BH11D	Deep bore to monitor groundwater quality upstream of irrigated and By-product applied areas

Test Identity	Unit of measure	Critical Range	BH8S July 2023	BH8S Oct 2023	BH8S Jan 2024	BH8S Apr 2024	BH8D July 2023	BH8D Oct 2023	BH8D Jan 2024	BH8D Apr 2024	BH9 July 2023	BH9 Oct 2023	BH9 Jan 2024	BH9 Apr 2024
Conductivity	µS/cm	*350* [1]	578	-	524	-	523	-	581	-	461	-	666	-
Nitrate	ppm	*0.7* [1]	2.8	-	3.1	-	4.0	-	2.9	-	15.8	-	13	-
pH	pH units	*6.5-7.5* [1]	6.8	6.9	6.6	7.1	6.6	6.8	6.9	6.8	6.5	6.6	6.9	6.9

Test Identity	Unit of measure	Critical Range	BH10 July 2023	BH10 Oct 2023	BH10 Jan 2024	BH10 Apr 2024	BH15S July 2023	BH15S Oct 2023	BH15S Jan 2024	BH15S Apr 2024	BH15D July 2023	BH15D Oct 2023	BH15D Jan 2024	BH15D Apr 2024
Conductivity	µS/cm	*350* [1]	585	-	721	-	860	-	373	-	807	-	317	-
Nitrate	ppm	*0.7* [1]	12.1	-	12	-	<0.1	-	6.4	-	<0.1	-	6.9	-
pH	pH units	*6.5-7.5* [1]	6.6	7.0	7.3	7.5	6.6	7.1	7.7	7.4	6.6	7.3	7.5	6.7

1. ANZG (2018) Australian & New Zealand Guidelines for Fresh & Marine Water Quality.

Bore Reference	Location
BH8S	Shallow bore to monitor groundwater quality downstream of irrigated, By-product and Sludge applied areas
BH8D	Deep bore to monitor groundwater quality downstream of irrigated, Lime Mud, Power Boiler Ash and Sludge applied areas
BH9	Deep bore to monitor groundwater quality downstream of the irrigated and By-product applied areas
BH10D	Deep bore to monitor groundwater quality off site and downstream of irrigated and By-product applied areas
BH15S	Shallow bore to monitor groundwater quality downstream of irrigated and By-product applied areas
BH15D	Deep bore to monitor groundwater quality downstream of irrigated and By-product applied areas

Test Identity	Unit of measure	Critical Range	BH13 July 2023	BH13 Oct 2023	BH13 Jan 2024	BH13 Apr 2024	BH14 July 2023	BH14 Oct 2023	BH14 Jan 2024	BH14 Apr 2024	BH16 July 2023	BH16 Oct 2023	BH16 Jan 2024	BH16 Apr 2024
Conductivity	µS/cm	*350* [1]	1030	-	996	-	792	-	749	-	1540	-	904	-
Nitrate	ppm	*0.7* [1]	<0.1	-	<0.1	-	0.8	-	0.2	-	<0.1	-	0.2	-
pH	pH units	*6.5-7.5* [1]	6.8	7.2	7.5	7.4	6.7	7.0	7.4	6.8	7.2	7.6	7.5	Dry

Test Identity	Unit of measure	Critical Range	BH17 July 2023	BH17 Oct 2023	BH17 Jan 2024	BH17 Apr 2024
Conductivity	µS/cm	*350* [1]	1190	-	1240	-
Nitrate	ppm	*0.7* [1]	<0.1	-	<0.1	-
pH	pH units	*6.5-7.5* [1]	7.2	7.5	7.4	8.0

1. ANZG (2018) Australian & New Zealand Guidelines for Fresh & Marine Water Quality.

<u>Bore Reference</u>	<u>Location</u>
BH13	Shallow bore to monitor seepage from the Winter Storage Dam
BH14	Shallow bore to monitor seepage from the Winter Storage
BH16 and BH17	Shallow bores to monitor seepage from the Winter Storage Dam

Attachment B : *Surface water 2023-2024*

Surface water monitoring

Test Identity	Critical Range	SW1	SW1	SW1	SW1	SW1	SW1	SW1	SW1	SW2	SW2	SW2	SW2	SW2	SW2	SW2	SW2
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
		3/10/2023	1/11/2023	1/12/2023	9/1/2024	1/2/2024	1/3/2024	3/4/2024	1/5/2024	3/10/2023	1/11/2023	1/12/2023	9/1/2024	1/2/2024	1/3/2024	3/4/2024	1/5/2024
pH (pH units)	*6.5-7.5* [1]	7.7	7.4	6.8	7.0	7.1	7.8	6.5	7.3	7.7	7.7	7.0	7.1	7.3	7.8	7.3	7.7
Total dissolved solids (mg/L)	*N/A*	248	213	210	222	212	257	222	224	257	255	211	261	293	315	302	319
BOD (mg/L)	*<15* [1]	<2	<2	<2	5.0	<2	19.0	10.0	8.0	<2	<2	<2	52.0	<2	14.0	9.0	8.0
Total suspended solids (mg/L)	*<45* [2]	<2	<2	<2	<2	9	80	88	10	<2	<2	<2	<2	10	38	32	30
Zinc (mg/L)	*<0.008* [1]	0.004	0.002	0.055	<0.002	0.014	<0.002	0.008	0.005	0.017	0.010	0.006	0.0	0.008	0.009	0.008	0.010
Phosphorus (total) (mg/L)	*<0.02* [1]	<0.01	0.22	0.03	0.06	0.1	0.26	0.05	0.06	0.02	0.01	0.08	0.09	0.04	0.10	0.10	0.03
Nitrogen (total) (mg/L)	*<0.25* [1]	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Manganese (mg/L)	*<1.9* [1]	0.034	0.033	0.059	0.094	0.123	0.958	0.101	0.110	0.116	0.099	0.063	0.103	0.197	0.222	0.188	0.222
Conductivity (µS/cm	*<350* [1]	387	349	334	354	328	401	362	350	402	415	348	431	455	493	509	499
Faecal Coliforms (fc	*<150* [1]	22	10	2	1060	190	160	1100	70	82	55	12	900	290	520	820	70
Oil & Grease (mg/L	*<5* [2]	3	4	<1	2.0	2.0	1.0	2.0	<1	3	3	<1	1.0	1.0	<1	2	<1

Test Identity	Critical Range	SW3	SW3	SW3	SW3	SW3	SW3	SW3	SW3	SW4	SW4	SW4	SW4	SW4	SW4	SW4	SW4
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
		3/10/2023	1/11/2023	1/12/2023	9/1/2024	1/2/2024	1/3/2024	3/4/2024	1/5/2024	3/10/2023	1/11/2023	1/12/2023	9/1/2024	1/2/2024	1/3/2024	3/4/2024	1/5/2024
pH (pH units)	*6.5-7.5* [1]	7.8	8.6	7.0	7.2	7.3	7.8	7.9	8.1	7.8	8.3	7.1	7.3	7.3	7.7	7.2	7.9
Total dissolved solids (mg/L)	*N/A*	268	290	223	257	356	398	333	357	429	445	401	432	496	563	501	514
BOD (mg/L)	*<15* [1]	<2	<2	<2	6.0	<2	5.0	3.0	2	4	4.0	4	11	3	12	8	10
Total suspended solids (mg/L)	*<45* [2]	2	<2	25	55	35	8	12	10	110	55	<2	<2	122	36	38	30
Zinc (mg/L)	*<0.008* [1]	0.019	0.015	0.005	0.008	0.0	<0.002	0.010	0.020	0.019	0.015	<0.002	0.016	0.031	0.010	0.025	0.021
Phosphorus (total) (mg/L)	*<0.02* [1]	0.1	0.01	0.13	0.10	0.1	0.1	0.03	0.03	0.44	0.25	0.15	0.27	0.18	0.32	0.34	0.40
Nitrogen (total) (mg/L)	*<0.25* [1]	<2	<2	2.0	<2	<2	<2	<2	<2	4	3	2	3	3	4	4	4
Manganese (mg/L)	*<1.9* [1]	0.118	0.102	0.036	0.149	0.288	0.443	0.205	0.222	1.050	0.222	0.097	0.498	0.160	0.849	0.155	1.200
Conductivity (µS/cm	*<350* [1]	418	461	365	420	554	623	641	558	670	704	590	636	772	880	811	803
Faecal Coliforms (fc	*<150* [1]	130	77	50	940	<1	150	150	30	510	88	55	1560	10	880	350	1600
Oil & Grease (mg/L)	*<5* [2]	3	4	<1	2.0	2.0	<1	2	<1	3	3	1	1.0	2	<1	1	1

Test Identity	Critical Range	SW5	SW5	SW5	SW5	SW5	SW5	SW5	SW5
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
		3/10/2023	1/11/2023	1/12/2023	9/1/2024	1/2/2024	1/3/2024	3/4/2024	1/5/2024
pH (pH units)	*6.5-7.5* [1]	7.9	8.3	7.3	7.3	7.4	8.0	7.9	8.3
Total dissolved solids (mg/L)	*N/A*	250	236	215	262	298	323	322	322
BOD (mg/L)	*<15* [1]	<2	<2	<2	6.0	<2	4.0	2.0	3.0
Total suspended solids (mg/L)	*<45* [2]	<2	<2	<2	<2	21	9	10	<2
Zinc (mg/L)	*<0.008* [1]	0.009	0.002	<0.002	<0.002	0.014	0.009	<0.002	0.015
Phosphorus (total) (mg/L)	*<0.02* [1]	0.03	0.03	0.10	0.07	0.05	0.05	0.02	0.03
Nitrogen (total) (mg/L)	*<0.25* [1]	<2	<2	<2	<2	<2	<2	<2	<2
Manganese (mg/L)	*<1.9* [1]	0.117	0.088	0.058	0.119	0.152	0.373	0.144	0.141
Conductivity (µS/cm	*<350* [1]	390	412	346	422	463	506	518	503
Faecal Coliforms (fc	*<150* [1]	22	10	5	1020	70	420	370	90
Oil & Grease (mg/L)	*<5* [2]	4	2	<1	2.0	2	<1	1	1

1. ANZG (2018) *Australian & New Zealand Guidelines for Fresh & Marine Water Quality* .
2. Visy P & P (2001) *NSW EPA Licence Variation Appendix 20232* .

Sampling Sites	Location
SW1	Sandy Creek upstream of Winter Storage Dam
SW2	Sandy Creek downstream of Winter Storage Dam
SW3	Deep Creek
SW4	Upstream of Winter Storage Dam
SW5	Downstream of Winter Storage Dam

Attachment C : *Point 10 2023-2024*

Monitoring Point 10 - DECANT

Grab sample

Pollutant	Unit of measure	Critical Range	Wastewater monitoring 2023-24											
			5/07/2023	2/08/2023	1/09/2023	3/10/2023	1/11/2023	1/12/2023	9/01/2023	1/02/2024	1/03/2024	2/04/2024	1/05/2024	3/06/2024
BOD	mg/L	<40 [1]	9	12	4	3	4	4	19	15	18	5	3	5
Nitrogen (total)	mg/L	<20 [1]	2	5	43	6	4	3	3	2	2	3	5	3
Oil & Grease	mg/L	<5 [1]	1	<1	4	4	<1	2	2	1	<1	4	1	1
pH	pH	5.5-9.5 [1]	7.2	7.4	7.1	7.9	7.7	7.3	7.6	7.8	7.8	7.0	7.1	7.1
Phosphorus (total)	mg/L	<5 [1]	0.74	0.72	<0.01	1.30	0.78	0.90	0.99	1.10	0.77	0.85	1.44	0.51
Total Suspended Solids	mg/L	<45 [1]	<2	3	4	3	3	4	4	18	5	15	8	11
Total Dissolved Solids	mg/L	<1000	136	155	160	161	150	166	177	208	204	211	250	244
Sodium Adsorption Ratio	SAR	<4.5 [2]	4	7	5	4	4	5	4	3	3	4	4	4
Zinc	mg/L	no data	0.016	0.017	0.037	0.033	0.029	0.028	0.030	0.029	0.040	0.038	0.050	0.044

1. Visy P & P (2016) NSW EPA Licence 10232. Chatswood, NSW.

2. DEC (2004) NSW EPA Environmental Guidelines. Use of Effluent by Irrigation. Chatswood, NSW.

Attachment D : *SMS October 2023 and April 2024*

Parameter	Desirable Range	Soil Monitoring Sites (SMS) - 9 October 2023						
		SMS1	SMS2	SMS3	SMS4	SMS5	SMS6	SMS7
		0-10cm	0-10cm	0-10cm	0-10cm	0-10cm	0-10cm	0-10cm
Nitrate Nitrogen (ppm)	>30[3]	2.1	2.3	17	8.5	20	17	51
Phosphorus - Colwell (ppm)	>30[3]	45	53	95	92	49	150	44
Phosphorus - (available) Bray (ppm)	>30[3]	16	9	10	11	18	45	9
P Buffer Index (PBI)	> 30[4]	59	56	61	170	64	86	94
Available K (ppm)	> 225	410	140	130	700	160	270	75
Sulphate Sulphur (KCl40) (ppm)	>10[1]	4	3	12	9	6	7	4
DTPA Zinc (ppm)	1 - 5[6]	2.7	4.4	2.4	4.8	1.4	5.3	2.2
DTPA Copper (ppm)	0.2 - 5[6]	0.69	2.7	1	1.2	0.66	1.6	0.39
DTPA Iron (ppm)	*no data*	250	120	100	52	110	140	380
DTPA Manganese (ppm)	1 - 5[6]	5.2	9.1	7.8	6.3	2.2	11	15
Boron (ppm)	>0.3[2]	0.5	0.7	0.5	1.1	0.4	0.6	0.3
EC (dS/m)	<0.5[1]	0.07	0.08	0.1	0.13	0.12	0.11	0.1
ECe (dS/m)	<2[1]	0.6	0.8	1.0	0.8	1.2	1.1	1
Organic C (% C)	2[1]	1.7	2.1	1.2	1.6	1.4	1.9	2.2
Chloride (ppm)	< 125[4]	15	<10	15	18	<10	11	<10
pH (H2O)	6 - 8[1]	6.6	7.6	8.0	8.0	8.1	7.8	5.5
pH (CaCl2)	5.5 - 7[1]	5.6	6.8	7.2	7.1	7.5	7.0	4.9
CEC (meq/100gm)	5 - 15[1]	6.4	10.7	7.6	12.4	11.4	9.9	4.5
Exchangeable Aluminium (ppm)	*no data*	0	0	0	0	0	0	0
Exchangeable Potassium (ppm)	*no data*	430.1	136.85	132.94	703.8	160.31	269.79	74.29
Exchangeable Sodium (ppm)	*no data*	4.598	27.588	41.382	45.98	22.99	32.186	4.598
Exchangeable Magnesium (ppm)	*no data*	97.24	72.93	60.775	194.48	60.775	97.24	60.775
Exchangeable Calcium (ppm)	*no data*	901.8	1943.88	1302.6	1763.52	2004	1643.28	761.52
Aluminium (meq/100gm)*	<1[2]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Calcium (meq/100gm)	n/a	4.5	9.7	6.5	8.8	10	8.2	3.8
Magnesium (meq/100gm)	n/a	0.8	0.6	0.5	1.6	0.5	0.8	0.5
Sodium (meq/100gm)	<4.3[2]	0.02	0.12	0.18	0.2	0.1	0.14	<0.02
Potassium (meq/100gm)	*no data*	1.1	0.35	0.34	1.8	0.41	0.69	0.19
Ca:Mg Ratio	>2[1]	5.7	16	13	5.5	20	10	7.5
K:Mg Ratio	*no data*	-	-	-	-	-	-	-
Aluminium %	<5%[1]	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Calcium %	65-80%[1]	71	90	87	71	91	83	84
Magnesium %	10-15%[1]	12	5.7	6.6	13	4.5	8.2	11
Sodium %	<5%[1]	<1.00	1.1	2.4	1.6	0.9	1.4	<1.00
Potassium %	1-5%[1]	17	3.3	4.5	15	3.6	7	4.3
EAT (H2O Class)	*no data*	8	8	7	7	7	7	8
EAT (Low SAR Class)	*no data*	-	-	-	-	-	-	-
EAT (High SAR Class)	*no data*	-	-	-	-	-	-	-
Aluminium total (mg/kg)	*no data*	3730	1430	1400	3780	1940	4650	2200
Arsenic (mg/kg)	<20[7]	-	-	-	-	-	-	-
Cadmium (mg/kg)	<1[7]	-	-	-	-	-	-	-
Chromium (mg/kg)	<100[7]	-	-	-	-	-	-	-
Copper (mg/kg)	<100[7]	-	-	-	-	-	-	-
Lead (mg/kg)	<150[7]	-	-	-	-	-	-	-
Mercury (mg/kg)	<1[7]	-	-	-	-	-	-	-
Nickel (mg/kg)	<60[7]	-	-	-	-	-	-	-
Zinc (mg/kg)	<200[7]	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen (mg/kg)	500-3000[4]	1530	1080	948	1360	1140	2230	1450
Total Phosphorus (mg/kg)	>30[4]	182	112	100	164	128	299	140

1. NSW Agriculture (1998) Interpreting Soil Results: Rules of Thumb. NSW Agriculture, Wagga Wagga
2. Soils: their properties and management: a soil conservation handbook for NSW. (1991) Ed. Charman & Murphy. Oxford University Press.
3. Gunter S (1997) Understanding Soil Tests. NSW Agriculture Publication, Tamworth.
4. Peverill, Sparrow & Reuter (1999) Soil Analysis: An Interpretation Manual. CSIRO Publishing, Collingwood.
5. Incitec Fertilisers et al. Technical Bulletin.
6. Soil Description Book (1997), Ken Wetherby, Cleve SA
7. NSW EPA (1997) Environmental Guidelines: Use & Disposal of Biosolids Products. NSW EPA Publication, Chatswood.MASCC Agricultural Land

Parameter	Desirable Range	Soil Monitoring Sites (SMS) - 9 October 2023						
		SMS1	SMS2	SMS3	SMS4	SMS5	SMS6	SMS7
		50-60cm	50-60cm	50-60cm	50-60cm	50-60cm	50-60cm	50-60cm
Nitrate Nitrogen (ppm)	>30[3]	1.1	<0.5	2.4	1	2.6	5	6.7
Phosphorus - Colwell (ppm)	>30[3]	10	9	11	15	6	7	6
Phosphorus - (available) Bray (ppm)	>30[3]	<5	<5	<5	<5	<5	<5	<5
P Buffer Index (PBI)	> 30[4]	530	49	21	150	450	540	350
Available K (ppm)	> 225	130	130	35	500	250	590	44
Sulphate Sulphur (KCl40) (ppm)	>10[1]	13	3	3	10	28	52	11
DTPA Zinc (ppm)	1 - 5[6]	0.12	0.13	0.31	2.9	0.21	0.26	0.06
DTPA Copper (ppm)	0.2 - 5[6]	0.17	0.06	0.1	0.38	0.35	0.04	0.18
DTPA Iron (ppm)	*no data*	9.8	50	39	26	17	5.8	23
DTPA Manganese (ppm)	1 - 5[6]	0.1	0.2	3.1	4.7	1.4	0.3	1.3
Boron (ppm)	>0.3[2]	0.2	0.6	0.1	0.4	0.6	1.2	0.3
EC (dS/m)	<0.5[1]	0.05	0.05	0.04	0.06	0.1	0.11	0.04
ECe (dS/m)	<2[1]	0.3	0.3	0.4	0.4	0.6	0.7	0.2
Organic C (% C)	2[1]	0.6	0.3	<0.2	0.4	0.5	0.4	0.6
Chloride (ppm)	< 125[4]	18	<10	<10	<10	11	20	<10
pH (H2O)	6 - 8[1]	6.5	7.9	7.9	7.4	5.5	5.5	5.7
pH (CaCl2)	5.5 - 7[1]	5.7	6.8	6.9	6.4	4.5	4.7	4.6
CEC (meq/100gm)	5 - 15[1]	10.5	6	1.5	7.1	10.1	9.7	9
Exchangeable Aluminium (ppm)	*no data*	0.0	0.0	0.0	0.0	134.9	63.0	45.0
Exchangeable Potassium (ppm)	*no data*	132.9	125.1	0.0	0.0	0.0	586.5	43.0
Exchangeable Sodium (ppm)	*no data*	27.6	32.2	18.4	87.4	25.3	112.7	0.0
Exchangeable Magnesium (ppm)	*no data*	607.8	97.2	12.2	133.7	12.2	243.1	376.8
Exchangeable Calcium (ppm)	*no data*	1002.0	961.9	240.5	921.8	320.6	1002.0	1022.0
Aluminium (meq/100gm)	<1[2]	<0.1	<0.1	<0.1	<0.1	1.5	0.7	0.5
Calcium (meq/100gm)	n/a	5	4.8	1.2	4.2	5.3	5	5.1
Magnesium (meq/100gm)	n/a	5	0.8	0.1	1.3	2.2	2	3.1
Sodium (meq/100gm)	<4.3[2]	0.12	0.14	0.08	0.24	0.54	0.49	0.11
Potassium (meq/100gm)	*no data*	0.34	0.32	0.09	1.3	0.63	1.5	0.11
Ca:Mg Ratio	>2[1]	1	6.4	8.6	3.2	2.4	2.5	1.6
K:Mg Ratio	*no data*							
Aluminium %	<5%[1]	<1.0	<1.0	<1.0	<1.0	15	6.9	5.8
Calcium %	65-80%[1]	48	80	79	60	52	52	57
Magnesium %	10-15%[1]	48	13	9.4	19	21	21	35
Sodium %	<5%[1]	1.2	2.3	5.3	3.4	5.3	5	1.3
Potassium %	1-5%[1]	3.2	5.4	6	18	6.3	15	1.3
EAT (H2O Class)	*no data*	5	5	5	5	5	5	5
EAT (Low SAR Class)	*no data*	-	-	-	-	-	-	-
EAT (High SAR Class)	*no data*	-	-	-	-	-	-	-
Aluminium total (mg/kg)	*no data*	43300	47200	41300	74300	63500	70100	63500
Arsenic (mg/kg)	<20[7]	-	-	-	-	-	-	-
Cadmium (mg/kg)	<1[7]	-	-	-	-	-	-	-
Chromium (mg/kg)	<100[7]	-	-	-	-	-	-	-
Copper (mg/kg)	<100[7]	-	-	-	-	-	-	-
Lead (mg/kg)	<150[7]	-	-	-	-	-	-	-
Mercury (mg/kg)	<1[7]	-	-	-	-	-	-	-
Nickel (mg/kg)	<60[7]	-	-	-	-	-	-	-
Zinc (mg/kg)	<200[7]	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen (mg/kg)	500-3000[4]	274	166	42	445	631	501	577
Total Phosphorus (mg/kg)	>30[4]	36	42	47	107	140	134	141

1. NSW Agriculture (1998) Interpreting Soil Results: Rules of Thumb. NSW Agriculture, Wagga Wagga
2. Soils: their properties and management: a soil conservation handbook for NSW. (1991) Ed. Charman & Murphy. Oxford University Press.
3. Gunter S (1997) Understanding Soil Tests. NSW Agriculture Publication, Tamworth.
4. Peverill, Sparrow & Reuter (1999) Soil Analysis: An Interpretation Manual. CSIRO Publishing, Collingwood.
5. Incitec Fertilisers et al. Technical Bulletin.
6. Soil Description Book (1997), Ken Wetherby, Cleve SA
7. NSW EPA (1997) Environmental Guidelines: Use & Disposal of Biosolids Products. NSW EPA Publication, Chatswood.MASCC Agricultural Land

Parameter	Desirable Range	Soil Monitoring Sites (SMS) - 4 April 2024						
		SMS1	SMS2	SMS3	SMS4	SMS5	SMS6	SMS7
		0-10cm	0-10cm	0-10cm	0-10cm	0-10cm	0-10cm	0-10cm
Nitrate Nitrogen (ppm)	>30[3]	25	19	11	24	15	14	9
Phosphorus - Colwell (ppm)	>30[3]	12	34	37	12	45	98	25
Phosphorus - (available) Bray (ppm)	>30[3]	<5	11	10	11	15	30	10
P Buffer Index (PBI)	> 30[4]	60	38	65	72	51	68	64
Available K (ppm)	> 225	58	160	90	150	110	260	100
Sulphate Sulphur (KCl40) (ppm)	>10[1]	10	11	14	11	12	12	4.3
DTPA Zinc (ppm)	1 - 5[6]	1.4	4.1	4.4	1.8	2.8	5.7	3.8
DTPA Copper (ppm)	0.2 - 5[6]	0.38	1.3	0.34	0.52	0.36	0.98	0.31
DTPA Iron (ppm)	*no data*	210	150	240	180	180	170	310
DTPA Manganese (ppm)	1 - 5[6]	7.7	7.1	8.4	9.9	6.1	8.2	7.6
Boron (ppm)	>0.3[2]	0.45	0.6	0.58	0.65	0.62	0.70	0.29
EC (dS/m)	<0.5[1]	0.11	0.13	0.11	0.13	0.10	0.13	0.06
ECe (dS/m)	<2[1]	1.1	1.3	1.1	1.3	1.0	1.3	0.6
Organic C (% C)	2[1]	1.67	2.71	2.50	2.29	2.63	2.73	2.14
Chloride (ppm)	< 125[4]	40	33	30	50	23	39	16
pH (H2O)	6 - 8[1]	6.3	6.8	6.6	6.5	6.9	7.0	6.0
pH (CaCl2)	5.5 - 7[1]	5.3	6.6	5.7	5.9	6.1	6.5	5.0
CEC (meq/100gm)	5 - 15[1]	6.33	8.75	8.60	8.18	10.6	11.0	5.89
Exchangeable Aluminium (ppm)	*no data*	0	0	0	0	0	0	0
Exchangeable Potassium (ppm)	*no data*	58.65	156.4	89.93	152.49	109.48	258.06	101.66
Exchangeable Sodium (ppm)	*no data*	119.548	96.558	117.249	121.847	98.857	121.847	4.598
Exchangeable Magnesium (ppm)	*no data*	114.257	121.55	145.86	158.015	106.964	170.17	63.206
Exchangeable Calcium (ppm)	*no data*	941.88	1382.76	1342.68	1202.4	1803.6	1683.36	1022.04
Aluminium (meq/100gm)*	<1[2]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Calcium (meq/100gm)	n/a	4.7	6.9	6.7	6.0	9.0	8.4	5.1
Magnesium (meq/100gm)	n/a	0.94	1.0	1.2	1.3	0.88	1.4	0.52
Sodium (meq/100gm)	<4.3[2]	0.52	0.42	0.51	0.53	0.43	0.53	0.029
Potassium (meq/100gm)	*no data*	0.15	0.40	0.23	0.39	0.28	0.66	0.26
Ca:Mg Ratio	>2[1]	5.0	6.9	5.6	4.6	10.0	6.0	9.8
K:Mg Ratio	*no data*	-	-	-	-	-	-	-
Aluminium %	<5%[1]	<1	<1	<1	<1	<1	<1	<1
Calcium %	65-80%[1]	75.0	79.0	77.0	73.0	85.0	77.0	86.0
Magnesium %	10-15%[1]	15.0	12.0	14.0	15.0	8.3	12.0	8.8
Sodium %	<5%[1]	8.3	4.8	6.0	6.5	4.0	4.8	0.49
Potassium %	1-5%[1]	2.3	4.6	2.7	4.8	2.6	6.0	4.5
EAT (H2O Class)	*no data*	7	7	7	5	7	7	8
EAT (Low SAR Class)	*no data*	-	-	-	-	-	-	-
EAT (High SAR Class)	*no data*	-	-	-	-	-	-	-
Aluminium total (mg/kg)	*no data*	3550	1220	1300	3550	2020	4010	2010
Arsenic (mg/kg)	<20[7]	-	-	-	-	-	-	-
Cadmium (mg/kg)	<1[7]	-	-	-	-	-	-	-
Chromium (mg/kg)	<100[7]	-	-	-	-	-	-	-
Copper (mg/kg)	<100[7]	-	-	-	-	-	-	-
Lead (mg/kg)	<150[7]	-	-	-	-	-	-	-
Mercury (mg/kg)	<1[7]	-	-	-	-	-	-	-
Nickel (mg/kg)	<60[7]	-	-	-	-	-	-	-
Zinc (mg/kg)	<200[7]	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen (mg/kg)	500-3000[4]	2280	2240	2590	2410	2960	2560	2430
Total Phosphorus (mg/kg)	>30[4]	101	101	95	155	135	399	102

1. NSW Agriculture (1998) Interpreting Soil Results: Rules of Thumb. NSW Agriculture, Wagga Wagga
2. Soils: their properties and management: a soil conservation handbook for NSW. (1991) Ed. Charman & Murphy. Oxford University Press.
3. Gunter S (1997) Understanding Soil Tests. NSW Agriculture Publication, Tamworth.
4. Peverill, Sparrow & Reuter (1999) Soil Analysis: An Interpretation Manual. CSIRO Publishing, Collingwood.
5. Incitec Fertilisers et al. Technical Bulletin.
6. Soil Description Book (1997), Ken Wetherby, Cleve SA
7. NSW EPA (1997) Environmental Guidelines: Use & Disposal of Biosolids Products. NSW EPA Publication, Chatswood.MASCC Agricultural Land

Parameter	Desirable Range	Soil Monitoring Sites (SMS) - 4 April 2024						
		SMS1	SMS2	SMS3	SMS4	SMS5	SMS6	SMS7
		50-60cm	50-60cm	50-60cm	50-60cm	50-60cm	50-60cm	50-60cm
Nitrate Nitrogen (ppm)	>30[3]	2.1	0.84	1.6	2.2	1.6	2.3	1.8
Phosphorus - Colwell (ppm)	>30[3]	<5.0	<5.0	<5.0	<5.0	<5.0	5.3	5.5
Phosphorus - (available) Bray (ppm)	>30[3]	<5	<5	<5	<5	<5	<5	<5
P Buffer Index (PBI)	> 30[4]	450	110	240	480	110	470	420
Available K (ppm)	> 225	51	140	55	72	36	260	48
Sulphate Sulphur (KCl40) (ppm)	>10[1]	13	46	8.4	13	2.9	46	10
DTPA Zinc (ppm)	1 - 5[6]	0.60	0.41	0.35	0.26	0.28	0.049	0.84
DTPA Copper (ppm)	0.2 - 5[6]	0.34	0.094	0.28	0.18	0.37	0.026	0.22
DTPA Iron (ppm)	*no data*	17	30	26	7.3	14	3.8	16
DTPA Manganese (ppm)	1 - 5[6]	0.20	1.0	0.65	0.41	1.80	0.70	2.40
Boron (ppm)	>0.3[2]	0.12	0.091	0.27	0.17	0.20	0.25	0.33
EC (dS/m)	<0.5[1]	0.08	0.16	0.08	0.07	0.05	0.09	0.04
ECe (dS/m)	<2[1]	0.5	1.0	0.5	0.4	0.3	0.6	0.2
Organic C (% C)	2[1]	0.53	0.24	0.55	0.50	0.27	0.27	0.77
Chloride (ppm)	< 125[4]	<10	27	11	<10	<10	23	<10
pH (H2O)	6 - 8[1]	6.7	6.1	6.4	7.2	7.3	5.6	5.4
pH (CaCl2)	5.5 - 7[1]	5.5	4.9	5.1	6.1	6.5	4.6	4.7
CEC (meq/100gm)	5 - 15[1]	9.22	14.7	10.7	11.1	6.40	7.90	8.58
Exchangeable Aluminium (ppm)	*no data*	0.0	20.7	17.1	0.0	0.0	83.6	143.9
Exchangeable Potassium (ppm)	*no data*	50.8	140.8	54.7	70.4	36.0	258.1	46.9
Exchangeable Sodium (ppm)	*no data*	252.9	436.8	252.9	158.6	57.5	108.1	4.6
Exchangeable Magnesium (ppm)	*no data*	461.9	850.9	437.6	316.0	91.2	206.6	230.9
Exchangeable Calcium (ppm)	*no data*	821.6	1062.1	1142.3	1503.0	1062.1	821.6	982.0
Aluminium (meq/100gm)	<1[2]	<0.10	0.23	0.19	<0.10	<0.10	0.93	1.60
Calcium (meq/100gm)	n/a	4.1	5.3	5.7	7.5	5.3	4.1	4.9
Magnesium (meq/100gm)	n/a	3.8	7.0	3.6	2.6	0.75	1.7	1.9
Sodium (meq/100gm)	<4.3[2]	1.1	1.9	1.1	0.69	0.25	0.47	0.086
Potassium (meq/100gm)	*no data*	0.13	0.36	0.14	0.18	0.092	0.66	0.12
Ca:Mg Ratio	>2[1]	1.10	0.76	1.60	2.90	7.10	2.40	2.60
K:Mg Ratio	*no data*	-	-	-	-	-	-	-
Aluminium %	<5%[1]	<1	1.5	1.8	<1	<1	12.0	18.0
Calcium %	65-80%[1]	44.0	36.0	54.0	68.0	83.0	52.0	57.0
Magnesium %	10-15%[1]	42.0	48.0	33.0	24.0	12.0	22.0	22.0
Sodium %	<5%[1]	12.0	13.0	10.0	6.3	3.9	5.9	1.0
Potassium %	1-5%[1]	1.4	2.4	1.3	1.7	1.4	8.3	1.4
EAT (H2O Class)	*no data*	6	5	5	6	5	6	5
EAT (Low SAR Class)	*no data*	-	-	-	-	-	-	-
EAT (High SAR Class)	*no data*	-	-	-	-	-	-	-
Aluminium total (mg/kg)	*no data*	48800	50100	48800	65500	67400	53300	45500
Arsenic (mg/kg)	<20[7]	-	-	-	-	-	-	-
Cadmium (mg/kg)	<1[7]	-	-	-	-	-	-	-
Chromium (mg/kg)	<100[7]	-	-	-	-	-	-	-
Copper (mg/kg)	<100[7]	-	-	-	-	-	-	-
Lead (mg/kg)	<150[7]	-	-	-	-	-	-	-
Mercury (mg/kg)	<1[7]	-	-	-	-	-	-	-
Nickel (mg/kg)	<60[7]	-	-	-	-	-	-	-
Zinc (mg/kg)	<200[7]	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen (mg/kg)	500-3000[4]	640	163	601	609	334	291	723
Total Phosphorus (mg/kg)	>30[4]	22	23	23	95	155	155	130

1. NSW Agriculture (1998) Interpreting Soil Results: Rules of Thumb. NSW Agriculture, Wagga Wagga
2. Soils: their properties and management: a soil conservation handbook for NSW. (1991) Ed. Charman & Murphy. Oxford University Press.
3. Gunter S (1997) Understanding Soil Tests. NSW Agriculture Publication, Tamworth.
4. Peverill, Sparrow & Reuter (1999) Soil Analysis: An Interpretation Manual. CSIRO Publishing, Collingwood.
5. Incitec Fertilisers et al. Technical Bulletin.
6. Soil Description Book (1997), Ken Wetherby, Cleve SA
7. NSW EPA (1997) Environmental Guidelines: Use & Disposal of Biosolids Products. NSW EPA Publication, Chatswood.MASCC Agricultural Land

Attachment E : *Nutrient budget 2023-2024*

WINTER 2023	CROP (VARIETY)	DATE SOWN	SOIL P STATUS (kg/ha)	SOIL N STATUS (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	CLOVER & RYEGRASS	n/a	58.8	2.6	13.2	42.2	1	180	45	200	28.0	24.8
CP2	LUCERNE & CLOVER	n/a	114.0	20.4	13.2	42.2	1	180	45	200	83.2	42.6
CP3	CLOVER & RYEGRASS	n/a	110.0	10.2	13.2	42.2	1	180	45	200	79.2	32.4
CP4	LUCERNE & CLOVER	n/a	58.8	24.0	13.2	42.2	1	180	45	200	28.0	46.2
CP5	LUCERNE & CLOVER	n/a	180.0	20.4	13.2	42.2	1	180	45	200	149.2	42.6
SHT	RYEGRASS	n/a	52.8	61.2	13.2	84.4	1	65	45	200	22.0	10.6

SUMMER 2023/24	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	CLOVER & RYEGRASS	n/a	28.0	24.8	26.4	42.4	1	180	45	200	10.4	47.2
CP2	LUCERNE & CLOVER	n/a	83.2	42.6	26.4	42.4	1	180	45	200	65.6	65.0
CP3	CLOVER & RYEGRASS	n/a	79.2	32.4	26.4	42.4	1	180	45	200	61.6	54.8
CP4	LUCERNE & CLOVER	n/a	28.0	46.2	26.4	42.4	1	180	45	200	10.4	68.6
CP5	LUCERNE & CLOVER	n/a	149.2	42.6	26.4	42.4	1	180	45	200	131.6	65.0
SHT	MILLET & BRASSICA	n/a	22.0	10.6	52.8	84.4	1	45	100	250	0.0	0.0

WINTER 2024	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYE/CLOVER/MILLET	tba	10.4	47.24	52.8	0	1	180	45	200	19.2	27.2
CP2	LUCERNE/CLOVER	tba	65.6	65	26.4	0	1	180	45	200	48.0	45.0
CP3	RYE/CLOVER/MILLET	tba	61.6	54.8	39.6	0	1	180	45	200	57.2	34.8
CP4	LUCERNE/CLOVER	tba	10.4	68.6	39.6	0	1	180	45	200	6.0	48.6
CP5	LUCERNE/CLOVER	tba	131.6	65	26.4	0	1	180	45	200	114.0	45.0
SHT	MILLET	tba	0	0	52.8	126.6	1	45	100	250	0.0	0.0

SUMMER 2024/25	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE/CLOVER	tba	19.2	27.24	26.4	0	1	180	45	200	1.6	7.2
CP2	LUCURNE/CLOVER/RYE	tba	48	45	26.4	0	1	180	45	200	30.4	25.0
CP3	LUCERNE/CLOVER	tba	57.2	34.8	26.4	0	1	180	45	200	39.6	14.8
CP4	LUCURNE/CLOVER/RYE	tba	6	48.6	26.4	0	1	180	45	200	0.0	28.6
CP5	LUCURNE/CLOVER/RYE	tba	114	45	26.4	0	1	180	45	200	96.4	25.0
SHT	OATS	tba	0	0	52.8	84.4	1	45	45	93	8.8	36.4

WINTER 2025	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE/CLOVER	tba	1.6	7.24	26.4	42.2	1	180	45	200	0.0	29.4
CP2	LUCURNE/CLOVER/RYE	tba	30.4	25	26.4	0	1	180	45	200	12.8	5.0
CP3	LUCERNE/CLOVER	tba	39.6	14.8	26.4	42.2	1	180	45	200	22.0	37.0
CP4	LUCURNE/CLOVER/RYE	tba	0	28.6	26.4	0	1	180	45	200	0.0	8.6
CP5	LUCURNE/CLOVER/RYE	tba	96.4	25	26.4	0	1	180	45	200	78.8	5.0
SHT	OATS	tba	8.8	36.4	52.8	84.4	1	45	45	93	17.6	72.8

SUMMER 2025/26	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE/CLOVER	tba	0	29.44	52.8	42.2	1	180	45	200	8.8	51.6
CP2	LUCERNE/CLOVER/MILLET	tba	12.8	5	52.8	42.2	1	180	45	200	21.6	27.2
CP3	LUCENRE/CLOVER	tba	22	37	52.8	42.2	1	180	45	200	30.8	59.2
CP4	LUCERNE/CLOVER/MILLET	tba	0	8.6	52.8	42.2	1	180	45	200	8.8	30.8
CP5	LUCERNE/CLOVER/MILLET	tba	78.8	5	26.4	42.2	1	180	45	200	61.2	27.2
SHT	BRASSICA	tba	17.6	72.8	52.8	42.2	1	45	45	93	26.4	67.0

WINTER 2026	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	8.8	51.64	22	0	3	193	25	200	8.8	44.6
CP2	LUCERNE	tba	21.6	27.2	22	0	3	193	25	200	21.6	20.2
CP3	RYEGRASS	tba	30.8	59.2	26.4	44	1	45	21	93	37.2	55.2
CP4	RYEGRASS	tba	8.8	30.8	26.4	44	1	45	21	93	15.2	26.8
CP5	RYEGRASS	tba	61.2	27.2	26.4	18.6	1	90	21	93	67.6	42.8
SHT	RYEGRASS	tba	26.4	67	26.4	44	1	45	21	93	32.8	63.0

SUMMER 2026/27	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	8.8	44.64	26.4	0	3	193	25	200	13.2	37.6
CP2	LUCERNE	tba	21.6	20.2	26.4	0	3	193	25	200	26.0	13.2
CP3	RYEGRASS	tba	37.2	55.2	22	11	3	53	21	47	41.2	72.2
CP4	RYEGRASS	tba	15.2	26.8	22	11	3	53	21	47	19.2	43.8
CP5	RYEGRASS	tba	67.6	42.8	22	11	3	53	21	47	71.6	59.8
SHT	RYEGRASS	tba	32.8	63	22	23	3	53	21	47	36.8	92.0

WINTER 2027	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	13.2	37.64	22	23	3	193	25	200	13.2	53.6
CP2	LUCERNE	tba	26	13.2	22	23	3	193	25	200	26.0	29.2
CP3	RYEGRASS	tba	41.2	72.2	26.4	23	1	45	21	93	47.6	47.2
CP4	RYEGRASS	tba	19.2	43.8	26.4	23	1	45	21	93	25.6	18.8
CP5	RYEGRASS	tba	71.6	59.8	26.4	23	1	45	21	93	78.0	34.8
SHT	RYEGRASS	tba	36.8	92	26.4	18.6	1	45	21	93	43.2	62.6

SUMMER 2027/28	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	13.2	53.64	26.4	0	3	193	25	200	17.6	46.6
CP2	LUCERNE	tba	26	29.2	26.4	0	3	193	25	200	30.4	22.2
CP3	RYEGRASS	tba	47.6	47.2	0	23	3	53	21	47	29.6	76.2
CP4	RYEGRASS	tba	25.6	18.8	0	23	3	53	21	47	7.6	47.8
CP5	RYEGRASS	tba	78	34.8	0	23	3	53	21	47	60.0	63.8
SHT	RYEGRASS	tba	43.2	62.6	22	23	3	53	21	47	47.2	91.6

WINTER 2028	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	17.6	46.64	22	0	3	193	25	200	17.6	39.6
CP2	LUCERNE	tba	30.4	22.2	22	0	3	193	25	200	30.4	15.2
CP3	WHEAT	tba	29.6	76.2	48.4	18	1	45	45	100	34.0	39.2
CP4	WHEAT	tba	7.6	47.8	26.4	39	1	45	45	100	0.0	31.8
CP5	RYEGRASS	tba	60	63.8	26.4	18	1	45	21	93	66.4	33.8
SHT	RYEGRASS	tba	47.2	91.6	26.4	39	1	45	21	93	53.6	82.6

SUMMER 2028/29	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	17.6	39.64	26.4	0	3	193	25	200	22.0	32.6
CP2	LUCERNE	tba	30.4	15.2	26.4	0	3	193	25	200	34.8	8.2
CP3	FALLOW	tba	34	39.2	0	0	0	0	0	0	34.0	39.2
CP4	FALLOW	tba	0	31.8	0	0	0	0	0	0	0.0	31.8
CP5	RYEGRASS	tba	66.4	33.8	22	23	3	53	21	47	70.4	62.8
SHT	RYEGRASS	tba	53.6	82.6	22	23	3	53	21	47	57.6	111.6

WINTER 2029	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	22	32.64	22	0	3	193	25	200	22.0	25.6
CP2	LUCERNE	tba	34.8	8.2	22	23	3	193	25	200	34.8	24.2
CP3	WHEAT	tba	34	39.2	39.6	63.6	1	45	45	100	29.6	47.8
CP4	WHEAT	tba	0	31.8	52.8	63.6	1	45	45	100	8.8	40.4
CP5	RYEGRASS	tba	70.4	62.8	22	18.6	1	45	21	93	72.4	33.4
SHT	RYEGRASS	tba	57.6	111.6	22	18.6	1	45	21	93	59.6	82.2

SUMMER 2029/30	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	22	25.64	0	23	3	53	21	47	4.0	54.6
CP2	RYEGRASS	tba	34.8	24.2	0	23	3	53	21	47	16.8	53.2
CP3	LUCERNE	tba	29.6	47.8	37.4	0	3	193	25	200	45.0	40.8
CP4	LUCERNE	tba	8.8	40.4	37.4	0	3	193	25	200	24.2	33.4
CP5	RYEGRASS	tba	72.4	33.4	0	23	1	53	21	47	52.4	62.4
SHT	RYEGRASS	tba	59.6	82.2	0	23	3	53	21	47	41.6	111.2

WINTER 2030	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	4	54.64	26.4	23	1	45	21	93	10.4	29.6
CP2	RYEGRASS	tba	16.8	53.2	26.4	23	1	45	21	93	23.2	28.2
CP3	LUCERNE	tba	45	40.8	22	0	3	193	25	200	45.0	33.8
CP4	LUCERNE	tba	24.2	33.4	22	0	3	193	25	200	24.2	26.4
CP5	RYEGRASS	tba	52.4	62.4	26.4	23	1	45	21	93	58.8	37.4
SHT	RYEGRASS	tba	41.6	111.2	26.4	23	1	45	21	93	48.0	86.2

SUMMER 2030/31	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	10.4	29.64	22	0	3	53	21	47	14.4	35.6
CP2	RYEGRASS	tba	23.2	28.2	22	0	3	53	21	47	27.2	34.2
CP3	LUCERNE	tba	45	33.8	22	0	3	193	25	200	45.0	26.8
CP4	LUCERNE	tba	24.2	26.4	22	23	3	193	25	200	24.2	42.4
CP5	RYEGRASS	tba	58.8	37.4	22	0	3	53	21	47	62.8	43.4
SHT	RYEGRASS	tba	48	86.2	22	0	3	53	21	47	52.0	92.2

WINTER 2031	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	WHEAT	tba	14.4	35.64	39.6	46	1	45	45	100	10.0	26.6
CP2	WHEAT	tba	27.2	34.2	39.6	46	1	45	45	100	22.8	25.2
CP3	LUCERNE	tba	45	26.8	22	46	3	193	25	200	45.0	65.8
CP4	LUCERNE	tba	24.2	42.4	22	0	3	193	25	200	24.2	35.4
CP5	WHEAT	tba	62.8	43.4	26.4	55	1	45	45	100	45.2	43.4
SHT	RYEGRASS	tba	52	92.2	26.4	23	1	45	21	93	58.4	67.2

SUMMER 2031/32	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	FALLOW	tba	10	26.64	0	0	0	0	0	0	10.0	26.6
CP2	FALLOW	tba	22.8	25.2	0	0	0	0	0	0	22.8	25.2
CP3	LUCERNE	tba	45	65.8	22	0	3	193	25	200	45.0	58.8
CP4	LUCERNE	tba	24.2	35.4	22	0	3	193	25	200	24.2	28.4
CP5	MAIZE	tba	45.2	43.4	44	162	3	53	50	250	42.2	8.4
SHT	RYEGRASS	tba	58.4	67.2	0	0	3	53	21	47	40.4	73.2

WINTER 2032	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	WHEAT	tba	10	26.64	39.6	69	1	45	45	100	5.6	40.6
CP2	WHEAT	tba	22.8	25.2	39.6	46	1	45	45	100	18.4	16.2
CP3	LUCERNE	tba	45	58.8	22	0	3	193	25	200	45.0	51.8
CP4	LUCERNE	tba	24.2	28.4	22	0	3	193	25	200	24.2	21.4
CP5	WHEAT	tba	42.2	8.4	39.6	55	1	45	45	100	37.8	8.4
SHT	RYEGRASS	tba	40.4	73.2	26.4	46	1	45	21	93	46.8	71.2

SUMMER 2032/33	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	5.6	40.64	26.4	21	3	193	25	200	10.0	54.6
CP2	LUCERNE	tba	18.4	16.2	26.4	21	3	193	25	200	22.8	30.2
CP3	LUCERNE	tba	45	51.8	22	21	3	193	25	200	45.0	65.8
CP4	LUCERNE	tba	24.2	21.4	22	21	3	193	25	200	24.2	35.4
CP5	FALLOW	tba	37.8	8.4	0	0	0	0	0	0	37.8	8.4
SHT	FALLOW	tba	46.8	71.2	0	0	0	0	0	0	46.8	71.2

WINTER 2033	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	10	54.64	22	0	3	193	25	200	10.0	47.6
CP2	LUCERNE	tba	22.8	30.2	22	0	3	193	25	200	22.8	23.2
CP3	RYEGRASS	tba	45	65.8	26.4	44	1	45	21	93	51.4	61.8
CP4	RYEGRASS	tba	24.2	35.4	26.4	44	1	45	21	93	30.6	31.4
CP5	RYEGRASS	tba	37.8	8.4	26.4	63.6	1	45	21	93	44.2	24.0
SHT	RYEGRASS	tba	46.8	71.2	26.4	63.6	1	45	21	93	53.2	86.8

SUMMER 2033/34	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	10	47.64	26.4	0	3	193	25	200	14.4	40.6
CP2	LUCERNE	tba	22.8	23.2	26.4	0	3	193	25	200	27.2	16.2
CP3	RYEGRASS	tba	51.4	61.8	11	23	3	53	21	47	44.4	90.8
CP4	RYEGRASS	tba	30.6	31.4	11	23	3	53	21	47	23.6	60.4
CP5	RYEGRASS	tba	44.2	24	22	23	3	53	21	47	48.2	53.0
SHT	RYEGRASS	tba	53.2	86.8	11	23	3	53	21	47	46.2	115.8

WINTER 2034	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	14.4	40.64	22	0	3	193	25	200	14.4	33.6
CP2	LUCERNE	tba	27.2	16.2	22	18.6	3	193	25	200	27.2	27.8
CP3	RYEGRASS	tba	44.4	90.8	26.4	18.6	1	45	21	93	50.8	61.4
CP4	RYEGRASS	tba	23.6	60.4	26.4	18.6	1	45	21	93	30.0	31.0
CP5	RYEGRASS	tba	48.2	53	26.4	42.6	1	45	21	93	54.6	47.6
SHT	RYEGRASS	tba	46.2	115.8	26.4	18.6	1	45	21	93	52.6	86.4

SUMMER 2034/35	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	14.4	33.64	22	22	3	193	25	200	14.4	48.6
CP2	LUCERNE	tba	27.2	27.8	22	0	3	193	25	200	27.2	20.8
CP3	RYEGRASS	tba	50.8	61.4	0	0	3	53	21	47	32.8	67.4
CP4	RYEGRASS	tba	30	31	22	0	3	53	21	47	34.0	37.0
CP5	RYEGRASS	tba	54.6	47.6	22	0	3	53	21	47	58.6	53.6
SHT	RYEGRASS	tba	52.6	86.4	22	0	3	53	21	47	56.6	92.4

WINTER 2035	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	14.4	48.64	22	0	3	193	25	200	14.4	41.6
CP2	LUCERNE	tba	27.2	20.8	22	0	3	193	25	200	27.2	13.8
CP3	WHEAT	tba	32.8	67.4	39.6	44	1	45	45	100	28.4	56.4
CP4	WHEAT	tba	34	37	26.4	44	1	45	45	100	16.4	26.0
CP5	RYEGRASS	tba	58.6	53.6	26.4	23	1	45	21	93	65.0	28.6
SHT	RYEGRASS	tba	56.6	92.4	26.4	23	1	45	21	93	63.0	67.4

SUMMER 2035/36	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	14.4	41.64	22	22	3	193	25	200	14.4	56.6
CP2	LUCERNE	tba	27.2	13.8	22	22	3	193	25	200	27.2	28.8
CP3	FALLOW	tba	28.4	56.4	22	22	3	53	21	47	32.4	84.4
CP4	FALLOW	tba	16.4	26	22	23	0	0	0	0	38.4	49.0
CP5	RYEGRASS	tba	65	28.6	22	23	3	53	21	47	69.0	57.6
SHT	RYEGRASS	tba	63	67.4	22	23	3	53	21	47	67.0	96.4

WINTER 2036	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	14.4	56.64	22	0	3	193	25	200	14.4	49.6
CP2	LUCERNE	tba	27.2	28.8	22	0	3	193	25	200	27.2	21.8
CP3	WHEAT	tba	32.4	84.4	52.8	46	1	45	45	100	41.2	75.4
CP4	WHEAT	tba	38.4	49	26.4	46	1	45	45	100	20.8	40.0
CP5	RYEGRASS	tba	69	57.6	26.4	18.6	1	45	21	93	75.4	28.2
SHT	RYEGRASS	tba	67	96.4	26.4	18.6	1	45	21	93	73.4	67.0

SUMMER 2036/37	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	14.4	49.64	22	23	3	53	21	47	18.4	78.6
CP2	RYEGRASS	tba	27.2	21.8	22	23	3	53	21	47	31.2	50.8
CP3	LUCERNE	tba	41.2	75.4	37.4	0	3	193	25	200	56.6	68.4
CP4	LUCERNE	tba	20.8	40	37.4	23	3	193	25	200	36.2	56.0
CP5	RYEGRASS	tba	75.4	28.2	0	23	1	53	21	47	55.4	57.2
SHT	RYEGRASS	tba	73.4	67	0	23	3	53	21	47	55.4	96.0

WINTER 2037	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	18.4	78.64	22	0	3	193	25	200	18.4	71.6
CP2	RYEGRASS	tba	31.2	50.8	22	0	3	193	25	200	31.2	43.8
CP3	LUCERNE	tba	56.6	68.4	44	63.6	1	45	45	100	56.6	77.0
CP4	LUCERNE	tba	36.2	56	44	63.6	1	45	45	100	36.2	64.6
CP5	RYEGRASS	tba	55.4	57.2	26.4	18.6	1	45	21	93	61.8	27.8
SHT	RYEGRASS	tba	55.4	96	26.4	18.6	1	45	21	93	61.8	66.6

SUMMER 2037/38	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	18.4	71.64	0	12.5	22	53	21	47	19.4	90.1
CP2	RYEGRASS	tba	31.2	43.8	0	12.5	22	53	21	47	32.2	62.3
CP3	LUCERNE	tba	56.6	77	37.4	0	3	193	25	200	72.0	70.0
CP4	LUCERNE	tba	36.2	64.6	37.4	0	3	193	25	200	51.6	57.6
CP5	RYEGRASS	tba	61.8	27.8	0	23	22	53	21	47	62.8	56.8
SHT	RYEGRASS	tba	61.8	66.6	0	23	3	53	21	47	43.8	95.6

WINTER 2038	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	32.2	62.3	22	0	3	193	25	200	32.2	55.3
CP2	RYEGRASS	tba	72	70	22	0	3	193	25	200	72.0	63.0
CP3	LUCERNE	tba	51.6	57.6	44	63.6	1	45	45	100	51.6	66.2
CP4	LUCERNE	tba	62.8	56.8	44	63.6	1	45	45	100	62.8	65.4
CP5	RYEGRASS	tba	43.8	95.6	26.4	44	1	45	21	93	50.2	91.6
SHT	RYEGRASS	tba	43.8	95.6	26.4	55	1	45	21	93	50.2	102.6

SUMMER 2038/39	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	32.2	55.3	0	23	22	53	21	47	33.2	84.3
CP2	RYEGRASS	tba	72	63	0	23	22	53	21	47	73.0	92.0
CP3	LUCERNE	tba	51.6	66.2	37.4	0	3	193	25	200	67.0	59.2
CP4	LUCERNE	tba	62.8	65.4	37.4	0	3	193	25	200	78.2	58.4
CP5	RYEGRASS	tba	50.2	91.6	0	0	22	53	21	47	51.2	97.6
SHT	RYEGRASS	tba	50.2	102.6	26.4	0	3	53	21	47	58.6	108.6

Attachment F : *By-products 2023-2024*

Pollutant	Unit of measure	Dregs & Grits by-products monitoring 2023-24												
		5/07/2023	2/08/2023	5/09/2023	3/10/2023	1/11/2023	1/12/2023	10/01/2024	1/02/2024	1/03/2024	2/04/2024	1/05/2024	3/06/2024	Mean
Arsenic	ppm	< 5	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	4
Cadmium	ppm	1.7	1.6	2	2	2	1	0.7	2	0.8	1	2	1	1.5
Chromium	ppm	43.7	38.8	42	47	60	32	28	39	26	28	43	47	39.5
Copper	ppm	84.9	99.5	120	150	100	65	65	110	89	75	120	110	99
Lead	ppm	224	92.9	160	74	61	53	150	120	160	140	180	410	152
Mercury	ppm	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.10
Nickel	ppm	29	25	32	40	48	33	17	27	21	22	33	39	31
Zinc	ppm	492	454	450	510	550	390	250	430	310	320	620	480	438
Sodium	ppm	14000	7570	19000	13000	8600	8900	16000	26000	18000	15000	17000	9400	14373
Moisture (Dry-basis)	%	94.4	61.6	-	-	-	-	-	-	-	-	-	-	78.0
Moisture (Wet-basis)	%	48.6	38.1	44	37	28	32	36	30	27	32	31	38	35.1
Boron	ppm	44	23	20	20	110	20	40	30	50	40	50	30	40
Conductivity	dS/m	6.08	6.53	5.80	6.60	4.90	2.60	8.90	23.00	8.10	8.60	4.20	1.90	7.3
Molybdenum	ppm	2	2	1	1	< 2	< 1	1	2	2	1	2	< 1	2
pH	pH	10.5	10.7	10.4	10.2	11.0	10.1	11.2	10.3	10.5	10.4	10.1	9.8	10.4
Selenium	ppm	< 2	< 2	< 4	< 4	< 8	< 3	< 2	< 4	< 2	< 4	< 8	3	4

Pollutant	Unit of measure	Lime mud by-products monitoring 2023-24												
		5/07/2023	2/08/2023	5/09/2023	3/10/2023	1/11/2023	1/12/2023	10/01/2024	1/02/2024	1/03/2024	2/04/2024	1/05/2024	3/06/2024	Mean
Arsenic	ppm	< 5	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	4
Cadmium	ppm	0.7	0.8	< 0.4	< 0.4	< 0.6	< 0.4	< 0.4	< 0.4	< 0.6	< 0.4	< 0.5	<0.5	0.5
Chromium	ppm	7.8	7.1	7	5	6	6	6	6	8	6	8	7	6.7
Copper	ppm	0.7	< 0.2	< 1	< 1	< 1	1	< 1	1	< 1	1	1	< 1	0.9
Lead	ppm	315	146	200	170	130	190	290	310	480	10	700	520	288
Mercury	ppm	< 0.05	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0
Nickel	ppm	1	2	< 1	< 1	< 1	2	< 1	1	< 1	< 1	< 1	< 1	1
Zinc	ppm	5.1	1.7	< 1	110	27	2	< 1	1	2	66	< 1	< 1	18.2
Sodium	ppm	11100	8800	12000	8300	12000	11000	10000	9300	11000	10000	13000	13000	10792
Moisture (Dry-basis)	%	50.8	24.8	-	-	-	-	-	-	-	-	-	-	37.8
Moisture (Wet-basis)	%	33.7	19.9	16.0	22.0	14.0	18.0	16.0	7.5	9.9	12	16	17	16.8
Boron	ppm	18	10	< 10	10	10	< 4	20	20	20	10	10	10	13
Conductivity	dS/m	1.960	1.840	0.940	0.350	0.790	0.680	0.750	0.920	0.440	0.510	0.380	0.640	0.9
Molybdenum	ppm	2	2	< 1	2	< 2	< 1	< 1	< 1	< 1	< 1	< 1	< 2	1
pH	pH	10.9	11.5	10.4	12.1	10.5	10.4	10.3	10.5	10.4	10.2	10.3	10.7	10.7
Selenium	ppm	<2	< 2	< 2	< 3	< 7	< 2	< 2	< 2	< 2	< 2	< 6	< 6	3.3

Pollutant	Unit of measure	Fly ash by-products monitoring 2023-24												
		5/07/2023	2/08/2023	5/09/2023	3/10/2023	1/11/2023	1/12/2023	10/01/2024	1/02/2024	1/03/2024	2/04/2024	1/05/2024	3/06/2024	Mean
Arsenic	ppm	7	5	6	6	9	8	12	8	7	10	7	26	9
Cadmium	ppm	1.3	1.0	0.7	0.9	1.0	1.0	< 0.4	1	0.9	0.9	1	1	0.9
Chromium	ppm	26.6	33.9	28	24	37	30	34	30	32	34	37	33	31.6
Copper	ppm	44.7	33.2	42	38	57	45	52	48	45	58	49	54	47.2
Lead	ppm	6	6	11	9	16	14	17	16	14	27	23	10	14
Mercury	ppm	0.1	< 0.1	0.1	0.1	< 0.1	0.1	< 0.1	0.1	< 0.1	0.1	< 0.1	<0.1	0.1
Nickel	ppm	20	19	21	21	31	25	19	23	24	25	25	23	23
Zinc	ppm	280	312	280	270	300	280	140	270	260	220	270	340	269
Sodium	ppm	1520	1020	1300	1200	1400	1800	1100	1600	1600	2300	1500	1600	1495
Moisture (Dry-basis)	%	13.7	13.6	-	-	-	-	-	-	-	-	-	-	13.7
Moisture (Wet-basis)	%	12.0	12.0	13.0	9.9	15.0	19.0	21.0	8.6	21	16	9	8.7	13.8
Boron	ppm	130	132	170	180	230	170	100	170	150	160	160	220	164
Conductivity	dS/m	12.90	13.100	8.800	10.000	8.700	9.400	3.700	8.500	7.200	8.900	7.100	14.00	9.0
Molybdenum	ppm	1	2	2	2	2	1	2	2	2	2	2	2	2
pH	pH	10.1	11.9	11.7	11.9	11.60	11.10	11.20	11.1	10.1	11.40	11.5	12.2	11.3
Selenium	ppm	< 2	< 2	< 2	< 3	< 7	< 2	< 2	< 2	< 2	< 2	< 2	< 6	2.8
Total Organic Carbon	ppm	34000	21000	23000	15000	42000	41000	20000	37000	43000	35000	18000	29000	29833

Pollutant	Unit of measure	Boiler Sand by-products monitoring 2023-24												
		5/07/2023	2/08/2023	5/09/2023	3/10/2023	1/11/2023	1/12/2023	10/01/2024	1/02/2024	1/03/2024	2/04/2024	1/05/2024	3/06/2024	Mean
Arsenic	ppm	< 5	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	4
Cadmium	ppm	< 0.2	< 0.2	< 0.4	< 0.4	< 0.6	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.5	< 0.4	0.4
Chromium	ppm	13.0	7.4	10	9	9	12	13	13	13	13	14	5	11.0
Copper	ppm	7.8	5.2	6	5	5	5	11	6	10	7	6	4	6.5
Lead	ppm	3	< 1	1	< 1	< 2	< 1	1	1	< 1	2	< 1	< 1	1
Mercury	ppm	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.10
Nickel	ppm	7	4	6	5	6	7	6	7	8	6	6	3	6
Zinc	ppm	53.0	38.7	53	63	37	50	51	57	56	41	56	25	48.4
Sodium	ppm	360	274	330	810	270	520	650	410	570	640	470	220	460
Moisture (Dry-basis)	%	8.8	3.7	-	-	-	-	-	-	-	-	-	-	6.3
Moisture (Wet-basis)	%	8.1	3.6	2.8	1.8	5.2	2.0	6.7	0.3	1	5.4	1.7	3.2	3.5
Boron	ppm	20	17	20	20	20	20	20	20	20	20	20	20	20
Conductivity	dS/m	0.180	0.171	0.590	0.380	0.570	0.460	1.400	0.500	0.310	0.720	0.630	1.600	0.6
Molybdenum	ppm	< 1	1	< 1	< 1	< 2	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1
pH	pH	10.0	11.1	10.2	10.2	10.8	10.6	10.4	10.6	10.5	10.5	10.5	10.6	10.5
Selenium	ppm	< 2	< 2	< 2	< 2	< 7	< 2	< 2	< 2	< 2	< 2	< 6	< 6	3

Attachment G : *Sludge 2023-2024*

Monitoring Point - Sludge
Sampled from SBR

Pollutant	Critical Range	Unit of measure	Sludge (treated) monitoring 2023-24											
			5/07/2023	2/08/2023	1/09/2023	3/10/2023	1/11/2023	1/12/2023	9/01/2024	1/02/2024	1/03/2024	2/04/2024	1/05/2024	3/06/2024
Manganese	0.2 [1]	mg/L	11.1	17.0	16.1	15.5	0.077	0.89	0.154	0.192	0.165	0.188	0.111	0.111
Total suspended solids	<45 [2]	mg/L	13300	7180	7720	19900	28	32	35	45	256	288	111	331
BOD	<15 [1]	mg/L	4260	6550	1130	1310	66	88	22	30	40	27	55	477
Sodium Adsorption Ratio	<4.5 [1]	SAR	2	1	3	4	4	4	4	3	3	4	4	3
Nitrogen (total)	<20 [2]	mg/L	953	3680	3880	155	26	16	11	40	27	10	5	106
Phosphorus (total)	<0.05 [1]	mg/L	93.4	220	43.6	23.7	1.85	2.82	2.99	6.51	4.57	1.69	2.01	13.7
Total dissolved solids	<225 [1]	mg/L	207	312	348	205	162	215	211	195	183	201	255	226
pH	6.0-8.5 [1]	pH	7	6.7	6.8	7.9	8.1	7.4	7.6	7.8	7.8	6.2	7.1	6.6
Conductivity	<350 [1]	uS/cm	1120	1690	543	320	269	367	353	302	286	308	398	353
Chloride	175	mg/L	24.3	26.4	24.6	27.1	28.1	35.2	28.8	34.5	22.9	18.4	48.2	45.5
Oil & Grease	<5 [2]	mg/L	3	127	316	18	<1	3	2	3	1	2	2	19
Sodium - dissolved	115	mg/L	41.8	70.8	55.3	52.8	40.3	50.3	43.0	43.2	37.1	56.8	60.5	47.1

1. ANZG (2018) Australian & New Zealand Guidelines for Fresh & Marine Water Quality.

2. Visy P & P (2016) NSW EPA Licence 10232. Chatswood, NSW.