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Quality Assurance and Quality Control by Approved Methods

Review of wastewater treatment and effluent application to land Allied Mills Pty Ltd – Picton Mill

1. Task outline

Under instruction from Allied Mills Pty Ltd, I visited the Picton Mill on Tuesday 12th July 2016 with the following objectives:

1. Obtain a detailed overview of the site operations of the wastewater treatment and land application of effluent
2. Inspect the aerated wastewater treatment system (AWTS)
3. Make on-site measurements of the treatment facility
4. Take a grab sample from the irrigation chamber for bacteriological and physiochemical analysis
5. Examine the effluent land application area (LAA)
6. Set out six representative sample sites within the LAA
7. Take soil samples to 0.9 m deep from each horizon
8. Return soil samples to laboratory and undertake physiochemical analysis
9. Prepare a report detailing the assessment of the AWTS and the LAA
10. Prepare a water balance and nutrient balance update
11. Propose a monitoring program that clearly identifies requirements for managing and reporting the health and environmental security of the sewage treatment and land application of the effluent

2. Background

The Environmental Impact Statement (KBR 2004) for the Picton Mill **provided** for a primary settling tank (10 kL), subsurface flow reed bed (80 m^2), storage tank (100 kL), UV disinfection and irrigation to a land application area (s.7.6.5) to treat wastewater from the staff and visitor use (35 persons), estimated at 3000 L/day (approx. 86 L/p.day).

A s.68 application to Wollondilly Shire Council was prepared by John Holland Pty Ltd to alter the wastewater treatment system to an Econocycle aerated wastewater treatment system (AWTS) to replace both the primary settling tank and the sub-surface flow reed bed. The application was successful; approval was dated 11th September 2007.

The Econocycle AWTS and the 1250 m^2 LAA have operated since installation under the same target effluent quality production as the original proposed septic tank and reed bed as outlined in Table 7.15 of the EIS (KBR 2004).

In July 2016, the NSW Department of Planning and Environment ("the Department") issued Allied Mills Pty Ltd with a Notice of Intent (16th June 2016) following a 'show cause' (9th June 2016) for failure to comply with conditions of consent. The order identified that:

a. The water quality criteria for the AWTS failed to meet the criteria nominated in the EIS for total nitrogen, total phosphorus, thermotolerant coliforms and pH; and
b. the soil testing of May 2015 had identified high levels of total nitrogen and total phosphorus in the land application area.

3. Site Inspection

I visited the Picton Mill to conduct a site inspection on 12th July 2016. The Site Manager, Mr Stephen Bowers, showed me the AWTS and the irrigation area. The location of the Econocycle and the irrigation area are set out in Attachment A.

I was provided with updated figures for the number of staff and visitors using the sewerage system as 45 persons per day.

Monitoring, by Allied Mills, of the effluent discharged from the AWTS over the period 26 October 2015 and 6th January 2016 for a total of 73 days, showed the average effluent discharge was 1950 L/day. The EIS estimated daily use of 3000 L.

Mr Bowers pointed out the location where the inline water meter has previously been installed in the outlet to the Econocycle. He also noted that the inline disc filter had been problematic and had been removed.

4. Wastewater Treatment

Observations were made of the internal condition of the AWTS, the presence of chlorination tablets and general cleanliness indicating good operating conditions.

On-site tests were performed for:

- dissolved oxygen (DO) in the final aeration chamber and the irrigation chamber;,
- pH, electrical conductivity (EC) and redox of irrigation chamber effluent; and
- free chlorine.

Two water samples were taken in sterile containers for numeration of thermotolerant bacteria (faecal coliforms, *E.coli)* and total coliforms. The samples were placed in an esky with ice bricks for return to the laboratory. Additional non-sterile samples were taken for physiochemical analysis from the irrigation chamber and also stored in the esky.

The results of the testing regime are set out in Attachment B and discussed under Section 6.

5. Land Application Area

The land application area is shown on Attachment A, in the corner between the entrance road and the side road, identified in the EIS Figure 2.1 as the 'North East Area', gently sloping towards the west.

Two rows of four irrigator risers are roughly parallel to the contour as shown in Attachment A. The overlap of the irrigators is not known and Attachment A, Figure 2 offers a typical pattern of overlap.

Six soil sample sites were set out to provide locations at which future soil testing could be conducted to minimise site and soil variability. Attachment A, Figure 2 identifies the six sites and the dimensions to permit return, in future sampling periods, to the same locations.

Auger holes (100 mm & 75 mm) were bored by hand to 900 mm at each of the six sites, the profile set out on a mat and photographed. Photographs are provided in Attachment C.

Representative samples were taken from the surface horizon and the two B horizons (B and B2) and returned to the laboratory for analysis. Bulk density samples were taken for each surface soil. The results of those analyses are set out in Attachment D and discussed in later sections.

6. Assessment

6.2 Wastewater Quality

The Econocycle AWTS was in good operating condition when inspected on 12th July 2016 and it was obvious that the system was being maintained. The dissolved oxygen (DO) in the aeration chamber, at 7.5 mg O_2/L (14.2°C), indicates that the oxygenation of the wastewater is high, achieving desirable outcomes. The DO reading is equivalent to 75% saturation at that temperature and altitude. The low BOD_5 (17 mg O_2/L) indicates that the effluent is within expected levels for a secondary treatment system.

The chlorination tablets were in place and the positive on-site reading of 0.5 mg free chlorine was recorded. The effluent was within drinking water standards for faecal coliforms (<1 cfu/100 mL) and E.coli (<1 cfu/100 mL), much higher quality than indicated in the EIS (1000 cfu/100 mL). The total coliform count is simply an indication of how effective the disinfection system is working, but do not pose a public health risk.

The effluent results are set out in Attachment B and reflect the typical quality expected of a system that is mostly human urine and faeces, not typical of domestic effluent where large volumes of laundry water and chemicals, and bathroom water contribute to dilution.

The effluent has a sodium adsorption ratio (SAR) of 1.8 which is suitable for irrigation without inducing sodium related problems. The effluent has low salinity.

The low ammonia-N level (8.6 mg N/L) compared with the nitrate-N concentration (44.6 mg N/L) indicates that the aeration is working very efficiently, noting that most of the incoming nitrogen would be in the form of urea and ammonia. The level of organic–N (9.9 mg/L) indicates that most of the decomposition of the human wastes were being processed in the treatment system. The total nitrogen is the sum of the nitrate-N and the organic N (total Kjeldahl nitrogen and ammonia). A level of 62.8 mg N/L is not unusual similar systems.

System that are dominated by wastes that exclude laundry wastes have a low total alkalinity that reduces the capacity of the microbes to denitrify. The effluent as tested had a total alkalinity of 27 mg/L when ideally a total alkalinity of more than 100 mg/L is required for effective denitrification. Hence, any denitrification that is to occur can only take place in the soil environment, not in the AWTS.

The total phosphorus (TP) level of 8.2 mg P/L is made up of 7.2 mg orthophosphate-P (soluble) and 1.0 mg/L or organic P (insoluble). The AWTS has no mechanism for either removing or reducing the TP of the incoming wastewater water.

Other water quality indicators are that the effluent is non-saline, has a sodium adsorption ratio of 1.8 that indicates that the effluent is unlikely to induce sodic conditions in the soil. The chloride level is low as is sulphur.

6.1 Interpretation of Water Quality Results

While predictions and targets were outlined in the EIS, in particular Table 7.16, the results of the current test need to be considered in context of impact on the environment, rather than simply raw numbers. The heading 'Loading' in EIS Table 7.16 is incorrect, since units of measure as milligrams per litre are concentrations, not loads.

The NSW EPA introduced Load Based Licensing in 2001 as a ‘fairer system that rewards cleaner industry’. Under the concentration regime, it would be legitimate to use ‘dilution as the solution to pollution’ to meet the criteria set out in the EIS. Under a load calculation, dilution plays no part and the simple calculation of load (concentration times volume).

Given that the EIS (2004) estimates the concentrations set out in Table 7.16 for an estimated daily volume of 3000 L, then the load can be calculated. Table 1 shows the same parameters, with the 12th July 2016 values for 2000 L/day against that load calculated for the EIS.

Table 1. Comparison of load based upon EIS values and July 2016 values.

1	2	3	4	5	6
Parameter	NSW EPA Target mg/L	EIS concentration mg/L	EIS calculated load kg/year	July2016 concentration mg/L	July 2016 Load kg/year
BOD	<40	<40	43.8	17	12.4
Total nitrogen	<50	<50	54.8	63	46.0
Total phosphorus	<10	<10	11.0	8.2	6.0
Total dissolved solids	<500	<500	548	503	367

The pH and thermotolerant coliforms were within the criteria set out in the EIS.

It is clear, that while the patronage of the wastewater system has risen from an estimated 35 to 45 persons per day (+29%), the volume of wastewater has fallen from 3000 L/day to a measured average 2000 L/day. Table 1 shows that, based upon the July 2016 values (column 6), the system is performing well within the criteria (column 4) that was supported in the EIS and approved.
It is my view there has been a misunderstanding of the interpretation of the criteria, rather than a non-compliance, relying upon concentration rather than effluent load as an indicator of performance.

A similar set of calculations could be performed on the data presented by GHD in the Revised AEMR (Nov2015). The point of concern is that the monitoring is related to concentration rather than load. A simple solution to the non-compliance for TN and TP would be to simply turn on a water tap and allow it to run permanently at 0.7 L/min to bring the volume up to the approved 3000 L/day and reduce the concentration to acceptable levels. The current ‘show cause’ is a penalty for water conservation and increased staffing.

The annual load of nitrogen and phosphorus is equivalent to one horse, to put the nutrient load in perspective.

7. Soil Results

The six locations selected within the land application area resulted in 18 soil samples, representing six surface, six B horizon and six B2 horizons to the profile depth of 900 mm.

It is clear from the photographs in Attachment C that there is a distinct colour change from the surface soil (0-350 mm) to the B horizon (350-700) and a slight colour change in the B2 horizon. The surface soil receives the immediate impact of the hydraulic and chemical load, but is also the most biologically active horizon. As erosion is unlikely to play a part in removing mineral soil on this vegetated site, the movement of nutrients can only be through atmospheric losses (volatilisation, denitrification), drainage or utilisation (decomposition) by the microfauna/flora and uptake by vegetation.

The nutrients of particular interest are those that can demonstrate that the land application area is not being overloaded with nutrients beyond the capacity of the area to assimilate those nutrients. Similarly, one needs to consider the target nutrients that are most likely to move with drainage from the site.

The ability of the site to adequately assimilate the nutrients/pollutants depends upon the soil profile as well as the irrigation schedule. In the documentation presented to me, I have not seen a previous description of the land application area, only two annual reports that simply sampled the topsoil (0-100 mm) without any recourse to the remainder of the soil profile.

7.1 Surface soil

The surface soil, the zone of maximum accumulation of biological activity is 350 mm deep and the top 100 mm is only the interface between the air and the soil, not a reflection of the assimilation ability of the soil. The May 2016 soil report only addressed this 100 mm interface.

Based on the six sample sites for this report, the surface soil is non-saline, non-sodic, with an average pHw in water of 6.96 (range 6.72-7.12). For the pH in 0.01M $CaCl_2$, the average was 6.15 (range 5.94 to 6.35). These values are ideal for pasture production and nutrient availability and do not require amendments of lime as at these pH values, aluminium is not mobile. Average surface salinity was very low (112 uS/cm).

Nitrate-N is an important nutrient that is easily leached from the soil matrix because as an anion (negatively charged ion) there is no retention mechanism within the soil and it is free to move with drainage water. The surface nitrate-N was 7.7 mg N/kg, a level of deficiency rather than excess. Ideal nitrate-N levels are over 20 mg N/kg.

Total nitrogen levels in the surface soil averaged 0.34% which is relatively low and offers poor reserves for micro-organisms. However, much of this TN is unavailable to plants and only slowly available for microbial consumption.

Similarly, available phosphorus in the surface averaged 7.07 mg P/kg, significantly less than plant requirements (>20 mg P/kg). Total phosphorus (combined available, organic and bound P) was 830 mg/kg which needs further explanation when one considers phosphorus sorption.

Organic carbon reserves in the surface soil averaged 1.97%, a lower than ideal value for a soil that has a history of effluent reuse . The surface soil has a low exchangeable sodium percentage (ESP) (1.3%) and is water stable but swelling in its reaction to a typical effluent.

Cation exchange capacity (CEC) averaged 14.4 cmol+/kg, a bonus for nutrient retention.

7.2 Sub-soil B horizon

The B horizon is, by definition an horizon where clay accumulates. This clay loam horizon, compared to the loam surface horizon, is generally from 350 mm to 700 mm below the surface and provides further treatment for percolating effluent.

Soil pHw averaged 7.34 and pHca averaged 6.32. These are ideal level and have no need for lime adjustment. While the soil has increased ESP to 6.3%, a level at which dispersion may occur, the samples slaked but did not disperse in typical effluent. As the soil is not disturbed at this depth, there is no issue with this elevated value.

The soil CEC remains high, a bonus for nutrient retention.

Available phosphorus levels are below levels of detection in this horizon, indicating that whatever phosphorus is available in the surface soil, and in decaying roots, none is in the plant available form.

Total phosphorus levels have fallen from an average in the surface of 830 mg/kg to 350 mg/kg in this horizon. Whatever phosphorus may be translocated by leaching or biological activity is of no consequence in this horizon. Phosphorus is not mobile between horizons, as will be explained later.

Nitrate-N migration is the nutrient that one monitors as an indication of potential leakage to groundwater. The average nitrate-N level in the B horizon was 0.20 mg/kg, just above the level of detection and significantly below plant requirement that are in the order of 15-20 mg/kg. The is strong evidence that nitrate-N is not leaching into the B horizon. Similarly, total nitrogen has diminished from 0.34% in the surface to 0.08% in the B horizon, again evidence that total nitrogen is not mobile.

Soil organic carbon, averaged 0.36% when levels below 1% are considered artefacts of previous eras.

An increase in chloride and sulphate in the B horizon may have natural causes, particularly as the levels of these nutrients in the effluent is low. The increase in magnesium and sodium are likely geologically influenced.

7.3 Subsoil B2 horizon

The B2 horizon is classified as the maximum accumulation of clay and has increased from clay loam B horizon to a light clay at about 700-750 mm below the surface.

Nitrate-N, total nitrogen, available phosphorus and total phosphorus levels are exceedingly low, all lower than the B horizon.

Certainly, the increase in magnesium and sodium are geologically based, with a significant loss of calcium resulting in a high ESP.

pH has decreased to pHw 5.77 and pHca 4.80 while salinity remains low.

8. Nutrient Assimilation

8.1 Phosphorus sorption capacity

While available phosphorus is a negative ion with no mechanism for attachment to charged cations, there is a strong affinity between aluminium and iron minerals in clay complexes such that the phosphorus ion is strongly adsorbed onto the mineral matrix and unavailable for plants or relocation. This property is measured as 'phosphorus sorption capacity'.

The phosphorus sorption capacity of the B and B2 horizons is very high and a significant benefit to effluent reuse in that the phosphorus is unlikely to leave the irrigation area. Using the measured P sorption rates (refer to Attachment D) the combined rate is 9400 kg/ha. The plant uptake rate for phosphorus is about 30 kg/ha. Using these values for a 50-year period, an irrigation area of 275 m^2 is required. Even if the effluent phosphorus concentration was double, the 1250 m^2 irrigation area is significantly oversized with respect to phosphorus.

For the 1250 m^2 irrigation area, a combination of plant uptake of phosphorus and P sorption, the irrigation area has an expected life in excess of 200 years. Phosphorus loading rate, even if it was double that measured on 12th July 2016 is of no risk to the environment.

8.2 Nitrogen loading rate

The total nitrogen measured on 12th July 2016 (62.8 mg N/L) for a daily volume of 2000 L equates to an annual loading rate of 46 kg (see Table 1). Allowing for immobilisation, volatilisation and denitrification losses of 40% in the soil environment, the soil needs to assimilate 38 kg per year. At a plant uptake rate of 300 kg N/ha for irrigated pasture, the LAA needs to be 1270 m^2.

The operating temperature of the AWTS is critical to the nitrogen concentration, low levels are typical of summer periods and high levels (poor denitrification) in winter. The effluent sample of 12th July 2016 was taken at an effluent temperature of 14.2°C and is likely to have a higher total nitrogen concentration than a summer sample.

8.3 Salinity and sodicity

The effluent has a very low salinity and the soil profile has low salinity in each of the three horizons. The effluent has a low SAR, unlikely to exacerbate the increasing ESP in the B and B2 horizons. As these horizons are not exposed and are not physically disturbed, the increase ESP is a function of landscape and of no environmental consequence.

9. Water Balance

The use of average monthly rainfall values for Picton equates to the summed monthly rainfall total being equivalent to the 73rd percentile annual rainfall. I have a preference for the use of 70th percentile monthly values, which for Picton equates to the 83rd percentile annual total – a very conservative value. A monthly time-step water balance has been run with the daily evaporation data for Richmond UWS (Stn No. 67021) and the 70th percentile monthly rainfall for Picton to estimate the irrigation area. The calculation is shown in Attachment E.

With no wet-weather storage proposed, and no allowance for water storage in the soil profile, based upon the light clay at 700 mm deep (the most limiting horizon), an area of 900 m^2 is required. Wet-weather storage invites a plethora of management issues, not the least is maintaining the disinfection quality during the period of storage. A water balance based upon no storage is the sensible option.

10. Summary

The nutrient assimilation and water balance calculations, based upon the 12th July 2016 effluent quality and the daily effluent production of 2000 L, are summarised as:

Hydraulic load	900 m^2
Nitrogen load	1270 m^2
Phosphorus load	275 m^2

A small increase in irrigation area is required, that may simply require an extra sprinkler on each of the two runs. An alternative is to move the lower run a further 6 m downslope, reducing the overlap of the sprinkler while increasing the overall wetted area.

11. Recommendations

The operation and maintenance of the Econocycle AWTS are producing an effluent that reflects the high inputs of human wastes and low domestic wastes; high in nitrogen and phosphorus, but low in total alkalinity. The system has limited capacity for denitrification because aerated systems have a primary function of reducing BOD and maintaining an aerated effluent. Both these function are counter to the requirement for denitrification – low oxygen, high BOD. However, with a suitable irrigation area to assimilate the nitrogen and phosphorus as well as the hydraulic load, the overall system should not be hampered by defined limits on effluent quality, except for those properties that directly relate to system function and public health.

11.1 Sewage Treatment

Allied Mills Pty Ltd may consider a formal contract with the local approved service agent for a three-monthly servicing of the Econocycle, in line with the procedure for domestic systems, with a copy of the servicing report forwarded to Wollondilly Council or Department of Planning and Environment as may be the current requirement. A current informal agreement is in place.

Before commencing each quarterly service, measure the following:

Measure at the irrigation chamber:

- Faecal coliforms, or *E.coli* (Thermotolerant coliforms)
  - goal <10 colony forming units per 100 mL in the irrigation chamber
- Measure dissolve oxygen in the irrigation chamber, on-site
  - goal- more than 5 mg O_2/L at 20°C
- Measure free available chlorine at the irrigation chamber, on-site
  - Goal 0.5 – 2.0 mg/L

Twice annually (one summer and one winter)
Collect 2 x 1 L samples from irrigation chamber for analysis for:

- Ammonia-N
- Nitrate-N
- Total N (nitrate-N plus Total Kjeldahl nitrogen(TKN))
- pH
- Electrical conductivity
- Orthophosphate-P
- Total phosphorus (TP)
- Major cations (sodium, calcium, potassium, magnesium)
- Calculate sodium adsorption ratio

These parameters need to be quantified without limit, as inputs to the irrigation area and reported on a progressive spreadsheet, rather than an isolated report.

11.2 Land Application Area

The tertiary treatment of the effluent from the AWTS occurs in the soil profile. Thus, the quality of the irrigation water needs to be applied over a sufficient area to allow natural assimilation of the nutrient and hydraulic load without causing off-site effects. The need to monitor the land application area must be done with a view to minimising natural variability within the soil profile.

To that end, six specific locations (Attachment A, Figure 2), termed environmental management areas (EMAs) have been identified that relate to spray application and border effects. In following years, the samples need to be taken from those same locations (within 1 m diameter) and compared with previous values. Because of the low nutrient application, annual soil reports are more than adequate; more frequent testing is rejected as wasteful of resources. Because of the high phosphorus sorption, once a decade may suffice.

I see no need to monitor the B2 horizon as it shows no effect from the previous decade of irrigation.

ANNUALLY, sample the soil at SIX designated EMAs within the irrigation area (Attachment A, Figure 2).

At each of the six sites, take samples from:

- the surface (A horizon 0-100 mm) and
- the top 100 mm of the B horizon (clay horizon) 350-450 mm

Soil properties to monitor on an annual basis, and report, without limit.

- Soil pH (1:5 in water) and (1:5 in 0.01M $CaCl_2$)
- Electrical conductivity (1:5 soil:water)
- Major cations (sodium, calcium, potassium, magnesium)
- Exchangeable acidity (measure of hydrogen and aluminium ions in soil solution)
- Calculation of exchangeable sodium percentage (ESP)
- Calculation of cation exchange capacity (CEC)
- Organic carbon (OC) Walkely & Black method
- Extractable phosphorus
- Extractable sulphur
- Nitrate-N (Mineral N)
- Chloride
- Emerson Aggregate Stability Test (performed with simulated effluent)

Monitoring total phosphorus in the soil has no merit because of the very high phosphorus sorption capacity. Excess phosphorus is simply locked up in this mechanism and unavailable for export.

Total nitrogen does not require a limit, since increases in organic matter because of root vigour and microbial activity can have a significant effect upon TN values with only positive environmental effects.

These annual results need to be maintained on a progressive spreadsheet where the changes from one year to the next can be evaluated.

12. Conclusion

The inspection of the Econocycle AWTS and the soil assessment I conducted of the irrigation area on 12th July 2016 and samples taken from each of three horizons, lead me to make the following observations.

The AWTS was in good condition, reflecting an effective maintenance regime. The quality of the effluent was within acceptable levels for such a treatment plant, although TN exceeded the EIS limit. Disinfection was successful with the bacteriological indicators meeting drinking water quality.

It is my view that the limits set in the EIS (2004) incorrectly label Table 7.6 with “load” when the units of measure are concentration. Thus, the Picton Mill is being disadvantaged because of its water conservation practices and increased patronage that limit water at the expense of concentration. With more persons using the system now than proposed in the EIS, the load based upon the current figures (Table 1) meet the EIS limits for load, rather than concentration. It is absurd to proposed that the Mill leave one tap running at 0.7 L/min to increase the discharge as a mechanism for decreasing concentration, but that would be the outcome.

The only requirements that need to be placed on the operation of the AWTS is its quarterly maintenance, an effective dissolved oxygen rate, a suitable target for disinfection and a measurable free chlorine in the irrigation chamber. Half yearly (winter and summer) monitoring of effluent quality is recommended as inputs to monitoring the loading to the land application area.

It is my view that apart from some landscape changes, the soil samples in the land application area show no signs of overloading. Indeed, the low levels of available phosphorus, nitrate-N are in the plant deficiency status. Too little nitrogen and phosphorus is being supplied for normal plant vigour. Simply defining total nitrogen and total phosphorus in isolation of the capacity of the soil to assimilate those nutrients is flawed.

The soil pH is ideal and I do not recommend additions of lime. Soil salinity is no issue while soil sodicity is deep within the profile where it is not detrimental to the landscape.

I do recommend, as suggested to the plant manager, that a small diversion bank be developed between the road above the irrigation and the irrigation area to divert runoff away from the irrigation area. A small diversion bank, not more than 200 mm high is all that is required for about 60 m, diverting runoff into the tree row.

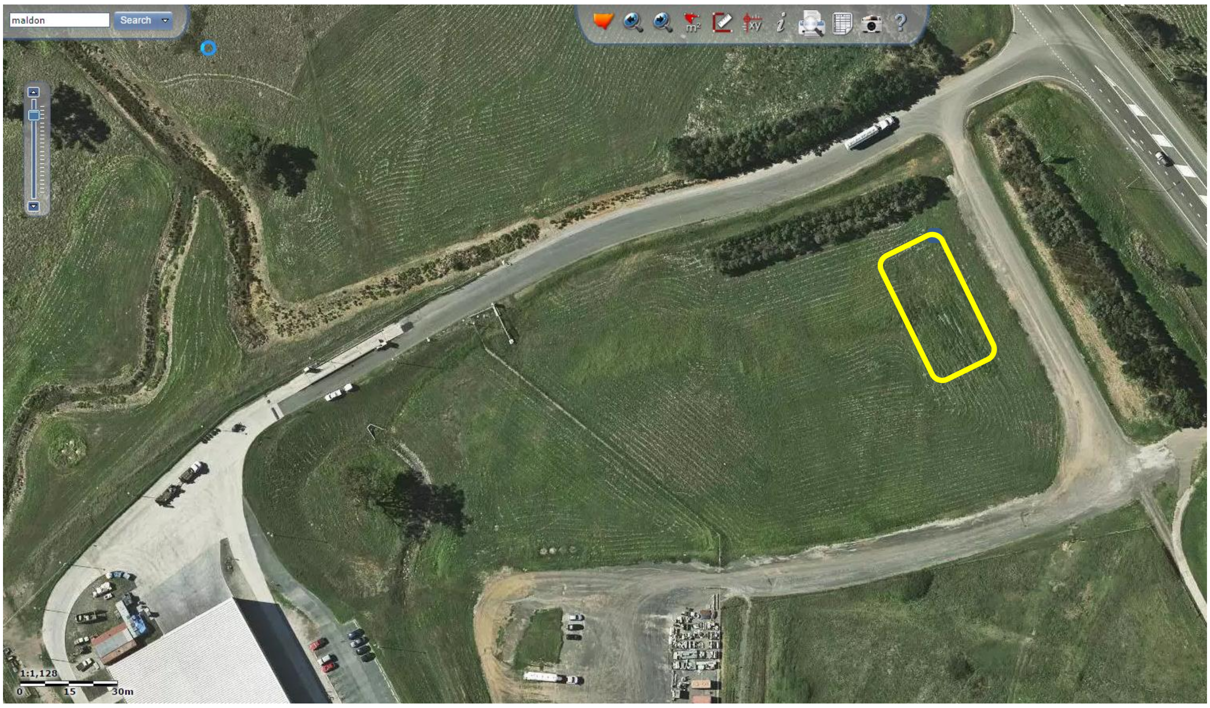
I also recommend that depressions in the irrigation area (natural depressions and wheel tracks) be levelled with topsoil from some area away from the irrigation area. Such actions prevent pooling of either irrigation water or rainfall in these depressions and adding burden to the hydraulic loading.

I understand the concerns of the Department with compliance with the EIS proposed limits, however, it is my view that Allied Mills is being censured for exceeding concentration limits when the load is the important criteria. Those loads of total nitrogen and total phosphorus need to be considered as inputs to the tertiary treatment system, not as impediments to operation. It is my view that nominating limits on TN and TP in the effluent is severely restricting the use of the toilets by staff and visitors.

With a clear monitoring program, as detailed above, and progressive analysis of samples that minimise natural soil variability, a clear focus on effluent management can be planned.

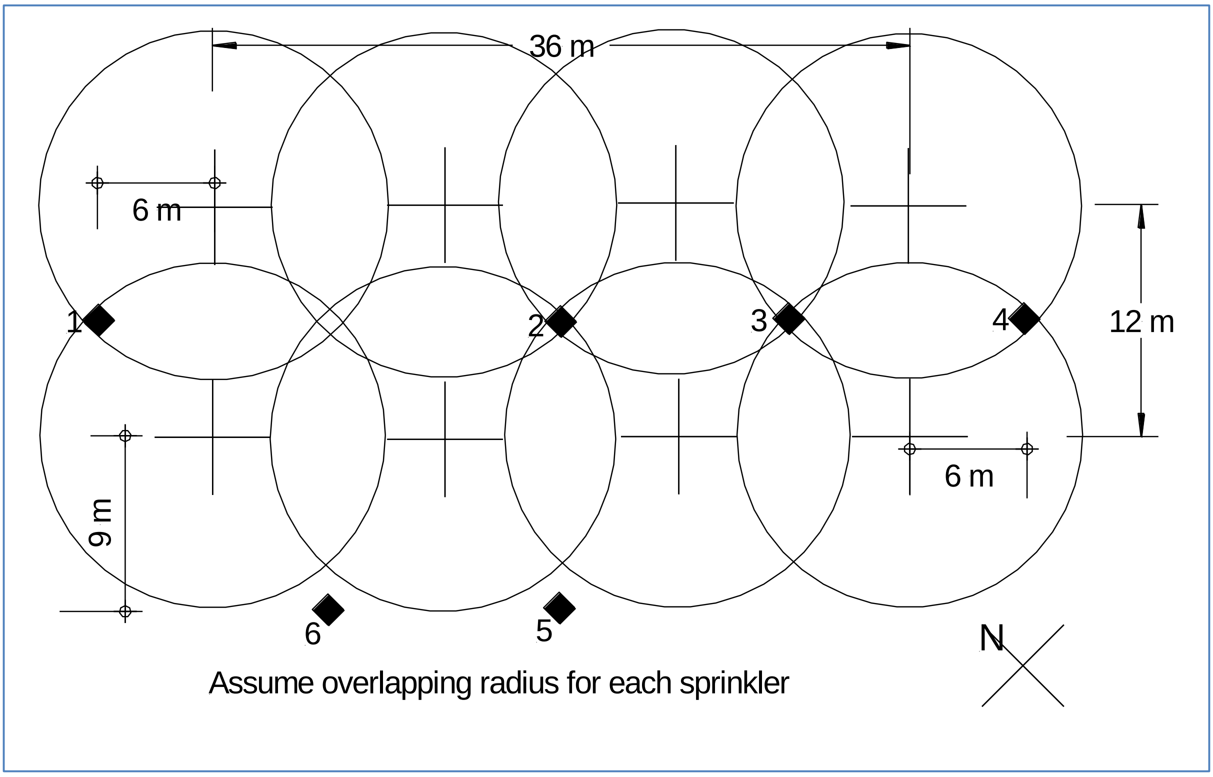
ATTACHMENT A

Location of the six soil sample locations with reference to the sprinkler layout



Attachment A, Figure 1 Location of irrigation area in northern corner of North East Area - not to scale

Image source: NSW Land & Property Information. Downloaded 10th July 2016



Attachment A, Figure 2 Location of soil boreholes relative to sprinklers

Borehole numbers correspond to soil descriptions and photographs

ATTACHMENT B

Water Report

Results of the on-site and laboratory analysis of samples taken from the irrigation chamber of the Econocycle aerated wastewater treatment system at 9.15 am Tuesday 12th July 2016.

Attachment B, Figure 1 Econocycle wastewater system, foreground pipes to irrigation area

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Analysis of Wastewater Sample

Client Allied Mills Pty Ltd, Picton Mill
Report 26th July 2016
Water Sample collected 12th July 2016
Analysis complete 26th July 2016
Sample collected by Dr Robert Patterson
Samples collected fresh, then chilled

RESULTS - PICTON MILL ECONOCYCLE IRRIGATION CHAMBER

mg L^{-1} = part per million)

Parameter	Irrigation chamber				***Units***	***Method***
BOD -5-day	17.0				mg L^{-1}	APHA 5210 B
Total suspended solids TSS	17				mg L^{-1}	APHA 2540 D
Total dissolved solids TDS	503				mg L^{-1}	calculation
Total alkalinity	27				mg L^{-1}	APHA 2320 B
Oil & Grease	Not tested				mg L^{-1}	USEPA 1664
pH	6.73				pH units	APHA 4500-H^+ B
NH_3-N	8.59				mg L^{-1}	APHA 4500-NH_3 C
NO_2 and NO_3 -N	44.6				mg L^{-1}	APHA 4110 B
TKN - N	18.2				mg L^{-1}	APHA 4500-N_{org} C
TN	62.8				mg L^{-1}	TKN + NO_2+NO_3
Soluble Reactive P (SRP)	7.19				mg L^{-1}	APHA 4110 B
Total phosphorus (TP)	8.23				mg L^{-1}	APHA 4500 P E
Chloride (Cl^-)	93.3				mg L^{-1}	APHA 4110B
Aluminium (Al^{3+})	0.037				mg L^{-1}	APHA 3120
Calcium (Ca^{2+})	44.8				mg L^{-1}	
Potassium (K^+)	26.8				mg L^{-1}	
Magnesium (Mg^{2+})	8.36				mg L^{-1}	
Sodium (Na^+)	51.2				mg L^{-1}	
Sodium adsorption ratio	1.8					Calculation
Sulphur ($SO_4^=$-S)	14.8				mg L^{-1}	APHA 4110B
Elect. conductivity (EC)	740				uS cm^{-1}	APHA 2510 B
Faecal Coliforms	FC <1; E.coli <1 TC 210				cfu/ 100 mL	Membrane Filter APHA 9222 D

6<0.x = measured but reading below detection level

Reference: APHA (2005) *Standard Methods for the Examination of Water and Wastewater*. 21st Edition 2005.

ATTACHMENT C

Soil profile photographs

Attachment C, Figure 1 View looking west over irrigation area

Attachment C, Figure 2 Looking south over irrigation area

Attachment C, Figure 3 Profile 1

Attachment C, Figure 4. Profile 2

Attachment C, Figure 5. Profile 3

Attachment C, Figure 6. Profile

Attachment C, Figure 7. Profile 5

Attachment C, Figure 8. Profile 6

ATTACHMENT D

Soil Profile Results

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Quality Assurance and Quality Control by Approved Methods

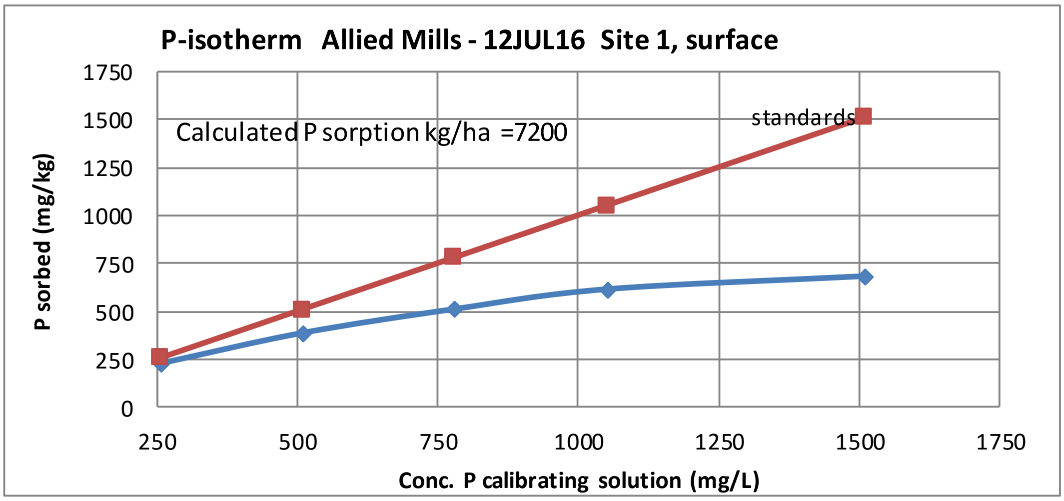
Analysis of Soil Sample for Wastewater System Design

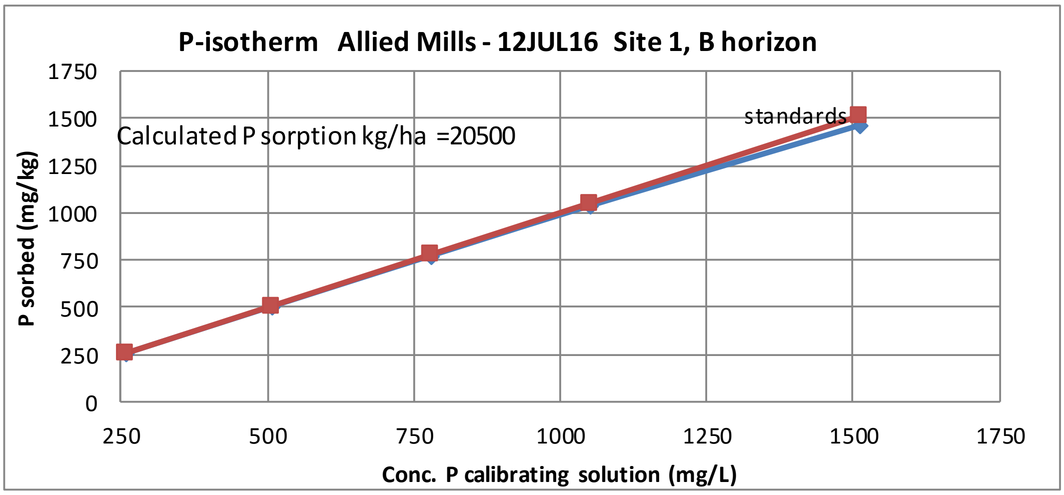
Client... Allied Mills Pty Ltd – Picton Mill *Date*.... 29th July 2016
Soil sample collected 12th July 2016 *Analysis completed*.29th July 2016
Source of soil: Picton Mill - designated effluent irrigation area

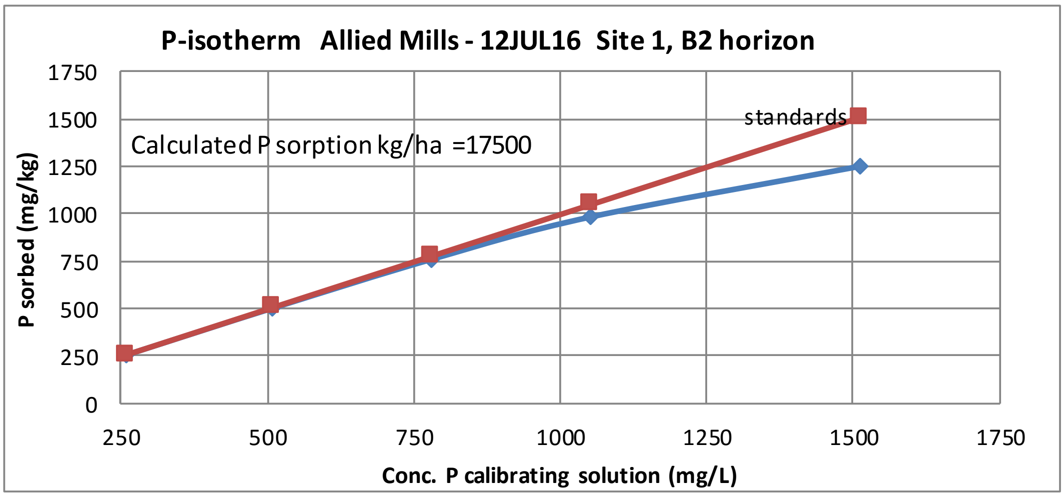
RESULTS – Profile 1

Parameter /Sample No.	0-300 mm	300-700 mm	700-1000 mm	Method
Client reference no.				
pH 1:5 in water	6.90	7.66	6.88	4A1
pH 1:5 in $CaCl_2$	6.20	6.81	5.92	4B1
EC (1:5 in water) (uS/cm)	123	121	234	3A1
Salinity hazard	Non-saline	Non-saline	Non-saline	EC/texture class
Exch. calcium (mg kg^{-1})	1501	972	497	15D3
Exch. potassium (mg kg^{-1})	304	82	59	15D3
Exch. magnesium (mg kg^{-1})	305	523	1108	15D3
Exch. sodium (mg kg^{-1})	18	8	539	15D3
Exch. acidity (cmol(+) kg^{-1})	0.0	0.1	0.1	15 G1.
Cation Exchange Capacity (meq+/100g)	10.9	9.5	14.2	calculation
Exch. Sodium Percentage	0.7	0.4	16.6	
Sodicity	Non-sodic	Non-sodic	Sodic	
Base Saturation (%)	100.0	99.2	99.4	
Ca: Mg ratio	3.0	1.1	0.6	
Chloride (mg kg^{-1})	28.2	50.8	183	5A3a
Nitrate-N (mg kg^{-1})	4.62	0.37	0.04	7B2
Total Nitrogen (%)	0.329	0.091	0.064	7A1
Organic Carbon (%)	2.05	0.53	0.32	6A1
Orthophosphate-P (mg kg^{-1})	4.8	<0.1	<0.1	9B1 (Bray)
Total phosphorus (mg kg^{-1})	717	360	284	other
Extractable sulphur (mg kg^{-1})	12.0	21.9	41.0	10D1
Soil Colour (moist)	5YR 2/4 very dark reddish brown	2.5YR 3/6 dark reddish brown	5YR 4/8 reddish brown	Munsell Colour
Field Texture	Loam	Clay loam	Light clay	Northcote 1979
Permeability Class	3	4	5	AS/NZS 1547:2012
DLR (irrigation) mm/day	4.0	3.5	3.0	AS/NZS 1547:2012
Initial dispersion test	Water stable, swell	Slake 1	Slake 1	SAR5, EC 1 dS/m
Emerson's Aggregate Test	Class 7	*3/6, slake 1	*3/6, slake 1	

Reference: Rayment, G.E. and Lyons, D. J.(2011) *Soil Chemical Methods - Australasia.* CSIRO Publishing. Canberra. All methods in accordance with accreditation procedures.
NOTE: The dispersion test is done in solution that represents domestic wastewater, with sodium adsorption ratio of 5 and EC of 1 dS/m. w/s = water stable in SAR5, EC 1 dS/m solution







Estimated phosphorus sorption for 1.0 m deep, based upon the depth of each horizon and average bulk density = 15 610 kg/ha

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Soil Scientists and Environmental Engineers

Lanfax Laboratories
ABN 72 212 385 096
Quality Assurance and Quality Control by Approved Methods

Analysis of Soil Sample for Wastewater System Design

Client... Allied Mills Pty Ltd – Picton Mill *Date*.... 29th July 2016
Soil sample collected 12th July 2016 *Analysis completed*.29th July 2016
Source of soil: Picton Mill - designated effluent irrigation area

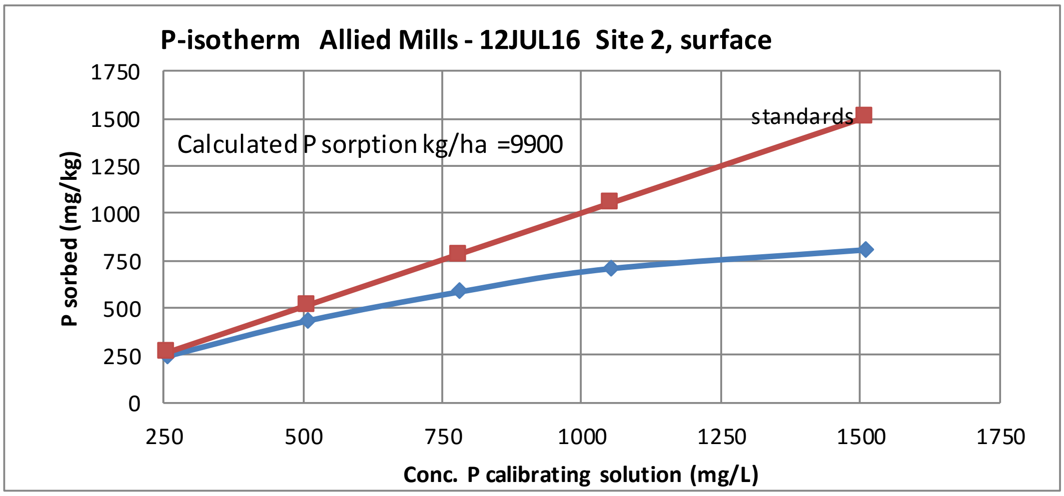
RESULTS – Profile 2

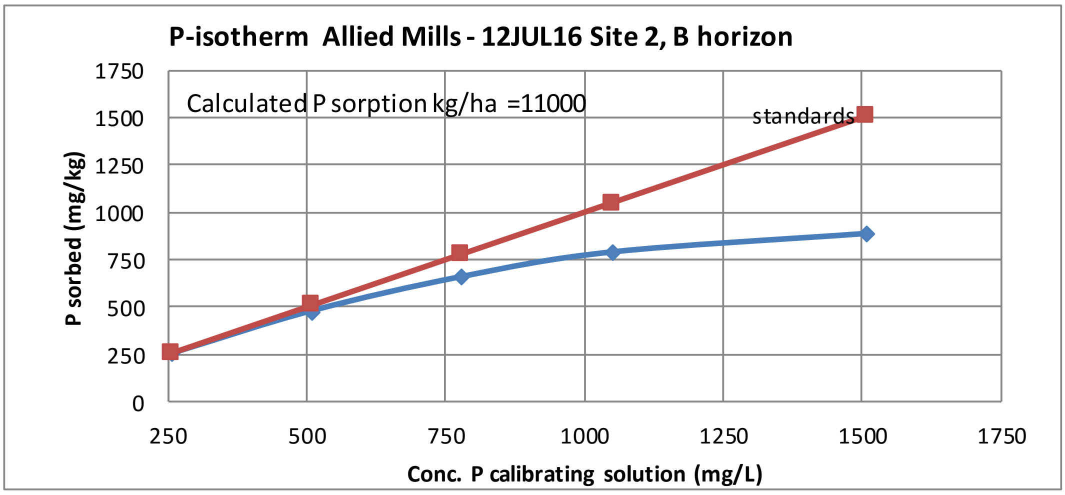
Parameter /Sample No.	0-350 mm	350-700 mm	700-1000 mm	Method
Client reference no.				
pH 1:5 in water	6.90	7.66	5.56	4A1
pH 1:5 in $CaCl_2$	6.09	6.70	4.40	4B1
EC (1:5 in water) (uS/cm)	121	142	195	3A1
Salinity hazard	Non-saline	Non-saline	Non-saline	EC/texture class
Exch. calcium (mg kg^{-1})	2486	1529	408	15D3
Exch. potassium (mg kg^{-1})	321	57	61	15D3
Exch. magnesium (mg kg^{-1})	294	642	868	15D3
Exch. sodium (mg kg^{-1})	83	258	444	15D3
Exch. acidity (cmol(+) kg^{-1})	0.1	0.1	3.3	15 G1.
Cation Exchange Capacity (meq+/100g)	16.1	14.3	14.5	calculation
Exch. Sodium Percentage	2.22	7.9	13.3	
Sodicity	Non-sodic	Sodic	Sodic	
Base Saturation (%)	99.5	99.4	77.4	
Ca: Mg ratio	5.1	1.4	0.3	
Chloride (mg kg^{-1})	26.9	75.4	113	5A3a
Nitrate-N (mg kg^{-1})	3.75	0.07	0.05	7B2
Total Nitrogen (%)	0.358	0.077	0.063	7A1
Organic Carbon (%)	2.16	0.31	0.23	6A1
Orthophosphate-P (mg kg^{-1})	5.3	<0.1	<0.1	9B1 (Bray)
Total phosphorus (mg kg^{-1})	931	329	336	other
Extractable sulphur (mg kg^{-1})	23.0	24.9	35.6	10D1
Soil Colour (moist)	5YR 4/1 brownish grey	5YR 4/6 reddish brown	5YR 4/6 reddish brown	Munsell Colour
Field Texture	Loam	Clay loam	Light clay	Northcote 1979
Permeability Class	3	4	5	AS/NZS 1547:2012
DLR (irrigation) mm/day	4.0	3.5	3.0	AS/NZS 1547:2012
Initial dispersion test	Water stable, swell	Slake 1	Slake 2	SAR5, EC 1 dS/m
Emerson's Aggregate Test	Class 7	*3/6, slake 1	*3/6, slake 2	

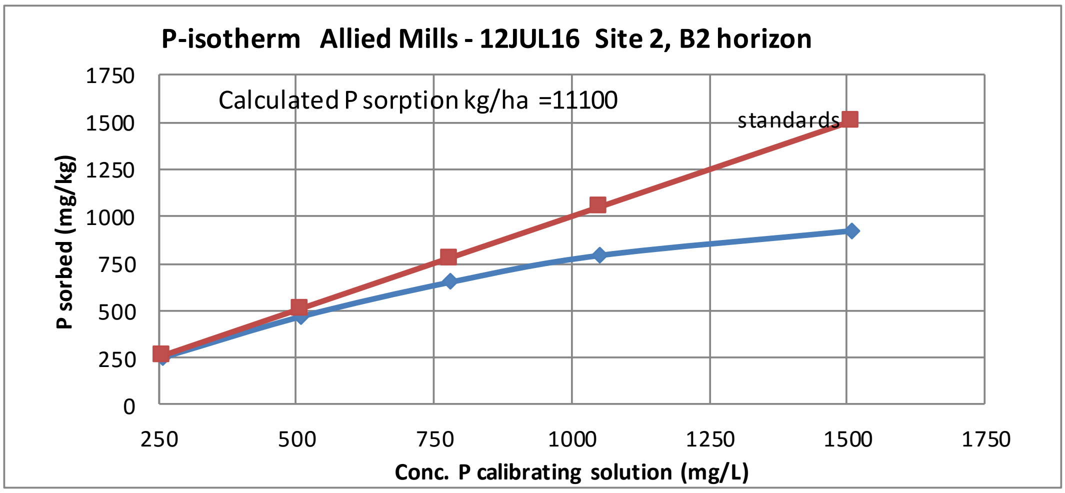
Reference: Rayment, G.E. and Lyons, D. J.(2011) *Soil Chemical Methods - Australasia.* CSIRO Publishing. Canberra. All methods in accordance with accreditation procedures.

NOTE: The dispersion test is done in solution that represents domestic wastewater, with sodium adsorption ratio of 5 and EC of 1 dS/m. w/s = water stable in SAR5, EC 1 dS/m solution

Slake - severity of slaking 1,2 or 3. Reported slaking means no dispersion.







Estimated phosphorus sorption for 1.0 m deep, based upon the depth of each horizon and average bulk density = 10 645 kg/ha

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Quality Assurance and Quality Control by Approved Methods

Analysis of Soil Sample for Wastewater System Design

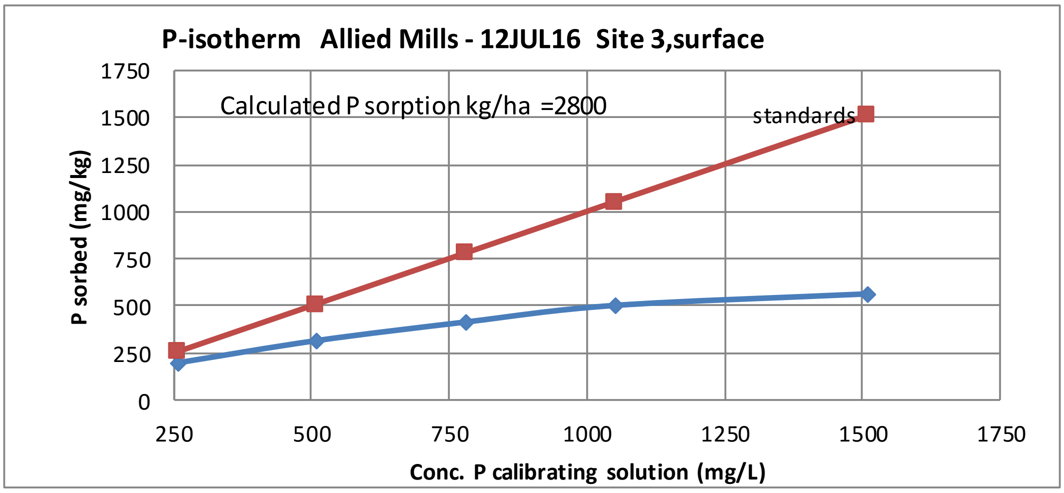
Client... Allied Mills Pty Ltd – Picton Mill *Date*.... 29th July 2016
Soil sample collected 12th July 2016 *Analysis completed*.29th July 2016
Source of soil: Picton Mill - designated effluent irrigation area

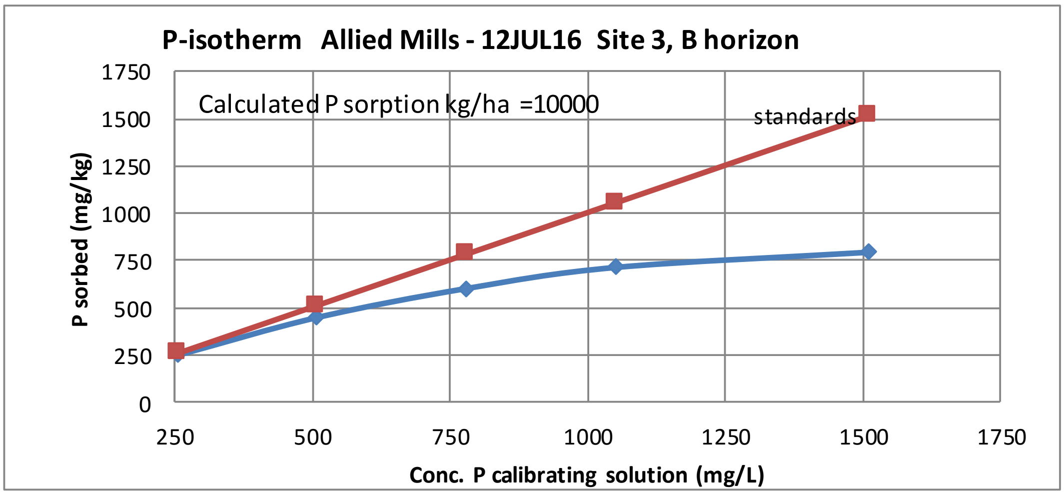
RESULTS – Profile 3

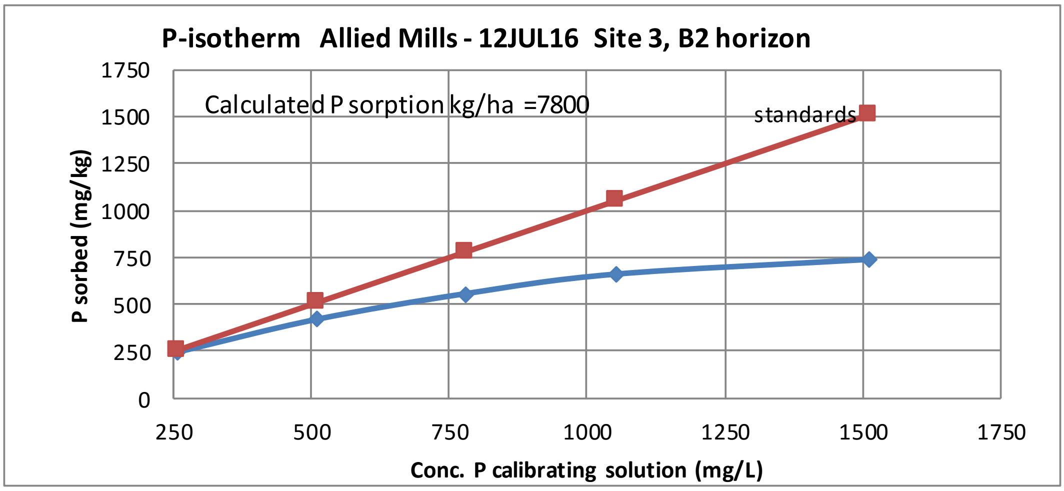
Parameter /Sample No.	0-300 mm	300-650 mm	650-900 mm	Method
Client reference no.				
pH 1:5 in water	7.07	7.02	5.90	4A1
pH 1:5 in $CaCl_2$	6.09	5.80	5.50	4B1
EC (1:5 in water) (uS/cm)	85	91	159	3A1
Salinity hazard	Non-saline	Non-saline	Non-saline	EC/texture class
Exch. calcium (mg kg^{-1})	2103	1234	324	15D3
Exch. potassium (mg kg^{-1})	418	63	56	15D3
Exch. magnesium (mg kg^{-1})	276	862	949	15D3
Exch. sodium (mg kg^{-1})	18	291	538	15D3
Exch. acidity (cmol(+) kg^{-1})	0.1	0.1	2.8	15 G1.
Cation Exchange Capacity (meq+/100g)	14.0	14.7	14.7	calculation
Exch. Sodium Percentage	0.6	8.6	15.9	
Sodicity	Non-sodic	Sodic	Highly sodic	
Base Saturation (%)	99.4	99.5	81.0	
Ca: Mg ratio	4.6	0.9	0.2	
Chloride (mg kg^{-1})	15.1	39.1	122	5A3a
Nitrate-N (mg kg^{-1})	6.85	0.60	0.02	7B2
Total Nitrogen (%)	0.315	0.070	0.064	7A1
Organic Carbon (%)	1.63	0.29	0.25	6A1
Orthophosphate-P (mg kg^{-1})	12.3	<0.1	<0.1	9B1 (Bray)
Total phosphorus (mg kg^{-1})	911	387	446	other
Extractable sulphur (mg kg^{-1})	11.3	17.4	22.0	10D1
Soil Colour (moist)	5YR 3/3 dark reddish brown	5YR 4/8 reddish brown	5YR 5/8 bright reddish brown	Munsell Colour
Field Texture	Loam	Clay loam	Light clay	Northcote 1979
Permeability Class	3	4	5	AS/NZS 1547:2012
DLR (irrigation) mm/day	4.0	3.5	3.0	AS/NZS 1547:2012
Initial dispersion test	Water stable, swell	Slake 2	Slake 2	SAR5, EC 1 dS/m
Emerson's Aggregate Test	Class 7	*3/6, slake 2	*3/6, slake 2	

Reference: Rayment, G.E. and Lyons, D. J.(2011) *Soil Chemical Methods - Australasia.* CSIRO Publishing. Canberra. All methods in accordance with accreditation procedures.

NOTE: The dispersion test is done in solution that represents domestic wastewater, with sodium adsorption ratio of 5 and EC of 1 dS/m. w/s = water stable in SAR5, EC 1 dS/m solution. Slake - severity of slaking 1,2 or 3. Reported slaking means no dispersion.







Estimated phosphorus sorption for 1.0 m deep, based upon the depth of each horizon and average bulk density = 7 070 kg/ha

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Analysis of Soil Sample for Wastewater System Design

Client... Allied Mills Pty Ltd – Picton Mill *Date*.... 29th July 2016
Soil sample collected 12th July 2016 *Analysis completed*.29th July 2016
Source of soil: Picton Mill - designated effluent irrigation area

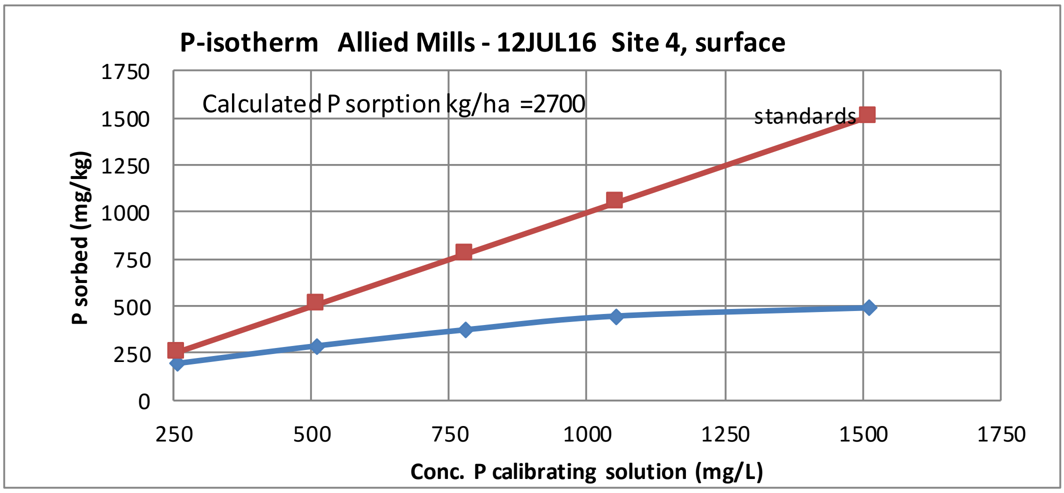
RESULTS – Profile 4

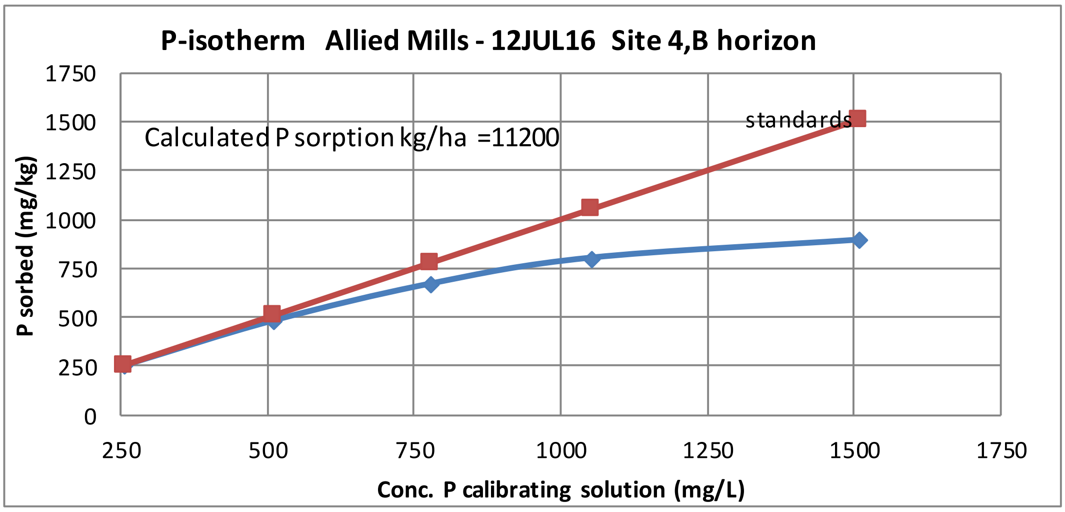
Parameter /Sample No.	0-350 mm	350-700 mm	700-900 mm	Method
Client reference no.				
pH 1:5 in water	6.72	7.62	5.93	4A1
pH 1:5 in $CaCl_2$	5.94	6.40	4.23	4B1
EC (1:5 in water) (uS/cm)	86	52	73	3A1
Salinity hazard	Non-saline	Non-saline	Non-saline	EC/texture class
Exch. calcium (mg kg^{-1})	2079	1512	169	15D3
Exch. potassium (mg kg^{-1})	289	53	46	15D3
Exch. magnesium (mg kg^{-1})	294	627	729	15D3
Exch. sodium (mg kg^{-1})	27	132	288	15D3
Exch. acidity (cmol(+) kg^{-1})	0.1	0.1	5.0	15 G1.
Cation Exchange Capacity (meq+/100g)	13.7	13.5	13.2	calculation
Exch. Sodium Percentage	0.9	4.3	9.5	
Sodicity	Non-sodic	Non-sodic	Sodic	
Base Saturation (%)	99.4	99.4	62.4	
Ca: Mg ratio	4.2	1.4	0.1	
Chloride (mg kg^{-1})	9.3	21.9	31.2	5A3a
Nitrate-N (mg kg^{-1})	22.0	0.06	0.03	7B2
Total Nitrogen (%)	0.319	0.077	0.060	7A1
Organic Carbon (%)	1.71	0.3	0.14	6A1
Orthophosphate-P (mg kg^{-1})	2.2	<0.1	0.5	9B1 (Bray)
Total phosphorus (mg kg^{-1})	622	303	442	other
Extractable sulphur (mg kg^{-1})	6.37	4.82	15.6	10D1
Soil Colour (moist)	5YR 3/2 dark reddish brown	5YR 4/8 reddish brown	5YR 5/4 dull reddish brown	Munsell Colour
Field Texture	Loam	Clay loam	Light clay	Northcote 1979
Permeability Class	3	4	5	AS/NZS 1547:2012
DLR (irrigation) mm/day	4.0	3.5	3.0	AS/NZS 1547:2012
Initial dispersion test	Slake 1	Slake 2	Slake 2	SAR5, EC 1 dS/m
Emerson's Aggregate Test	*3/6, slake 1	*3/6, slake 2	*3/6, slake 2	

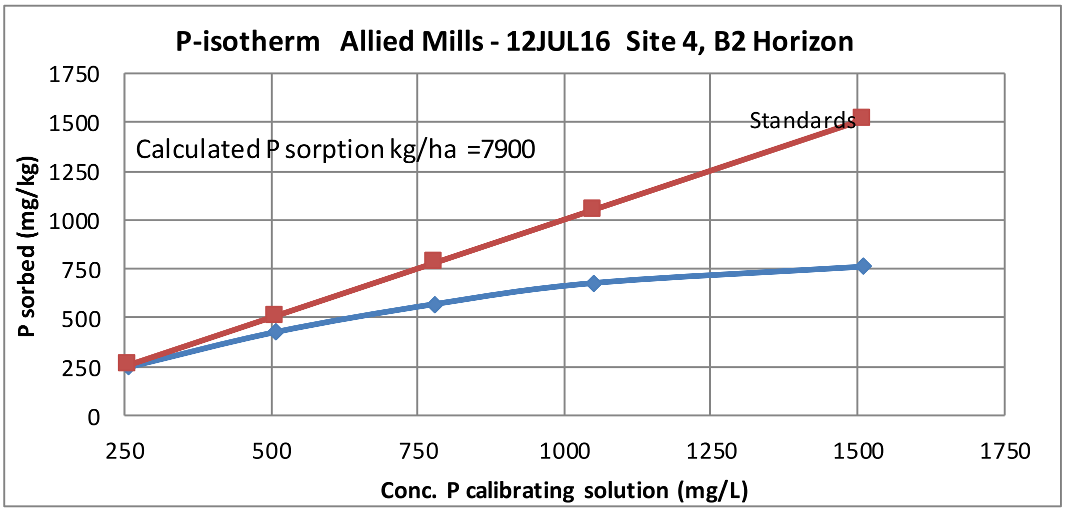
Reference: Rayment, G.E. and Lyons, D. J.(2011) *Soil Chemical Methods - Australasia.* CSIRO Publishing. Canberra. All methods in accordance with accreditation procedures.

NOTE: The dispersion test is done in solution that represents domestic wastewater, with sodium adsorption ratio of 5 and EC of 1 dS/m. w/s = water stable in SAR5, EC 1 dS/m solution

Slake - severity of slaking 1,2 or 3. Reported slaking means no dispersion.







Estimated phosphorus sorption for 1.0 m deep, based upon the depth of each horizon and average bulk density = 7235 kg/ha

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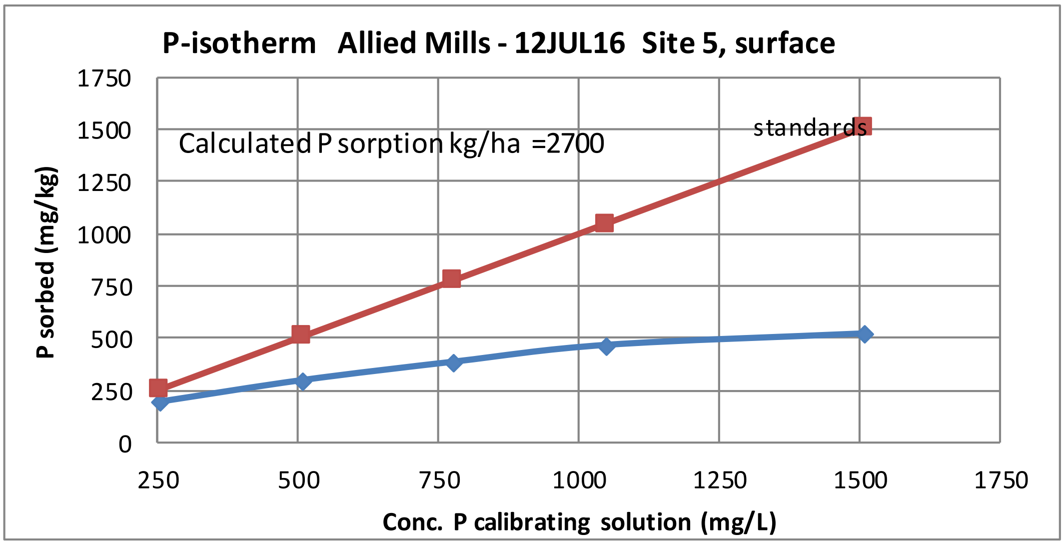
Analysis of Soil Sample for Wastewater System Design

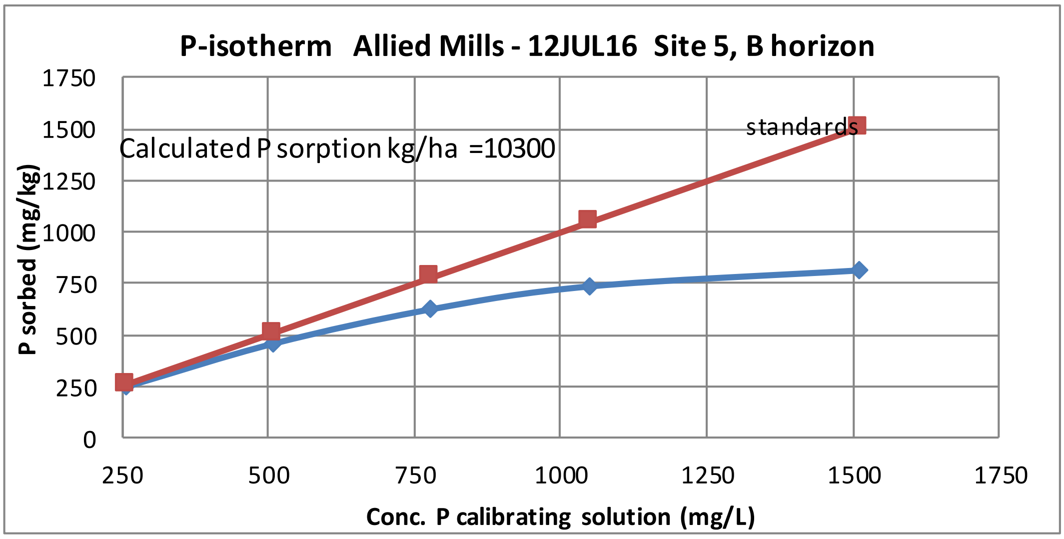
Client... Allied Mills Pty Ltd – Picton Mill *Date*.... 29th July 2016
Soil sample collected 12th July 2016 *Analysis completed*.29th July 2016
Source of soil: Picton Mill - designated effluent irrigation area

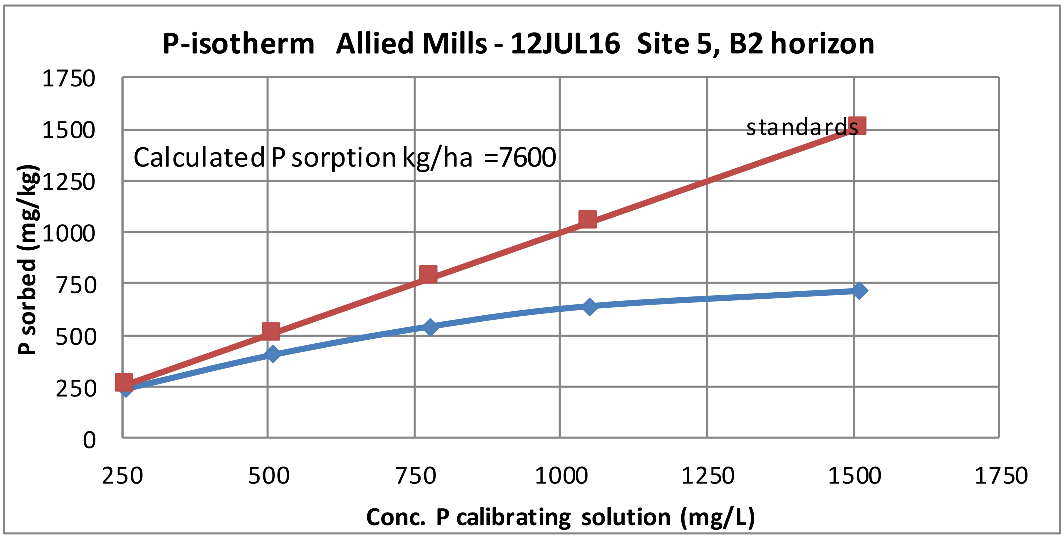
RESULTS – Profile 5

Parameter /Sample No.	0-300 mm	300-700 mm	700-1000 mm	Method
Client reference no.				
pH 1:5 in water	7.12	7.63	4.97	4A1
pH 1:5 in $CaCl_2$	6.24	6.62	4.41	4B1
EC (1:5 in water) (uS/cm)	101	126	641	3A1
Salinity hazard	Non-saline	Non-saline	Slightly saline	EC/texture class
Exch. calcium (mg kg^{-1})	2030	1720	418	15D3
Exch. potassium (mg kg^{-1})	469	64	54	15D3
Exch. magnesium (mg kg^{-1})	306	617	978	15D3
Exch. sodium (mg kg^{-1})	41	240	820	15D3
Exch. acidity (cmol(+) kg^{-1})	0.1	0.1	2.3	15 G1.
Cation Exchange Capacity (meq+/100g)	14.1	14.9	16.2	
Exch. Sodium Percentage	1.3	7.0	22.1	calculation
Sodicity	Non-sodic	sodic	Highly sodic	
Base Saturation (%)	99.4	99.5	85.6	
Ca: Mg ratio	4.0	1.7	0.3	
Chloride (mg kg^{-1})	12.9	93.2	815	5A3a
Nitrate-N (mg kg^{-1})	3.87	0.07	0.03	7B2
Total Nitrogen (%)	0.314	0.087	0.066	7A1
Organic Carbon (%)	2.09	0.33	0.24	6A1
Orthophosphate-P (mg kg^{-1})	7.4	<0.1	0.5	9B1 (Bray)
Total phosphorus (mg kg^{-1})	790	350	606	other
Extractable sulphur (mg kg^{-1})	9.9	6.3	22.8	10D1
Soil Colour (moist)	5YR 4/1 brownish grey	2.5YR 4/6 reddish brown	7.5YR 5/3 dull brown	Munsell Colour
Field Texture	Loam	Clay loam	Light clay	Northcote 1979
Permeability Class	3	4	5	AS/NZS 1547:2012
DLR (irrigation) mm/day	4.0	3.5	3.0	AS/NZS 1547:2012
Initial dispersion test	Slake 1	Slake 1	Slake 2	SAR5, EC 1 dS/m
Emerson's Aggregate Test	*3/6, slake 1	*3/6, slake 1	*3/6, slake 2	

Reference: Rayment, G.E. and Lyons, D. J.(2011) *Soil Chemical Methods - Australasia.* CSIRO Publishing. Canberra. All methods in accordance with accreditation procedures.
NOTE: The dispersion test is done in solution that represents domestic wastewater, with sodium adsorption ratio of 5 and EC of 1 dS/m. w/s = water stable in SAR5, EC 1 dS/m solution
Slake - severity of slaking 1,2 or 3. Reported slaking means no dispersion.







Estimated phosphorus sorption for 1.0 m deep, based upon the depth of each horizon and average bulk density = 6830 kg/ha

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Analysis of Soil Sample for Wastewater System Design

Client... Allied Mills Pty Ltd – Picton Mill *Date*.... 29th July 2016
Soil sample collected 12th July 2016 *Analysis completed*.29th July 2016
Source of soil: Picton Mill - designated effluent irrigation area

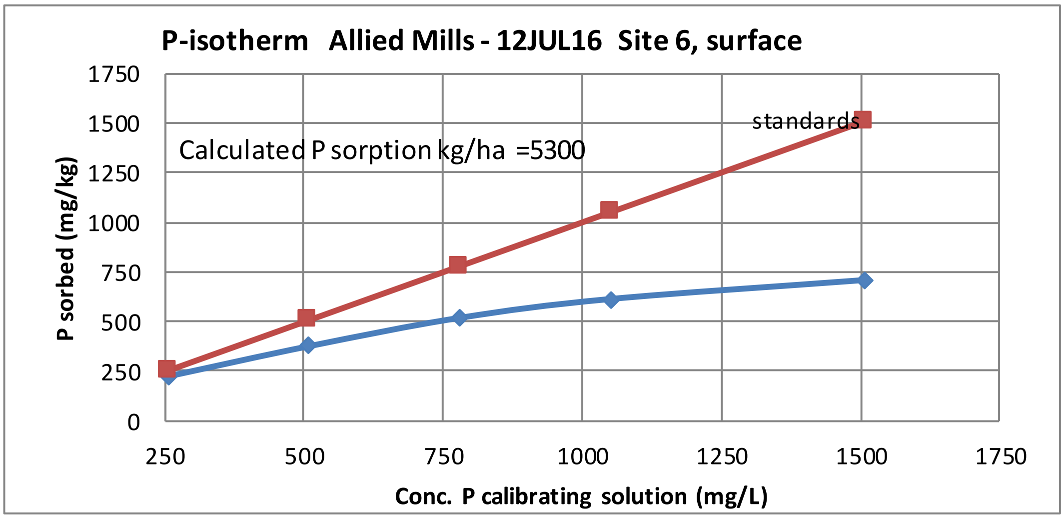
RESULTS – Profile 6

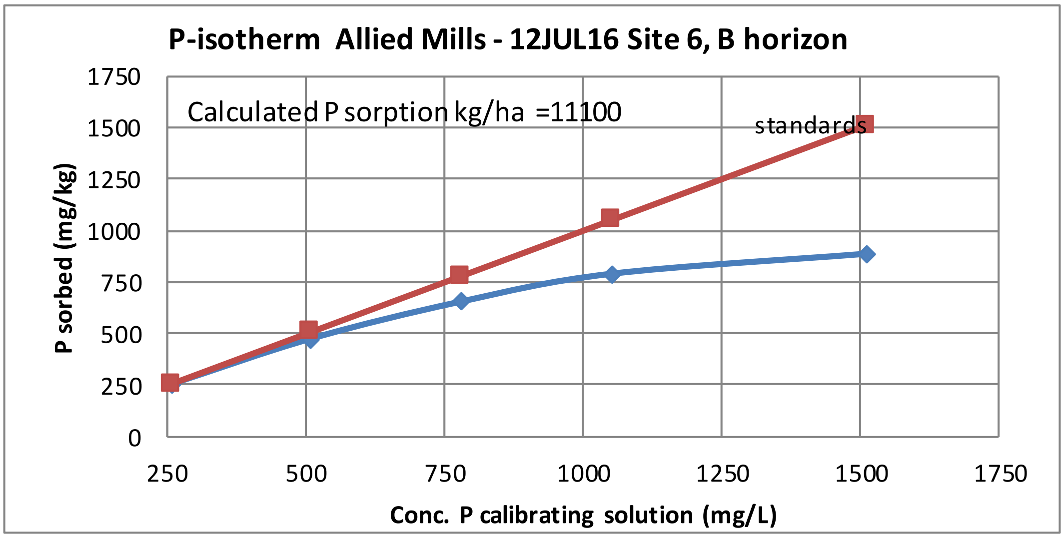
Parameter /Sample No.	0-400 mm	400-700 mm	700-900 mm	Method
Client reference no.				
pH 1:5 in water	7.05	6.47	5.40	4A1
pH 1:5 in $CaCl_2$	6.36	5.56	4.36	4B1
EC (1:5 in water) (uS/cm)	155	149	240	3A1
Salinity hazard	Non-saline	Non-saline	Non-saline	EC/texture class
Exch. calcium (mg kg^{-1})	2638	1056	200	15D3
Exch. potassium (mg kg^{-1})	328	62	63	15D3
Exch. magnesium (mg kg^{-1})	355	813	987	15D3
Exch. sodium (mg kg^{-1})	82	606	605	15D3
Exch. acidity (cmol(+) kg^{-1})	0.1	0.1	3.1	15 G1.
Cation Exchange Capacity (meq+/100g)	17.4	13.5	15.0	calculation
Exch. Sodium Percentage	2.0	9.7	17.5	
Sodicity	Non-sodic	Sodic	Highly sodic	
Base Saturation (%)	99.5	99.4	79.2	
Ca: Mg ratio	4.5	0.8	0.1	
Chloride (mg kg^{-1})	44.0	59.6	189	5A3a
Nitrate-N (mg kg^{-1})	5.18	0.02	0.05	7B2
Total Nitrogen (%)	0.416	0.084	0.067	7A1
Organic Carbon (%)	2.16	0.38	0.21	6A1
Orthophosphate-P (mg kg^{-1})	10.4	<0.1	<0.1	9B1 (Bray)
Total phosphorus (mg kg^{-1})	1005	361	250	other
Extractable sulphur (mg kg^{-1})	24.7	40.0	31.5	10D1
Soil Colour (moist)	5YR 4/2 greyish brown	5YR 4/8 reddish brown	5YR 4/8 reddish brown	Munsell Colour
Field Texture	Loam	Clay loam	Light clay	Northcote 1979
Permeability Class	3	4	5	AS/NZS 1547:2012
DLR (irrigation) mm/day	4.0	3.5	3.0	AS/NZS 1547:2012
Initial dispersion test	Water stable, swell	Slake 1	Slake 2	SAR5, EC 1 dS/m
Emerson's Aggregate Test	Class 7	*3/6, slake 1	*3/6, slake 2	

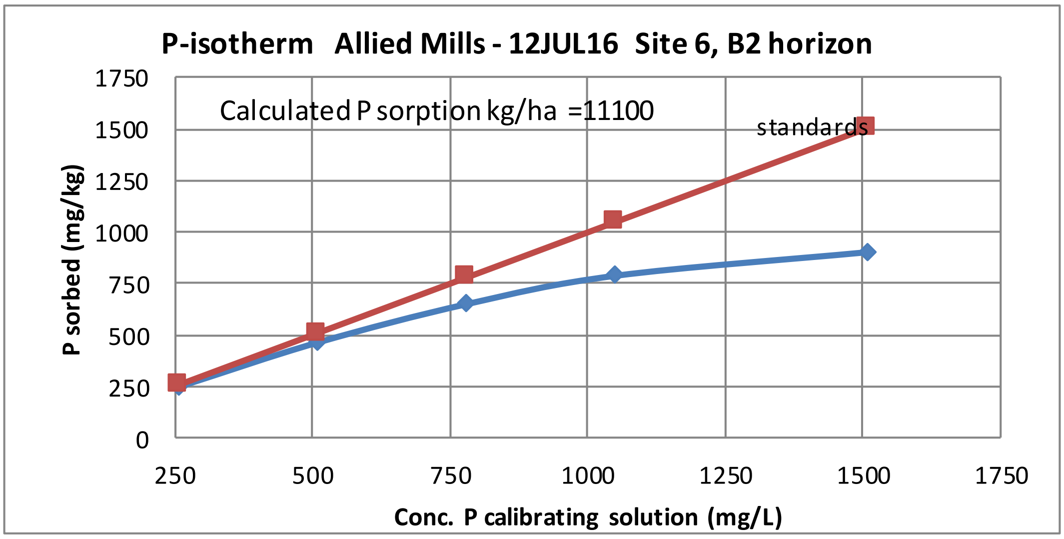
Reference: Rayment, G.E. and Lyons, D. J.(2011) *Soil Chemical Methods - Australasia.* CSIRO Publishing. Canberra. All methods in accordance with accreditation procedures.

NOTE: The dispersion test is done in solution that represents domestic wastewater, with sodium adsorption ratio of 5 and EC of 1 dS/m. w/s = water stable in SAR5, EC 1 dS/m solution

Slake - severity of slaking 1,2 or 3. Reported slaking means no dispersion.







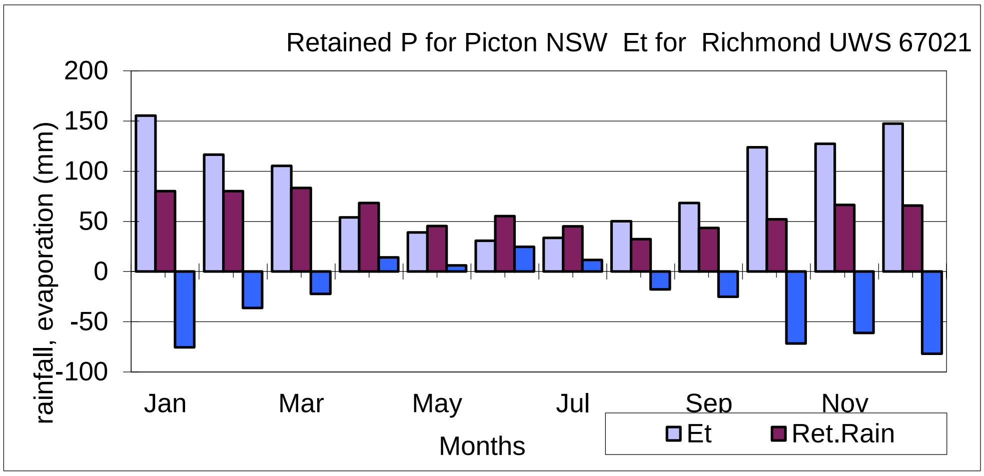
Estimated phosphorus sorption for 1.0 m deep, based upon the depth of each horizon and average bulk density = 8780 kg/ha

ATTACHMENT E

Water Balance

The water balance is based upon the 70th percentile monthly rainfall for Picton and the average daily evaporation for Richmond UWS (the nearest data source).

The model has been run for a nil in-ground storage scenario, thus avoiding any need for wet-weather storage or periods of excess soil moisture.



Attachment E, Figure 1 - Retained rainfall and evaporation for Picton

Picton NSW					Evap.data		**Richmond UWS 67021**			
70th percentile 68052					average monthly pan evaporation					
Source: AS1547-1994 - Table G1			(Prepared by R.A. Patterson, Lanfax Labs. Armidale updated JUL16)							

1			2	3	4	5	6	7	8	9
Month	Days	daily pan	Pan Eo	Et	Rainfall	Retained	LTAR*N	Disposal	Effluent	Size of
	per	Eo		+Cf*Eo	P	Rainfall		rate/month	applied	area
	month	(B.Met)				Re=(1-r)P	3	(Et-Re)+	per month	(8)/(7)
								LTAR*N	2000	
		mm	mm	mm	mm	mm	mm	mm	L	m2
Jan	31	5.9	182.9	155	106.7	80.0	93	168.4	62000	368
Feb	28	4.9	137.2	117	107.07	80.3	84	120.3	56000	465
Mar	31	4	124.0	105	110.94	83.2	93	115.2	62000	538
Apr	30	3	90.0	54	90.98	68.2	90	75.8	60000	792
May	31	2.1	65.1	39	60.46	45.3	93	86.7	62000	715
Jun	30	1.7	51.0	31	73.48	55.1	90	65.5	60000	916
Jul	31	1.8	55.8	33	59.98	45.0	93	81.5	62000	761
Aug	31	2.7	83.7	50	43.24	32.4	93	110.8	62000	560
Sep	30	3.8	114.0	68	57.8	43.4	90	115.1	60000	522
Oct	31	4.7	145.7	124	69.5	52.1	93	164.7	62000	376
Nov	30	5	150.0	128	88.44	66.3	90	151.2	60000	397
Dec	31	5.6	173.6	148	87.52	65.6	93	174.9	62000	354
		Totals	**1373**	**1052**	**956.11**	**717.1**				

TABLE G2 - Depth of stored effluent First trial - choose from col.9 table above

1	2	3	4	5	6	7	8	9	10	11
month	first trial	application	Disposal	(3)-(4)	Increase	Starting	increase	computed	**reset if**	equivalent
	area	rate	rate		depth of	depth	depth	depth	**Et deficit**	storage
	(m2)	(8)*/(2)	per month		stored	effluent	effluent	effluent	**<0**	10 x area
			(above)'		effluent	for		(X)		
		(mm)	(mm)	(mm)	(5)/porosity	month	+(6)	(mm)	(mm)	(L)
Dec								0.0	0	
Jan	900	69	168	-100	-249	0	-249	-249	0	0
Feb		62	120	-58	-145	0	-145	-145	0	0
Mar		69	115	-46	-116	0	-116	-116	0	0
Apr		67	76	-9	-23	0	-23	-23	0	0
May		69	87	-18	-45	0	-45	-45	0	0
Jun		67	65	1	3	0	3	3	3	794
Jul		69	81	-13	-32	3	-32	-29	0	0
Aug		69	111	-42	-105	0	-105	-105	0	0
Sep		67	115	-48	-121	0	-121	-121	0	0
Oct		69	165	-96	-240	0	-240	-240	0	0
Nov		67	151	-85	-211	0	-211	-211	0	0
Dec		69	175	-106	-265	0	-265	-265	0	0
Jan		69	168	-100	-249	0	-249	-249	0	0
Feb		62	120	-58	-145	0	-145	-145	0	0
Mar		69	115	-46	-116	0	-116	-116	0	0
Apr		67	76	-9	-23	0	-23	-23	0	0
May		69	87	-18	-45	0	-45	-45	0	0

From calculations in tables above for optimised drainfield area, using Appendix G AS1547-1994

	Porosity in disposal area	**40%**	
Variables Table	**Runoff Coeff =**	**0.25**	**percentage runoff**
	Summer Crop Factor =	**0.85**	**crop transpiration rate Oct-Mar**
	Winter Crop Factor	**0.6**	**crop transpiration rate -Apr-Sep**
Change as required	**LTAR =**	**3**	**L/m2/day**
	FLOWS=	**2000**	**L/day**