

Scanned

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Core Cider Highvale Orchard
Merrivale Road
Pickering Brook WA

Attention: John Della Franca

Hi John,

Comments on Soil Test Results

As part of my report on wastewater reuse to the orchard, I have put your soil test results through our computer based 'Soil Chemistry Interpretation Model'. From this I have prepared some graphs to help to explain some improvements to soil health that should benefit orchard production and fruit quality and ensure that wastewater nutrients are used by the crop.

Graph 1. Three blocks have **strongly acid subsoils**. Need to apply lime or dolomite annually at about 1 t/ha. But not to block A.

Graph 2. Strongly acid subsoils have **high aluminium** which may be toxic and this restricts root growth and soil exploration which reduces water and nutrient uptake.

Graph 3. Available phosphorus (Colwell P) is extremely high (toxic ?) in topsoils of three blocks (450-700 mg/kg). These would be more than 5 times the required level. Previous highest soil test P I have seen in a vineyard soil sample was 350 mg/kg.

I noticed your comment about orchardists continuing to apply super. Would there be interest in someone with my background in soil chemistry/soil testing/ consulting giving a **talk to your local growers group on soil health issues**. I have done several down this way recently to potato growers, vineyard managers and dairy/beef farmers.

Graph 4. CEC varies with soil type, organic matter and pH. Note that **subsoils have very limited reserves of essential cation nutrients**. CEC of <3 is extremely low by world standards.

Graph 5. Proportion of **exchangeable Mg** varies widely across blocks. Aim for about 25-30% of CEC. Liming is so important for management of Mg supply.

Graph 6. Mg is preferentially leached (compared with calcium) from strongly acid soils. Hence the proportion of Mg may be very low in acid subsoils. Ca supply is also reduced.

Graph 7. Huge variation in K levels. Block A needs a boost, block E needs just a crop

replacement rate, but the others have a large surplus of K, as much as about 300 kg/ha in blocks B, D, E and F.

Graph 8. When K is low Na increases, which can further lower K availability. Note how the K to Na ratio is low in block A. This needs to be >1.0 .

A couple of other questions?

Are you able to intercept water draining from the orchard?

What was the reason that drippers were used rather than mini sprinklers for the new reticulation system. Is regular movement of the driplines something that has been or would be considered?

Are manures of any type used presently.

Cool season grasses to take up N over winter may need to be considered to formulate an effective nutrient management package. These would need to be slashed regularly for green manure. Would this be a problem.

Is the area of the irrigated orchard 7ha.

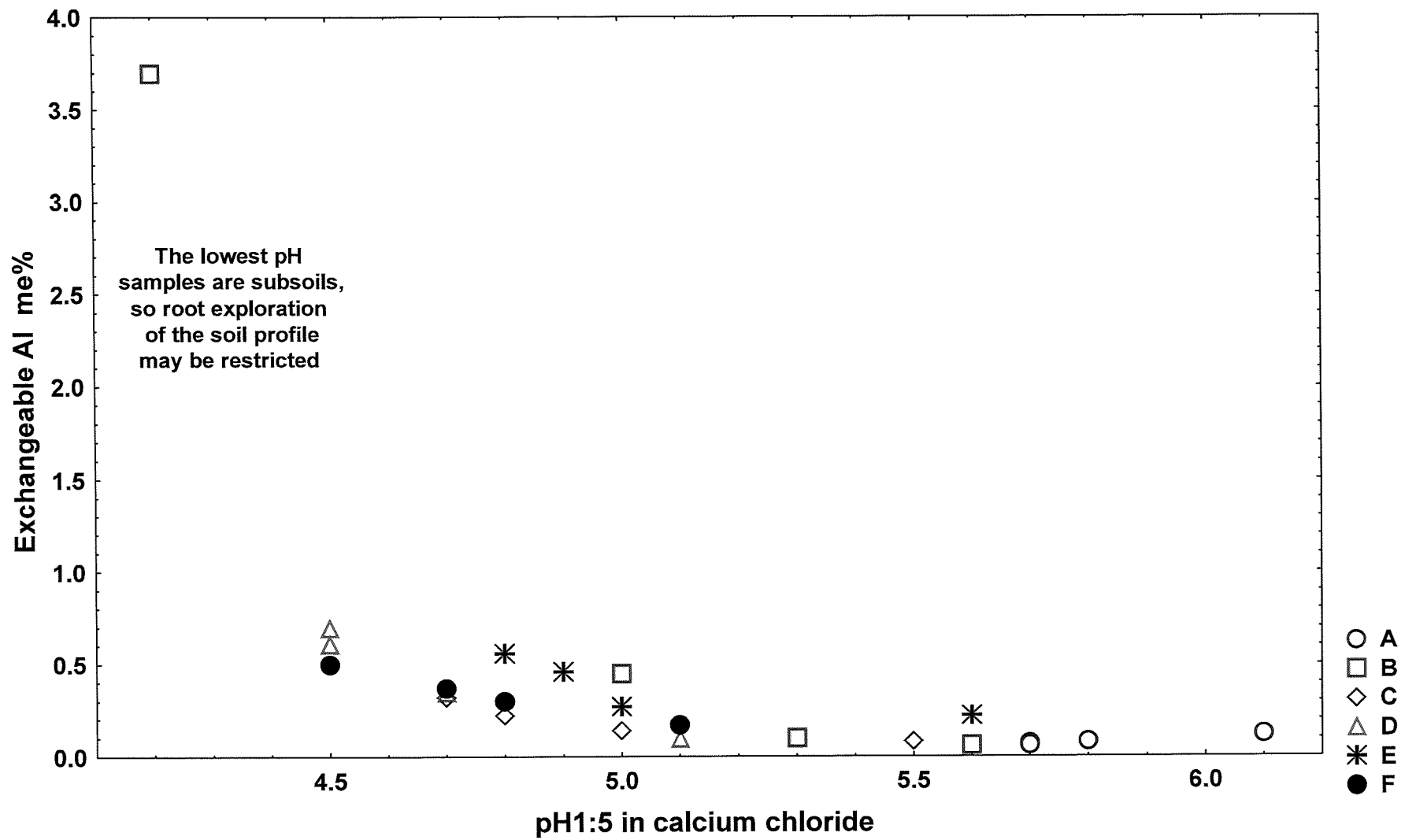
I still have not received info on monthly irrigation or fertiliser programs.

Yours faithfully

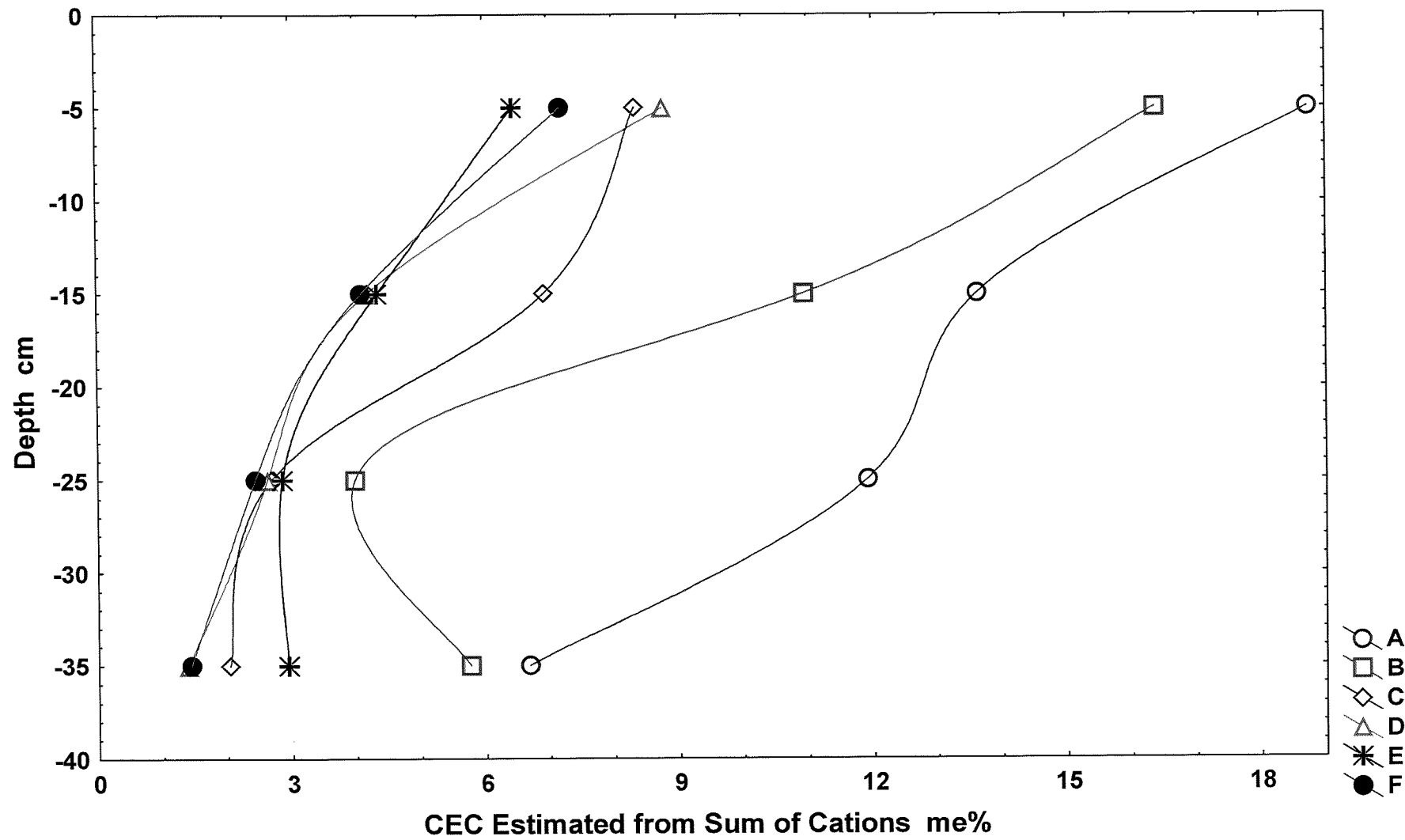
RC Jeffery
Soil Management Consultants Pty Ltd
25 July 2013

PS Our Invoice for time spent so far is attached.

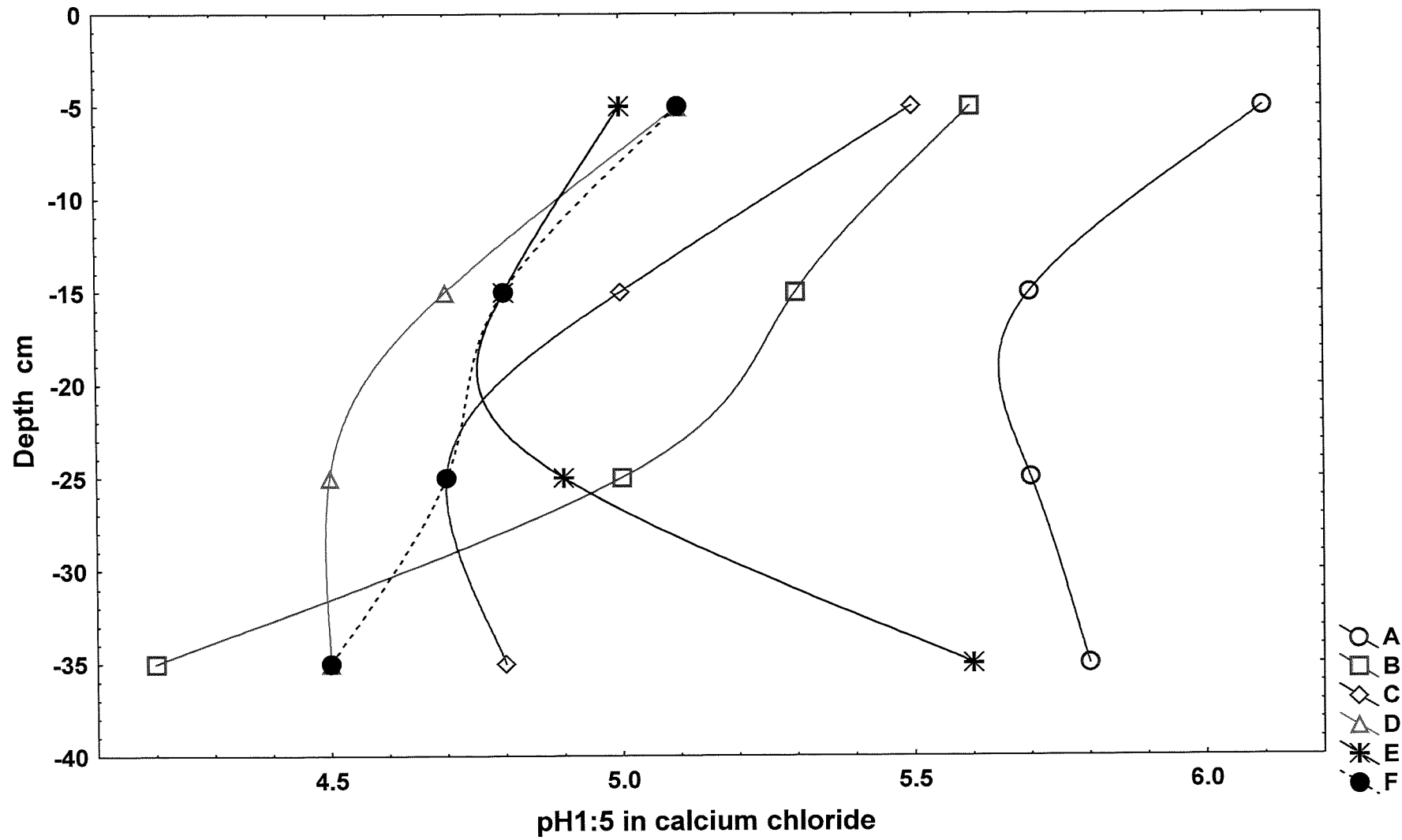
(2) Highvale Orchard Soils Exchangeable Aluminium Increases with Low pH



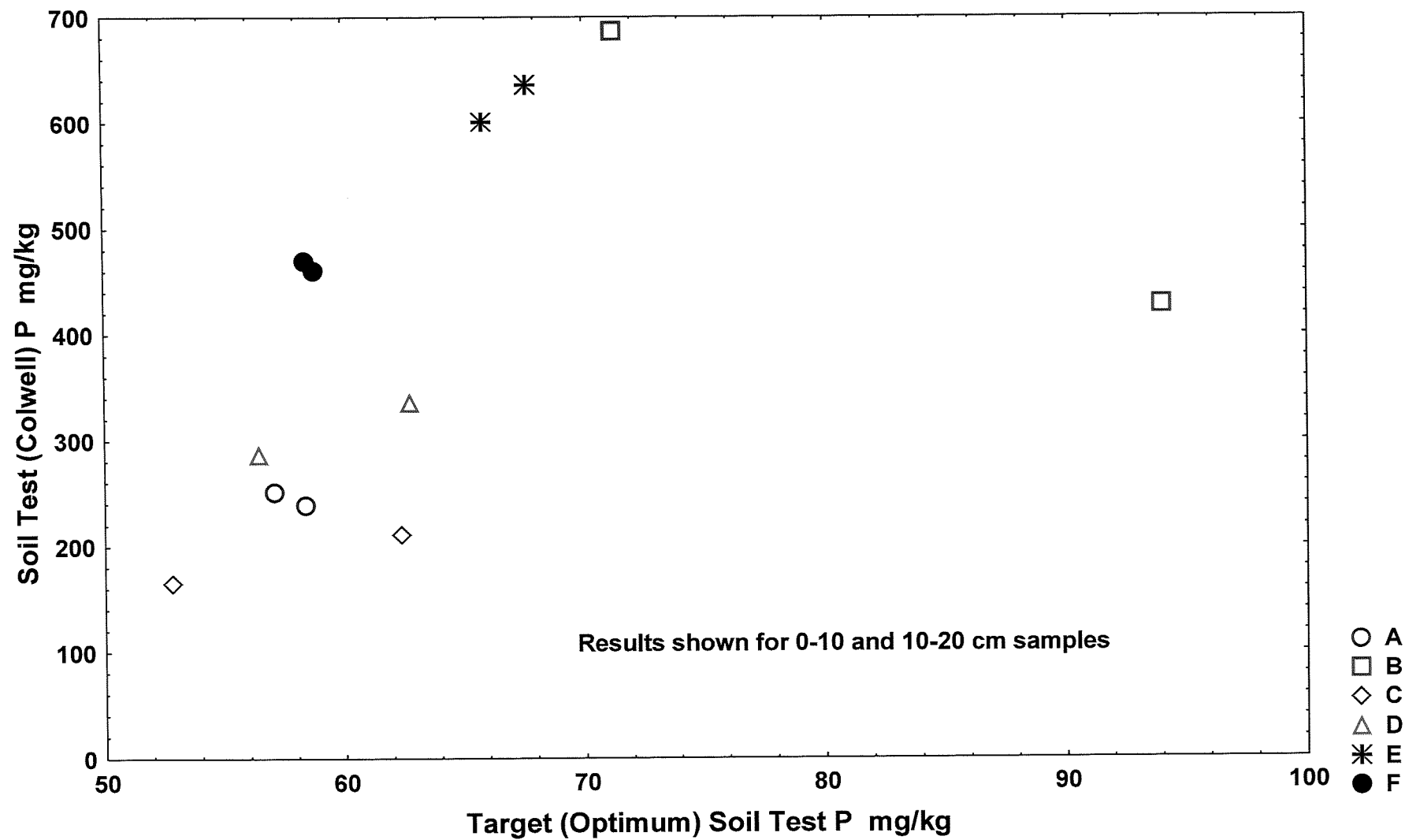
(4) Highvale Orchard Soils Variation in Cation Exchange Capacity



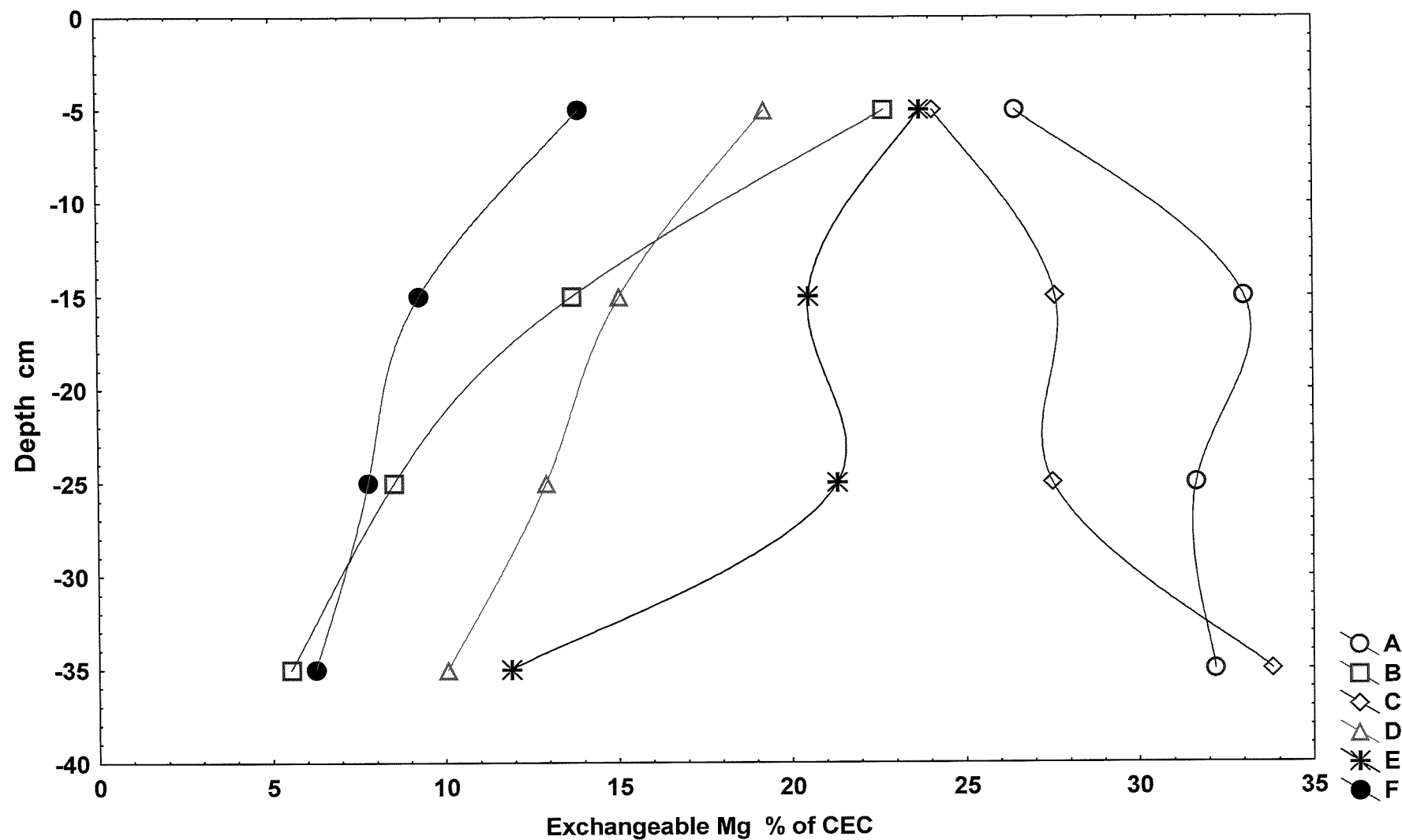
(1) Highvale Orchard Soils Profile pHCa



(3) Highvale Orchard Soils Comparison of Soil Test Phosphorus with 'Target' P



(5) Highvale Orchard Soils Proportion of Exchangeable Magnesium



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Project Report

Project Title: Nutrient and Irrigation Management for
Reuse of Treated Wastewater to Highvale Orchard,
Pickering Brook

Prepared by: RC Jeffery
Soil Management Consultants Pty Ltd
August 2013

Prepared for: John Della Franca
Core Cider
Highvale Orchard Pty Ltd

INTRODUCTION

Core Cider-Highvale Orchard Pty Ltd (Principal John Della Franca) has a restaurant and a mixed apple-pear-citrus orchard for cider production located on Merrivale Road, Pickering Brook (**Figure 1**). The total area of the property is 7.5ha, of which 6 ha is the orchard. The irrigation system has recently been upgraded to drip-irrigation which will permit fertigation of nutrients as part of the fertiliser and soil amendment program.

The proponent plans to increase the size of the restaurant to serve up to 180 people per day, daytime only. An improved wastewater treatment system will be based on the TAYLEX CAB system which is designed to treat wastewater to a level of <10 mg/L for BOD, <10mg/L for suspended solids and <10 cfu/100mLs for coliforms.

Treated wastewater (TWW) will be irrigated onto the orchard, with modification to the current fertiliser program and irrigation schedule to allow for the nutrient and water inputs from TWW. In this way the nutrient load to the orchard will not exceed, and may even be less than, the recommended fertiliser inputs for a productive orchard.

There are no specifications for nutrient concentrations of TWW from the TAYLEX CAB system so regular monitoring will be carried out to establish Total Nitrogen (TN), Total Phosphorus (TP), salinity and pH levels. Initially nutrient concentrations in TWW will be taken as the average level for domestic septic tank wastewater.

LOCATION and ENVIRONMENTAL SENSITIVITY

The property lies within the catchment of Piesse Brook, which is in a Public Drinking Water Source Area (PDWSA). Therefore the Department of Water requires that written approval is sought for 'any new or upgraded fertigation proposal within a proclaimed PDWSA' (Department of Water 2008).

Highvale Orchard is a mixed apple-pear-citrus orchard for on-site cider production, typical of land use in the immediate area that is mainly for the production, packaging and processing of fruit from long-established orchards.

As such the Department of Water recognises that fertigation with TWW may be approved when the proponent can effectively demonstrate that the proposal will not increase the nutrient load compared with recommended horticultural fertiliser practises. Soil Management Consultants (SMC) was contracted by the proponent to prepare a Nutrient and Irrigation Management Plan for reuse of TWW to the orchard.

SOILS PROPERTIES

The orchard is located on the Darling Range where land resources were mapped by the Department of Agriculture and land capability was assessed for rural-residential and agricultural land use (King and Wells 1990). The property is within the Yarragil (Yg1) Land Unit (concave valleys in the western portion of the plateau). Major soil types are given as moderately well drained yellow duplex soils and yellow or brown massive earthy soils on valley sideslopes.

A comprehensive soil sampling and analysis program was carried out in September

2012. Soil profile samples to a depth of 40cm were taken from a single site within six blocks in the orchard. Surface soil descriptions were given as either loam or gravel loam grading to gravel loam or clay loam or sandy clay at depth. The complete laboratory report is in **Appendix 1**, and the parameters relevant to environmental assessment are summarised in **Table 1**.

Table 1. Range of results for selected parameters of soil samples to 40cm taken in September 2012 from six blocks at Highvale Orchard.

Sample Depth cm	0-10	10-20	20-30	30-40
Organic Carbon %	2.4-4.6	1.8-3.9		
pH _{Ca}	5.0-6.1	4.7-5.7	4.5-5.7	4.2-5.8
Soil reaction	Slightly to moderately acid		Moderately to strongly acid	
EC1:5 mS/m	6-10	4-7	3-10	3-14
Salinity Level	Low or very low in all samples			
PRI	7-27	8-330	13->1000	18->1000
Colwell P mg/kg	160-600	210-640	38-410	18-80
Topsoil P status	Very high	Very high		
PBI (calc) mg/kg	100-180	120-330	110-400	80-400
[^] Profile P-retention Rating	Moderate to very high			
Ammonium-N mg/kg	7-40	4-14	2-6	1-6
Nitrate-N mg/kg	7-20	2-6	1-4	<1-3
Mean Available N (as nitrate) kg/ha	13	4	2	1

PBI calculated from PRI (adjusted for Colwell P) via the Freundlich Equation

[^] Classification of nutrient retention from Allen and Jeffery 1990

A separate full report on soil conditions was sent to the proponent with recommendations for improvements to soil fertility that should benefit orchard production and fruit quality. During follow up discussions it was agreed that SMC would develop a soil sampling and leaf analysis program to monitor soil profile pH, fertility, soil structure and nutrient levels, and crop nutritional status based on established industry criteria. Baseline soil and leaf analysis data would be collected before irrigation commenced with TWW.

Organic Carbon

Organic carbon concentrations were normal for orchard soils. Current levels would be maintained or possibly increased with recent adoption of a biodynamic (green manure) orchard management approach.

Soil Reaction (pH_{Ca})

Although blocks were developed at the same time, there were variations in results for pH_{Ca}. Topsoil samples varied by about 1 unit and subsoil samples from three blocks were strongly acid in reaction (pH_{Ca} 4.5 or less). Given the history of fertiliser-N applications and infrequent lime applications, soil type differences (gravel content and soil texture) probably determined the degree of acidification that has occurred over time. Annual lime or dolomite applications were recommended for some blocks.

Available Phosphorus (Colwell Soil Test P)

Concentrations of Colwell P were high to very high in topsoil samples (160-640 mg/kg). The large range in results may have been due to the small number of cores taken at sampling. Current levels would reflect many years of application of mixed NPK and superphosphate fertilisers to the orchard. In three blocks with lower PRI soils (blocks A, E and F), a significant amount of P has been leached to the 20-30cm layer so that Colwell P results were 150-400 mg/kg in those samples.

The proponent has not applied superphosphate based fertilisers to the orchard for at least 10 years, although Dynamic Lifter has been used occasionally. Use of such manure based fertilisers that are relatively enriched with P will be discontinued to facilitate more effective management of soil P levels. Leaf analysis results will be used to support the hypothesis that fertiliser-P will not be needed for many years.

Soil Profile P-Retention Rating (PRI and PBI)

Phosphorus Retention Index (PRI) results for samples to 20cm (PRI 7-36) from all but one block reflect the effects of very high Colwell P concentrations to lower PRI. For 30-40cm samples (except block E), PRI results ranged from 41 to >1000. For all blocks except E sample PRI increased with soil depth, due to both the lower Colwell P concentrations and an increase in soil texture (clay content). Apart from Block E, soil profiles would be classified as having a high to very high P-retention rating (Allen and Jeffery 1990). It is most likely that deeper subsoil samples from block E would also have a higher PRI, and this will be investigated in the future sampling program.

Inorganic Nitrogen (Ammonium and Nitrate-N)

The average concentrations of ammonium and nitrate-N in topsoil samples to 20cm were 13 and 8 mg/kg respectively, which are low by horticultural standards, but typical of broadacre pasture soils. For example, for 670 pasture topsoil samples taken in late summer to autumn (SMC data), 2/3 had ammonium-N concentrations of 5-20 mg/kg (mean 14), and 3/4 had nitrate-N concentrations of 1-20 mg/kg (mean 13).

Limitations of Analysis for Soil Inorganic N

Analysis for inorganic N via routine laboratory methods can give misleading results,

due to the effects of oven drying of samples to promote mineralisation of organic matter and potential 'contamination' of ammonium and nitrate-N results. For environmental monitoring purposes, inorganic N must be dissolved from soil samples at their natural field moisture level (ie before drying).

In a study of methods for analysis of soil inorganic N (SMC 2007), oven drying of topsoil samples at 40 degC increased ammonium-N by a factor of 2-2.5, from 1-14 mg/kg for moist samples up to 5-31 mg/kg for dried samples. For nitrate-N the increase was generally 1-5 mg/kg, although for two samples there were increases of 24 and 50 mg/kg respectively after drying. It was concluded that extraction of inorganic N from field moist samples is the only method that can be relied upon for accurate results.

In any event, soil analysis for inorganic N is problematic due to leaching of nitrate, seasonal factors and the timing of fertiliser applications. A better approach is to match nitrogen inputs with crop growth requirements and an accepted rate of fertiliser to achieve production targets. This is outlined later.

CLIMATE DATA and IRRIGATION SCHEDULES

Climate data for Highvale Orchard (Table 2) are based on rainfall for Mundaring Weir for the period 2000-2009 (Water Corporation 2010) and evaporation for Perth (BOM).

Table 2. Climate data for the 'dry season' at Highvale Orchard, weekly irrigation rates for a crop factor of 0.8 and the total volume for 6 ha of orchard.

Month	Rainfall*	Evap^	NPE	Irrigation	Volume per month
	mm	mm	mm	@ CF = 0.8	kL
				mm/week	
Sept	96	90	~0	~0	strategic
Oct	45	140	95	17	4600
Nov	31	195	164	31	7900
Dec	6	250	244	44	11700
Jan	19	265	246	44	11800
Feb	19	225	206	41	9900
Mar	15	200	185	33	8900
Apr	40	120	80	15	3800
May	123	80	~0	~0	strategic
Totals	395	1565	1220		59 ML

* Average monthly rainfall for Mundaring Weir 2000-2009, excluding one year when 195mm of rain was recorded in April

^ Average monthly evaporation for Perth NPE = Nett pan evaporation

Compared with Mundaring Weir for 2000-2009, data for the Bickley Weather Station for the past 41 years show similar average monthly rainfall for the summer months, but 10-20 mm higher monthly rainfall for October-November and March-April (Bureau of Meteorology 2010). The long term Bickley results may not reflect the recent trend to significantly lower rainfall during autumn and spring for the lower west region.

Evaporation at Mundaring has not been recorded at local weather stations, so average monthly rates for Perth were used (BOM), and these were adjusted for rainfall to estimate the monthly nett pan evaporation (NPE).

Irrigation requirements for orchard production are determined by NPE and the crop factor (CF). At Highvale Orchard a crop factor of 0.8 is used to calculate weekly irrigation rates, resulting in an estimated annual total of 59 ML of irrigation water use. A crop factor of 0.8 is consistent with that used for vineyards, although for the latter crop a lower crop factor (about 0.5) is used for the shoulder months of the 'dry season' (McCarthy et al 1999).

WASTEWATER VOLUME, COMPOSITION and NUTRIENT LOADS

The proponent plans to increase the size of the restaurant to serve up to 180 people per day, daytime only. **Wastewater output** from the restaurant is assumed to be 45 litres per person, for a maximum of 8.1 kL/day, equivalent to a **maximum of 3 ML/year**. This would represent **no more than 5% of the annual irrigation water use** at Highvale Orchard. Assuming an average of about 70% occupancy for the restaurant over a year, the output of TWW is more likely to be about 2 ML/year.

An improved wastewater treatment system will be based on the TAYLEX CAB system which is designed to treat wastewater to a level of <10 mg/L for BOD, <10mg/L for suspended solids and <10 cfu/100mLs for coliforms, producing disinfected TWW suitable for reuse via drip irrigation.

Table 3. Predicted maximum and realistic volume of TWW and annual nutrient loads for drip-irrigation to 6ha of Highvale Orchard.

Volume of TWW	TWW Total N mg/L	TWW Total P mg/L	Nitrogen kg/ha/yr	Phosphorus kg/ha/yr
Maximum 180 persons at 45 L/day for 365 days = Max 3 ML/year	Avge 65 for STE	Avge 15 for STE	32	7.5
Realistic average 70% occupancy = 2 ML/year	45 Possible in TWW	10 Possible in TWW	15	3.3

No data are given for nutrient concentrations from the TAYLEX CAB system, as each site is considered to be unique and the 'actual nutrient concentrations achieved would

not be known until the treatment plant is fully functional' (Taylex Tanks Brochure). Assuming a worst case scenario, the average nutrient concentrations of domestic septic tank effluent (STE) are used initially for calculation of the potential nutrient loads to the orchard from irrigation of TWW (Table 3). Average nutrient concentrations in STE are accepted to be about 65 mg/L for TN and 15 mg/L for TP (Department of Water 2010, Siegrist et al 2013).

TWW from the TAYLEX CAB system is likely to have significantly lower levels of nutrients compared with STE due to removal of organic matter and suspended solids. Research in the USA comparing STE with that from a textile biofilter unit (TFU) showed that the TFU removed 90% of BOD, 30% of TN, 95% of faecal coliforms and 68% of dissolved organic carbon (Siegrist et al 2013). If there is a 30% reduction in both nutrients via the TAYLEX CAB system, then TWW concentrations would be about 45 and 10 mg/L respectively for TN and TP.

A realistic lower level of nutrient load to the orchard is shown in Table 3, based on a TWW volume of 2 ML/year and reduced TN and TP concentrations from the TAYLEX CAB system. These calculations indicate that **the nutrient loads to the orchard may lie within the ranges of 15-30 kg/ha/year for N and 3-8 kg/ha/year for P.**

FERTILISER HISTORY

The fertiliser history for Highvale Orchard is summarised in Table 4.

Period 1983-2003

From 1983 to 1997 average rates of 50, 34 and 35 kg/ha/year of N, P and K respectively were applied. For N this was somewhat less than **the industry recommended rate of 70-100 kgN/ha/year for an apple and pear orchard** of mature bearing trees (Bright 2005).

The average annual rate of fertiliser-P application (34 kg/ha/year) would have been well in excess of crop requirements (about 1/10 of the N rate), which would explain the high to very high Colwell P levels in topsoil samples.

In 2002-2003 only Dynamic Lifter was used, with N application at a similar level to earlier years, and continuing the excess of P for crop growth.

Period 2004-2011

From 2004, a more conservative approach was adopted with sowing of a green manure crop in autumn to use N from a combination of soil reserves, clover growth and occasional Dynamic Lifter application. Use of the latter fertiliser will be discontinued as it would tend to maintain the current excessive soil P levels.

Although crop yield and quality was generally good, in later years (2010 and 2011) there were some indications from leaf colour (general paleness of older leaves) on several blocks that **N supply may have been less than optimum**. This would not be surprising given the very low application rate of fertiliser-N since 2004 compared with industry recommendations.

Table 4. Summary of fertiliser history since 1983 at Highvale Orchard, and the latest strategy using fertigation compared with industry recommendations and nutrients from proposed reuse of TWW.

Period	Fertilisers	N	P	K
		kg/ha		
1983-1997	Vigran, Superphosphate, NPK, Urea, Potash, Hort Special, Dynamic Lifter	750	510	530
Average over 15 years kg/ha/year		50	34	35
2002-2003	Dynamic Lifter 13 tonne	78	52	33
2004-2011	Occasional Dynamic Lifter for green manure crop	Relied on soil reserves of P/K for clover growth plus some Dynamic Lifter		
Industry recommended rate kg/ha/year		70-100	7-10	30-40
2012-2014	Fertigation with urea, potassium nitrate and calcium nitrate kg/ha/year	50	Nil	20
2015 on	TWW maximum kg/ha/year	30	8	?
2015 on	TWW realistic kg/ha/year	15	3	?

Period 2012-2014

With installation of the drip irrigation system, it became feasible to fertigate soluble N fertilisers such as urea, calcium nitrate and potassium nitrate, with the aim of supplying a similar average rate of about 50 kgN/ha/year as was used in the period up to 2003. No fertiliser-P was applied and the rate of K was to be determined eventually by soil and leaf analysis, but commenced at 20 kgK/ha/year.

The extra N applied in 2012-2013 proved beneficial and resulted in excellent crops of high quality fruit for cider production. Leaf colour improved in the blocks previously showing marginal N deficiency.

The practice has continued of growing a green manure crop over winter, to boost soil organic carbon levels, to provide a slow-release source of nutrients, and to maintain good soil cover to prevent erosion on sloping land.

NUTRIENT and IRRIGATION MANAGEMENT for TWW REUSE

It is estimated that the nutrient loads to the orchard from reuse of TWW may lie within the ranges of 15-30 kg/ha/year for N and 3-8 kg/ha/year for P (Table 4). The actual levels will be determined from regular monitoring of TWW volume and composition

after the WWTP has been commissioned.

Nitrogen

The estimated rate of N applied in TWW is below the target level set by Highvale Orchard of 50 kgN/ha/year, and about 1/3 (at maximum) of the industry recommended rate. When reuse of TWW commences, no extra fertiliser-N will be applied until the WWTP has stabilised and reliable volume and nutrient analysis data have been accumulated.

Fertiliser-N is normally applied to apple and pear crops in spring and summer during periods of active growth or fruit set (Bright 2005). TWW will be drip irrigated all year round including the months when fruit trees are dormant, so **establishment of cool season grasses to take up available N from TWW** is essential for minimising potential leaching losses of nitrate. The grass cover will be slashed regularly to maintain active growth and to produce a green manure crop. This has already been a regular practice at Highvale Orchard for many years, so no change to soil management will be necessary.

Phosphorus

The estimated rate of P applied in TWW is well below the historical average level for Highvale Orchard of about 30 kgP/ha/year. The industry recommended rate is for at least crop replacement. This would be about 1/10 of the N rate plus extra to match loss of available P due to soil fixation reactions. Hence a level of 7-10 kgP/ha/year is suggested as a maintenance rate for P in Table 4. The input from TWW is estimated to be 3-8 kg/ha/year.

A commitment is given to discontinue using Dynamic Lifter as a broadcast fertiliser because of the relatively high proportion of P.

With regard to other **essential major nutrients** (K, Ca, Mg and S), sodium chloride and pH, the inputs of these from TWW will be taken into account for the overall fertiliser program when analysis data are available.

TWW Storage and Irrigation Management

The TAYLEX CABS system produces disinfected TWW that is suitable for irrigation via spray or drippers (Taylex Tanks Brochure). Initially two 10 kL tanks will be constructed to provide short term storage of TWW during periods of rainfall.

At a realistic rate of 70% occupancy for the restaurant, TWW output will be about 6 kL/day, an irrigation rate of only 0.1 mm/ha/day over the whole orchard. During summer this is negligible compared with crop water requirements of about 6 mm/day. During late autumn to early spring when rainfall exceeds evaporation, and depending on rainfall patterns and TWW storage levels, irrigation may be directed totally to the citrus orchard area (about 0.5ha) where a conventional under tree spray irrigation system was retained. This would allow irrigation at 5 mm/hour (25 kL/hour to 0.5ha) by uniform distribution of TWW across the area.

MONITORING

Monitoring will include:

Volume of TWW: The WWTP comes with a flow meter.

Composition of TWW: As part of the system proving stage, TWW will be analysed for BOD, suspended solids and coliforms. When fully operational samples from the storage tank will be analysed for pH, electrical conductivity (EC), chloride, inorganic nitrogen (ammonium, nitrate-N), phosphorus, sodium, potassium, calcium, magnesium and sulphur.

Baseline Soil and Leaf Tissue Data: The six blocks that were soil tested previously will be resampled by SMC in spring and analysed as before. Extra subsamples will be taken for inorganic N analysis of moist samples. Samples of leaf tissue from apple, pear and citrus sections will be taken in mid summer for nutrient analysis. For the first few years this will be done annually.

REFERENCES

Department of Water (2008), *Irrigation with Nutrient-Rich Wastewater*, Water Quality Protection Note 22, July 2008.

PD King and MR Wells (1990), *Darling Range Rural Land Capability Study*, WA Department of Agriculture Land Resources Series No. 3.

DG Allen and RC Jeffery (1990), *Methods for Analysis of Phosphorus in WA Soils*, Chemistry Centre Report of Investigation No. 37.

Soil Management Consultants (2007), *Assessment of Methods for Measurement of Soil Inorganic Nitrogen at the Albany Effluent Irrigated Tree Farm*, Report to Water Corporation Great Southern Region.

Department of Water (2010), *Nutrient and Irrigation Management Plans*, Water Quality Protection Note 33, June 2010.

RL Siegrist, JE McCray, KS Lowe, TY Cath and J Munakata-Marr (2013), *Onsite and Decentralised Wastewater Systems: Advances from a Decade of Research and Educational Efforts*, Journal of the Australian Water Association, Volume 40 No. 1.

MG McCarthy, LD Jones and G Due (1999), *Irrigation Principles and Practices*, in *Viticulture Volume : Practices*, BG Coombe and PR Dry editors.

J Bright (2005), *Apple and Pear Nutrition*, Prime Fact No. 85, NSW DPI.

WASTEWATER REUSE PROJECTS by SMC:

Mt Barker Chicken Company at Kendenup, 2005-2009.

Great Southern Regional Cattle Saleyards at Mt Barker, July 2006.

Halls Head WWTP reuse to the Mandurah Country Club, November 2006.

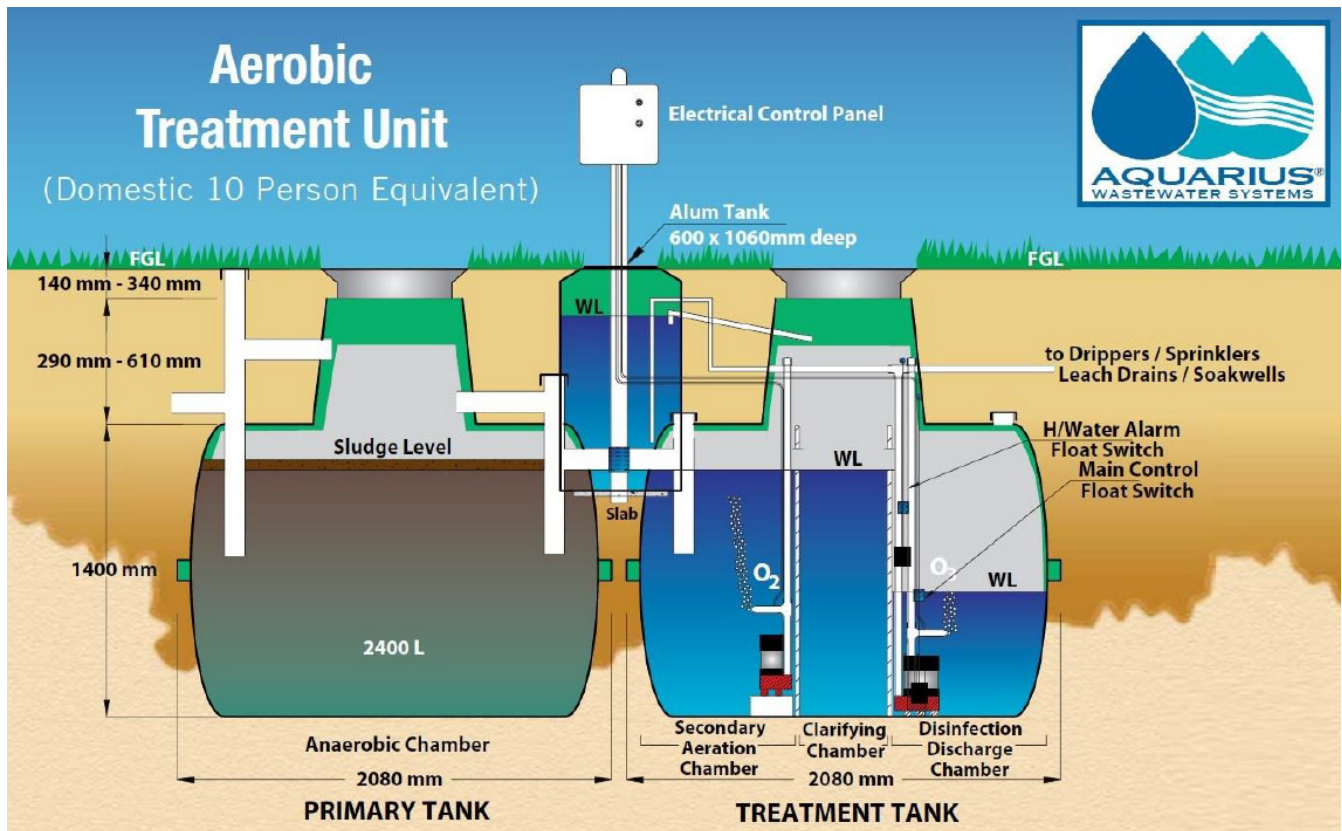
Hopetoun WWTP reuse to Hopetoun Golf Course, September 2007.
Albany WWTP reuse to Albany Tree Farms multi-component project, 2006-2012.
Williams WWTP reuse to Williams Oval, 2008
Dunsborough WWTP reuse to a woodlot, 2009.
Margaret River recycled water project, 2008.
Dongara WWTP reuse to Dongara Golf Course, 2009-10.
Denmark WWTP reuse to Denmark Golf Course or woodlots, 2008, 2013.
Walpole WWTP reuse to woodlots, 2008, 2010, 2013.
Mundaring WWTP reuse to sportsfields and pasture, 2010.
Kalbarri WWTP reuse to Kalbarri Golf Course, 2011.
Carnarvon WWTP reuse to Carnarvon town, 2011.
Beverley WWTP reuse to Beverley Oval, 2011.
Kemerton WWTP reuse to a woodlot, current project.
Toodyay WWTP reuse to a woodlot, current project.

AEROBIC TREATMENT UNITS



ECO STRUCTURES

AEROBIC TREATMENT UNITS (ATU)



ATU OPTIONS FOR ECO TENT COMBINATIONS

Hydraulic Loading

Hydraulic loading as per "Regulation 29 and Schedule 9" of the Department of Health for an Eco-tourism accommodation facility/tent site/caravan park bay is 140L per day per person.

- 1 Tent 2 people - $140L \times 2 = 280L$
- 5 tents 10 people - $140L \times 10 = 1400L$
- 10 tents 20 people - $140L \times 20 = 2800L$
- 20 tents 40 people - $140L \times 40 = 5600L$

All units come with pedestrian covers as standard, heavier load classes available on request. *Disposal Fields will be dependent on site and soil conditions for individual cases and will be priced accordingly, a generic example of each type will be listed below.*

SCHEDULE OF RATES BY TENT / PEOPLE QTY

Eco Tent	Unit Required	Agent Cost Supply Ex Works
1-5 Tents	O-2NR - 1.8KL	\$8,645.00 +GST
5-10 Tents	O-2NR - 4KL	\$12,900.00 +GST
10-20 Tents	O-2NR - 6KL	\$22,377.00 +GST
20-30 Tents	O-2NR - 10KL	\$30,937.00 +GST

Please note Systems become commercial grade from 6KL upwards

GENERIC EXAMPLES OF DISPOSABLE FIELD FONFIGURATIONS

For sandy soils to suit O-2NR – 1.8KL Only to be used as a guide for information purposes.

1. Flatbed Leach Drains

The flatbed leach drains are supplied with the distribution pipes, sockets, end plugs, 40mm round to square fittings, geotextile cloth and a 2-port automatic diversion valve.

Standard 10m (2 x 5m configuration) Price: \$1,710.00 plus GST supply only Ex works



2. Subsurface Drip Irrigation

For Landscaping Area/Beds – The 150m² Subsurface Drinker Field (8LPH dripline at 1m spacing – Product Code DF150K) comes as a kit which includes an Arkal disc filter and all required components. Price also includes pump upgrade to accommodate drippers.

Price: \$995.00 plus GST supply only Ex works



Accordingly as the systems increase in capacity the disposal field will need to increase to allow for the additional loading – Please contact Aquarius Wastewater Systems for individual project pricing.

Our proposal includes the supply only of:

- An Aquarius System in plastic tanks suitable for installation in a non-trafficable area; as well as any associated pumps, control panels and fittings as shown on attached drawing. The prices quoted above are based on an invert level of the sewer drains entering the Primary Tank of the ATU to be 650- 850mm from FGL.
- Supply of Flatbed Leach Drains or Subsurface Drip Irrigation Kit (if selected)

Our proposal excludes:

- Installation and commissioning
- Delivery of Equipment to Site
- Feeder pipe from ATU to disposal area
- The provision of a concrete pump up tank if required, nor any associated pumps, control panels, fittings, transportation or installation
- Any electrical work

Installation

Aquarius Wastewater Systems is a distributor of ATU's and affiliated products and does not carry out installations. We however can put you in contact with trained agents that can install, service and commission the system for you.

NB: Installation and commissioning to be by a third-party independent contractor, ... That you are required to contract with directly for these services.

Service and Maintenance

As a Department of Health's requirements, the system requires six monthly servicing and needs to be serviced by an AWS approved Service Agent that is registered with the Department of Health WA. For pricing, an accurate quote will need to come from a service agents. Costs vary according to location – estimate \$250.00-350.00 plus GST.

Electrical / Power Requirements

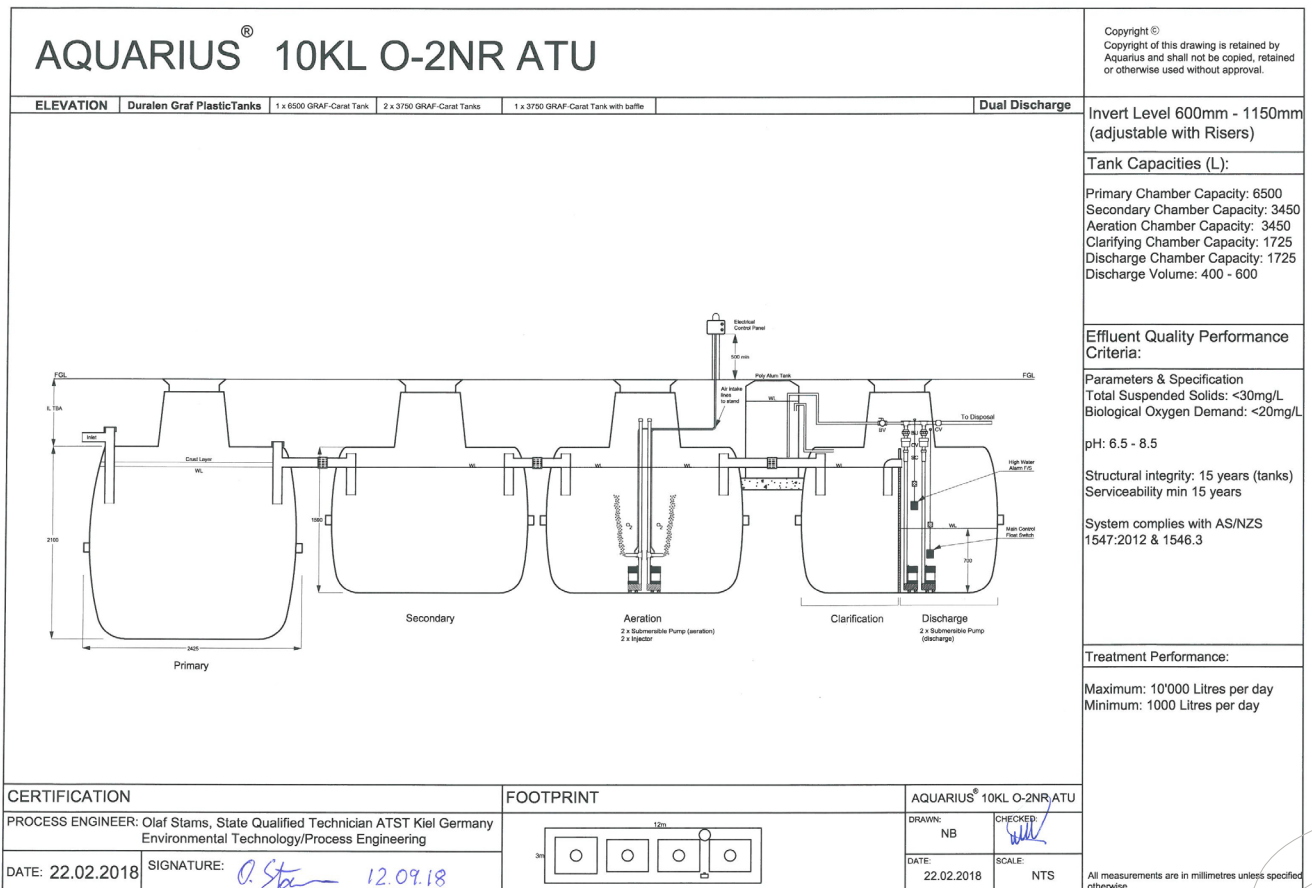
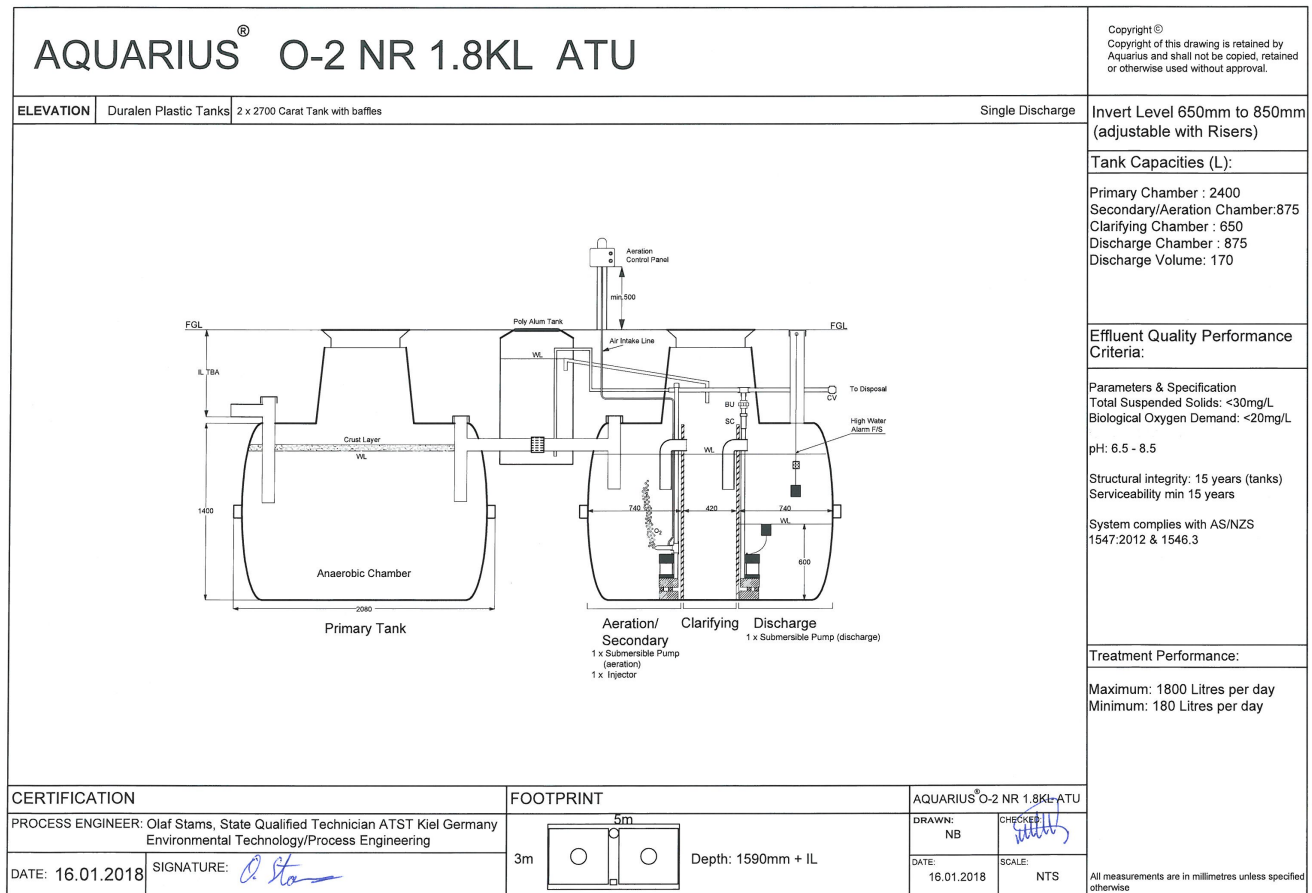
Our ATU's Power requirement for systems up to 4KL is single phase, 240-volt, 50 Hz, 20-amp. This is required to be on an independent separate, D circuit breaker, within the distribution board of the house (minimum 2.5 mm cable). For ATU's 6KL and above an independent separate D circuit breaker will also be required however it will need to be a 32-amp rating. Power cable to the ATU control panel is the responsibility of the owner/builder.

Warranty Conditions

The system must be installed, commissioned and serviced by an AWS approved Installer and Service Agent that is registered with the DoH WA. A copy of the local Council "Permit to Use", signed Service and Maintenance Agreement and completed Warranty Form must be supplied to Aquarius Wastewater Systems upon completion of the job to validate all warranties.



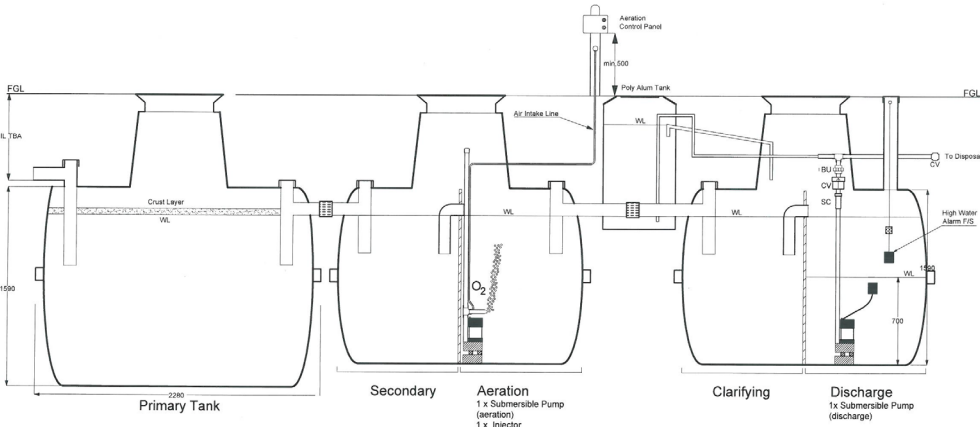
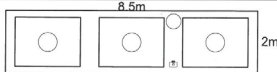
DOMESTIC UNITS



COMMERCIAL UNITS

AQUARIUS® O-2 NR 4KL ATU

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ELEVATION		Duralen Plastic Tanks	2 x 2700 Carat Tank with baffles 1x 3750 Carat Tank	Single Discharge	Invert Level 650mm to 850mm (adjustable with Risers)
					Tank Capacities (L): Primary Chamber : 3340 Secondary/Aeration Chamber: 1300 Clarifying Chamber : 1300 Discharge Chamber : 1300 Discharge Volume: 500
					Effluent Quality Performance Criteria: Parameters & Specification Total Suspended Solids: <30mg/L Biological Oxygen Demand: <20mg/L pH: 6 - 8 Structural integrity: 15 years (tanks) Serviceability min 15 years System complies with AS/NZS 1547:2012 & 1546.3
					Treatment Performance: Maximum: 4000 Litres per day Minimum: 400 Litres per day
					All measurements are in millimetres unless specified otherwise
CERTIFICATION		FOOTPRINT		AQUARIUS® O-2 NR 4KL ATU	
PROCESS ENGINEER: Olaf Stams, State Qualified Technician ATST Kiel Germany Environmental Technology/Process Engineering				DRAWN: NB	CHECKED: 
DATE: 16.01.2018	SIGNATURE: 			DATE: 16.01.2018	SCALE: NTS

AQUARIUS® 6KL O-2NR ATU

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ELEVATION		Dual Discharge	
Dualen Graf Plastic Tanks		Invert Level 600mm - 1150mm (adjustable with Risers)	
1 x 4800 Canst Tank		Tank Capacities (L):	
2 x 3750 Canst Tank with baffles		Primary Chamber Capacity: 4400 Secondary Chamber Capacity: 1725 Aeration Chamber Capacity: 1725 Clarifying Chamber Capacity: 1725 Discharge Chamber Capacity: 1725 Discharge Volume: 400-600	
		Effluent Quality Performance Criteria:	
		Parameters & Specification Total Suspended Solids: <30mg/L Biological Oxygen Demand: <20mg/L pH: 6.5 - 8.5	
		Structural integrity: 15 years (tanks) Serviceability min 15 years	
		System complies with AS/NZS 1547:2012 & 1546.3	
		Treatment Performance:	
		Maximum: 6000 Litres per day Minimum: 600 Litres per day	
CERTIFICATION		AQUARIUS® 6KL O-2NR ATU	
PROCESS ENGINEER: Olaf Stams, State Qualified Technician ATST Kiel Germany Environmental Technology/Process Engineering		DRAWN: NB CHECKED: [Signature]	
DATE: 22.02.2018		DATE: 22.02.2018	
SIGNATURE: [Signature] 12.09.18		SCALE: NTS	
		All measurements are in millimetres unless specified otherwise	