TAHIMANA SUBDIVISION

101 LOTS

DECENTRALISED WASTEWATER SCHEME SPECIFICATION REPORT

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CONTENTS

TABLES OF TABLES

TABLES OF FIGURES

APPENDIX

DRAWINGS

6425-00	Cover Page: Drawing List and Design Parameters
6425-04	Typical Air Vacuum Valve Detail
6425-05	Typical Cleanout Port Detail
6425-06	Typical Isolation Valve Detail
6425-07	Typical Service Connection Detail
6425-08	Typical House Connection Detail
6425-09	4,000L Prelos Processor Detail
6425-10	Wastewater Treatment Plant Plan
6425-11	Wastewater Treatment Plant Cross Section
6425-12	Land Treatment Area Detail
0040-13	WWTP Earthwork Detail

1.0 INTRODUCTION

Innoflow Technologies NZ Ltd (Innoflow) present this report which outlines the specification details for the proposed wastewater scheme to service Tahimana Ltd subdivision (101 lots), located at Stagecoach Road, Nelson. This design includes 101 on lot pumped septic tanks (also termed prelos tanks), liquid only pressure sewer, a communal wastewater treatment plant and a land treatment system. A set of drawings, which should be read in conjunction with this report, have been provided to visualise the proposed system.

2.0 WASTEWATER MANAGEMENT OVERVIEW

2.1 Wastewater Management Concept

The wastewater management scheme proposed for this subdivision incorporates a decentralised collection, central treatment, and land treatment for further renovation of effluent. The scheme incorporates the following key components and is illustrated in Figure 1.

1. On-lot pumped septic tanks at each lot to provide primary treatment of wastewater (Prelos tanks).
2. A wastewater collection system comprising a pressurised liquid only sewer.
3. A communal wastewater treatment plant (AdvanTex® recirculating textile packed bed reactors) to provide secondary treatment, as well as remove nutrients.
4. An effluent dispersal system comprising of a pressure compensating drip irrigation field.

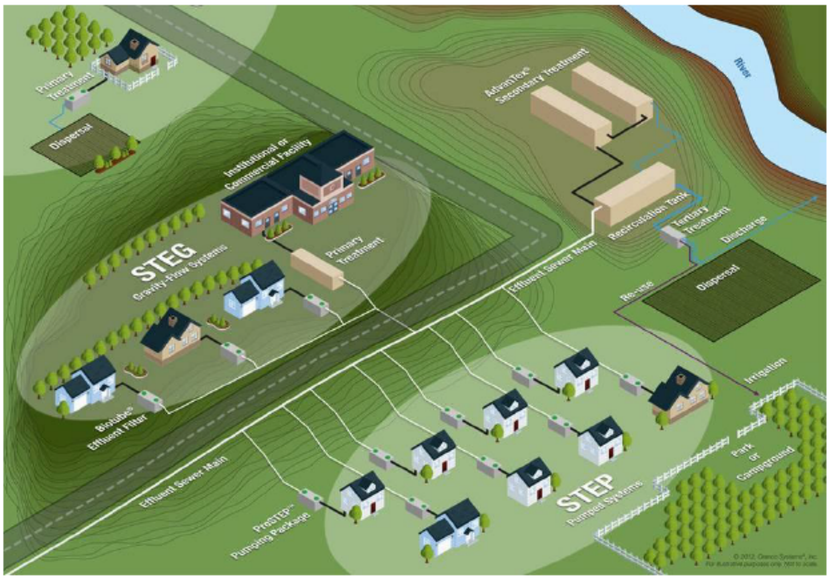

Figure 1- Example Schematic of Decentralised Treatment

2.2 Wastewater System Design Summary

Peak Flow, Influent Wastewater Characteristics and Target Effluent Quality

- Average daily flow: 73.3 m^3/day
- Peak Daily Flow: 91.658 m^3/day

- Influent BOD_5: <515 mg/L
- Influent TSS: <676 mg/L
- Influent TKN: <94 mg/L
-

  90th Percentile
- Effluent BOD_5: <20 mg/L
- Effluent TSS: <30 mg/L
- Effluent TN: <34 mg/L

  Maximum
- Effluent BOD_5: <30 mg/L
- Effluent TSS: <45 mg/L
- Effluent TN: <50 mg/L

- Land application method: Pressure Compensating Dripline Irrigation (PCDI)
- Soil loading rate: 2 mm/day

On-Lot Treatment

- 101 x 4 m^3 Prelos Processor Tanks (STEP) with an MVP Panel

Wastewater Treatment Plant

- 1 x influent Magflow meter
- 2 x 23 m^3 pre-anoxic tank with filtrate return line
- 4 x (stage 1) 23 m^3 recirculation tank with dosing pumps
- 12 x (stage 1) AX100 packed bed reactor pods
- 4 x 23 m^3 Post-Anoxic Tank
- 1 x (stage 2) 23 m^3 recirculation tank with dosing pumps
- 3 x (stage 2) AX100 packed bed reactor pods
- 2 x 23 m^3 treated effluent tank and a Pump Station with irrigation pumps.
- 1 x 23 m^3 alkalinity dosing tank
- 1 x carbon dosing system
- 1 x TCOM control panel

Land Application

- Treated effluent rising main.
- 10 x 4,583 sqm sectors comprising of 45,829 lineal meters of pressure compensating dripline irrigation laid at 1m centres.

3.0 DESIGN PARAMETERS

3.1 Peak Wastewater Flow Calculations

The wastewater treatment plant system has been designed based on influent strength and daily flow stipulated below. For design purposes a peak daily flow shall occur no more than once in any seven-day period, and an average flow is a 30-day average.

Table 1- Design Peak Daily Flows

Input Design Parameters		
Qave	m^3	73.3
Qpeak	m^3	91.658
Dwellings		
Occupancy	People	252.5
Flow Allowance	L/Person/Day	165
Dwellings		101
DWPF		2
PWWWF		0.1

Note 1 - Occupancy totals from Engineer

3.2 Design Influent Parameters

Influent wastewater generated from the site shall be domestic strength in nature, with the following combined maximum influent strengths.

Table 2- Design Equivalent Mass Loads

Equivalent Mass Loads per Person per Day		
BOD_5	grams	85
TSS	grams	95
TKN as N	grams	15.5
NH_3	mg/L	7.8
Total P as P	grams	3.0

Note 2 - From Crites & Tchobanoglous 1998, Table 4-12

Table 3- Design Mass Load Conversion

Equivalent Mass Load Conversion Factor (Residential)		
BOD_5	grams	100%
TSS	grams	100%
TKN as N	grams	100%
NH_3	grams	100%
Total P as P	grams	100%

Table 4-Design Influent Strength (Maximum)

Raw Influent Strength (Maximum Dry Weather)		
BOD_5	mg/L	515
TSS	mg/L	576
TKN	mg/L	94
NH_3	mg/L	47
TP	mg/L	18
FOG	mg/L	165
Alkalinity as $CaCO_3$	mg/L	-

3.3 Design Effluent Quality

The following tables describe the design effluent quality from the treatment plant.

Table 5- Target Effluent Quality Limits

Final Effluent Quality			
		90%ile (less than)	*maximum (less than)*
$cBOD_5$	mg/L	20	30
TSS	mg/L	30	45
TN	mg/L	34	50
NH_3	mg/L	-	-
TP	mg/L	-	-
E.Coli	cfu/100 mL	-	-

3.4 Toxicity

The assumption has been made that the influent strength detailed in the table above is domestic in nature, with no commercial and industrial waste. The influent stream shall not contain concentrations of toxic substances that may adversely affect the performance of the biological processes required for the system to operate. Below is a list of toxic compounds that are known to negatively impact the system and are not to discharge into the treatment plant. Note: This is not a complete list, other harmful compounds are likely to exist that will adversely affect the performance of the plant.

Table 6- List of chemicals not to be discharged into wastewater system.

Toxic Compound(s)	Example	Result
Heavy Metals	Copper, Nickel, Zinc, Cadmium, Chromium	Stop ammonia oxidation (reversible)
Metal-binding compounds[1]	Sodium Sulfide	Stop ammonia oxidation (reversible)
Bind heme and proteins[1]	Ethyl xanthate (mining industry)	Stop ammonia oxidation; cell death
Hydrazine (H_2N_2)[1]	Rocket fuel	Stop ammonia oxidation
Chlorination		Cell death
Uncouplers of oxidative phosphorylation and inhibitors of electron transport[1]	DNP (2, 4-Dinitrophenol) MCCP (m-Chlorocarbonyl-cyanize phenylhydrazone)	Cell death
Short-chain alcohols and amines[1]	Methanol, Ethanol, n-butanol	Cell death
Phenol[2]		Stop ammonia oxidation; cell death
Nitrous oxide (N_2O)[1]	Aerosol propellants	Stop ammonia oxidation
High levels of nitrite (NO_{2-})		Stop ammonia oxidation
Quaternary amines	Disinfectant, surfactant, fabric softeners, shampoo	Cell death
UV light[3]		Stop ammonia oxidation

Toxic Compound(s)		Concentration resulting in 50% inhibition (mg/L)
L-Histidine		0.5
Thiosemicarbazide		0.9
Nitrourea	***	1
Allylthiourea		1.2
8-Quinolinol		1.5
L-Arginine		1.7
L-Valine		1.8
Diethyldithiocarbamate		2
L-Threonine		3.6
L-Lysine		4
Quinacrine	***	5
Diphenylthiocarbazone		7.5
L-Methionine		9
o-Phenanthroline		9
Phenazine methosulfate		10
Dicyclohexylcarb-diimide		10
2-Chloro-6-trichloromethyl-pyridine		11
Ethyl xanthate		12
Dipryidyl		16
2,4-Dinitrophenol	**	37
3-Aminotriazole		70
Aminoguanidine	**	74
Methanol	*	160
Dichlorophenolinde-phenol		250
Hydrazide		300
Methylamine		310
Trimethylamine		590
Tetremethylammonium Chloride		2200
Ethanol		4100
Acetone	*	8100
N-Butanol	*	8200
Aminoehtanol		12000
Ethyl Acetate	*	18000
N-Propanol	*	20000

* Included in the list of significant chemicals

** Inhibitors of both NH_3 and NO_2 oxidation

*** Inhibitors of NO_2 oxidation

All others inhibit NH_3 oxidation

4.0 PRESSURISED LIQUID ONLY SEWERS

4.1 Drainage from Lots

Raw wastewater from each lot shall enter the effluent sewer via conventional 100 mm DWV gravity sewer pipes (or as determined suitable onsite). We have assumed that all pipework can be laid at a shallow depth, with all tanks buried at a depth of less than 900mm (soil cover to tank roof).

Figure 2- Gravity pipework from dwelling to the Prelos tank.

4.2 Primary Wastewater Treatment (Prelos Tanks)

Wastewater from each dwelling will be collected in an on-lot 4 m³ pumped septic tank, which is also referred to as a prelos tank. This essentially is an onsite septic (STEP) tank fitted with a specialist pumping assembly which shall pump liquid waste only to the communal treatment system via the liquid only effluent sewer network.

Each tank will be fitted with Orenco pump kit, which incorporates the following key components.

- 1 x Biotube Pump Vault
- 1 x Biotube Effluent Filter
- 1 x Discharge Hose & Valve Assembly,
- 1 x Float Tree
- 1 x PF (50Hz)100512CV Orenco PF Series Pump,
- 1 x external Splice Box (SBEX).

Figure 3- Example of STEP Tank Pumping Kit

Table 7- Prelos Tank Specification

Tank Manufacturer	Orenco
Tank Model	Prelos 1000U
Number of Tanks	101
Tank Volume	4 m^3
Construction	Fiberglass
Dimensions	Diameter: 2400 mm Height: 1550 mm
Number of pumps per tank	1
Pump Model	PF (50Hz)100512CV
kW	0.37 kW
Voltage	230 V
Amperage	4.1 A
Hz	50 Hz
Operating Range	0.3-0.7 L/s
Flow Rate at TDH	approximately 0.6 L/sec @ 20 m
Outlet Diameter	50 mm
Motor Protection	IP68
Float Arrangement	High Level, Pump on/off, Low level/redundant off
Access Risers	2 x 610 mm Dia x 450 mm high Fibreglass access risers
Access Lids	2 x 610 mm Dia fiberglass lid and bolts (model FL24g)

4.3 Prelos Tank Sizing and Pump-Out Intervals

Assuming an average of 3-bedroom (5 person occupied) house, The tanks have been designed to provide >3 days hydraulic retention time, which provides adequate retention for solid settlement and anaerobic digestion. The tanks will need to be pumped out periodically as sludge builds up in the tank, typically once every 3-5 years for a permanently occupied house, and less frequently for intermittently occupied homes. Assuming the design flows are accurate and suitable maintenance is provided, the graph below shows pump out frequencies with a confidence level of graph 95%.

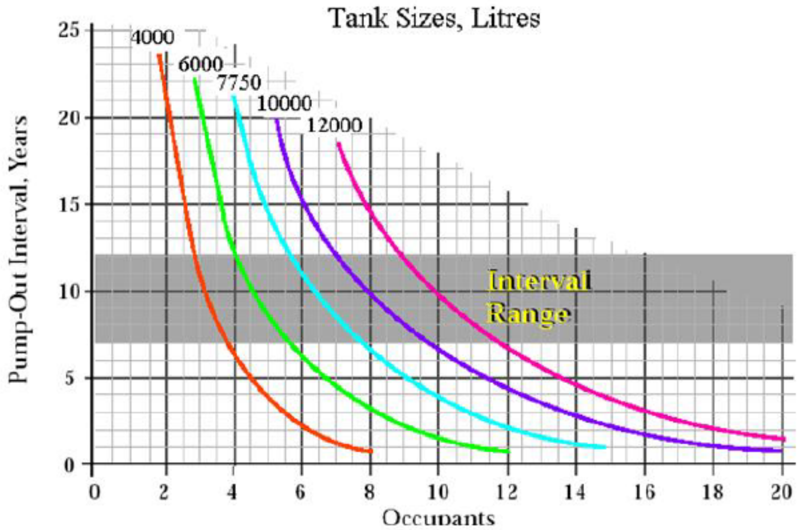

Figure 4- Pump-out Intervals at 95% confidence. Source: Orenco Systems Inc

All proposed on-lot septic tanks will contain 24 hours emergency storage above the high-level alarm trigger level. In the event of pump or power failure emergency storage is provided to allow adequate time to rectify any fault. The pump and discharge assembly can be disconnected, and a new pump fitted within a few minutes by simply unscrewing a socket union and rewiring.

The on-lot septic tanks and equipment are designed to be low maintenance and should require no homeowner intervention. The pumps utilised are reliable, long-life, multi-stage turbine pumps. A control panel and float switches control the pump and automatically deal with high or low-level situations. The effluent filters are very low maintenance, having a large surface area.

Orenco outlet Biotube effluent filters have been specifically designed for its ability to remove total suspended solids to no greater than 30 mg/L. This also protects the downstream components of the wastewater treatment system in a consistent and predictable way.

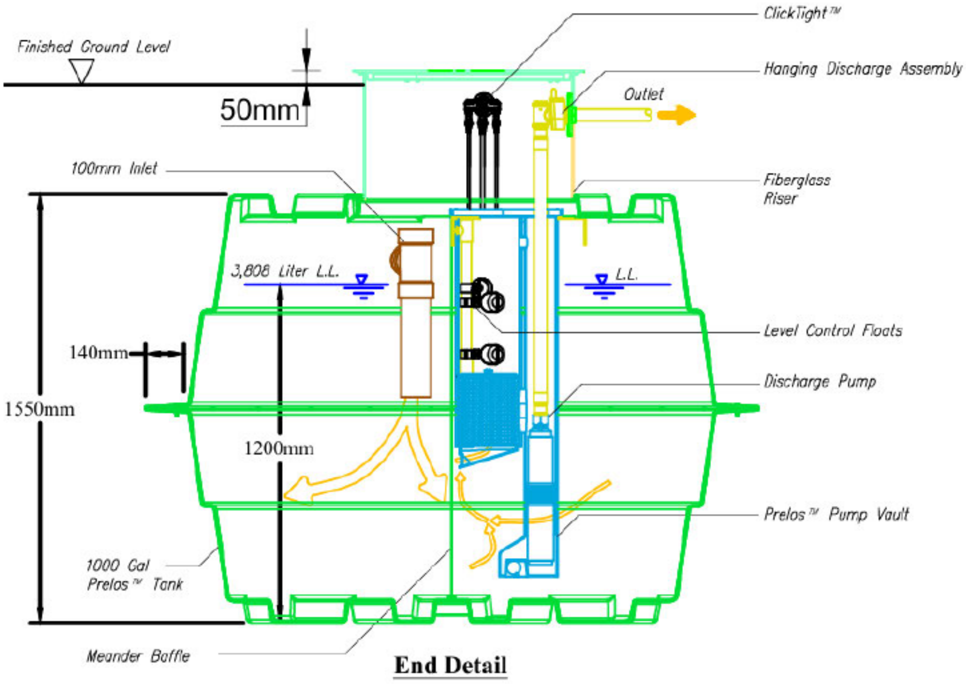

Figure 5- Snapshot of Sectional View of CM-1060 Infiltrator Tank

4.4 Residential Liquid Only Effluent Sewer Design Calculation Basis

The design of a liquid only effluent sewer using prelos tanks is based primarily on peak flow rates, which is calculated by assigning occupancy flow allowances for 101 Equivalent Dwelling Units (EDU). Empirical studies have resulted in a relationship between the number of EDU's and peak flow rate. The figure below presents these data, from which a simplified equation can be calculated.

Simplified Equation: $$\frac{\text{No. EDU's} + D}{2}$$

Where:

D is the flow rate from a single pump.

Where occupancy is known, the Simplified Equation can be modified as follows.

Modified Equation: $$\frac{\text{(Population per EDU)} * \text{(EDU's)} + D}{6}$$

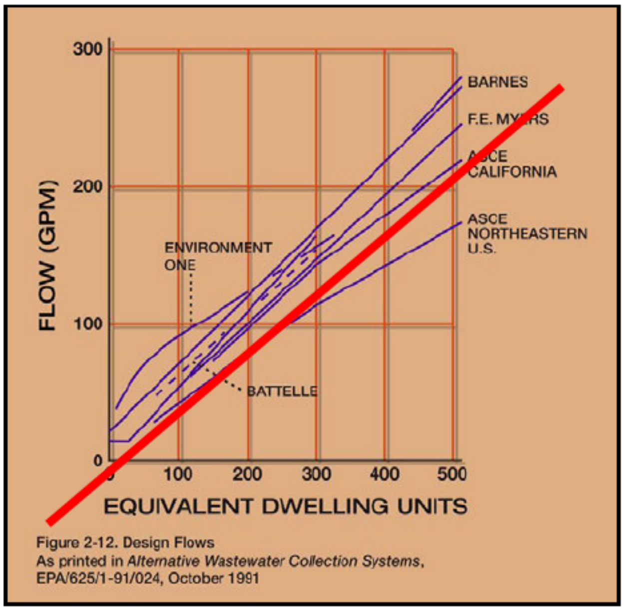

Figure 6- Relationships between design peak flow and the number of EDU's. Red line denotes the simplified equation.

Once the peak flow rate is determined for a section of pipe, we use Hazen Williams head loss equations to calculate the velocity and friction losses within that pipe. Selection of the correct pipe diameter will ensure effluent is transported in the most efficient and economical manner possible.

Velocity: $V = 1.318CR^{0.63} S^{0.54}$

Where:

V = Velocity of flow

C = Hazen-Williams coefficient (C = 150)

R = Hydraulic radius (flow area divided by wetted perimeter)

S = Slope of the energy gradient line

Head loss: $hf = 10.5(L)\ (Q/C)^{1.85}\ (D)^{-4.87}$

Where:

Hf = Headless through the length of pipe

L = Length of pipe

Q = Flow rate (gal/min for this equation)

C = Hazen-Williams coefficient

D = Inside diameter of pipe

One of the main aims of the effluent sewer design is to vary the size of the effluent sewer pipes to suit the use of a single pump model at every site, and generally to maintain velocity at less than 1.5 m/sec. As shown on the provided hydraulic grade analysis, this has been achieved through the selection of these pipes.

4.5 Burial Depth

Effluent sewer pipes are typically buried to a depth of 600 mm in road berms, defined as the vertical distance from the top of the installed pipe to the finished ground surface above it. Burial depth under carriageways is greater, typically 900 mm. Notwithstanding the above, burial depth of the effluent sewer mainlines shall be in accordance with appropriate Construction Standards.

4.6 Pipe Sizing

The total dynamic head (TDH) is calculated for all locations along the effluent sewer mainline where dwellings connect into the effluent sewer. For individual sections, calculations are based on all dwellings connected at the end of the line, i.e., dwellings will connect along the length of the line however for design purposes it is assumed all connect at the end, thus providing an added level of conservatism to the design. From this we calculate friction losses, which when added to the static head to provide a TDH at any given point.

4.7 Service Lateral

Service laterals are to be Nominal outside Diameter (DN) 32 mm. Connections at the tank and at the boundary service connection shall be 25 mm British Standard Pipe (BSP) threaded. Head loss through the property service lateral has not been included in any calculations as losses are minimal (i.e., less than 0.5 m) and the mainline design is conservative.

4.8 Fittings

All PE pipe connections are to be electro-fusion welded fittings. Other jointing methods such as butt welding and end-load resistant mechanical joints are also acceptable.

Where possible, all bends on the effluent sewer mainlines are to be curved pipe bends and not 90º elbow fittings. Whilst elbows are acceptable in effluent sewer designs, we consider that installation methods will allow curved pipe bends, which minimise the need for pipe connections. Where curved pipe installation occurs, we shall follow the manufacturer's recommendation for minimum pipe bend radius.

4.9 Pressure Testing

Pressure testing of all pipes and fittings up to and including service connections will be carried out after pipe laying and jointing and before joints are backfilled. To minimise the amount of water needed for the pressure test, short pipe sections should be tested individually, and then water transferred to the next section of pipe.

There are several options to pressure test PE pipes, from measuring the rate of test pressure decay to simple pass/fail methods. For all pressure tests, the pressure should be limited to no more than 1.25 times the rated pressure, and this should be reduced accordingly if the test water temperature is above 20 ºC.

4.10 Backfill and Reinstatement

We have not allowed to excavate the trench or backfill and reinstate. This is because much of the effluent sewer will be laid in a common services trench that has been opened and backfilled by others. Pipe bedding is not needed. Soil from the excavation can be used as backfill material around the effluent sewer pipe provided there are no large or angular objects that might damage the pipe.

4.11 Service Connections

Each STEP tank should be connected to the wastewater main effluent sewer line via a service connection. This service connection protects the house from back-pressure and allows the house to be isolated from the effluent sewer in an emergency. It is normal for the service connections to be installed at the same time as the main sewer line.

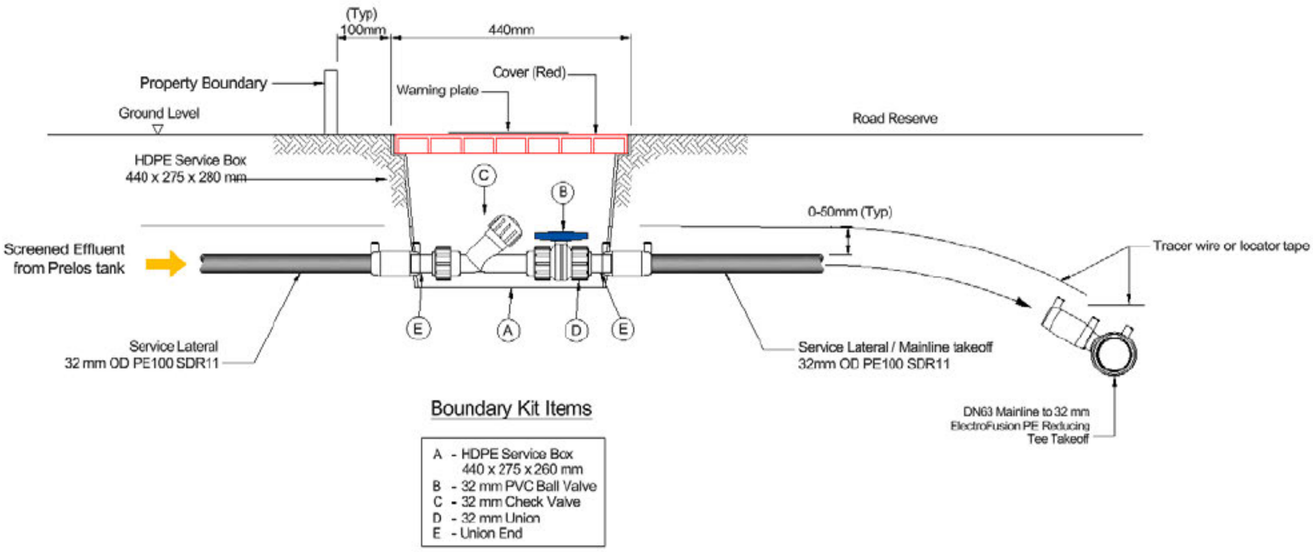

Figure 7- Typical Effluent Sewer Service Connection

4.12 Cleanout Ports

Clean out Port assemblies will be installed at the ends of the collection lines to allow the clean out/flush of the effluent sewer in the event of blocking. Included with the assembly is a PVC enclosure with a lockable fibreglass access lid for simple servicing.

4.13 Air Release Assemblies

Air release assemblies should be installed in the collection lines at certain places to prevent the formation of air pockets and negative pressure situations in the collection lines. Innoflow has allowed to supply air release assembly kits (if required) specifically designed for this application. Included with the assembly is a PVC enclosure with a lockable fibreglass access lid for simple servicing. The recommended locations have been shown on the appended hydraulic grade analysis line.

5.0 SECONDARY TREATMENT WASTEWATER TREATMENT

It is proposed to install an AdvanTex® recirculating textile packed bed reactor (rtPBR) wastewater treatment plant to provide advanced secondary treatment, shown in the schematic below. Recirculating packed bed reactors recognised as one of the most stable treatment processes available, able to produce a consistently high-quality effluent, even under fluctuating loads and wastewater strengths.

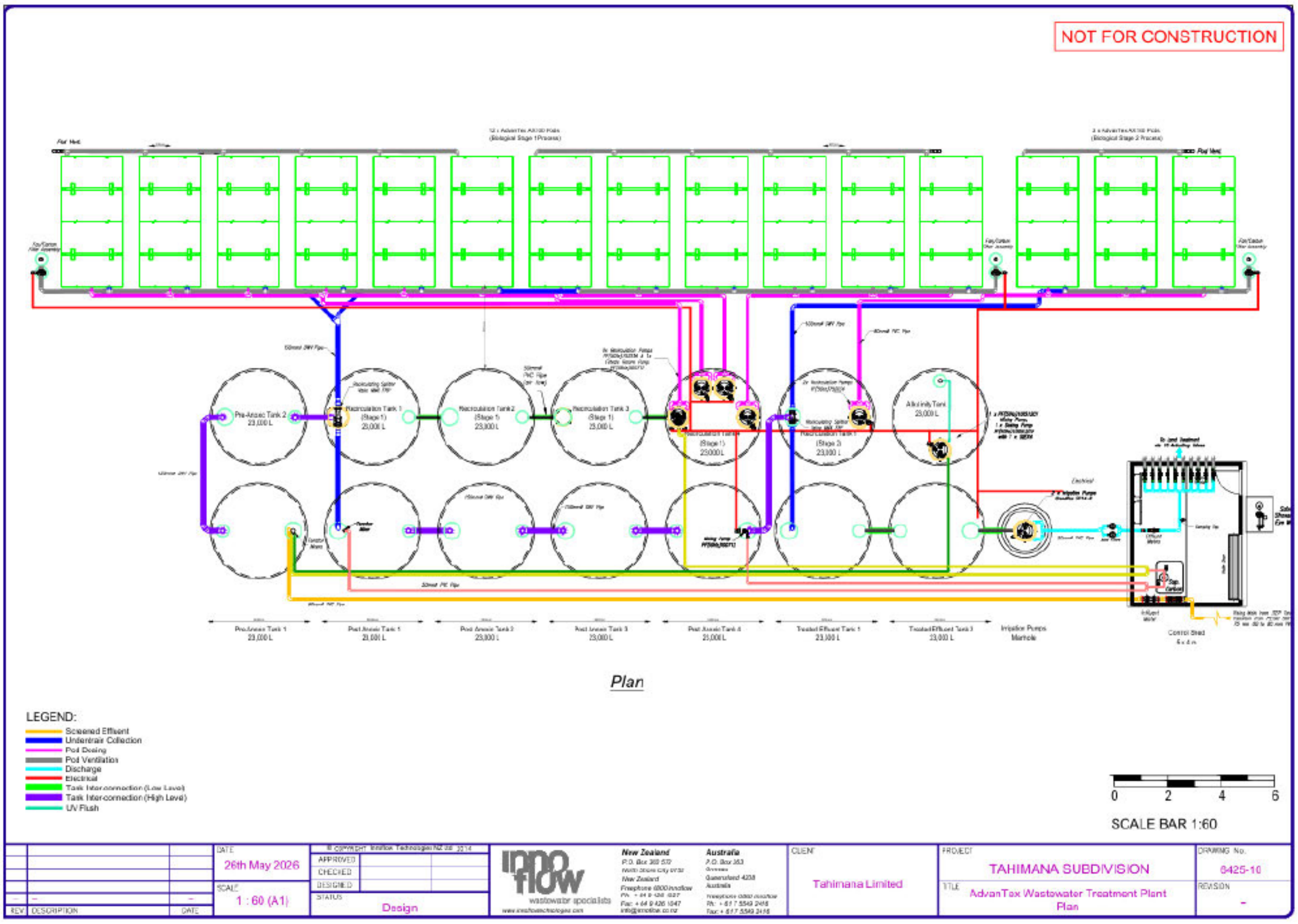

Figure 8- Snapshot of Proposed Wastewater Treatment Plant

5.1 Pre-Anoxic Tank

2 x 23 m³ pre-anoxic tanks are proposed and receives both influent residential effluent sewer as well as a portion of returned nitrified effluent that has passed through the packed bed reactor. The anoxic conditions within this tank provide a suitable environment for denitrification as well as diluting the influent stream.

Table 8- Pre- Anoxic Tank Specification Table

Tank Manufacturer	Alpha Precasts
Number of Tanks	2
Tank Volume	$23m^3$

Dimensions	Height: 2800mm Diameter: 3600 mm
Hydraulic Retention Time @ Peak	> 0.5 Day
Access Risers	2 x 450 mm Dia x 450 mm high PVC Ribbed access risers (Model: RR1818) 2 x 610 mm Dia x 450 mm high PVC Ribbed access risers (Model: RR2418)
Access Lids	2 x 450 mm Dia fiberglass lid and bolts (model FL18g) 2 x 610 mm Dia fiberglass lid and bolts (model FL24g)

5.2 Alkalinity Dosing Tank

To provide pH adjustment, supplemental alkalinity dosing will be supplied in the form of magnesium hydroxide into the first pre-anoxic tank. This will be delivered via a liquid chemical feed system that is stored, mixed and pumped from an underground 23 m³ tank, as depicted in the figure below. The alkalinity tank consists of a dosing pump and a mixing pump. This pump will be timer controlled to provide a high degree of mixing and assimilation of alkalinity.

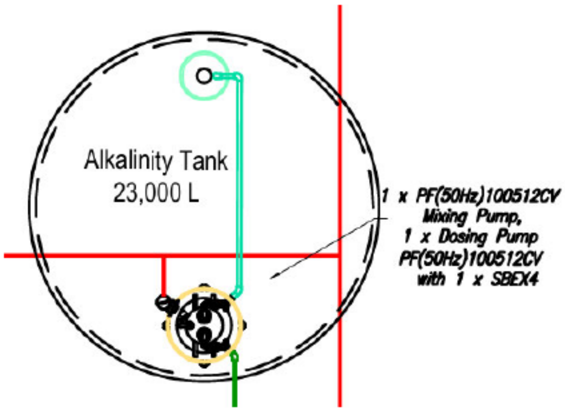

Figure 9- Example of proposed dry supplemental feed system

Table 9- Alkalinity Tank Specification Table

Tank Manufacturer	Alpha Precasts
Number of Tanks	1
Tank Volume	23 m^3
Dimensions	Height: 2800 mm Diameter: 3600 mm
Pump Manufacturer	Orenco
Number of Dosing Pumps	1
Dosing Pump Model	PF (50Hz)100512CV
kW	0.37 kW
Voltage	230 V
Amperage	4.1 A
Hz	50 Hz
Operating Range	0.3-0.85 L/s
Flow Rate at TDH	approximately 0.6 L/sec @ 20 m
Outlet Diameter	32 mm
Motor Protection	IP68
Number of Mixing Pumps	1

Mixing Pump Model	PF (50Hz)100512CV
kW	0.37 kW
Voltage	230 V
Amperage	4.1 A
Hz	50 Hz
Operating Range	0.3-0.85 L/s
Flow Rate at TDH	approximately 0.6 L/sec @ 20 m
Outlet Diameter	32 mm
Motor Protection	IP68
Access Risers	1 x 450 mm Dia x 450 mm high PVC ribbed access risers (Model: RR1818) 1 x 610 mm Dia x 450 mm high PVC ribbed access riser (Model: RR2418)
Access Lids	1 x 450 mm Dia fiberglass lid and bolts (model FL18g) 1 x 610 mm Dia fiberglass lid and bolts (model FL24g)

5.3 Recirculation Tank – Stage 1 and 2

5 x 23m³ recirculation tanks (4 for stage 1 and 1 for stage 2) dose the stage 1 and 2 AX100 packed bed reactors. These tanks are fitted with timer dosed pumps that pump a blend of effluent over the textile filters in the packed bed reactor in a timer controlled and flow equalised fashion. A recirculation splitter float valve assembly is also installed in these tanks to ensures that the optimal recycle ratio is always maintained, maximising treatment efficiency for a consistently high-quality effluent.

In this way, the recirculation tank ensures that the packed bed reactor receives a continuous source of oxygen and food during periods of little or no flow, ensuring that the micro-organisms are maintained at peak condition, ready to receive shock or varying that provide the necessary flow rates to dose the textile with effluent.

Table 10- Recirculation Tanks (Stage 1 and 2) Specification Table

Tank Manufacturer	Alpha Precasts
Number of Tanks	4 - Stage 1 1 – Stage 2
Tank Volume	23m³
Dimensions	Height: 2800 mm Diameter: 3600 mm
Hydraulic Retention Time @ Peak	>1 day
Pump Manufacturer	Orenco
Number of Pumps (Stage 1)	8
Recirc Pump Model (Stage 1)	PF (50Hz)752034
kW	1.49 kW
Voltage	380 V
Amperage	4.0 A
Hz	50 Hz
Operating Range	3.3-6.0 L/s
Flow Rate at TDH	approximately 4.8 L/sec @ 15 m
Outlet Diameter	50 mm
Motor Protection	IP68
Float Arrangement	High Level, Timer Override, Low level/redundant off

Number of Pumps (Stage 2)	2
Recirc Pump Model (Stage 2)	PF (50Hz)752034
kW	1.49 kW
Voltage	380 V
Amperage	4.0 A
Hz	50 Hz
Operating Range	3.3-6.0 L/s
Flow Rate at TDH	approximately 4.8 L/sec @ 15 m
Outlet Diameter	50 mm
Motor Protection	IP68
Float Arrangement	High Level, Timer Override, Low level/redundant off
Number of Pumps	1
Filtrate Return Pump Model	PF (50Hz)500712
kW	0.56 kW
Voltage	230 V
Amperage	6.4 A
Hz	50 Hz
Operating Range	2.25-4.1 L/s
Flow Rate at TDH	approximately 3.25 L/sec @ 10 m
Outlet Diameter	50 mm
Motor Protection	IP68
Access Risers	Stage 1 Tank: 3 x 450mm Dia x 450mm high PVC ribbed access risers (Model: RR1818) 2 x 610mm Dia x 450mm high PVC ribbed access risers (Model: RR2418) 5 x 760mm Dia x 450mm high fiberglass access risers (Model: RF3018) Stage 2 Tank: 1 x 610mm Dia x 450mm high PVC ribbed access riser (Model: RR2418) 1 x 760mm Dia x 450mm high fiberglass access riser (Model: RF3018)
Access Lids	Stage 1 Tank: 3 x 450 mm Dia fiberglass lid and bolts (model FL18g) 2 x 610 mm Dia fiberglass lid and bolts (model FL24g) 5 x 760 mm Dia fiberglass lid and bolts (model FL30g) Stage 2 Tank: 1 x 610 mm Dia fiberglass lid and bolts (model FL24g) 1 x 760 mm Dia fiberglass lid and bolts (model FL30g)

5.4 AdvanTex® Recirculation Textile Packed Bed Reactor – Stage 1 and 2

15 x AdvanTex AX100 packed bed reactor pods for the (12 for the stage 1 and 3 for the stage 2) are proposed to provide aerated biological treatment of wastewater. In total, these pods provide approximately 150 m² or 1500 sqft of textile. The textile is loaded in the following manner. The first stage process provided treatment to a standard secondary level (effluent $cBOD_5$ <20 mg/L and TSS <30 mg/L). The second stage of the system provides another layer of treatment and is expected to treat effluent to an advanced secondary level (that is <15mg/L of both parameters respectively).

Peak

- <0.4kg BOD/m² (stage 1), <0.2kg BOD/m² (stage 2)
- <2m³/m² (stage 1), <1m³/m² (stage 2)
- <0.035kg TKN/m² (stage 1), <0.07kg TKN/m² (stage 2)

The AdvanTex rtPBR is essentially a bed of highly specialised textile nestled in a pre-made pod to which the effluent is uniformly dosed through a pressure distribution system using a timer-controlled dosing regimen. These small precise doses at multiple point sources across the reactor bed ensure thin film application of the effluent maximising retention times within the reactor for renovation.

This unique complex fibre structure of the textile media has an immense surface area for biomass colonization, (up to 5 times greater than sand) and a much greater void space (~3 times higher than sand) to ensure free flow of oxygen through the media interstices. Its high field moisture capacity ensures long, intimate, contact times of the wastewater with the biomass for almost complete renovation.

Figure 10- Example of AX100 installation

Table 11- AX100 Pod (Stage 1 and 2) Specification Table

Manufacturer	Orenco Systems Inc.
Model	AdvanTex AX100
Textile Surface Area per Pod	9.6 m²
Number of Pods	15 (12 for stage 1 and 3 for stage 2)
Number of Spray Nozzles per Pod	8
Ventilation Fan Model	CF1818
Number of Fans	3
Phase	Single
Voltage	230V
Amperage	1.8A
Hz	50Hz

Operation	Continuous
Air Flowrate	5.8 m^3/min
RPM	2900/min
Maximum Power Consumption	0.06 kW
Activated Carbon	Granular cracked carbon

5.5 Fresh Air Ventilation

Each unit contains a fresh air inlet point, designed to allow air ventilation throughout the hanging textile. Venting each pod involves drawing fresh air through the inlet at the end of each pod, through the textile sheets, and out through an activated carbon filter/fan. The fan used to circulate the fresh air is a small 110 watt "ducting type" fan, designed for continuous operation.

To maintain a steady state in each pod, the fan will operate continuously. It should be noted that the fan is not designed to provide an artificially high population of microbes inside the AdvanTex® pods. Since the fan is small, the airflow is only slight and simply required to prevent stagnant conditions. The carbon filter, ventilation fan and heater will be housed inside a green fibreglass enclosure installed at the same height as the AdvanTex® pods.

Odours do not generally permeate from an rtPBR unless there is a serious issue. To help control and scrub any air that is forced out of the plant, carbon filters are included on access lids to allow the balancing and diffusion of air as water levels rise and fall within the tanks.

5.6 Post-Anoxic Tank

Secondary treated effluent from the outlet of the Stage 1 recirculation discharges into 4 x 23m^3 post anoxic tank for denitrification. In this tank, nitrate is converted to nitrogen gas which is them removed from the wastewater stream. It is expected that to 80% of influent TKN is removed. Supplemental carbon is added to this tank proportional to influent flow to provide the necessary carbon to nitrogen ratio (>4:1). The tank will contain a turbine pump to stir the contents of the tank and thoroughly mix the added carbon with the treated effluent.

Our design assumes a BOD content of less than 20 mg/L at the point entry into the post anoxic tanks, and a required carbon to nitrogen ratio (C:N) of 6:1. These parameters are considered conservative and we should be able to optimise the process and thus reduce the volume of carbon required.

Table 12- Post-Anoxic Tank Specification Table

Tank Manufacturer	Alpha Precasts
Number of Tanks	4
Tank Volume	23m^3
Dimensions	Height: 2800 mm Diameter: 3600 mm

Hydraulic Retention Time @ Peak	>1 day
Number of Pumps	1
Pump Model	PF (50Hz)500712
kW	0.56 kW
Voltage	230 V
Amperage	6.4 A
Hz	50 Hz
Operating Range	2.25-4.1 L/s
Flow Rate @ TDH	approximately 3.25 L/sec @ 10 m
Outlet Diameter	50 mm
Motor Protection	IP68
Access Risers	4 x 450 mm Dia x 450 mm high PVC ribbed access risers (Model: RR1818) 4 x 610 mm Dia x 450 mm high PVC ribbed access risers (Model: RR2418)
Access Lids	4 x 450mm Dia fiberglass lid and bolts (model FL18g) 4 x 610mm Dia fiberglass lid and bolts (model FL24g)

5.7 Treated Effluent Storage Tank

Treated effluent from the wastewater treatment plant will be collected and stored in 2 x 23m³ treated effluent storage tanks. Two pumps will be fitted in this tank which is suitably sized for the land application field (specifications below). A pulse effluent flow water meter, and two Arkal filters will be installed in the pumped outlet of the tank.

Table 13- Treated Effluent Tank Specification Table

Tank Manufacturer	Alpha Precasts
Number of Tanks	2
Tank Volume	23m³
Dimensions	Height: 2800 mm Diameter: 3600mm
Hydraulic Retention Time @ Peak	>0.5 days
Number of Pumps	2
Pump Model	SP14-8
kW	2.2 kW
Voltage	230 V
Amperage	14.6 A
Hz	50 Hz
Operating Range	0.35-5.0 L/s
Flow rate @ TDH	approximately 2.8 L/sec @ 40 m
Outlet Diameter	50 mm
Motor Protection	IP68
Access Risers	2 x 450 mm Dia x 450 mm high PVC ribbed access risers (Model: RR1818) 2 x 610 mm Dia x 450 mm high PVC ribbed access risers (Model: RR2418) 1 x 760 mm Dia x 450 mm high fiberglass access risers (Model: RF3018)
Access Lids	2 x 450 mm Dia fiberglass lid and bolts (model FL18g) 2 x 610 mm Dia fiberglass lid and bolts (model FL24g) 1 x 760 mm Dia fiberglass lid and bolts (model FL30g)

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6.0 CONTROLS AND TELEMETRY

6.1 TCOM Control Panel

A TCOM control panel will be supplied to control the wastewater treatment plant. The control panel attends the functions and requirements of the specific wastewater Treatment Plant.

Moreover, this panel controls general operations of the plant such as pump run times, fan run, water meter readings and monitoring of sensors. The panel also allows for automatic call-out to pagers, SMS via Cell phone and/or emails during alarm conditions or when the panel detects trends that could lead to system failure. It can maintain logs for system conditions and events, such as Pump Run Time, Pump Cycles, and Alarm Conditions and Downloadable logs into a *. dive or ASCII format for simple conversion to common spreadsheet or word processor programs. Please refer to attachments for samples of reports that can be generated through Hyper Terminal and downloaded to a spreadsheet program.

The Control panel can be set to run in three options- Manual, off or Automatic. In Automatic, the programmed settings control the on/off time of the nominated pump. Set to off, it will turn off the nominated pump, or set in manual, it will allow the nominated pump to run whilst the manual switch is engaged.

6.2 Networking Protocols

Ethernet (permits peer-to-peer communications, up to 16 peers)

- Modbus (permits our controller to serve as master or slave)
  a. When “master,” permits connection to off-the-shelf Non-proprietary devices that support Modbus protocols. Can control and monitor up to 32 slaves.
  b. When “slave,” permits connection to and communication with Modbus masters.

An IBM compatible interface is standard and Item™ or hyper terminal will interface with the panel enabling the backup for programming and data downloads.

6.3 Telemetry

Telemetry is a technology that allows the remote measurement and reporting of information. Innoflow Technologies NZ Limited provides its telemetry through Digital Telemetry, who are a company specialising in the provision of wireless telemetry services for your remote equipment. They connect to our remote, unattended equipment wirelessly using proven Siemens wireless controllers and modems connected to their network of management servers, through which customers can securely access their equipment using RS232/serial, digital I/O, analogue input or current loop (4-20mA) from any Internet connection in the world.

7.0 LAND TREATMENT AREA

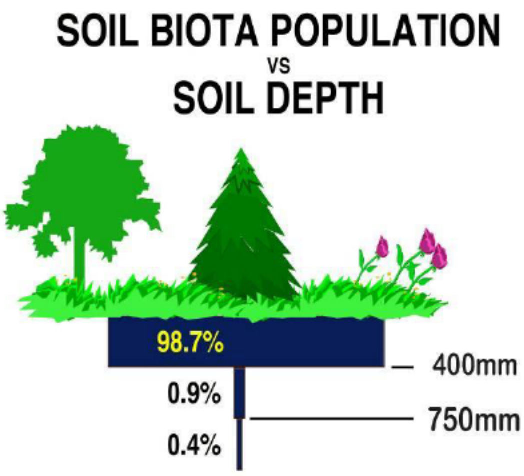
Soil assessments and categorisations have been conducted by others. Based on the provided information, it is proposed to irrigate highly treated effluent to 45,829m² of surface laid pressure compensating drip irrigation lines, as summarised in the figure below.

The effluent from the AdvanTex® packed bed reactor system is treated to an enhanced secondary level and has quite different properties and environmental effects compared to wastewater which has received primary (septic tank) treatment only. Specifically, whereas application of septic tank effluent to the ground will result in long-term clogging of the soil, application of the highly treated packed bed reactor effluent will produce no reduction in soakage capacity of the soil even in the long-term.

Design Parameters:

Qpeak	=	91,658 LPD
Soil Loading Rate	=	2 mm/day
Land Treatment Area	=	45,829 m²
Number of Zones	=	10
Sector Size	=	4,583 m²
Sector Sequencing	=	Electric Actuating Ball Valves
Emitter flow rate	=	1.0 L/hr
Emitter spacing	=	0.5 m
Dripline spacing	=	1.0 m
Sector flow rate	=	9,165 L/hr
Pump Duty	=	2.6 L/sec @ 25 m TDH

Figure 11- Land Application Design Specification



This method of dispersal offers a unique flexibility allowing installation in areas of least value, such as median strips, road verges, landscaped areas, or steep hillside slopes.

The use of drip irrigation within the "A" soil horizon maximises the potential for evapo-transpiration in addition to ground soakage. The growth of the plants in the area will be promoted with the application of water and nutrients. The application of the treated effluent directly into the biologically active topsoil layer ensures that

complete treatment of the effluent occurs. The effluent from the treatment plant is collected and buffered in a treated effluent tank and then pumped to the dispersal area under timer control.
The effluent is dispersed in a series of irrigation lines laid above the ground throughout the dispersal area installed on a 1m x 0.5m grid. TNL valves and air release valves must be installed at appropriate points in the system.

A manual flushing valve is fitted to the end of each drip line. The end of each line should be marked with either stakes or valve boxes for easy location during maintenance. The disposal system will be sectored so that reliable, low-power turbine pumps can be utilised to pressurise the disposal network and utilisation of sector areas will be rotated.

Final polishing of the effluent and natural nutrient removal occurs as the effluent is utilised by plants or soaks in to the ground. It is proposed to discharge highly treated effluent to a multi-sector land application system comprising pressure compensating drip irrigation lines – laid on the surface, spaced at approximately 1 metre centres. Utilising 2.0 litres/m²/day (2.0 mm/day) application rate an area of 4.5829 Ha is required for land treatment.

The advantages of the irrigation system are:

- Low areal loading rates to minimise the potential for ground saturation.
- Sectored distribution and small frequent even distribution.
- Evapo-transpiration is maximised.
- Final renovation through the soil is maximised by use of large areas for better assimilation by soil, bacteria and vegetation.
- Ideally suited over uneven terrain.
- It is cost effective, reliable and very low maintenance.

7.1 Electric Actuator Valves

Distribution to the land application system for each sector will be achieved through Electric Actuator Ball Valves. These valves are useful for distributing effluent to multiple zones. Digitalization makes these valves easier to identify the valve positions, control system status and access data allowing better system monitoring. Additionally, a reduction in long term operation and maintenance costs is realised due to a reduced size and/or number of pumps.

The valve mechanism has two main components: the ball valve itself and the electric actuator that controls it. The valve has an electric motor to rotate a perforated ball within the valve body, which either aligns the hole with the pipeline in open position to allow flow or rotates the ball 90 degrees to block the flow closed position. The electric actuator automates this process by converting electrical energy into the necessary rotational mechanical energy. The electric actuator receives electrical signals from the control panel to open or close the valve.

To protect the valves, these valves will be installed in the discharge line to the land application inside the closed control shed.

7.2 Header Pipe

Treated effluent pumped from the treatment plant will convey to the land application system via a 63 mm OD MDPE pipe. The pipe proposed will be rated to a maximum operating pressure of 9.0 bar.

Figure 12- Example of Surface laid header pipe and drip lines. Tapping Barb (Upper insert) and Tube Non-Leakage Valve (Lower insert)

7.3 Tube Non-Leakage Valves

Tube Non-Leakage Valves (TNL) will be installed at the beginning of each drip line lateral. These in-line valves have a self-locking mechanism to prevent the upper drip lines and manifold pipes from draining into the lower lines when the pump stops, and pressure drops.

- Closing Pressure - 0.4 bar
- Operating Pressure - 1.0 bar
- Check Valve - 0.3 bar

7.4 Pressure Compensating Drip Line

Netafim pressure compensating drip irrigation lines will be used to evenly distribute effluent over the entire land application area. The drip line proposed is Netafim Bioline with a drip emitter every 500 mm designed to consistently discharge 1.6 litres per hour. These emitters are pressure compensating up to 35 m, which means the entire sector must be pressurised before any discharge and when discharge occurs, all emitters discharge together.


Figure 13- Examples of Installation of surface laid drip irrigation fields

7.5 Manual Flushing Valves and Boxes

Flushing taps will be fitted to the terminal ends of all laterals and marked with a durable valve box. The taps are used to manually flush any build-up inside the pipe on an annual basis in accordance with the manufacturer's instructions.

8.0 OPERATION AND MAINTENANCE

Maintenance of key components shall be carried out every three months. It is proposed to engage S3 Limited, a wholly owned subsidiary of Innoflow Technologies Limited, to carry out the required maintenance. Emergency call outs carried out shall be handled by S3. Sample collection, packaging, and submission to the laboratory shall be carried out by the local environmental sampling agency, if required. It is expected that grounds maintenance shall be carried out by others. Below is a table showing the required checks at each service.

Table 14- Operations and Maintenance Tasks

Component	Maintenance Frequency
On-lot pumped septic tanks (Prelos tanks)	
Inspect tank levels and integrity	1 x per 1.5-2 years
Inspect and Clean Tank Biotube Vault & clean if required (Septic Tanks)	1 x per 1.5-2 years
Measure and Log Biomass/Grease Level in Septic Tank	1 x per 1.5-2 years
Recommend Removal Accumulated Biomass/Grease	1 x per 1.5-2 years
Visually inspect operation of odour control	1 x per 1.5-2 years
Recirculation tank & AdvanTex recirculating textile packed bed reactor	
Inspect flow pattern of pod spray nozzles	1 x per 3 months
Inspect integrity of pod lids/lid hardware	1 x per 3 months

Flush pod distribution laterals	1 x per 3 months
Complete sludge/scum testing of each tank	1 x per 3 months
Check operation & clean all pumps	1 x per 3 months
Clean & check operation of all control floats	1 x per 3 months
Check operation of fan & ventilation systems (vents etc.)	1 x per 3 months
Check splitter valve operation	1 x per 3 months
Verify timer operation settings (advise from Innoflow engineer)	1 x per 3 months
Check outlet pipe work to downstream components	1 x per 3 months
Treated effluent tank & water meter	
Inspect tank levels and integrity including access risers etc.	1 x per 3 months
Inspect and clean treated effluent tank floats and alarms	1 x per 3 months
Inspect and clean treated effluent tank pump	1 x per 3 months
Measure and log biomass level in treated effluent tank	1 x per 3 months
Ensure water meter operation, ensure pulse signals to TCOM panel	1 x per 3 months
Ensure water meter operation, ensure pulse signals to TCOM panel	
Check enclosure integrity & for any moisture	1 x per 3 months
Visually check all electrical components for signs of fatigue or failure (burning/melting etc)	1 x per 3 months
Ensure communications	1 x per 3 months
Land Application system	
Inspect, clean & assure operation of sequencing valves	1 x per 6 months
Flush distribution laterals	Annually
Assess wastewater irrigation fields for any obvious leaks	Annually
Reporting	
Forward maintenance inspection summary to client	1 x per 3 months

9.0 COMPONENT LIFE EXPECTANCY

Table 15- Component Life Expectancy

Recirculating packed bed reactor textile filters	>50 years
Recirculating packed bed reactor pod	>50 years
Concrete tanks	>50 years
Recirculating packed bed reactor pod lids	>35 years
Recirculation tank splitter valve	>25 years
Orenco systems inc. STEP Tank pumps	>25 years
Control panel mother board	>25 years
Biotube effluent filter	>25 years
Recirculating packed bed reactor pod lid struts	>20 years
Pvc and pe pipework and fittings	>20 years
Pump discharge assemblies	>20 years
Pulse water meters	>20 years

Control panel	>20 years
Orenco systems inc. Treated effluent pumps	>15 years
General electrical components	>15 years
Pvc access riser and fibreglass lids	>10 years
Orenco systems inc. Recirculation pumps	>10 years
Float switches	>10 years
Active carbon fan vents	> 5 years