Technical Memorandum

To:	Byron Shire Council (c/o Planners North)
From:	Jesse Munro
Date:	9th February 2021
Pg/Attach.:	4 + attachments
Job ref:	1-16804_07c_BHCF_2020

AWC

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BHCF Pty Ltd - Proposed Mixed Use Development DA – Sewage Management

Consent is sought for a Mixed-Use Development of the Linnaeus property (Lot 1 DP 1031848, 951 Broken Head Road, Broken Head) permitting certain existing facilities to continue to be used for Private Education; allowing the remaining facilities to also be used for Eco Tourism and providing additional new facilities for Eco Tourism purposes.

The Linnaeus Estate property has a history of residential accommodation and well designed and managed ancillary potable water and sewage management systems. It is proposed to upgrade the existing on-site communal sewage treatment plant (STP) to adequately treat the predicted sewage loads for the proposed development. The approved and partially existing land application area has been deemed sufficient to adequately dispose of the treated wastewater volumes which will be generated.

Proposed Development

The private education residences (#2 and #34) and the private education accommodation (#12-16) located within the 7(f1) zone and unbuilt #18 will continue with a private education use. Approved, but not built private education accommodation (#19-23 and #28-33) will not be constructed. Approval is sought to also utilise the remaining existing built private education accommodation units (#3-11 and 17) and the existing built centre accommodation units (#24-27) for Eco Tourism purposes.

Further, one new rainforest retreat (C building); four new tree house cabins (B buildings); 22 new beach cabins (A buildings) and one new tree house retreat building are proposed to be constructed and used for Eco Tourism accommodation.

Australian Wetlands Consulting Pty Ltd
ABN 81 140 533 919

Full details in relation to the architecture of the proposed development is provided in the DA Plan Set Drawings (Harley Graham Architects, 2020). An excerpt of the Plan Set is attached for convenience (Sheet No. DA 02, Revision 04, 17/09/2020).

In support of the Eco Tourism accommodation, consent is sought to erect two fire refuge buildings and construct a depot and parking precinct. Ancillary to the Mixed Use generally, buildings proposed include poolside facilities, a shed in the vegetable growing area and minor alterations to the existing centre.

Predicted Effluent Load

The predicted daily sewage generation of the total development has been calculated and provided in the GEOLink (2021) document *Water Supply & Wastewater Assessment – Proposed Mixed Use Development at Linnaeus Estate* (submitted as part of the DA).

The peak generation volume is **22,602L/day**. It must be noted that this is peak loading, based on full occupancy. 100% occupancy will be a rare occurrence and as such this volume is conservative in terms of sewage treatment and disposal capacity.

Upgrade STP

The existing sewage treatment plant (STP) has a true capacity to treat, to a tertiary level, 15KL of sewage per day (Aerofloat, 2018). As such the STP requires an upgrade to accommodate the 22,602L/day expected sewage generation from the proposed development.

Aerofloat have prepared a detailed design to upgrade the STP incorporating improved treatment technologies. The proposed upgrade will add to the existing STP infrastructure to provide an increased volumetric capacity from 6KL/day (15KL/day true capacity) to 30KL/day with the final effluent quality being retained. The proposed additional components include:

- Relocated screen to remove solids from the raw sewage pumped from the dwellings; discharges via gravity to the new MBBR
- A new 3KL capacity Moving Bed Biofilm Reactor (MBBR) which includes removable air lances, hydrostatic level transmitter, DO sensor, bio media and screened overflow
- The proposed Intermittent Aeration Tank (IAT) utilises the existing concrete tank and is fitted with an aerator, decant system and an ultrasonic level sensor
- All required pipework, sensors and controls
- A process flow diagram is provided on page 19 of the Aerofloat report (refer Attachment 2)

The Aerofloat STP upgrade design provides which higher level detail on the proposed upgrade components is attached along with a diagram (AWC, 2020) showing existing and proposed components.

The expected effluent quality from the upgraded STP will be in accordance with Table 1.

Table 1 Treated effluent quality from upgraded STP (Source: Aerofloat, 2018)

Parameter	Value (90th Percentile)
pH	6.5-8.0
Suspended Solids (mg/L)	<30
BOD5 (mg/L)	<20
Total Nitrogen (mg/L)	<10
Total Phosphorus (mg/L)	<1
Faecal Coliforms (CFU/100mL)	<30

Disposal

As the property does not have access to a reticulated municipal sewage treatment system an on-site disposal system has been designed, partially constructed, and used. The existing portion of the irrigation area has been used since 2002 within ongoing management and maintenance provided by ThinkWater.

The system utilises land application with a subsurface irrigation system. There are two irrigation blocks located on forested valley slopes totalling 3.446 hectares; Stage 1 has been installed and totals 1.458 ha, and Stage 2 is yet to be installed with an area of 2.008ha. Attached is the irrigation design and system philosophy prepared by ThinkWater (2020).

AWC previously undertook an assessment to determine the land capability of the proposed total irrigation area in terms of land application of treated effluent. The assessment showed that the 3.446 hectares of irrigation area has a capability of accepting a loading of 51,750L/day with an application rate of ~1.5mm/day dependant on various management and weather factors. The land capability assessment report (AWC, 2017) is attached.

Summary and Conclusion

The proposed development will have a sustainable sewage management system installed comprising an upgrade to the existing STP, and finalisation of the existing approved irrigation area for disposal. Attached are detailed design documents for both the STP upgrade and irrigation area, along with a study report determining the capacity of the existing irrigation field to accept treated wastewater.

Attachments

1. Excerpt DA Plan Set Drawings (Harley Graham Architects, 2020) - Sheet No. DA 02, Revision 04, 17/09/2020
2. AWC (2017) Linnaeus Estate – Land Capability Report – Treated Wastewater Disposal (1-16804_04_b, 02/11/2017)
3. Aerofloat (2018) *Process Mechanical and Electrical Design Sewage Treatment Plant Upgrade* (July 2018)
4. AWC (2020) Linnaeus STP Upgrade – Existing and Proposed STP Components (Revision B 19/10/2020)
5. ThinkWater (2020) *Treated Wastewater Disposal System*
    - Sheet 1304-01 *Land Application Area Overview* (Issue B, 21.7.20)
    - Sheet 1304-02 *Effluent Disposal Pump and Filtration Process Diagram* (Issue B, 21.7.20)
    - BHCF Pty Ltd – On Site Reclaim Water Dispersal - Sub Surface Drip Irrigation System. System Philosophy (21st July 2020)

BUILDING CLASSIFICATION LIST

DA Buildings - Existing

N#	Name	Area	Proposed Occupancy	Category	I.D
2	Hill House	220	4.5	Residence	Existing
3	Accomodation (Hill)	184	3.5	Accommodation Type A	Existing
4	Accommodation	184	3.5	Accommodation Type A	Existing
5	Accommodation	184	3.5	Accommodation Type A	Existing
6	Accommodation	184	3.5	Accommodation Type A	Existing
7	Accommodation	184	3.5	Accommodation Type A	Existing
8	Accommodation	184	3.5	Accommodation Type A	Existing
9	Accommodation	184	3.5	Accommodation Type A	Existing
10	Accommodation	184	3.5	Accommodation Type A	Existing
11	Accommodation	184	3.5	Accommodation Type A	Existing
12	Accommodation	184	3.5	Accommodation Type A	Existing
13	Accommodation	184	3.5	Accommodation Type A	Existing
14	Accommodation	184	3.5	Accommodation Type A	Existing
15	Accommodation	184	3.5	Accommodation Type A	Existing
16	Accommodation	184	3.5	Accommodation Type A	Existing
17	Accommodation	184	3.5	Accommodation Type A	Existing
24	Centre Accom	55	2	Accommodation Type B	Existing
25	Centre Accom	55	2	Accommodation Type B	Existing
26	Centre Accom	55	2	Accommodation Type B	Existing
27	Centre Accom	55	2	Accommodation Type B	Existing
CB.1	Centre	368	-	Community Building	Existing
CB.4	Pool	65	-	Community Building	Existing
CB.8	Crab	60	-	Community Building	Existing
CB.9	Interpretive Centre	150	-	Community Building	Existing
		3,843 m²	65		

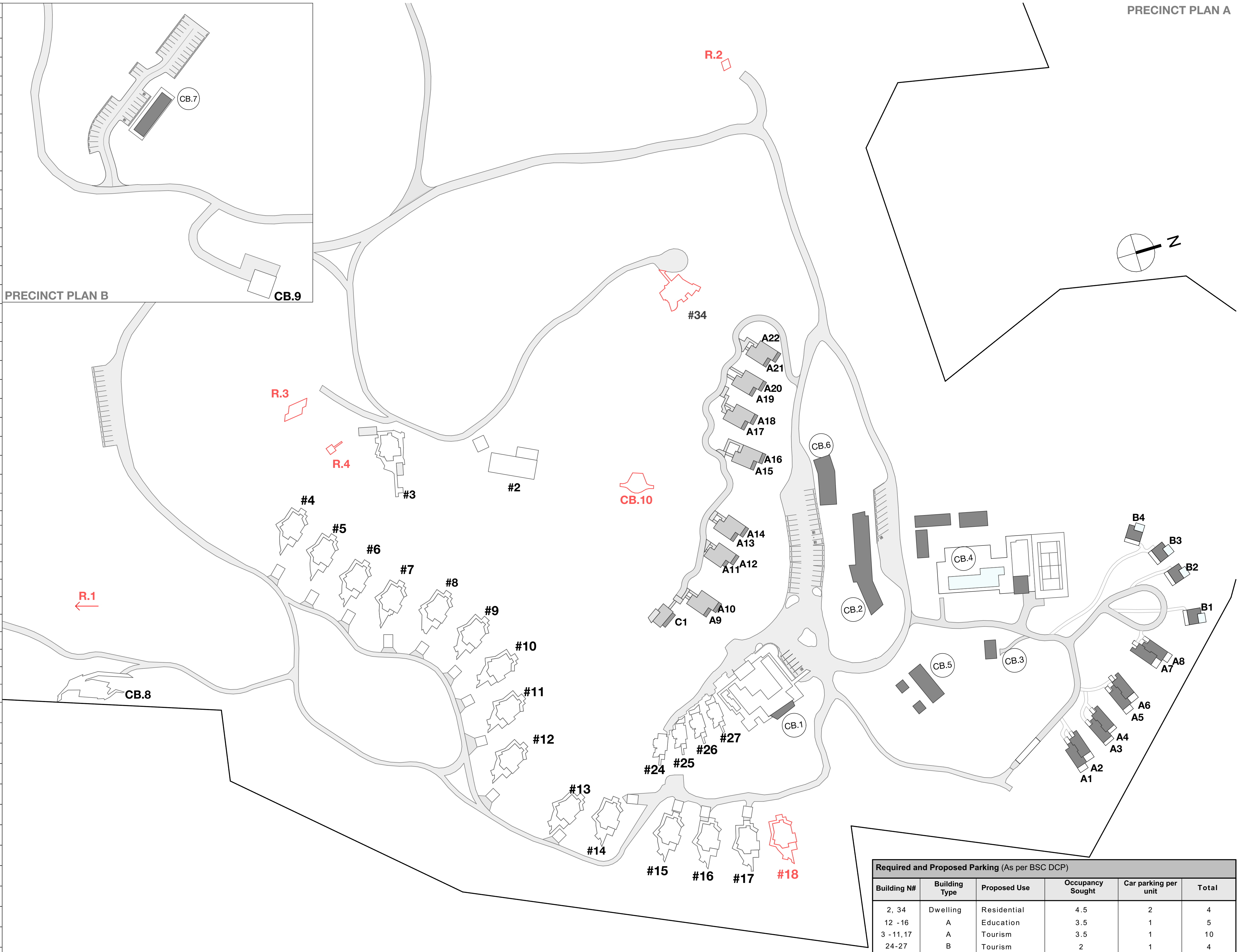
DA Buildings - Approved/Unbuilt

N#	Name	Area	Proposed Occupancy	Category	I.D
1.1	Refuse Building	36	-	Community Building	Approved/Unbuilt
18	Accommodation	184	3.5	Accommodation Type A	Approved/Unbuilt
34	Hill House	205	4.5	Residence	Approved/Unbuilt
CB.10	Underground Chapel	41	-	Community Building	Approved/Unbuilt
R.1	Retreat A	39	-	Retreats	Approved/Unbuilt
R.2	Retreat B	32	-	Retreats	Approved/Unbuilt
R.3	Retreat C	68	-	Retreats	Approved/Unbuilt
R.4	Retreat D	9	-	Retreats	Approved/Unbuilt
	TOTAL	614 m²	8		

DA Buildings - Proposed

N#	Name	Area	Occupancy	Category	I.D
A	Cabin (9-22)	630	28	Cabin Type A	Proposed
A	Cabin (1-8)	360	16	Cabin Type A	Proposed
B	Rainforest Retreat (1-4)	176	8	Cabin Type B	Proposed
C	Treehouse Retreat	55	2	Cabin Type C	Proposed
CB.1	Centre Additions	41	-	Community Building	Proposed
CB.2	Refuge Building 1	370	-	Community Building	Proposed
CB.3	Refuge Building 2	50	-	Community Building	Proposed
CB.4	Food Offering (Pool)	64	-	Community Building	Proposed
CB.4	Wellness Facilities	313	-	Community Building	Proposed
CB.5	Shed	186	-	Community Building	Proposed
CB.6	Bin + Store Building	135	-	Community Building	Proposed
CB.7	Depot Building	164	-	Community Building	Proposed
	TOTAL	2,544 m²	54		
	Unallocated		21.5		

PROPOSED OCCUPANCY 148.5



LEGEND

- Existing Buildings
- Approved + Unbuilt buildings.
- Proposed New Buildings

Required and Proposed Parking (As per BSC DCP)					
Building N#	Building Type	Proposed Use	Occupancy Sought	Car parking per unit	Total
2, 34	Dwelling	Residential	4.5	2	4
12 -16	A	Education	3.5	1	5
3 -11,17	A	Tourism	3.5	1	10
24-27	B	Tourism	2	1	4
A1-A8	Cabin A	Tourism	2	1	8
A9 - A22	Cabin A	Tourism	2	1	14
B1-B4	Cabin B	Tourism	2	1	4
C1	Cabin C	Tourism	2	1	1
-	-	Staff	75	0.5	38
-	-	On-Site Manager	1	1	1
-	-	Visitors	-	-	10
Total Carparks Required					99

HARLEY GRAHAM ARCHITECTS

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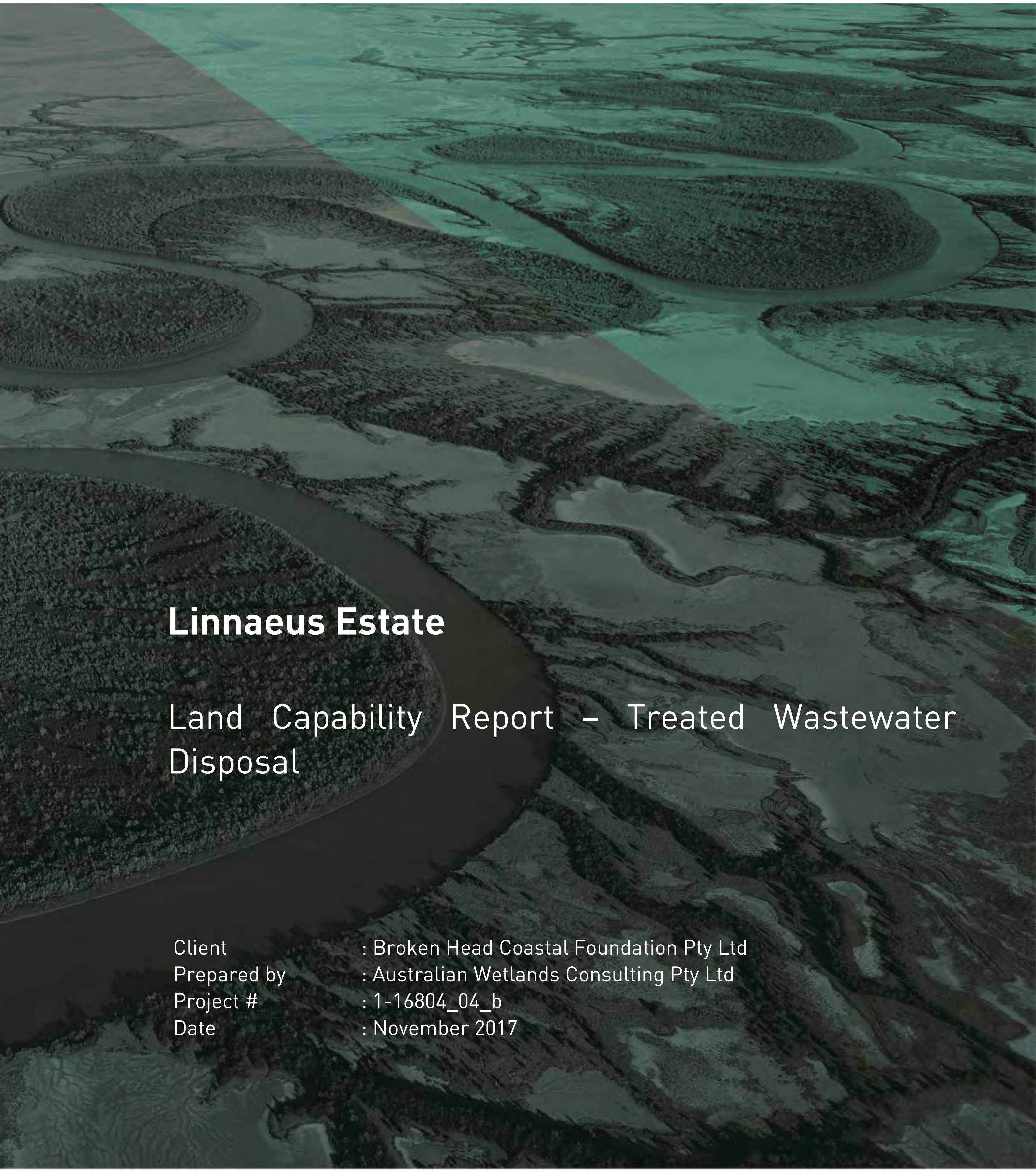
- All building works to be carried out in accordance with the Building Code of Australia (BCA) and to the satisfaction of the principle certifying authority.
- Builders/Contractors are to verify all dimensions prior to commencement of site work or off-site fabrication.
- Figured dimensions take precedence - do not scale.

REV	ISSUE NAME	DATE
01	DEVELOPMENT APPLICATION	24/3/20
02	REVISED DA	2/6/20
03	REVISED DA	24/7/20
04	REVISED DA - AS PER RFS RESPONSE	17/9/20

CLIENT: Linnaeus Property Trust
ADDRESS: 951 BROKEN HEAD RD
REVISION: DA
SCALE: 1:2000
JOB NAME: HGA 206 - ECO TOURISM
LOT + DP: LOT 1 DP 1031848
PAPER: A3
SHEET N#: DA 02
DRAWING: **Precinct Plan A + B + (Existing + Proposed)**
DRAWN: H.P
CHECKED: H.G
DATE: 17/9/20



Linnaeus Estate

Land Capability Report – Treated Wastewater Disposal

Client : Broken Head Coastal Foundation Pty Ltd
Prepared by : Australian Wetlands Consulting Pty Ltd
Project # : 1-16804_04_b
Date : November 2017

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Linnaeus Estate

Land Capability Report – Treated Wastewater Disposal

Project control

Project name: **Linnaeus Estate**

Land Capability Report – Treated Wastewater Disposal

Job number: 1-16804_04_b
Client: BHCF Pty Limited
Contact: Stan Ruch

Prepared by: Australian Wetlands Consulting Pty Ltd

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Date:	Revision:	Prepared by:	Reviewed by:	Distributed to:
30/10/2017	A	Jesse Munro	Damian McCann	Stan Ruch
02/11/2017	B	Jesse Munro	minor amendments	Stan Ruch

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List of Tables

1 Introduction and Background

AWC has been engaged by the BHCF Pty Ltd (Broken Head Coastal Foundation) to prepare a land capability assessment for the Linnaeus Estate site. The property assessed is Lot 1, DP 1031848, No. 951 Broken Head Road, Broken Head NSW 2481.

1.1 Aims and Objectives

The aim of this assessment is to determine the capability of the existing and approved irrigation areas to accept treated wastewater as the means of disposal. A total daily volume will be nominated which will be converted to an equivalent number of people predicted to produce that daily volume.

1.2 Existing Approvals

Byron Shire Council issued a Section 68 Approval to Install On-Site Sewage Management Systems No.98/0146#220575 and *Renewal of Approval to Operate an On-site A Sewage Management System /*dated 17 February 2014 (Approval No. 70.2006.1039.1).

A separate Section 68 Approval to upgrade the System was approved */*dated 8 January 2007 (Approval No. 70.2006.1039.1).

1.3 Preliminary Discussions with Byron Shire Council

Preliminary discussions regarding the capability of the existing disposal field were undertaken with Byron Shire Council Environmental Officer, Emma Holt. The use of the Byron Shire Council OSMS Model for this application was approved in principle. This report provides detail and justification of the inputs and results of the model as discussed and determined during the preliminary discussions.

2 Land Capability Assessment

This section details the existing irrigation system in order to provide some context to the land capability assessment and information with regard the use of the Byron Shire Council OSMS model.

2.1 Existing Disposal Field

The existing wastewater disposal irrigation field has been designed by Rothwells Pump and Irrigation (now ThinkWater Alstonville) (refer to plan in Appendix C) and approved by BSC. The irrigation area comprises two opposing internal slopes of a minor valley, located upslope of the existing sewage treatment plant. Appendix C holds wo plans showing general location and layout of the existing disposal field. Only one side of the irrigation field has been constructed, it is expected that the remaining irrigation field is to be constructed in accordance with the approved plans prior to any increase in hydraulic loading. Photo 1 and Photo 2 show examples of the existing irrigation system.

Photo 1 Irrigation infrastructure, PVC pipework manifolds and delivery lines, valves, pressure gauge, vacuum release valve and signage

Photo 2 pressure compensating irrigation lines on surface in some locations where root damage would occur if subsurface

2.1.1 Size

The surface area of the existing disposal field totals 3.446 hectares (34,460m²) comprising a block of 1.458 hectares and another block of 2.008 hectares.

2.1.2 Slope

The irrigation area is located on the internal opposing slopes of a minor valley. The slopes are generally of 20-30%. Established low forest vegetation covers the majority of the irrigation field. Photo 3 shows an example of the slope and vegetation of the irrigation area.

Photo 3 example slope and vegetation cover of the existing irrigation field

2.1.3 Soils

The soils of the site have been reviewed and assessed in order to inform the capability assessment. Review of the Morand (1994) document and a ground truth soil investigation has been carried out. Additionally, an extensive investigation of the existing irrigation area was undertaken by Simmonds & Bristow in 2004.

2.1.3.1 Morand

Review of Soil Landscapes of the Lismore-Ballina 1:100 000 Sheet (Morand, 1994) shows the site of the existing disposal area is located on the Billinudgel (bi) Erosional Landscape. A summary of the information provided by Morand (1994) is provided below.

Landscape: *Low rolling hills of the Neranleigh-Fernvale Group. Relief is 50-100m, slopes 10-20% and locally >33%. Slopes are generally moderately long (100-300m). Ridges and crests are narrow (100-150m). Partly cleared open Eucalypt forest. Littoral closed-forest at Brunswick and Broken Heads.*

Soils: *Shallow to moderately deep (100cm), moderately well drained Yellow Podzolic Soils and Yellow Podzolic Soil/Soloth intergrades on crests and slopes. Deep (>100cm), moderately well drained Yellow Podzolic Soils and Red Podzolic Soil/Red Earths on siltstone.*

Limitations: *Hardsetting, shallow, stony, and erodible soils of low fertility. Steep slopes and localised mass movement.*

Geology: *Neranleigh Fernvale Group. Thinly bedded fissile shales, siltstones and sandstones with occasional more massive units such as greywacke, volcanic tuffs, agglomerates, sandstones and massive cobble conglomerates.*

2.1.3.2 Previous Soil testing by Simmonds & Bristow

As part of previous investigations Simmonds & Bristow (2004) undertook extensive soil testing and analysis of the soils in the existing disposal field. Twenty three (23) boreholes were made and analysed for soil horizon depth, soil texture and Constant Head Permeability testing undertaken in accordance with AS4419. Bore logs from the assessment are provided in Appendix A; Table 2-1 provides a summary of the borelogs.

Generally, the topsoils are around 150mm deep and of sandy clay loam texture. Permeability rates of the topsoils range from 0.9-24cm/hr which translates to 2160-5760mm/day.

Subsoil depths vary substantially from 0.05-1.2m depth, depending on the position on the slope, generally deeper at the base of the slope. Permeability of subsoils ranged from 0.1-30cm/hr which equates to 240-7200mm/day. These permeability rates are important to determine potential application rate and land capability.

Table 2-1 Summary of bore log information from the existing irrigation area (Source Simmonds & Bristow, 2004)

	Depth#	Constant Head Permeability#	Description#
Topsoil	0 – 0.25m	0.9 - 24cm/hr	generally grey or grey-brown sandy clay loam
Subsoil (1)	0.05 – 0.75m	0.1 – 20cm/hr	Orange/Yellow/grey brown clay loam, some with Saprolitic fragments
Subsoil (2)	0.05 – 1.2m	0.1 – 30cm/hr	Fragmented and collapsed Saprolite, primary lithic fabric evident in some locations
# - values shown are a range of values provided by Simmonds & Bristow (2004) Appendix A provides the full bore log record			

2.1.3.3 AWC Site investigation 2017

A single borehole was made on the site of the existing irrigation area on 26th April 2017 by Jesse Munro of AWC to confirm the soil characteristics described in Table 2.1. The borehole was made on the top of the slope at a location typical of the existing irrigation area. Soil character present aligns with the detail provided by both Morand (1994) and Simmonds & Bristow (2004) in that the soils are clay loam dominated with increasing clay content with depth. The clay is not massive; it is relatively friable with peds evident. Table 2-2 provides some detail from the borehole investigation.

Table 2-2 Borelog and photograph - AWC soil ground truth investigation

Depth (mm)	Texture/description	Photo
0-100	brown clay loam topsoil, high organic matter/leaf litter	
100-500	Gradual change from brown clay loam to yellow/orange light clay	
500-1000	yellow/orange clay, not massive, friable. No rock fragments evident	

2.2 Effluent quality

Effluent quality and the treatment capacity of the existing STP has not been assessed as part of this report. It is assumed that the STP will continue to treat the effluent to the standard stipulated in the 'approval to operate'. Table 2-1 provided the minimum effluent quality expected for the STP at the site. These targets have been tested and met through sampling and analysis since the STP was commissioned.

Table 2-3 Minimum effluent quality from STP in accordance with 'approval to operate'

Parameter	Value (90^{th}%ile)
pH	5.5-8.5
Suspended Solids (mg/L)	<30
BOD5 (mg/L)	<20
Total Nitrogen (mg/L)	<10
Total Phosphorus (mg/L)	<1
Faecal Coliforms (CFU/100mL)	<30

2.3 Predicted Effluent Volume

The existing approval to operate (including upgrades) and other approval documentation has limited the daily treatment of effluent to 16,800L/day from the development and is based on very conservative criteria and an unproven site. The purpose of this assessment is to show that the existing disposal field can accept substantially more. It should be noted the upper limit of 16,800L/day has not yet been reached as the staged development has not been fully constructed, and the upgrades to the OSMS not yet completed.

2.4 Constraints

The primary constraint of the existing irrigation area is the slope. Typically slopes greater than 15% are considered constrained; the slopes of the existing irrigation area are typically between 20-30%. This constraint has been overcome through a number of safeguards and conservative actions with regard the land capability assessment. These include:

- The sewage treatment plant can produce very highly treated wastewater (refer Section 2.2)
- The irrigation area has established forest vegetation that will absorb the vast majority of water and nutrients applied
- The development will rarely have 100% capacity, so although the site will be given an equivalent population capacity, that number will be the peak with occupancy generally lower
- In accordance with AS1547:2012, the slope constraint compels a 50% reduction in application rate, affecting a 100% increase in total irrigation area

2.5 Byron Shire Council OSMS Model

In order to assess the capability of the existing disposal field, and after discussion with Council Officers, the Byron OSMS Model was considered to be appropriate for use. The inputs to the model are discussed below. This model is designed for use on individual properties with individual effluent disposal fields.

Byron Shire Council has a proprietary model that was formulated to determine the size of land application areas for On-site Sewage Management Systems. This model uses specific localised climatic data to undertake long time-period water and nutrient balances and was used to assess the capacity of the existing disposal field. Table 2-4 sets out the inputs to the model, while Appendix B details the results of the BSC OSMS Model.

Because this model is designed for use on individual properties with individual effluent disposal fields, the model was run using 10% of the actual disposal to enable fast and more accurate model runs; results were then multiplied by 10.

The results of the model show that 103,500L/day can be adequately disposed of using the existing irrigation field. This is equivalent to the predicted wastewater loading from 690 people.

2.6 Reduction in DIR due to slope

As a conservative measure, and in recognition that the irrigation field has steep slopes the Design Irrigation Rate (DIR) is to be reduced. Table M2, *Recommended Reductions in DIR According to Slope,* within AS 1547:2012 *Onsite domestic wastewater management* recommends a 50% reduction in DIR for slopes of 20-30%. Essentially this reduces the potential hydraulic load and application rate to the irrigation area by half. **Therefore the land capability of the existing irrigation area is 51,750L/day (50% x 103, 500L/day) equivalent to 345 people.**

The daily volume of 51,710L over the area of the existing irrigation field (3.446 ha) equates to a daily application rate of 1.5mm.

2.7 AS1547:2012

A cross check with AS1547:2012 was made to ensure the capacity was correct. In accordance with *Table M1 Recommended design irrigation rate (DIR) for irrigation systems* of AS1547:2012, drip irrigation on light clays should be applied at 3mm/day. When the 50% loading is applied due to slope, it equals the application rate calculated and determined through using the BSC OSMS model (1.5mm/day).

2.8 Reserve Area

Due to the overall size of the allotment, there is ample opportunity to have a replicate reserve disposal area.

Table 2-4 Inputs to the BSC OSMS model and comments

Parameter	Model Input	Comment/Justification
The parameters detailed in the table cells below relate to the input cells in the current Byron OSMS Design Model, attached at Appendix A.		
Persons	69 **(690 when multiplied)**	resulting in total daily load of 10350L **(103,500L when multiplied)**
Buffer to permanent water/intermittent water	100m/40m	All applicable buffers can be achieved
Block size	50,000m² (5ha)	The total block is substantially larger, approximately 112ha, this was used as multiple assessments will take place. (50ha when multiplied)
Daily effluent flow according to type	150L/p.d	As per AS:1547 2012 for reticulated water supply. The actual daily usage is expected to be less as: • occupancy is typically substantially less than 100% • water supply is collected, treated and stored on site however the supply is reticulated within the development • water saving devices are standard fixtures
Treatment system	AWTS	This is default to simulate the high treatment of the proposed system.
N loss in treatment system (% reduction)	87%	Based on the 'approval to install an on-site wastewater management system' (BSC 2007) the effluent quality from the STP will be <10mg/L TN and <1mg/L TP (refer Section 2.2) which equates to an 87% reduction in TN. Calculation: Raw sewage = 4.2kg/y/person TN =0.011kg/p/day TN = 76.7mg/L Treated sewage = 10mg/L thus reduction value = **86.96%** ((76.7mg/l - 10mg/L)/76.6mg/L)
Phosphorus production per person per year	0.06kg/p/yr	This is reduced from 0.6kg/p/yr based on the effluent concentrations of <1mg/Kg (refer Section 2.2) Calculation: concentration of 1mg/L after treatment = 150mg/day/person (1mg/L * 150L) = 54,750mg/p/yr (150mg/d/p * 365days) = **0.055kg/yr/person** (rounded up to 0.6)

Parameter	Model Input	Comment/Justification
The parameters detailed in the table cells below relate to the input cells in the current Byron OSMS Design Model, attached at Appendix A.		
P soil sorption according to soil type	Duplex Soils (8,000kg/ha/m)	Based on soil maps (Morand, 1994) and soil borehole test, the site is located on the Billinudgel (bi) soil landscape
Soil texture & structure beneath system	Light clays – strongly structured (Ksat 0.12-0.5m/day)	Clay subsoils based on the soil borelog provided in the Simmonds & Bristow (2004) document and soil borehole test.
% Effective rainfall	Mounded bed	Irrigation area is on steep land
Soil Texture in root zone	Clay	Sandy clay loams in the topsoil based on the soil borelog provided in the Simmonds & Bristow (2004) document and soil borehole test
Water Table/Bedrock Depth	3.0m	water table >3.0m below ground surface
Land Application Type	SSI	SSI = Subsurface Irrigation Laterals at 2.0m separation
Percolation (mm/d)	4mm/day	BSC OSMS model default of 4mm/day. Already conservative value based on percolation testing by Simmonds & Bristow where the minimum percolation rate equalled 240mm/day for subsoil
Average depth of root zone	0.5m	The default in the OSMS model is 0.3m, however as the existing disposal area has established forest vegetation, a conservative root zone depth of 0.5m was used.

3 Conclusion

This land capability assessment focused on the existing approved irrigation area used for disposal of treated wastewater at the Linnaeus Estate site. The existing irrigation area of 3.446 hectares has the capacity to adequately dispose of **51,750L/day equivalent to 345 people.** This value depends on a number of factors:

- The existing Sewage Treatment Plant continues to produce a highly treated wastewater to the specifications determined in the BSC Approval to Operate (refer Section 2.2)
- Management of the irrigation disposal area, as stipulated in the BSC Approval to Operate, including monitoring, reporting and maintenance, continues
- The existing irrigation system is partially constructed, it is expected that the full irrigation system is to be constructed as per the approved plans prior to any substantial increase in occupancy

The BSC OSMS Model was used to determine the capacity of the irrigation field. The inputs to the model are considered conservative to ensure a sustainable capacity was determined:

- The occupancy will rarely be at 100%, therefore the daily loads will be less reducing the application rate and potentially increasing the treatment capacity of the STP
- Although the high level of treatment was factored into the model, the high level of treatment reduces potential impact to the receiving environment
- The irrigation area determined by the OSMS Model was doubled in recognition that the irrigation disposal system is on a site with slopes generally in the 20-30% range.

4 References

Simmonds & Bristow (2004) *Broken Head Coastal Foundation, Review of Effluent Irrigation Areas & Sewage Management Scheme*

Morand, D. T. (1994) *Soil Landscapes of the Lismore-Ballina 1:100 000 Sheet* Report, Soil Conservation Service of NSW, Sydney.

Australian Standard (AS/NZS) 1547:2012 *On-site domestic wastewater management*

Appendix A

Excerpt of Simmonds & Bristow (2004) *Broken Head Coastal Foundation, Review of Effluent Irrigation Areas & Sewage Management Scheme*

(Appendix B – Summary Pit logs from existing irrigation areas with Section 96 approval, locations as below.)

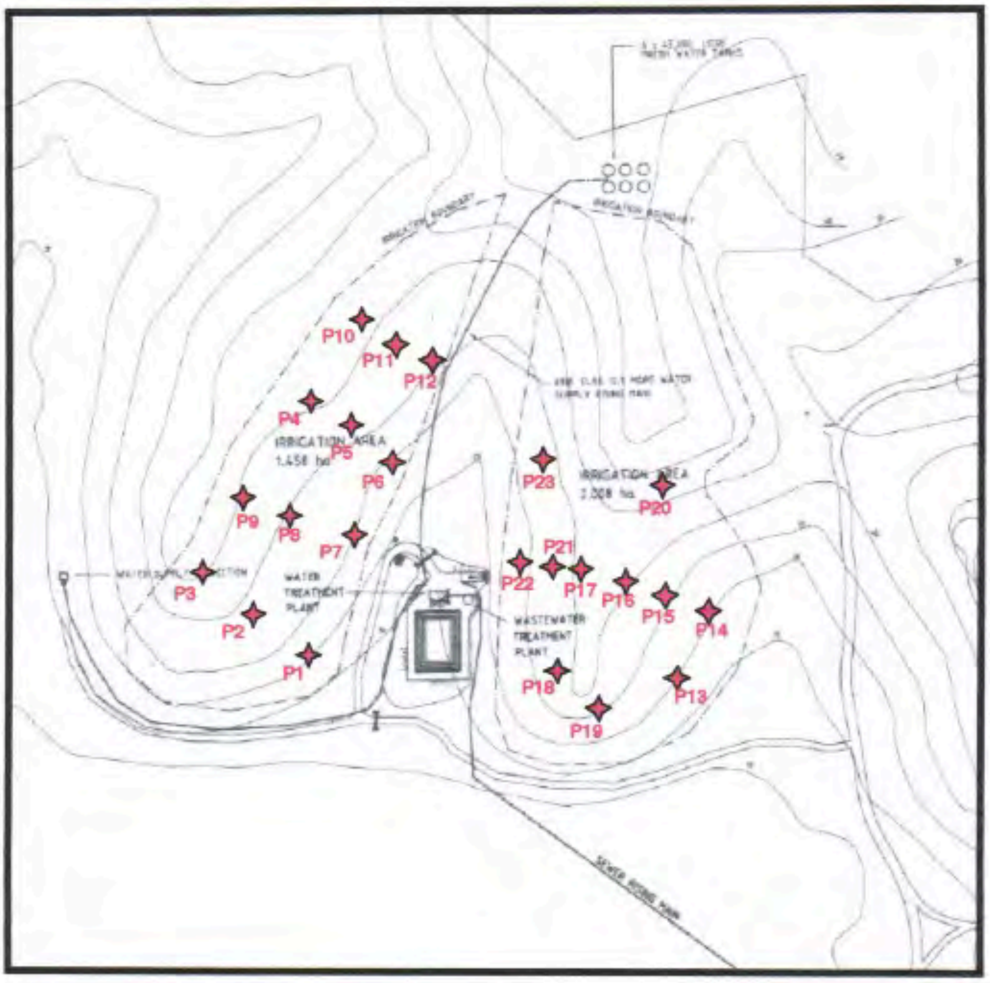
Broken Head Coastal Foundation

Review of Effluent Irrigation Areas

&

Sewage Management Scheme

APPENDIX B – SUMMARY PIT LOGS FROM EXISTING IRRIGATION AREAS WITH SECTION 96 APPROVAL, LOCATIONS AS BELOW.



Pit 1 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.15	21	Grey-brown clay loam topsoil. Minor stone line.
		0.15-0.35	4.2	Yellow brown clay loam subsoil with saprolitic fragments.
	0.5			Fragmented and collapsed saprolite. Saprolite fragments slightly indurated. Saprolitic metasediment basement (claystone/siltstone). Primary lithic fabric recognisable though completely polymorphed by clay minerals. Root penetration and fracturing strong to moderate.

Figure B: 1 - Graphic, Sampling and Descriptive Log for Pit 1 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 2 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.1	2.8	Grey-brown sandy clay loam top soil.
		0.1-0.35	0.2	Yellow brown sandy silty clay colluvial sub-soil, mixed saprolitic fragments, clays and quartz fragments from reworked veins in saprolite.
		N/S		
	0.5	0.5-0.6	0.5	
				Fragmented and collapsed saprolite. Saprolite fragments slightly indurated, root penetration and fracturing strong to moderate.

Figure B: 2 - Graphic, Sampling and Descriptive Log for Pit 2 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 3 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.1	1.8	Grey-brown sandy clay loam topsoil.
	0.5			Saprolitic metasediment basement (claystone/siltstone). Primary lithic fabric recognisable. Relatively fresh, close to saprock interface.

Figure B: 3 - Graphic, Sampling and Descriptive Log for Pit 3 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 4 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.1	4.5	Grey-brown clay loam topsoil.
		0.1-0.35	1.6	Yellow brown clay loam subsoil with saprolitic fragments.
	0.5			Fragmented and collapsed saprolite. Saprolite fragments slightly indurated.

Figure B: 4 - Graphic, Sampling and Descriptive Log for Pit 4 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 5 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.1	2.7	Grey-brown sandy clay loam topsoil.
		0.1-0.3	7.7	Yellow brown clay loam subsoil with saprolitic fragments.
	0.5	0.4-0.5	0.2	Fragmented and collapsed saprolite.

Figure B: 5 - Graphic, Sampling and Descriptive Log for Pit 5 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 6 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.05	5.7	Grey-brown sandy clay loam topsoil.
		0.05-0.35	10	Yellow brown clay loam subsoil with saprolitic fragments.
	0.5	0.35-0.5	0.2	Fragmented and collapsed saprolite.

Figure B: 6 - Graphic, Sampling and Descriptive Log for Pit 6 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 7 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
		0-0.2	11	Grey-brown sandy clay loam topsoil.
		0.2-0.4	11	Yellow brown clay loam subsoil with saprolitic fragments.
		0.4-0.6	0.3	Fragmented and collapsed saprolite.

Figure B: 7 - Graphic, Sampling and Descriptive Log for Pit 7 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 8 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
		0-0.16	4.8	Grey-brown sandy clay loam topsoil.
		0.16-0.35	0.8	Yellow brown clay loam subsoil with saprolitic fragments.
		0.35-0.55	1.5	Fragmented and collapsed saprolite.

Figure B: 8 - Graphic, Sampling and Descriptive Log for Pit 8 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 9 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
		0-0.1	2.9	Grey-brown sandy clay loam topsoil.
		0.1-0.3	2	Yellow brown clay loam subsoil with saprolitic fragments.
		0.3-0.45	0.9	Fragmented and collapsed saprolite.

Figure B: 9 - Graphic, Sampling and Descriptive Log for Pit 9 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 10 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.2	7.6	Grey-brown sandy clay loam topsoil.
	0.5			Saprolitic metasediment basement (claystone/siltstone). Primary lithic fabric recognisable. Relatively fresh, close to saprock interface.

Figure B: 10 - Graphic, Sampling and Descriptive Log for Pit 10 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 11 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.2	4.5	Grey-brown sandy clay loam topsoil.
		0.2-0.4	14.9	Yellow brown clay loam subsoil with saprolitic fragments.
	0.5	0.4-0.65	1.8	Fragmented and collapsed saprolite.

Figure B: 11 - Graphic, Sampling and Descriptive Log for Pit 11 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 12 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.1	16	Grey-brown sandy clay loam topsoil.
	0.5			Saprolitic metasediment basement (claystone/siltstone). Primary lithic fabric recognisable. Relatively fresh, close to saprock interface.

Figure B: 12 - Graphic, Sampling and Descriptive Log for Pit 12 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 13 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0, 0.5, 1.0, 1.5	0-0.2	1.8	Grey-brown sandy clay loam topsoil.
		0.2-0.75	20	Orange brown clay loam subsoil with saprolitic fragments.
		0.75-1.2	1.3	Fragmented and collapsed saprolite.
				Saprolitic metasediment basement (claystone/siltstone). Primary lithic fabric recognisable though completely polymorphed by clay minerals. Root penetration and fracturing strong to moderate.

Figure B: 13 - Graphic, Sampling and Descriptive Log for Pit 13 with AS4419 Constant Head Permeability results (C.H.Permeability).

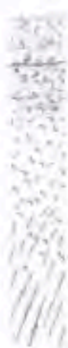
Pit 14 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0, 0.5, 1.0, 1.5	0-0.22	2.5	Grey sandy clay loam topsoil.
		0.22-0.43	11	Grey brown clay loam subsoil.
		0.43-1.2	0.2	Fragmented and collapsed saprolite.
				Saprolitic metasediment basement (claystone/siltstone). Primary lithic fabric recognisable though completely polymorphed by clay minerals. Root penetration and fracturing strong to moderate.

Figure B: 14 - Graphic, Sampling and Descriptive Log for Pit 14 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 15 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.2	4.4	Grey-brown sandy clay loam topsoil.
		0.2-0.42	0.1	Grey brown clay loam subsoil.
	0.5	0.42-0.8	0.1	Grey/orange/brown, fragmented and collapsed saprolite.
	1.0			Saprolitic metasediment basement (claystone/siltstone). Primary lithic fabric recognisable though completely polymorphed by clay minerals. Root penetration and fracturing strong to moderate.

Figure B: 15 - Graphic, Sampling and Descriptive Log for Pit 15 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 16 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.12	7.3	Grey sandy clay loam topsoil.
		0.12-0.42	4.8	Yellow/grey brown clay loam subsoil.
	0.5	0.42-1.0	0.2	Yellow brown, fragmented and collapsed saprolite.
	1.0			Saprolitic metasediment basement (claystone/siltstone). Primary lithic fabric recognisable though completely polymorphed by clay minerals. Root penetration and fracturing strong to moderate.

Figure B: 16 - Graphic, Sampling and Descriptive Log for Pit 16 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 17 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.1	3.5	Grey sandy clay loam topsoil.
		0.1-0.3	4.8	Yellow/grey brown clay loam subsoil.
	0.5	0.3-0.6	0.3	Yellow/grey/brown, fragmented and collapsed saprolite.
	1.0			Saprolitic metasediment basement (claystone/siltstone). Primary lithic fabric recognisable though completely polymorphed by clay minerals. Root penetration and fracturing strong to moderate.

Figure B: 17 - Graphic, Sampling and Descriptive Log for Pit 17 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 18 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.16	13	Stoney, grey-brown sandy clay loam topsoil.
		0.16-0.45	3.4	Yellow/brown/grey clay loam subsoil.
	0.5	0.45-0.8	0.2	Yellow/brown/grey, fragmented and collapsed saprolite.
	1.0			Saprolitic metasediment basement (claystone/siltstone). Primary lithic fabric recognisable though completely polymorphed by clay minerals. Root penetration and fracturing strong to moderate.

Figure B: 18 - Graphic, Sampling and Descriptive Log for Pit 18 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 19 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.05	2.6	Grey-brown sandy clay loam topsoil.
		0.05-0.3	0.6	Grey/orange/brown, fragmented and collapsed saprolite.
	0.5			
	1.0			Saprolitic metasediment basement (claystone/siltstone). Primary lithic fabric recognisable though completely polymorphed by clay minerals. Root penetration and fracturing strong to moderate.

Figure B : 19 - Graphic, Sampling and Descriptive Log for Pit 19 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 20 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.2	0.9	Grey sandy clay loam topsoil.
		0.2-0.4	0.2	Yellow/brown/grey clay loam subsoil.
	0.5	0.4-0.7	1.5	Yellow/brown fragmented and collapsed saprolite.
	1.0			Saprolitic metasediment basement (claystone/siltstone). Primary lithic fabric recognisable though completely polymorphed by clay minerals. Root penetration and fracturing strong to moderate.

Figure B : 20 - Graphic, Sampling and Descriptive Log for Pit 20 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 21 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.13	6.7	Grey sandy clay loam topsoil.
		0.13-0.43	4.9	Grey brown clay loam subsoil.
	0.5	0.43-0.8	17	Yellow/brown fragmented and collapsed saprolite.
	1.0			Saprolitic metasediment basement (claystone/siltstone). Primary lithic fabric recognisable though completely polymorphed by clay minerals. Root penetration and fracturing strong to moderate.

Figure B : 21 - Graphic, Sampling and Descriptive Log for Pit 21 with AS4419 Constant Head Permeability results (C.H.Permeability).

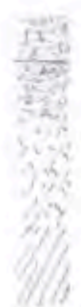
Pit 22 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.25	22	Grey sandy loam topsoil.
		0.25-0.5	9.8	Brown grey clay loam subsoil.
	0.5	0.5-0.8	1	Yellow/brown/grey, fragmented and collapsed saprolite.
	1.0			Saprolitic metasediment basement (claystone/siltstone). Primary lithic fabric recognisable though completely polymorphed by clay minerals. Root penetration and fracturing strong to moderate.

Figure B : 22 - Graphic, Sampling and Descriptive Log for Pit 22 with AS4419 Constant Head Permeability results (C.H.Permeability).

Pit 23 Graphic Log	Depth (m)	Samples	C.H. Permeability (cm/hr)	Descriptive Log
	0.0	0-0.12	24	Grey sandy clay loam topsoil.
		0.12-0.33	12	Grey brown clay loam subsoil.
	0.5	0.33-0.7	30	Yellow/brown, fragmented and collapsed saprolite.
	1.0			Saprolitic metasediment basement (claystone/siltstone). Primary lithic fabric recognisable though completely polymorphed by clay minerals. Root penetration and fracturing strong to moderate.

Figure B : 23 - Graphic, Sampling and Descriptive Log for Pit 23 with AS4419 Constant Head Permeability results (C.H.Permeability).

Appendix B

Byron Shire Council OSMS Model output

Byron OSMS Design Model *Version:* 1-16804_linneaus_existing_10%_LandCap_2.xls

Set Defaults

bedrooms
persons
STEP 1

STEP 2
persons (Grp 1) 69
persons (Grp 2) 0

STEP 3
Buffer to permanent water
Buffer to intermittant water

STEP 4
Block size (m2) 50000
100

STEP 5
Daily effluent flow accord. water supply type
Reticulated supply (bore,spring,creek) 180L/p.d
Reticulated + std. water saving devices 145L/p.d
Roof water harvesting 140L/p.d
Roof water harvesting + std. water sav. 115L/p.d

STEP 6
Grp1: ☑ Toilet, ☑ Bathroom, ☑ Laundry, ☑ Kitchen
Grp 2: ☐ Toilet, ☐ Bathroom, ☐ Laundry, ☐ Kitchen
Wastewater stream

Total Daily Flow (L/day) *	10350	Daily Effluent Flow per person (L/day)	150	% black to tot WW in a full system	32%
TN production per year (kg/year)	289.80	N prod. per capita (kg/person/yr)	4.20	% black to tot WW in a full system: TN	70%
TN reduced by all N loss (kg/year) *	30.14	N loss in treatment system (% reduction)	87%	N loss in disposal bed (% reduction)	20%
N Plant Uptake rate (kg/ha/year)	200				
Phosphorus in effluent (Ip) (kg/yr) *	3.80	P prod. per person per yr (kg/person/yr)	0.06	Proportion black to total wastewater in a full	40%

STEP 7
Treatment system
Septic (primary teatment only)
AWTS
Septic + single pass sandfilter (SPF)
Septic + SPF, 25% septic return flow
Septic + recirculating sandfilter
Septic + reedbed

STEP 8
P soil sorption accord. soil type
"Alluvial"Soils 1 (dp,mu,my,te) 10,000 kg/ha/m
"Alluvial"Soils 2 (cr) 2,000 kg/ha/m
Red Basaltic Soils (bg,ca,co,el,ew,mb,ro,wo) 10,000 kg/ha/m
Duplex Soils (ba, bi,bu,mi, ni) 8,000 kg/ha/m
Podzol Soils (ab,bo,br,eb,fh,ki,ku,og,po,ty,wy) 1,000 kg/ha/m

Nitrogen Report

P uptake by plants (Hp) (kg/ha/yr)	10	N plant uptake (kg/yr)	30.14
P soil sorption (Ps) (kg/ha/m depth)	8000	N load exceedence	0.00
Water Table/ Bedrock Depth (m) (STEP 10)	3.00	N load percolated (kg/yr)	0.00
Buffer to Water Table (Bwt) (m)	0.5	N released (perc+exceed.) (kg/yr)	0.00
Time for accumulation of P(years)	50	**Enviro.N limit (kg/yr)**	9.93
Final area (m^2)	**3388**	Nitrogen area (m^2)	1010
Phosphorus area (m^2)	93	Hydraulic area (m2)	3388
Water balance area (m^2)	3388		
☑ Specific Crop Coeff.(grass=1.00)	1.00		
% Effective Rainfall	65%		
Percolation (mm/d)	4		

Total N-load 30.14kg/yr

STEP 9
Soil texture & structure beneath system
Gravels,Sands Ksat >3.0m/d
Sandy loams - weakly structured Ksat >3.0m/d
Sandy loams - massive Ksat 1.4 - 3.0m/d
Loams - high/moderate structured Ksat 1.5 - 3.0m/d
Loams - weakly structured or massive Ksat 0.5 - 1.5m/d
Clay loams - high/mod structured Ksat 0.5 - 1.5m/d
Clay loams - weakly structured Ksat 0.12 - 0.5m/d
Clay loams - massive structured Ksat 0.06 - 0.12m/d
Light clays - strongly structured Ksat 0.12 - 0.5m/d
Light clays - moderately structured Ksat 0.06 - 0.12m/d
Light clays - weak. structured or massive Ksat <0.06m/d
Med. to heavy clays - strong. struct. Ksat 0.06-0.5m/d
Med. to heavy clays - mod. structured Ksat <0.06m/d
Med. to hvy clays - weak. struct. or massive Ksat<0.06m/d
DISPERSIVE soil (Modified Emerson Aggregate test)

STEP 11
% Effective Rainfall
Mounded bed
Level bed with grass

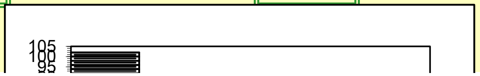
STEP 12
Soil texture in root zone
Coarse Sand
Fine sand, Sandy loams
Loams,Clay loams,Silt
Clay (light,med,heavy)

Avg depth of root zone (m)	0.50	Effective porosity of root zone	0.34	Avail.Water Capacity (AWC) of root zone	0.13
Avg depth bluemetal (etc) in trench below root zone (m)	0.00	Effective porosity of bluemetal in trench below root zone	0.00	Default AWC of bluemetal in trench below root zone	0.00
Soil Moisture Holding Capacity: saturation & AWC (mm)	170.00	65.00			
Permissible percentile exceedence	5.00%	SSI laterals pipe separation (m)	2.00		
Minimum effluent application (mm/day/m^2)	3.05				

Land Application Type
STEP 13
SSI
ETA

STEP 14
Calculate (or Cntl- q)

STEP 15
2.00



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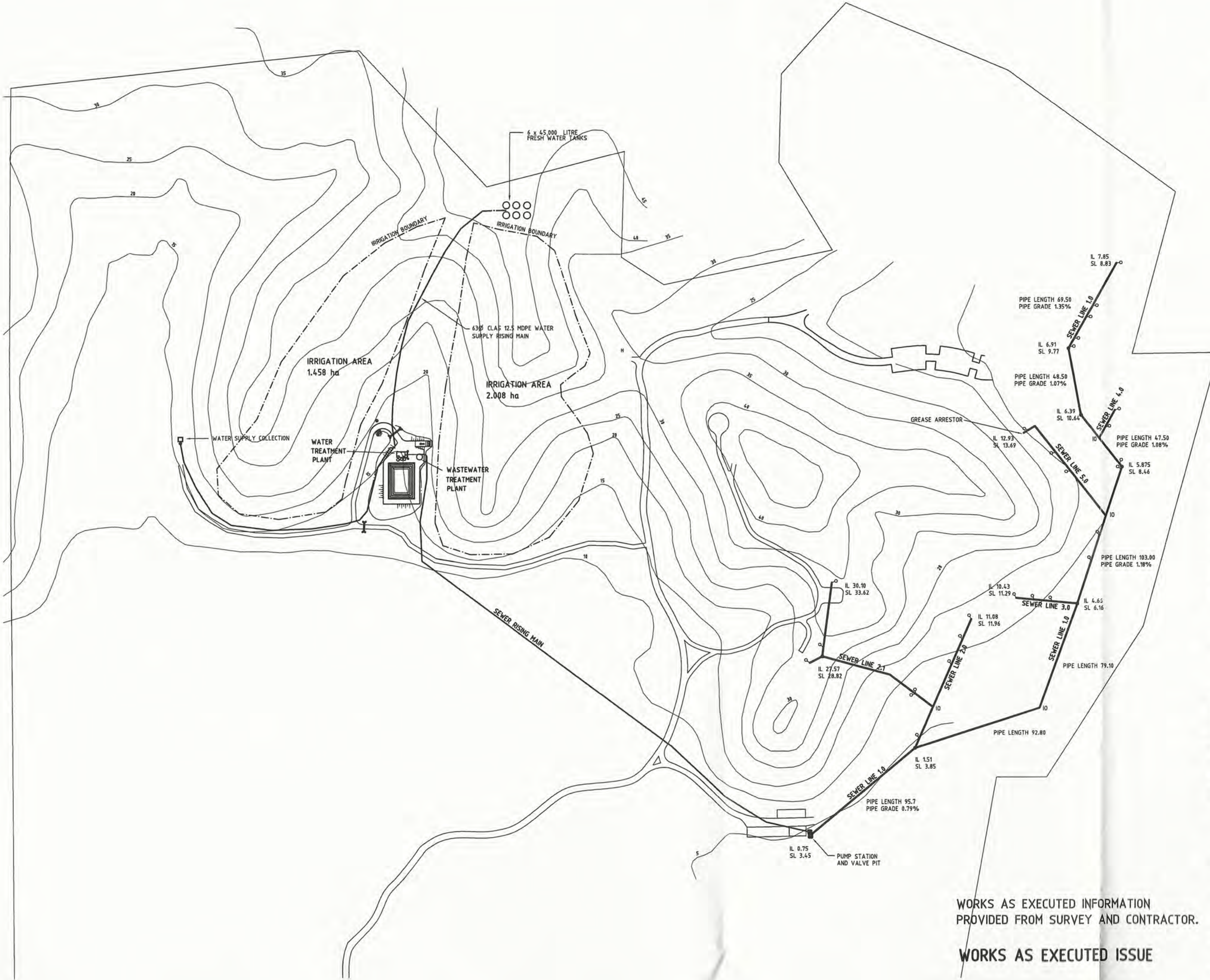
Appendix C

Plans of Existing Irrigation Area

GeoLINK (29/05/03) Site Layout Sewer Works as Executed (showing general location of existing disposal fields)

Rothwells Pump and Irrigation (26th April 2000) Effluent Disposal Area (showing detailed irrigation design and reserve disposal fields)



LEGEND

- EXISTING SURFACE CONTOUR
- GRAVITY SEWER LINE
- SEWER RISING MAIN 75Ø x PN12.5 MDPE
- SEWER CONNECTION (FUTURE BUILDING)

No	Description	Date	Initial
M	WAE - EFFLUENT IRRIGATION	29/05/03	TRE
L	LAYOUT - WAE CONTOURS	14/11/01	TRE
K	SITE SEWER AND WATER	31/10/01	TRE
J	SEWER	16/10/01	TRE
I	WAE - SEWER	17/09/01	TRE
H	SECTION 68 MODIFIED	24/08/01	TGR
G	SEWER LINE No 1 ALTERED	20/08/01	TGR
F	ENTRY ROADS - ADMIN	12/07/01	TRE
E	ENTRY ROADS - ADMIN	12/07/01	TRE
D	SEWER AND WATER LAYOUT	03/06/01	TRE
C	WTP, LAYOUT AMENDED	06/12/00	TRE
B	WTP AND DAM AMENDED	28/11/00	TRE
A	WTP, LAYOUT AMENDED	03/10/00	RTK

AMENDMENTS

Client

BROKEN HEAD COASTAL FOUNDATION PTY. LTD.

Project

BROKEN HEAD COASTAL FOUNDATION
951 BROKEN HEAD ROAD, BROKEN HEAD

GeoLINK
ENGINEERS
PLANNERS
LANDSCAPE ARCHITECTS

LEVEL 1, 64 BALLINA STREET, LENNOX HEAD, N.S.W. 2478.
telephone (02) 66877666 facsimile (02) 66877782
email: lennoxhd@geolink.net.au

Title

SITE LAYOUT
SEWER WORKS AS EXECUTED

Designed	Drawn	Checked
TRE	RTK	
Approved		Date

Scale: SCALE A 1:2500 (AT A3) 0 20m 40m 60m

Drawing No. 96/216/01 M Amend

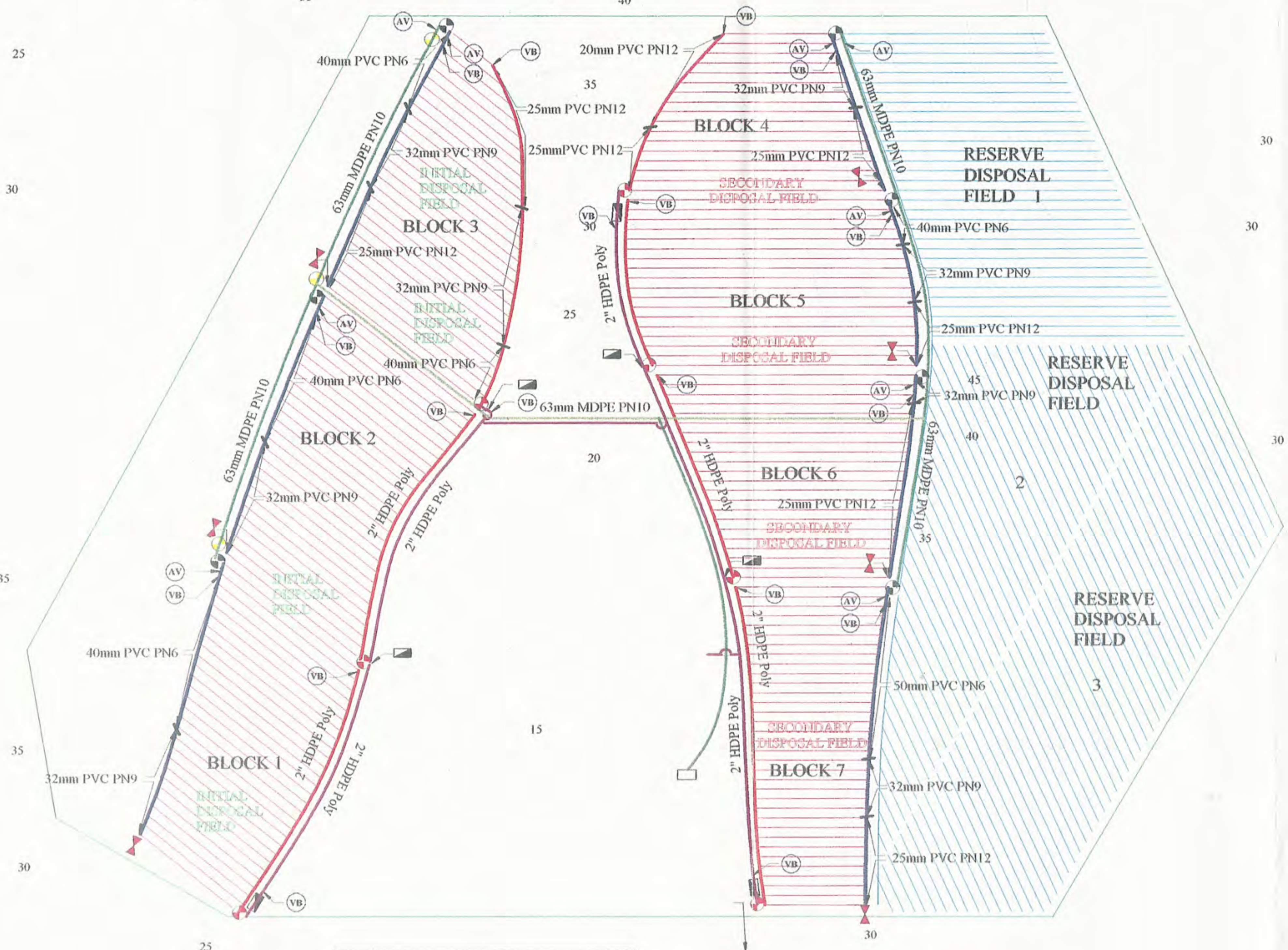
UPR No. 96216725

WORKS AS EXECUTED INFORMATION PROVIDED FROM SURVEY AND CONTRACTOR.

WORKS AS EXECUTED ISSUE

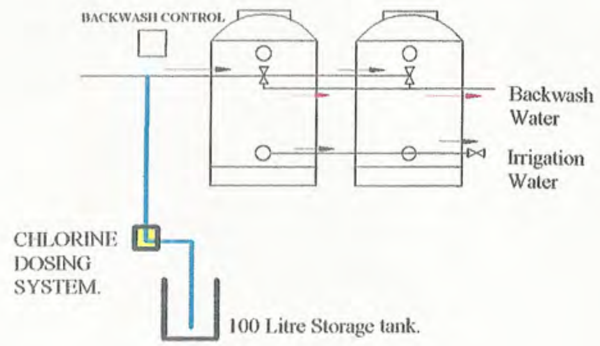
PROJECT :BROKEN HEAD COASTAL FOUNDATION.

EFFLUENT DISPOSAL AREA.

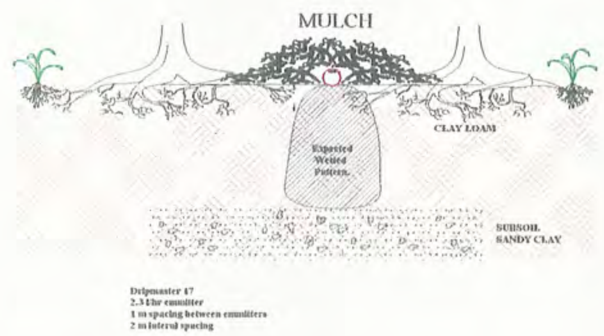


GRAVEL FILTER

Disc Filter installed after gravel filter 'Treflan' impregnated cartridge to be used. 130 micron .



Proposed Installation of Surface Lateral System.



AV AUTOMATIC AIR RELEASE VALVE

VB VACUUM BREAKER

NETAFIM DM17 DRIPLINE 2.3 l/hr @ 1.0 m SPACING.

SCOUR VALVE [Normally Closed]

ISOLATION VALVE [Normally Open]

Horizontal Checkvalve

Automatic Control Valve [Normally Closed]

Automatic Control Valve [Normally Open]

40 mm STD Filter. 130 micron

IRRIGATION DATA.

Max. Flow Rate : 0.63 l/sec [irrigation] Block 2.
: 4.08 l/sec [Flushing] Block 7

Mean Application Rate : 1.15 mm/hr

Duration of Irrigation. : 1 hour /station.[nominal , determined by dam level , weather conditions and system loading.]

Total Output Per Irrigation [Initial Area.] : 6.3 kl / 3 hour watering cycle.

Note : These comments are based on visual observations only. Actual on site trials would need to be carried out for accurate soil/water relationships to be determined.

CERTIFIED IRRIGATION DESIGNER AGRICULTURAL DRIP/MICRO ADM2084

ADM2084

Lee Rothwell.
Director
CID Agricultural Drip/Micro

FERNIE HOLDINGS Pty Ltd TRADING AS

ROTHWELLS PUMP & IRRIGATION.

SCALE :	DATE :	DRAWN :	REFERENCE :
1 : 1000	26th April 2000	Lee Rothwell	Bro1350

Byron Bay

PO Box 2605
Byron Bay NSW 2481
P 02 6685 5466
byron@awconsult.com.au

BHCF Pty Limited

Process Mechanical and Electrical Design Sewage Treatment Plant Upgrade

July 2018

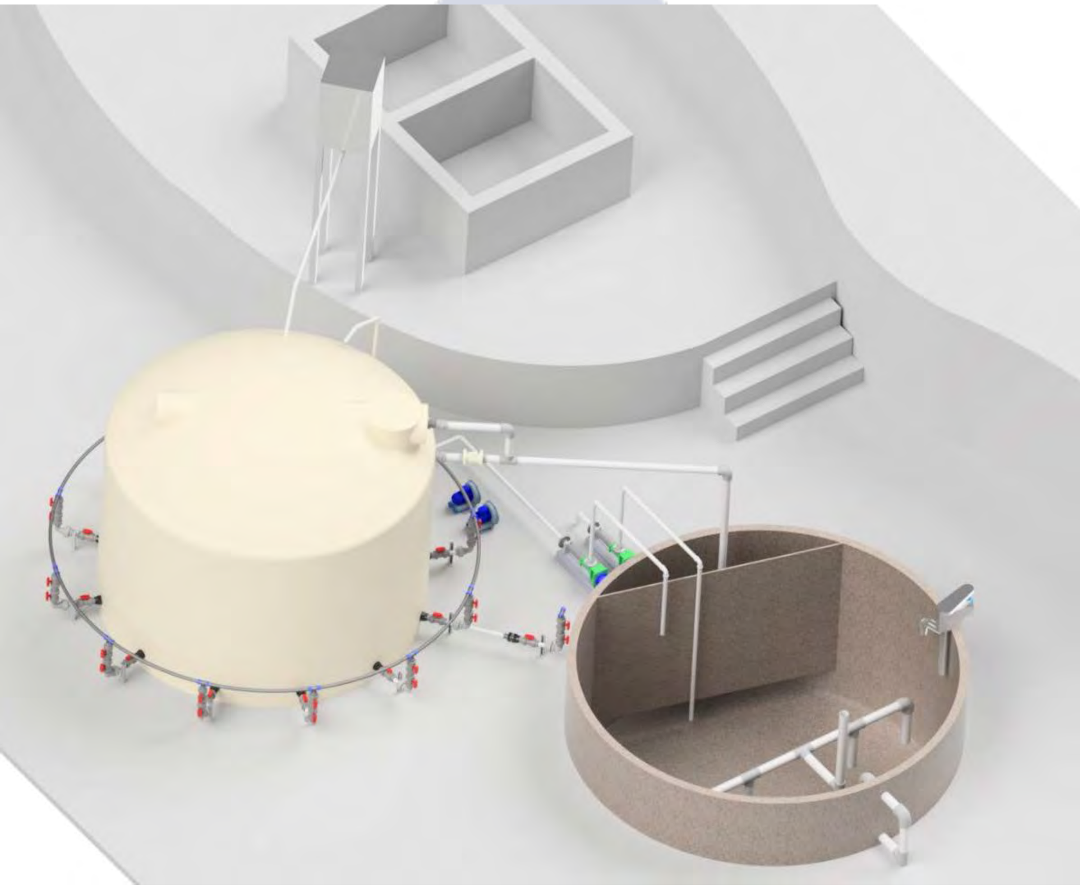


Table of Contents

1. Introduction

Aerofloat has been engaged by BHCF Pty Limited (BHCF) to review the approved future upgrade to the operation of the Sewage Treatment Plant (STP), situated at 951 Broken Head Road, Broken Head. The previous upgrade was designed some 12 years ago and the current technologies utilised for sewage treatment now allow for more efficient processing and increased equivalent person (EP) capabilities.

The subject STP operates under the following existing approvals;

- Byron Shire Council issued a Section 68 Approval to Install On-Site Sewage Management Systems No.98/0146#220575 and Renewal of Approval to Operate an On-site Sewage Management System (dated 17 February 2014 (Approval No. 70.2006.1039.1).
- A separate Section 68 Approval to upgrade the System was approved (dated 8 January 2007 (Approval No. 70.2006.1039.1) and it is this design that is the subject of this review and redesign.

This design upgrade increases the STP process capability to 200 EP. It supersedes the design of Simmonds and Bristow report #60828, dated 17 November 2006, but utilises a similar footprint. That approval was given to modify the BHCF STP, to enable the plant to treat 112 EP or 16,800L/d.

The existing Sewage treatment plant currently treats 6000 litres of domestic sewage per day (BOD5=300mg/L; Suspended Solids=300mg/L; TKN=100mg/L). The modifications covered by this specification will increase the capacity to 30000L/d, treating the sewage to a tertiary effluent standard. The final effluent is to be utilised on site for irrigation as per the current approvals and operation. The Effluent Irrigation capability is covered by a separate report by Australian Wetland Consultants on Land Capability (1-16804_04_b November 2017) and utilises the existing current effluent fields for dispersal (Note: the irrigation design is included in that report).

This process, mechanical and electrical specification provides more details on the modifications necessary to upgrade the existing treatment plant to treat a capacity of 30,000 litres per day from an existing true capacity of 15,000 litres per day.

The upgraded treatment plant is designed to continue to produce the approved effluent quality as follows;

Water Quality Parameter		**Value (90th percentile)**
pH		6.5 – 8.5*
Suspended Solids	mg/L	<30
BOD5	mg/L	<20
Total Nitrogen	mg/L	<10
Total Phosphorus	mg/L	<1
Faecal Coliforms	orgs/1ooml	<30

2. Existing Plant - Design Calculations

2.1. General

The Design calculations below are for the existing sewage treatment plant and make reference to the guidelines for the Planning and Design of Sewerage Schemes as produced by the Water Resources Commission, Department of Primary Industries.

The design calculations enable a comparison to be made between the existing plant and the proposed upgraded plant which will be summarised later in this document.

The design parameters are as follows:

Effective Volume of existing tank (IAT): 26.6 m^3

Number of persons serviced by the plant: 100

Organic (BOD) load (assume 50 gm/person/day BOD): 5 kg/day

Average Dry Weather daily Flow (assuming 150L/person/day): 15,000L/day

2.2. Food/Micro-Organism Ratio

The plant is designed to operate at a mixed liquor suspended solids (MLSS) concentration of 3,500mg/L and this is used for design purposes.

The mass of micro-organisms in the plant (M) is:

=4,000mg/L x 26.6m^3 (volume of tank)/1000

= 106 kg

The organic (BOD) load is 5 kg and this is the food (F) to the plant on a daily basis.

Hence the F/M ratio is:

=5 kg/106 kg

=0.047

This is less than the figure of 0.05 specified in the guidelines.

2.3. Aeration Capacity and Oxygen Requirements

The existing 2.2 kW aerator can transfer 2kg of O_2/hr.

The peak oxygen requirements are 3.5 times the BOD load (4.5kg/day), taking into account –

- diurnal peaks,
- carbonaceous oxidation,
- Nitrification,
- De-nitrification and
- endogenous decay
- the operating conditions (field correction factor - AOR),

The oxygen requirements are calculated as follows -

Oxygen required:

=3.5 x 5 kg/day

= 17.5 kgO_2/day

The tank is aerated for approximately 12 hours per day so the oxygen requirements are:
=17.5 kgO_2/day / 12

=1.46 kgO_2/hour

The aeration capacity (2kgO_2/hr) is greater than the requirements of 1.46 kgO_2/hr so there is adequate aeration for peak flows.

2.4. Hydraulic Loading – Average and Peak flows – Decant rate

Average dry weather flow (ADWF): 15,000L/day (as stated above in 1.1)

ADWF: 0.625m3/hr

In small scale systems the peak dry weather flow (PDWF) can be as high as 2.5 times the average hourly flow:

PDWF = 1.56 m^3/hr

Surface area of IAT = 16.6m^2

Rise rate of the tank during peak hourly flows: 0.094 m/hour

As the tank has 0.5m of hydraulic capacity during peak flows the tank can process for more than 4 hours before reaching the overflow level for displacement of treated effluent. Therefore, the following cycle times at peak flows would be:

Aerate: 3hr

Settle: 1hr

Decant: 0.5hr

Total rise during cycle: 0.38m

Aeration duty during peak flows: 67% (3 hours aeration per 4.5hours)

Aeration per day during peak flows is at the rate of 16 hours per day - note aeration capacity above was based on only 12 hours per day.

From section 2.3 above the oxygen requirements are –

=17.5 kgO_2/day / 16 hours/day

=1.1 kgO_2/hr of oxygen required

This is just over half the capability of the sinkair aerators so the aerators are adequate for the existing plant.

The decant rate required to decant 4.5 hours of peak flow @ 1.56m^3/hour is 4 litres per second. The decanter can decant at 8 litres per second so the decant mechanism and hydraulic loading are very conservatively designed.

2.5. Detention Time

The effective capacity of the plant is 26.6m^3 and the ADF is 0.625m^3/hr during periods when the population is at its maximum of 100 people. Hence the detention time during these periods is 42.6 hrs. This is much more than the 24 hours stated in the DLG guidelines and is adequate for the design load.

2.6. Sludge Handling

Sludge is automatically wasted from the main tank by the waste activated sludge pump to the drying beds. The pump will pump during the Aeration period for a set adjustable time period. Depending on the load on the plant the frequency will vary.

The guidelines state that 0.1sq meter of drying bed area is required per equivalent population and this has been provided.

2.7. Treated Effluent – Chlorine contact time.

The treated effluent is decanted into the existing effluent storage dam (1.25Ml capacity), at a relatively constant rate of 8 litres per second throughout the decant period. The liquid chlorine (12.5% chlorine as sodium hypochlorite) is designed to dose up to 5mg/l of free chlorine. Disinfection occurs within the Chlorine contact tank for 20 -30 minutes prior to the irrigation system commencing its disposal program in the designated fields.

3. Proposed Plant Upgrade – Process Summary

The following process description is the upgraded sewage treatment system which incorporates the existing sewage treatment system components and is generally in line with the Symonds and Bristow proposed concept, except more up to date technology is proposed.

The process description references the process flow diagram supplied by Aerofloat BHCF-AF-PFD.

3.1 Screen (E-100)

The sewage from the pump station is screened using a wedge wire screen and then is gravity fed into the MBBR-AAT (TK-105)

3.2 Moving Bed Biofilm Reactor – Aerobic/Anoxic Tank MBBR-AAT (TK-105)

This tank is a 30,000L poly ethylene tank (nominal capacity) fitted with removable air lances, a hydrostatic level transmitter, a dissolved oxygen sensor, bio media and a screened overflow.

This tank receives the screened sewage and cycles between aerobic and anoxic conditions by turning the air blowers on and off. This tank is connected to the Intermittent Aeration Tank - IAT (TK-110) via an over flow from the MBBR-AAT and a control valve that decants the MBBR-AAT tank to the IAT.

This cycling between aerobic and anoxic conditions is to optimise the nitrogen removal process, that is nitrification and denitrification.

3.3 Intermittent Aeration Tank IAT (TK-110)

This tank is the existing concrete tank fitted with a 2.2 kW Sinkair aerator and a GLS decant system. As part of the upgrade it will be fitted with an ultrasonic level sensor.

The IAT further biologically treats the sewage during aeration, settling and decant cycles. The IAT is fitted with a RAS and WAS pumps. The RAS (return activated sludge) pump draws wastewater/sludge from the IAT to the MBBR-AAT, this increase the biological sludge concentration in the MBBR-IAT and improves treatment efficiencies. The WAS (waste activated sludge) pumps the excess settled sludge from the bottom of the IAT to the drying beds

3.4 Irrigation/storage dam (TK-115)

The irrigation/storage dam is an existing effluent dam.

The treated effluent from the sewage treatment plant is gravity fed intermittently through the gas lock syphon decant system to the effluent dam. Disinfection occurs within the Chlorine contact tank for 20 -30 minutes prior to the irrigation system commencing its disposal program in the designated fields.

4. Proposed Plant Upgrade - Design Calculations

4.1. General

The Design calculations below are for the proposed sewage treatment plant upgrade and make reference to the guidelines for the Planning and Design of Sewerage Schemes as produced by the Water Resources Commission, Department of Primary Industries mentioned above and these guidelines are very similar to the NSW EPA guidelines.

The proposed upgrade is to install a new upfront Aerobic Anoxic Tank (AAT) based on Moving Bed Biofilm Reactor (MBBR) followed by the existing IAT. Flow to the IAT will be held back during the settle and decant period in the IAT. There will also be a return activated sludge (RAS) pump to return some of the solids back to the MBBR so the AAT tank will act as a combined fixed film and suspended growth tank. There will be perforated filter in the transfer line to the IAT to prevent the bio-media from migrating to the IAT tank.

The design parameters are as follows:

Effective Volume of system: Existing tank 29.1m3 + New MBBR tank 18.3m3 = 47.4m3

Number of persons serviced by the plant: 200

Organic load (assume 50 gm/person/day BOD): 10 kg/day

Average Dry Weather daily Flow (assuming 150 L/person/day): 30,000L/day

4.2. Food/Micro-Organism Ratio

The plant is designed to operate at a mixed liquor suspended solids (MLSS) concentration of 4,500mg/L and this is used for design purposes. This is higher than the existing plant concentration as the MBBR will contain bio media and promote fixed film growth meaning the biological waste will not be washed through the system as rapidly. Hence there will be a higher concentration of biological solids in the overall system.

The mass of micro-organisms in the plant (M) is:

=4,500mg/L x 47.4m3 (volume of tank)/1000

= 213kg

The organic (BOD) load is 10 kg and this is the food (F) to the plant on a daily basis.

Hence the F/M ratio is:

=10 kg/213 kg

=0.047

This is less than the figure of 0.05 specified in the guidelines.

4.3. Aeration Capacity and Oxygen Requirements

There will be a separate aeration system for each of the tanks (one blower and one sinkair aerator), both aerators will be fitted with 2.2kW motors. The 2.2 kW aerators can transfer 2kg of O2/hr each so will give a total 4kgO2/hr.

The peak oxygen requirements are estimated to be 3.5 times the BOD load (10 kg/day), taking into account -

- diurnal peaks,
- carbonaceous oxidation,
- Nitrification,
- De-nitrification and
- endogenous decay
- the operating conditions (field correction factor - AOR),

The oxygen requirements are calculated as follows.

Oxygen required:

=3.5 x 10 kg/day

= 35 kgO2/day

The oxygen supplied per day when the tank is being aerated continuously in the AAT and for 9.6 hours per day in the IAT is:
=2 x 9.6 + 2x 24

=57.2 kgO2/day

The aeration capacity of 57.2 kgO2 /day is much greater than the maximum criteria of 35 kgO2/hr. Hence there is adequate aeration for peak flows.

4.4. Hydraulic Loading – Average and Peak flows – Decant rate

Average dry weather flow (ADWF): 30,000L/day (as stated above)

ADWF: 1.25 m3/hr

In small scale systems the peak dry weather flow (PDWF) can be as high as 2.5 times the average hourly flow:

PDWF = 3.125 m3/hr

Surface area of IAT = 16.6m2

Rise rate of the tank during peak hourly flows: 0.188 m/hour

As the tank has 0.5m of hydraulic capacity during peak flows the tank can process for more than 2.5 hours during peak flow conditions, before reaching the overflow level for displacement of treated effluent. Therefore the following cycle times at peak flows are proposed:

Aerate: 1hr

Settle: 1hr

Decant: 0.5hr

Total rise during cycle: 0.38 m

Aeration duty during peak flows: 40% in IAT (1 hour aeration per 2.5hours) and 100% in AAT. This equates to aeration per day during peak flows at the rate of 9.6 hours per day in IAT and 24 hours per day in AAT. The proportion of aeration in each of the IAT and AAT is the basis for calculations for the aeration shown above in section 4.3.

The decant rate required to decant 2.5 hours of peak flow @ 3.125 m3/hour is 4 litres per second. The decanter can decant at 8 litres per second so the decant mechanism and hydraulic loading are very conservatively designed.

4.5. Detention Time

The effective capacity of the plant is 47.4m3 and the ADF is 1.25m3/hr, this gives 37.9 hr detention time. This is much more than the 24 hours stated in the DLG guidelines and is adequate for the design load.

4.6. Sludge Handling

Sludge is automatically wasted from the main tank by the waste activated sludge pump to the drying beds. The pump will pump during the Aeration period for a used adjustable time. Depending on the load on the plant the frequency will vary. The plant is also fitted with a return activated sludge pump which returns some of the sludge to the MBBR to increase MLSS concentrations.

The guidelines state that 0.1sq meter of drying bed area is required per equivalent population. This is already provided with the existing drying beds.

4.7. Treated Effluent – chlorine contact time

The treated effluent is decanted into the existing effluent storage dam (capacity 1.25Ml), at a relatively constant rate of 8 litres per second throughout the decant period. The liquid chlorine (12.5% chlorine as sodium hypochlorite) is designed to dose up to 5mg/l of free chlorine. Disinfection occurs within the Chlorine contact tank for 20 -30 minutes prior to the irrigation system commencing its disposal program in the designated fields.

5. Summary Design Parameters Existing vs Proposed Plant

Parameter	Existing Plant	Proposed Plant
Effective volume of the system	$26.6m^3$	$47.4m^3$
Number of persons serviced by plant	100 ep	200 ep
Organic Load	5 kg/day	10 kg/day
Average Dry Weather Flow (Daily)	15,000L/day	30,000L/day
MLSS	4,000mg/L	4,500mg/L
F/M	0.047	0.047
Aeration Capacity	$2kgO_2/hr$	$4kgO_2/hr$
Oxygen Requirements (daily)	17.5 kgO_2/day	35 kgO^2/day
Oxygen Requirements available	32 kgO_2/day	67.2 kgO_2/hr
Average Dry Weather Flow (hourly)	$0.625m^3/hr$	$1.25m^3/hr$
Peak Dry Weather Hourly Flows	$1.5625m^3/hr$	$3.125m^3/hr$
Rise Rate of IAT Tank	0.094m/hr	0.188m/hr
Aeration Cycle Time	3hr	1hr
Settle Cycle Time	1hr	1hr
Decant Cycle time	0.5hr	0.5hr
Total rise during cycle	0.38m	0.38m
Aeration Duty During Peak Flows in IAT	67%	40%
Detention Time	43 hr	38 hr

6. Proposed Plant Upgrade – Mechanical Scope of Work

The following is the mechanical specification for the upgrade work to be done on the sewage treatment plant at BHCF

6.1 Screen

6.1.1 General

The screen will be re-located to next to the drying beds on the elevated platform. The existing screen will be relocated to its new position.

6.1.2 Pipework

The existing pipework connected to the inlet of the screen will be disconnected and re-routed to the new screen position. The outlet of the screen will be gravity fed to the MBBR-AAT supported according to pipe manufactures specifications.

6.1.3 Screen stand

The screen will be supported on a stand designed to hold the total wet weight of the screen and have a factor of safety.

6.1.4 Testing

The pipework will be tested for leaks.

6.2 MBBR-AAT Moving Bed Biofilm Reactor – Aerobic/Anoxic Tank

6.2.1 General

The tank is a 30,000L Bushman's industrial grade polyethylene tank with a specific gravity of 1.5 (1.5 times the plastic used for rainwater tanks)

6.2.2 Air blower system

The air blowers will meet all relevant Australian standards. Blower pipework will be constructed from polyethylene pipe and fittings rated to withstand pressure and temperature and sized to reduce head loss in the air distribution system.

Lances with be designed to be removed without having to remove the bio media from the tank.

6.2.3 Civil works

The MBBR / AAT tank and inlet screen will be located on new concrete slabs and will be structurally design by a qualified structural engineer.

6.2.4 Pipework

The outlet of the screen will be gravity fed to the MBBR-AAT supported according to pipe manufactures specifications. The outlet pipework will be fitted with a removable filter to stop the media from flowing into the IAT.

6.2.5 Instruments

The MBBR-AAT will be fitted with:

- A dissolved oxygen probe, to measure the dissolved oxygen of the MBBR-AAT to optimise the aeration supply to the micro-organisms in the tank.

-A hydrostatic level sensor will record the level in the tank

6.2.6 Bio-media

The MBBR-AAT will approximately 15m3 of bio media to facilitate the growth of fixed film micro-organisms in the MBBR-AAT

6.2.7 Testing

The tank will be tested for leaks from any tank penetrations and pipework. The air blower pipework will be tested for leaks and for even air distribution. The blowers will be get tested for pressure, rotation, and current draw

All automation and system cycles will be simulated, run and observed.

6.3 IAT Intermittent Aeration Tank

6.3.1 General

The IAT is an existing concrete tank that will be form and integral part of the plant upgrade. Minor modifications will be made to the tank.

6.3.2 RAS pump (Return Activated Sludge)

A new RAS pump will be located adjacent to the IAT and will return mixed liquor to the MBBR-AAT on an intermittent basis to further enhance the performance of the MBBR-AAT. The pump will be fitted with a check valve and a pressure relief system using air operated pinch valves.

6.3.3 WAS pump (Waste Activated Sludge)

The WAS pump will be located next to the IAT tank on a cement slab fixed to the slab. The pump draws thickened mixed liquor from the lower part of the IAT and pumps it to the drying beds for dewatering. The pump will be connected to the existing drying bed pipeline if the pipeline is in an acceptable condition, if not a new line will need to be run to the drying beds. The pump will be fitted with a check valve and a pressure relief system using air operated pinch valves.

6.3.4 Flocculent for Phosphorus Removal

A sodium aluminate (or equivalent such as Poly Aluminium Chloride) dosing system including, pipework, & chemical storage tank will be provided for the removal of phosphorus from the effluent.

6.3.5 Pipework

All pipework will be PVC pipe or blue line polyethylene where applicable and supported according to pipe manufacturer specifications.

6.3.6 Instruments

The IAT will be fitted with:

-An ultrasonic level sensor to measure the level of the tank to control the GLS decant mechanism.

6.3.7 Testing

All pumps fitted will be tested for current draw, rotation, leaks and the pressure relief system will be tested.

All pipework will be tested for leaks.

All instruments will be calibrated if needed and their functionality tested.

The new automation system will be tested to ensure that the aeration, settling and decant cycles are run and observed.

6.4 Irrigation/Storage Dam

6.4.1 Pipework

Existing pipework will be inspected for integrity.

6.4.2 Testing

If pipework needs to be replaced leak testing will be done

7. Proposed Plant Upgrade – Electrical Scope of Work

The following is the electrical specification for the upgrade work to be done on the sewage treatment plant at Broken Heads Coastal Foundation

7.1 Panel

The Control panel will be constructed from Stainless steel sheet material and rated to IP56. The panel will be locked with a winged key drive. The panel will be fitted with an emergency stop and a main switch.

7.2 Panel Design

The electrical panel will be subject a HAZOP/Design review meetings between Aerofloat and BHCF to ensure all situations are considered in the design. The design will be reviewed by Aerofloat's engineering team.

7.3 Panel components

All electrical components will be compliant with the relevant Australian standards.

7.4 Power supply

A 3-phase power supply will be provided into the main switch of the electrical panel.

7.5 Indicators and Switches

The control panel will be fitted with on/off/manual selector switches for all pumps/equipment, as well as running lights for the equipment. High level alarms will be provided.

7.6 PLC Control System

The system will be controlled using an Allen Bradley PLC which will have remote monitoring capabilities. The final system functionality will be refined during the HAZOP and design review meetings.

7.7 Alarms

The front of the main control panel is fitted with an alarm light and siren. This alarm is activated by the following:

-High level in any of the tanks

-Equipment failure to run

-Circuit breaker trip

-Parameters out of specification for certain period of time (Dissolved oxygen or any other instruments fitted)

The current alarms are shown on the Human Machine Interface (HMI) as well as a log of past alarms.

7.8 Remote Monitoring/Trending

A log of the tank levels and Dissolved Oxygen will be kept using the HMI. There will also be remote viewing capabilities of the HMI by Aerofloat and BHCF Plant Management.

8. Proposed Plant Upgrade – Effluent Quality and Training

8.1 Effluent Quality

The sewage treatment plant is expected to produce an effluent quality suitable for disposal by irrigation as summarised in the table below:

Water Quality Parameter		Value (90th percentile)
pH		6.5 – 8.5*
Suspended Solids	mg/L	<30
BOD5	mg/L	<20
Total Nitrogen	mg/L	<10
Total Phosphorus	mg/L	<1
Faecal Coliforms	orgs/1ooml	<30

8.2 Operations & Maintenance Manual

An O&M manual will be provided and BHCF's Plant Manager will be trained during the final stages of installation, testing and commissioning of the plant.

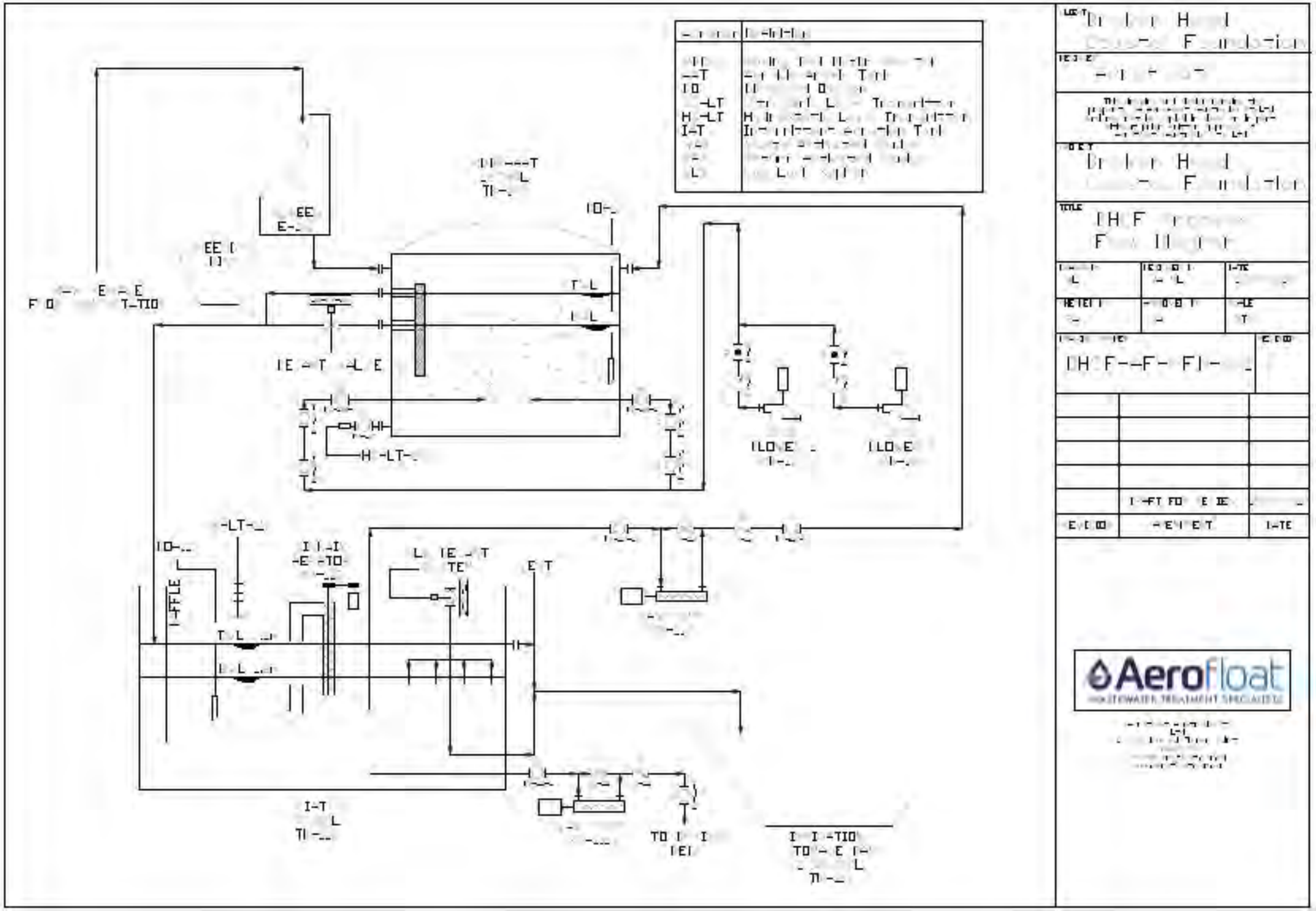
8.3 Training

Training of BHCF personnel will take place during and immediately after commissioning of the upgrade of the sewage treatment plant.

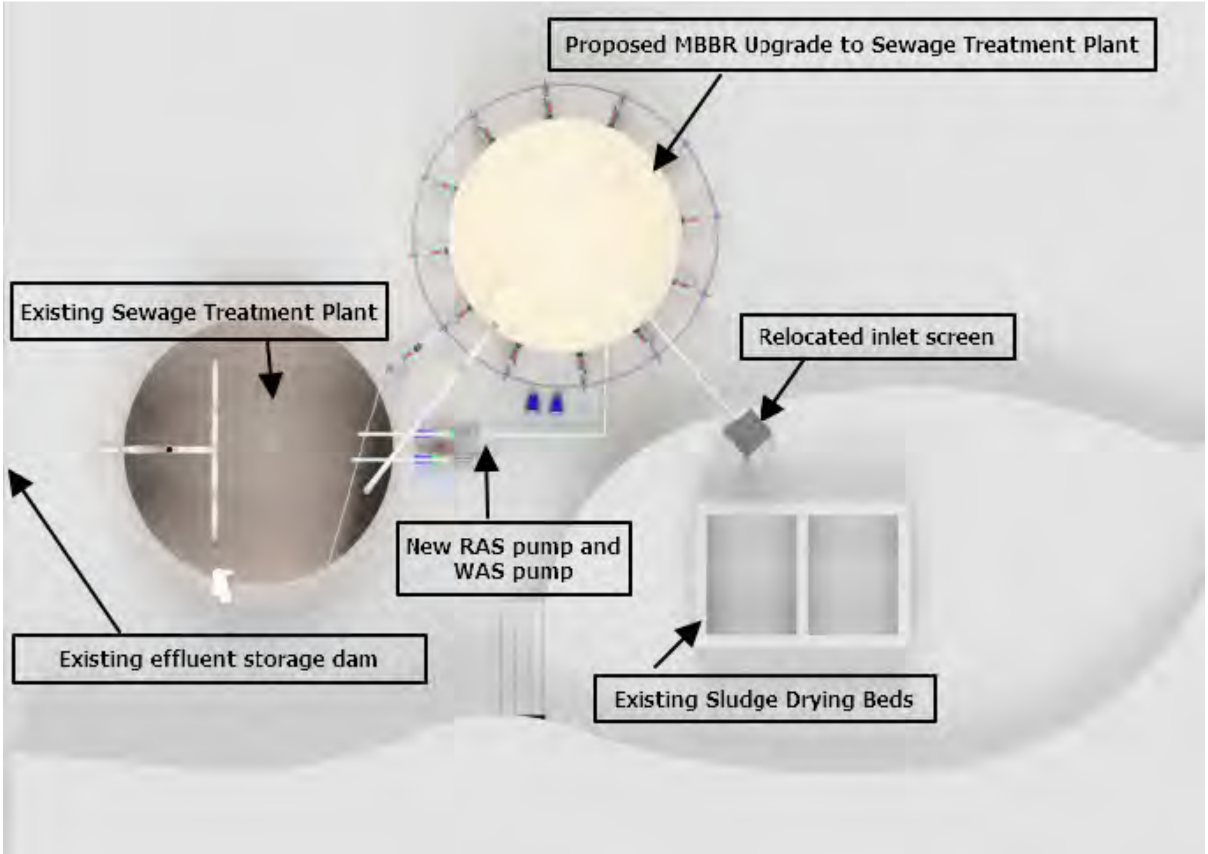
The training offered will include the system process, trouble shooting and maintenance required.

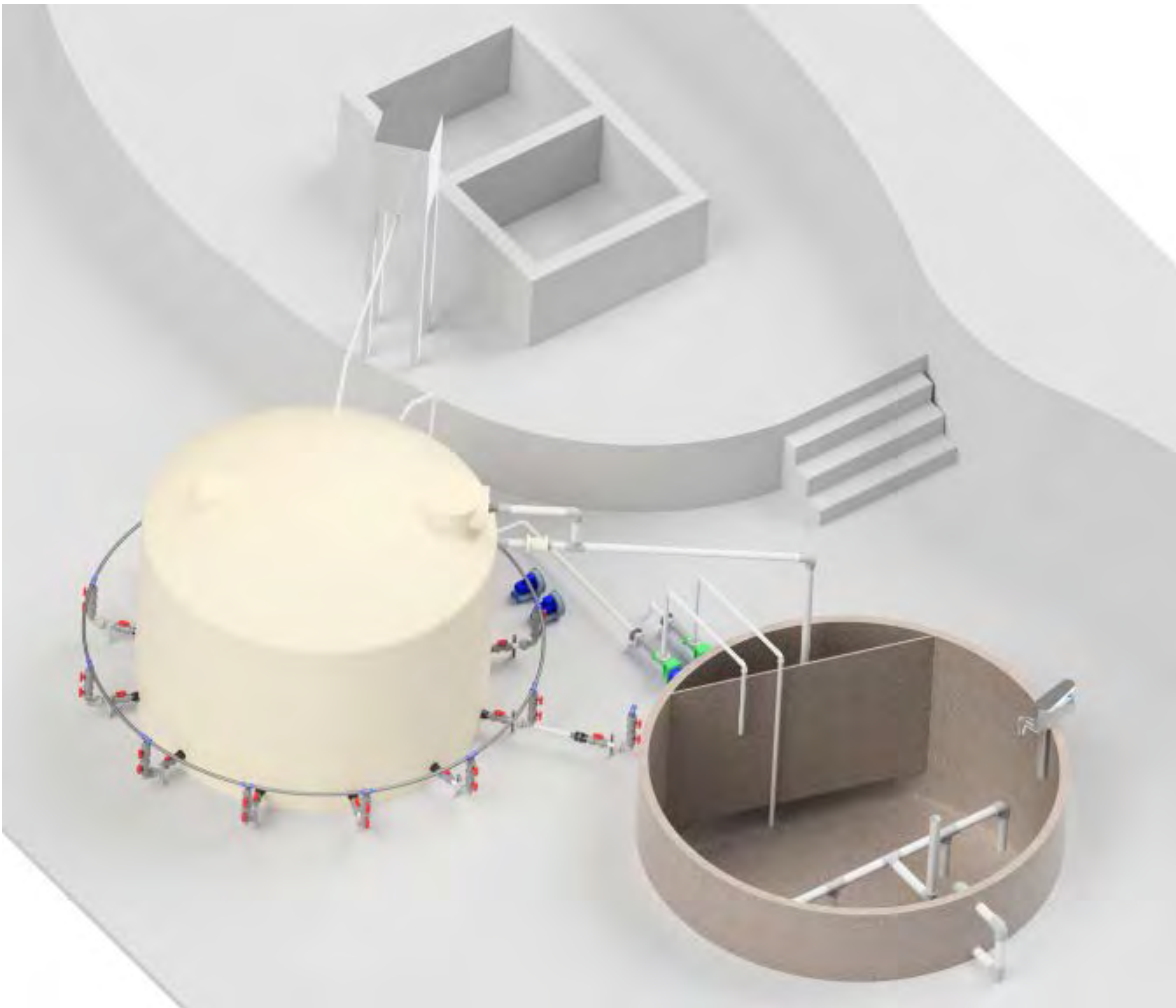
Aerofloat also provides 6 months of phone support for operators trained by Aerofloat.

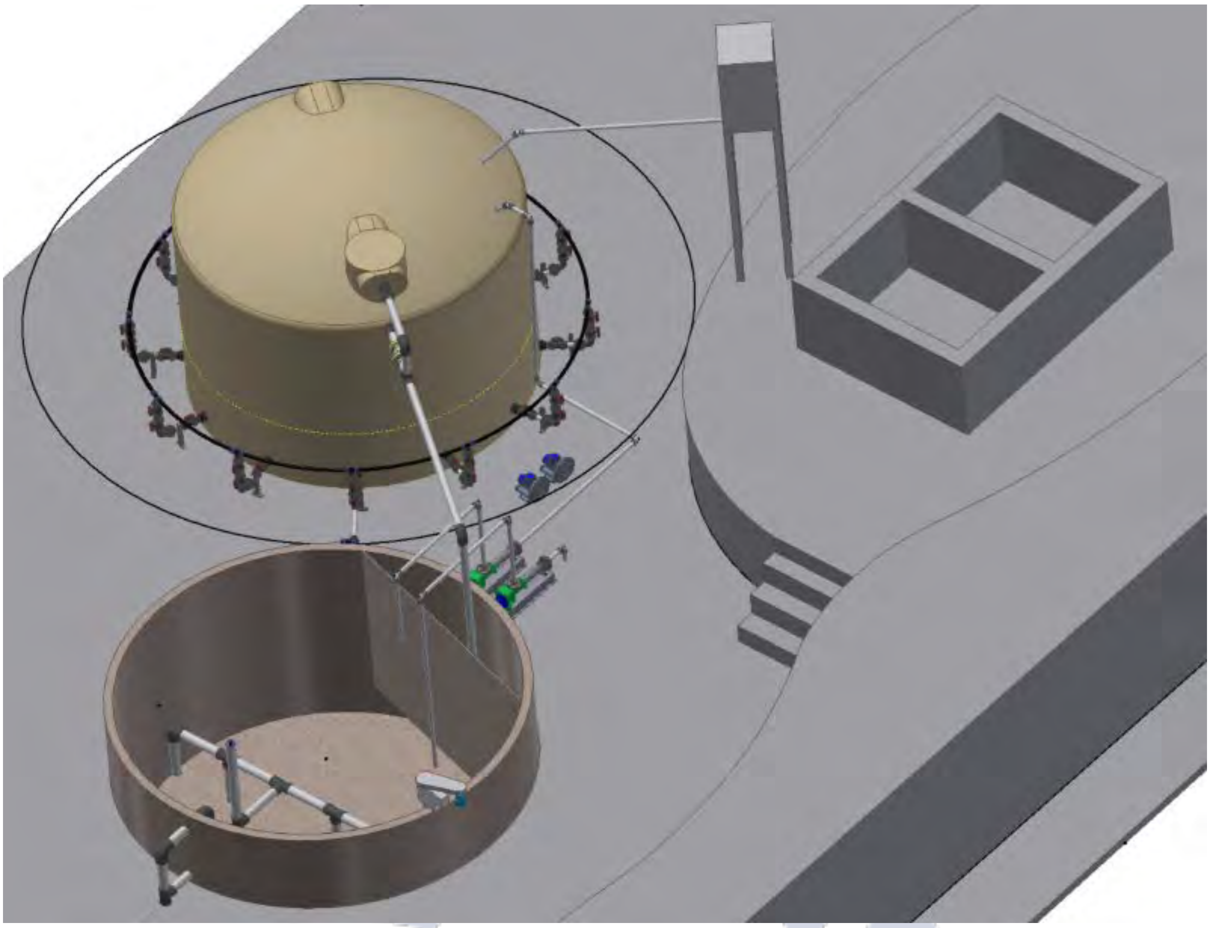
9. Process Flow Diagram

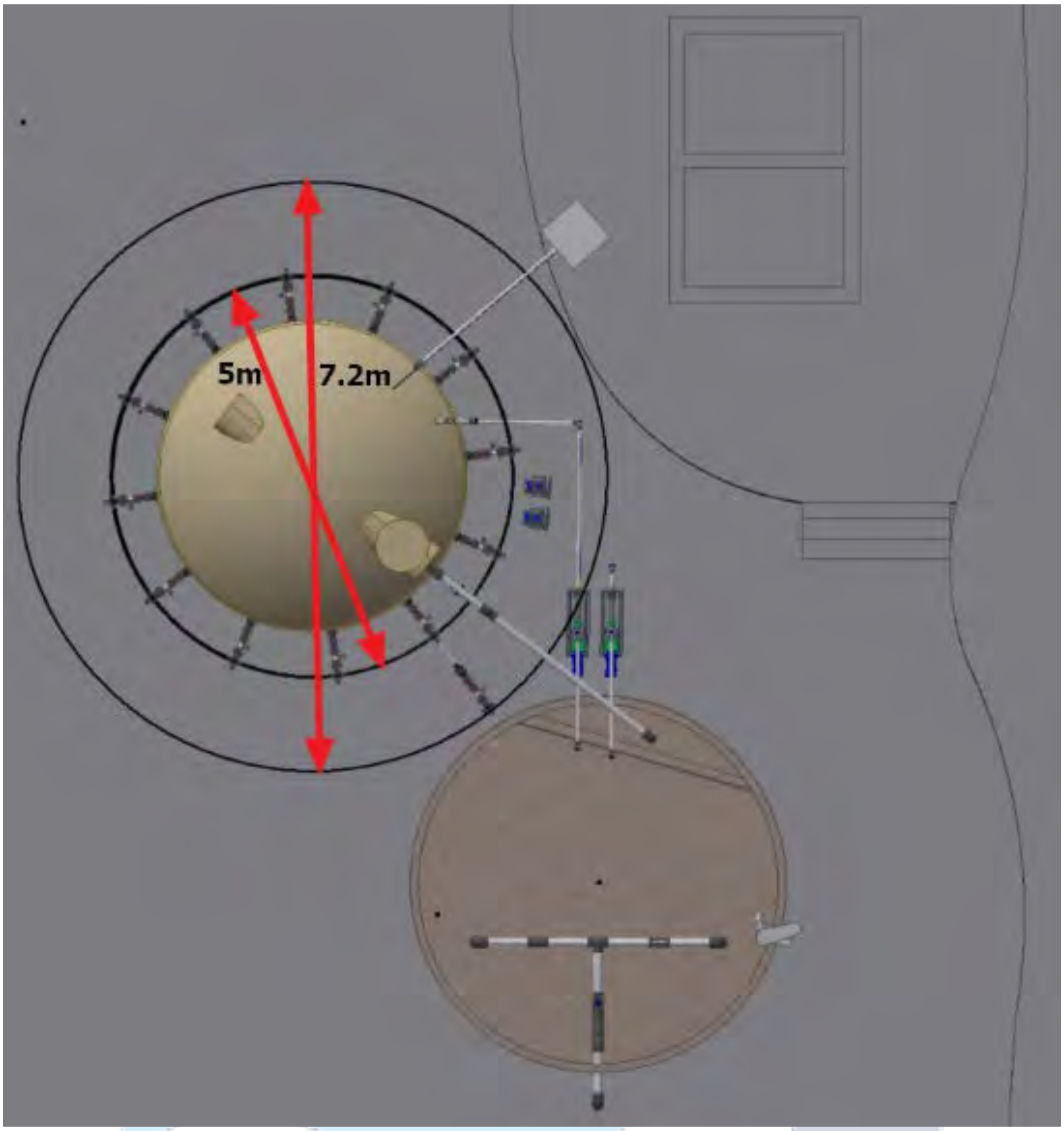


10. General Arrangement Drawings





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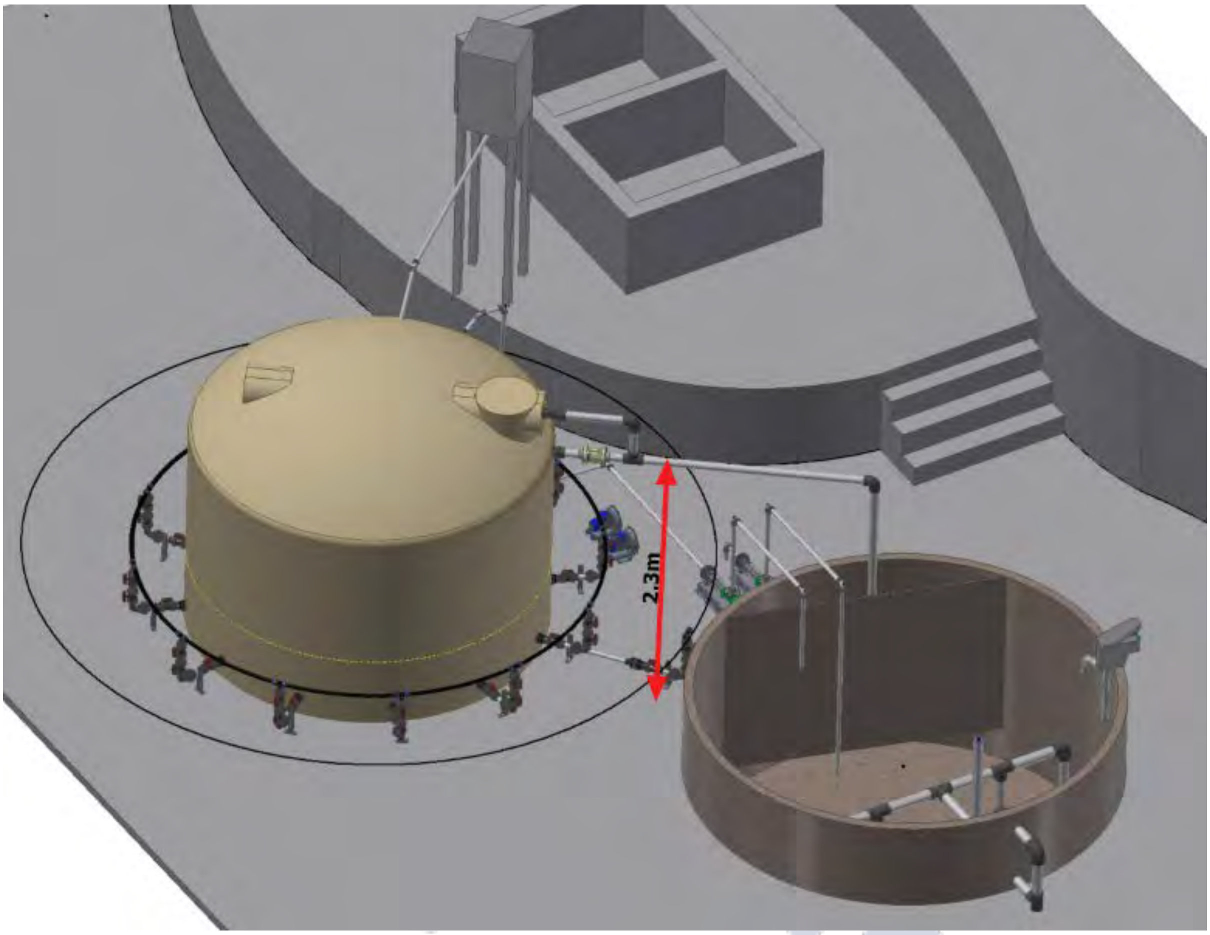
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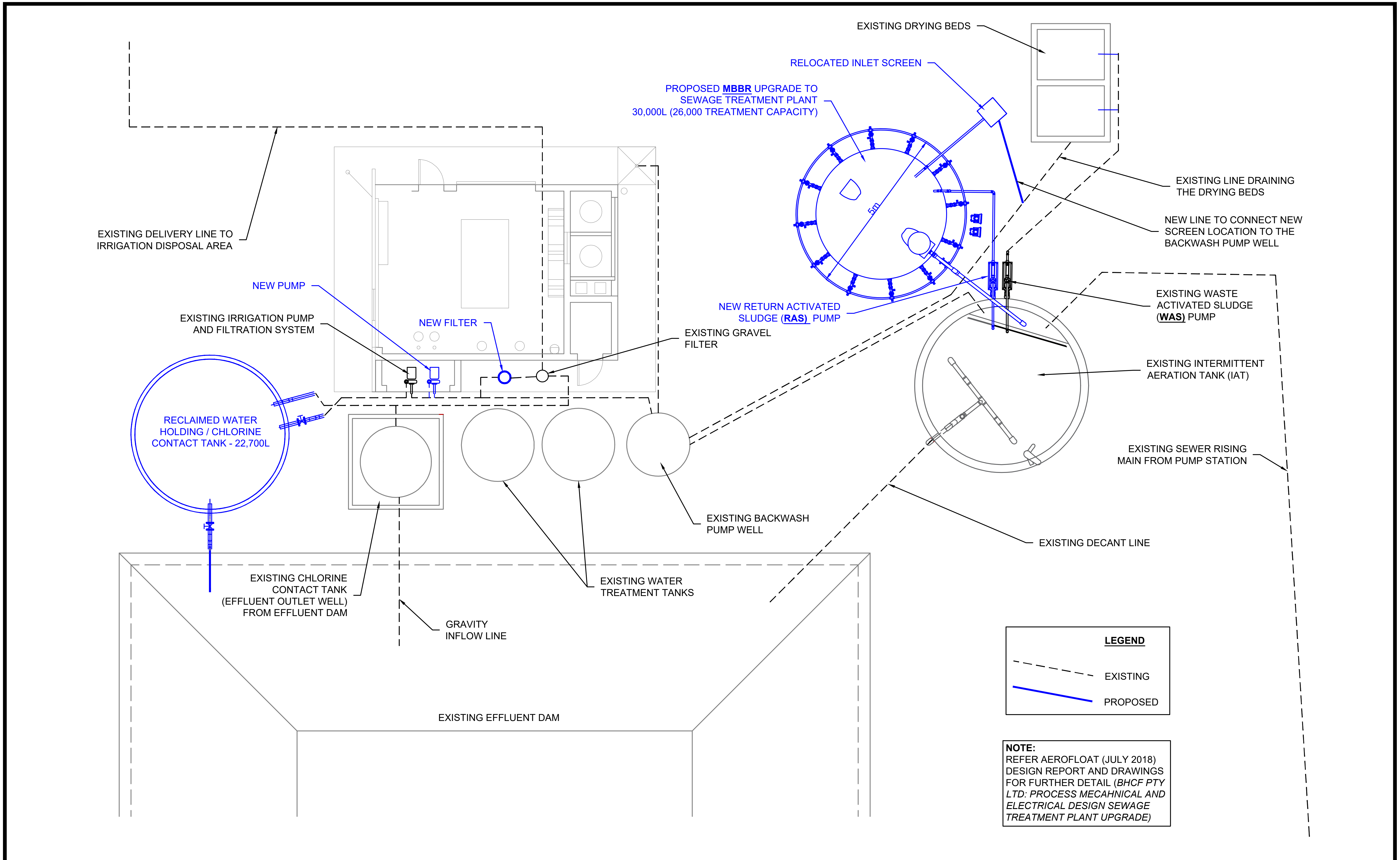

NOTE:
REFER AEROFLOAT (JULY 2018) DESIGN REPORT AND DRAWINGS FOR FURTHER DETAIL (*BHCF PTY LTD: PROCESS MECAHNICAL AND ELECTRICAL DESIGN SEWAGE TREATMENT PLANT UPGRADE)*

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CLIENT: **BHCF Pty Ltd**

DO NOT SCALE FROM PLANS, TO BE ADAPTED ON SITE BY CONTRACTOR & CONFIRMED BY PROJECT SUPERVISOR, SIZING, CALCULATIONS, STRUCTURES, & COMPACTION TO BE CONFIRMED BY ENGINEER OR SUITABLY QUALIFIED PERSONS. ENGINEERS CERTIFICATE BY OTHERS.

REV.	ISSUE / AMENDMENTS	DATE
A	REVISION A	24/07/2020
B	REVISION B	19/10/2020

DESIGNED JM
DRAWN JM
CHECKED DM

PROJECT: **LINNAEUS STP UPGRADE - 2020**

DRAWING: EXISTING AND PROPOSED STP COMPONENTS

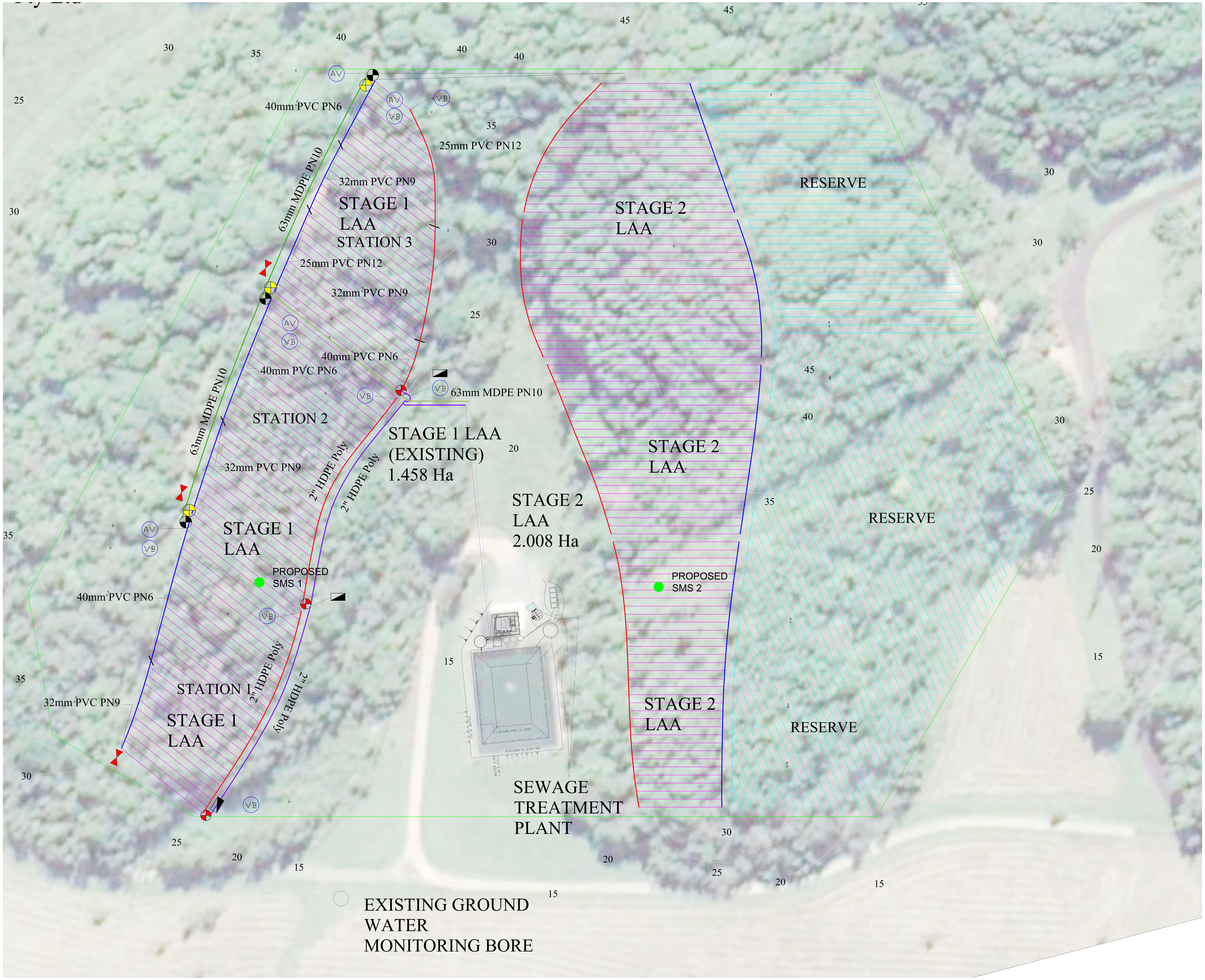
DWG No. 1-16804_STP2020_

CAD FILE No. 1-16804_STP2020.dwg

SCALE: NOT TO SCALE - SCHEMATIC ONLY

DRAWING CREATED 17 / 06 / 2020

REV. B



ORIGINAL PLANS SUPPLIED BY:

Do not scale from drawing. Use indicated dimensions at all times. Verify all dimensions and set-outs on site before commencing work. Clarify discrepancies before commencing work.

ISSUE	REV.	AMENDMENT	BY	DATE
A		GENERAL OVERVIEW	LIR	22.6.20
B		GENERAL OVERVIEW	LIR	21.7.20

- AV AUTOMATIC AIR RELEASE VALVE
- VB VACUUM BREAKER
- NETAFIM DM17 DRIPLINE 2.3 l/hr @ 1.0 m SPACING.
- SCOUR VALVE [Normally Closed]
- ISOLATION VALVE [Normally Open]
- Horizontal Checkvalve
- Automatic Control Valve [Normally Closed]
- Automatic Control Valve [Normally Open]
- 40 mm STD Filter. 130 micron

CLIENT:
BHCF Pty Ltd
PO Box 464
LENNOX HEAD NSW 2478

PROJECT TITLE:
TREATED WASTEWATER DISPOSAL SYSTEM

DRAWING TITLE:
LAND APPLICATION AREA OVERVIEW

thinkwater. BEYOND IRRIGATION
Fernie Holdings Pty Ltd
ABN 97 003 667 481
24 - 26 Russellton Drive
Alstonville NSW 2477
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lee.rothwell@thinkwater.com.au

SCALE @ A1: NTS

SCALE @ A3: NTS

SCALE BAR:

NORTH

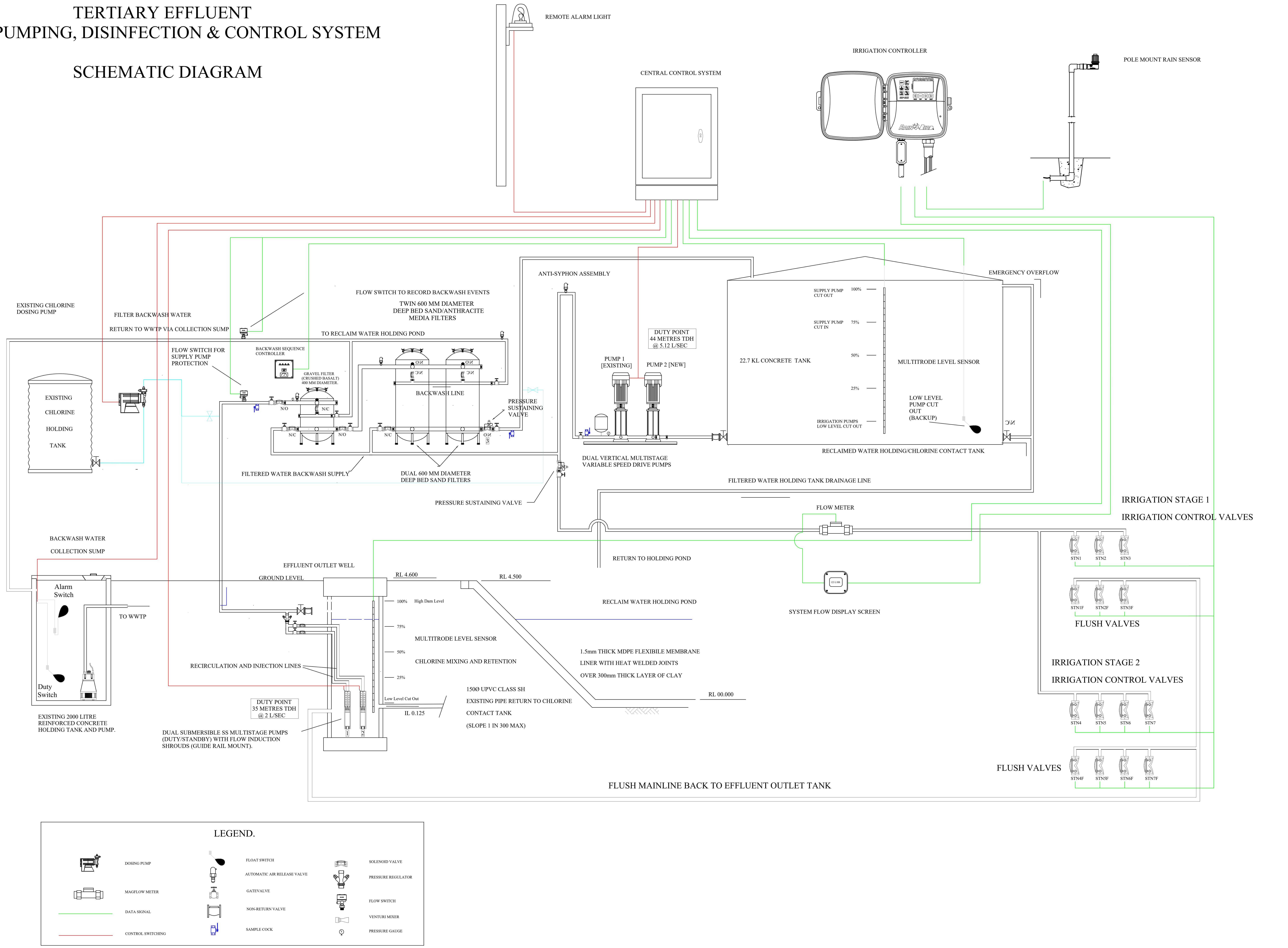
PROJECT NUMBER: 1304

DRAWING NUMBER: 1304-1

REVISION NUMBER: A1

TERTIARY EFFLUENT
PUMPING, DISINFECTION & CONTROL SYSTEM

SCHEMATIC DIAGRAM



ORIGINAL PLANS SUPPLIED BY:

Do not scale from drawing. Use indicated dimensions at all times. Verify all dimensions and set-outs on site before commencing work. Clarify discrepancies before commencing work.

ISSUE	REV.	AMENDMENT	BY	DATE
A		GENERAL OVERVIEW	LIR	22.6.20
B		GENERAL OVERVIEW	LIR	21.7.20

CLIENT:
BHCF Pty Ltd
PO Box 464
LENNOX HEAD NSW 2478

PROJECT TITLE:
TREATED WASTEWATER DISPOSAL SYSTEM

DRAWING TITLE:
EFFLUENT DISPOSAL PUMP AND FILTRATION PROCESS DIAGRAM.

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SCALE @ A1: NTS
SCALE @ A3: NTS
SCALE BAR:
NORTH

PROJECT NUMBER:	DRAWING NUMBER:	REVISION NUMBER:
1304	1304-2	A1

<u>BHCF Pty Ltd</u>

ON SITE RECLAIM WATER DISPERSAL

SUB SURFACE DRIP IRRIGATION SYSTEM.

<u>SYSTEM PHILOSOPHY.</u>

Item 1 RECLAIMED WATER SUPPLY PUMPS

Water from the holding pond is pumped via two (2) 1.5 kW 415 V 3 phase electro-submersible stainless steel multi stage pump sets operating in duty/standby control configuration. Each pump will be capable of the duty point 2 l/sec at 35 metres TDH (Total Dynamic Head). Pumps will start on low-level signal from Irrigation Water Holding Tank and run until holding tank is full or until filters are required to backwash. Pump operation will also cease on low Holding Dam level, re-initiating on dam level rise.

Item 2 FILTRATION SYSTEM

Reclaimed water will be filtered prior to discharge into holding tank. This will be done through a two-stage process using media tanks as filter beds.

Stage 1
400mm diameter tank.
Crushed Basalt Media
Removal of suspended solids down to 80 micron.
Filtering Velocity – 57.30 m/hr

Stage 2
2 x 600mm diameter tanks (GRP)
Media 1 Under-bed Gravel 1.5 to 3.0mm
Media 2 Sand 0.55 to 1.1mm
Media 3 Anthracite
Filtering Velocity – 12.73 m/hr

Filters will be sequentially backwashed using pre-filtered water from the holding tank, supplied under pressure from the irrigation pumping system.

Supply pumps will be isolated during the backwash process.

Backwash water will be directed to an existing in-ground collection sump from where it will be pumped to the WWTP for re-processing.

Filtration system operation will be coordinated via a dedicated backwash controller.

Filters will backwash on preset pressure differential as well as on a timer. Filter timing system will start irrigation pumps independently of irrigation program to ensure filter beds are fluidised daily. (Prevents media from solidifying due to microbial activity)

Item 3 CHLORINATION SYSTEM

Chlorination of reclaim water is achieved via the use of a dosing pump which injects Sodium Hypochlorite (12.5% solution) at 5 ppm into a 22.7 KL Irrigation Water Holding/Chlorine Contact Tank (IWHT). The dosing pump (Peristaltic Type) is activated via an in line flow switch located on the return line.

The central control system determines the start up sequence through sensor output data from the Reclaimed Water Outlet Well (RWOW) level and the IWHT level.

The 22.7 KL holding volume of the IWHT and inlet flow of 2 l/sec (7.2 kl/hr) ensures that reclaimed water has a minimum contact period of 3 hours.

Item 4 IRRIGATION WATER HOLDING/CHLORINE CONTACT TANK

This tank is to be of concrete construction, fully enclosed having dimensions:

- 3.8 metres ∅ x 2.65 metres height
- Wall thickness 100 mm

Tank volume is nominally 22,700 litres.

Tank drainage line would return to the Reclaimed Water Holding Pond, as would the emergency overflow.

Item 5 IRRIGATION SUPPLY PUMPS

Pumping system consists of dual Lowara SV8-05 vertical multistage, 2.2 kW 415V 3 phase pump sets (one existing) complete with frequency controlled Variable Speed Drives. The system will operate to maintain a constant line discharge pressure across the range of flow rates encountered over the various irrigation blocks (Stations 1 to 7), both for water injection into the soil, and for system flushing.

Pumps would be activated from the Irrigation Controller for irrigation and for filter backwash. Once activated, the pumps would operate in sequence so that a single pump will run and deliver flows up to 2.56 l/sec at 44 metres TDH. At flow rates above this value, the second pump would activate and increase speed to maintain a continuous pressure. (up to 5.12 l/sec at 44 metres TDH).

To ensure pumps cannot exceed their maximum flow rate, (eg when irrigation /line flushing and filter backwashing is required), a pressure sustaining valve will be fitted on the downstream side of the pump unit to maintain sufficient backpressure to prevent pump damage (or nuisance low pressure fault shutdown) and to ensure adequate pressure for effective filter backwash.

Item 6 FLOW METER

A flow meter will be installed downstream of the pump unit, (after the backwash water line) to record system flow (both instantaneous and historic records). This will be available on an LCD screen at the flow meter site, or via the Irrigation Controller located in the Plant Room.

Flow meter data will be used to assess the integrity of the irrigation system. By matching the correct irrigation station flow rates against the actual current irrigation flow rates, the control system can determine whether a fault condition has occurred and therefore isolate and report the problem area.

Item 7 IRRIGATION AREA

The irrigation area shall be divided into two (2) zones. Stage 1 (Existing) 1.458 Ha. and Stage 2 (2.008 Ha) proposed.

Area 1 has three (3) irrigation stations.
Area 2 will have four (4) irrigation stations (subject to final design.)

The irrigation stations will operate sequentially from 1 to 7. Areas that are constrained due to excessive soil moisture levels or high ground water levels will be isolated from this sequence until such time as the constraints are removed, or the Reclaimed Water Holding Pond is excessively high.

The irrigation water dispersal system is comprised of subsurface integrated pressure compensated dripline (Netafim Uniram CNL 16mm ∅ 1.6 l/hr/emitter @ 0.40 metre spacing along lateral) Laterals will be installed at 1-metre centres across the LAA. Drip lines to be covered with 100mm mulch layer.

Lateral configuration will achieve a Mean Application Rate (MAR) of 4 mm/hr.

These laterals will be manifolded together at the inlet end by a Submain, and at the distal end by a Flushline.

Solenoid valves will be actuated by 24 volt AC signal from irrigation controller to open and isolate flows to the irrigation station areas. Control wiring will be installed below ground in a conduit running parallel to the mainline in a common trench.

Solenoid valves will be located in valve boxes below ground level, and will pressure regulate down stream flows to 200 kPa.

Submain and Flushline manifolds will be uPVC. Lateral offtakes will be tapping saddles approved by the manufacturer.

Clips used to fasten laterals to the grommet offtakes shall be stainless Steel.

Mainline and flushing mains will be PN12.5 Medium Density Polyethylene.

System flushing will occur every time an irrigation station changes to the next station, as the flushing solenoid valves (Normally open) allow the residual water in the line to drain under gravity back to the Effluent Outlet Well at each station change. Note: this system has been working without issue since the installation of Stage 1 LAA in 2002.

Item 8 IRRIGATION CONTROL SYSTEM

An irrigation controller will be installed in the plant room to accept inputs from external sensors, start pumps, and to power the irrigation solenoid valves that automate the irrigation sequence. It will be programmed to provide the logic for high/low level pump control and over ride of irrigation due to holding dam, groundwater and soil moisture levels.

The Effluent Outlet Well and the Reclaimed Water Holding/Contact Tank will be fitted with Multitrode level sensors and a Multitrode Indicator Controller for each probe. These will provide reliable level indication to the Central Control System (CCS).

The CCS will control the two supply pumps according to the level in the treated effluent well, but also according to the filtered water tank level and the filter flush cycle. In the case of potential Reclaimed Water Holding Pond overflow, limited irrigation will be turned on at a rate of 1 mm/day to the irrigation area, regardless of soil moisture or ground water level. These events will be provided in the report.

Groundwater quality from the existing Monitoring Bore will be sampled as per the routine monitoring and reporting program.

A rain switch will be located at the plant room, and will pause the irrigation cycle when any significant downpours occur.(events > 5mm/hour)

Soil moisture content will be measured continuously using two (2) Sentek soil moisture sensors. (One on stage 1 area, and one on stage 2 area) Sensors will provide live data to a depth of 600mm to the operator to allow for refined irrigation management based on soil real time moisture levels.

Irrigation of reclaimed water will cease (in the corresponding areas) when soil moisture levels exceed 80% of field capacity.

A flow meter will be installed to measure total flow from the irrigation pumps. This will be reported along with the flow to each block, calculated from the on time of the particular block control valve. Normal irrigation rate will be 2 mm/day to each block (30 minutes duration /irrigation station) unless it is overridden by soil moisture status. High holding dam level will override soil moisture level inputs, initiating irrigation to the field at a rate of 1 mm/day (maximum) until dam level recedes below the critical level.

Item 9 PIPE BURST PROTECTION

Burst protection for irrigation infrastructure will be achieved by continuously monitoring the flow rate for each irrigation station via a flow meter. If the set irrigation flow rate is exceeded by 20%, then that irrigation zone will be hydraulically isolated, and an alarm signal initiated. Re-starting a faulty irrigation station will require manual intervention from an operator.

In the event of a major pipe burst, the Pump Controller will shut down the pumps on a Low Pressure reading, thereby isolating the entire irrigation system until the fault is repaired.