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Wastewater Assessment for North Byron Parklands

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Disclaimer

The information contained in this report is based on independent research undertaken by Strider Duerinckx and Heather Murphy of Whitehead & Associates Environmental Consultants Pty Ltd (W&A). To my knowledge, it does not contain any false, misleading or incomplete information. Recommendations are based on an honest appraisal of the site's opportunities and constraints, subject to the limited scope and resources available for this project, and follow relevant best practice standards and guidelines where applicable, including:

- AS/NZS 1547: 2012: *On-site Domestic Wastewater Management* (Standards Australia / Standards New Zealand, 2012);
- Environment & Health Protection Guidelines: *On-site Sewage Management for Single Households* (Department of Local Government, 1998); and
- Byron Shire Council (2001). *On-site Sewage Management Strategy*.

Copyright Note

Executive Summary

This WWA provides a description of the existing wastewater loads and characteristics generated by the current event use of the North Byron Parklands (NBP) and estimated wastewater loads for the proposed use of the Site in the future through three stages of growth. The WWA also provides a comprehensive assessment of the general site suitability and capacity for managing the predicted effluent loads; and recommendations for suitable On-site Sewage Management Systems (OSMS). The WWA is a proof of concept document to satisfy an EIS process and it is expected that a comprehensive WasteWater Management Plan (WWMP) will be prepared to enable a s68 approval to operate to be obtained including:

- Engineering design of the treatment system and irrigation area;
- Irrigation Management Plan (IMP) on operational requirements for irrigation; and
- Compost Management Plan (CMP) on operational requirements for compost land application and reuse (if undertaken).

The Site is generally suited to on-site wastewater management and has the capacity to manage the predicted loads from the proposed five-day large events at 6 month intervals, a three-day medium event, five single-day small events, and two single day minor events, plus the operation of a 180 person conference centre and ancillary 120 person overnight accommodation and small day spa.

We estimate that the mix of ongoing and peak festival wastewater generation has an obvious incremental increase in volumes generated and stored, but the overall storage volume and daily treatment rate required to reset the On-Site Sewage Management System (OSMS) over five months is similar for all three growth stages. It is recommended that a technology mix is adopted that includes:

- Ongoing use of batch style dry compost toilets in dedicated amenities blocks for the festival precinct;
- A mix of micro flush compost toilets (Centrex 2000) at conference accommodation and associated day-spa and flushing toilets at the conference centre;
- Festival kitchen sullage to be collected and trucked offsite to Ballina or Byron Bay STPs (544kL/annum);
- Collection of compost seep, hand basin and shower greywater, urinal water, and conference centre kitchen sullage in a series of pump-wells (EONE 2014IP), and pumping to a master treatment system located approximately at the footprint of the existing temporary holding tanks;
- Installation of minimum 2,381kL storage capacity in eight storage tanks;
- Construction of a custom reed bed treatment system of 467m^2 area capable of treating 35kL/day to a secondary standard, with chlorine disinfection. The treatment system consists of four parallel treatment trains for ease of constructability and reliability;
- The treated effluent to be applied to the land over 36,000m^2 via surface spray irrigation using travelator irrigators, with a backup short term application area of the existing 24 Intermittently Dosed Sand Filter Beds (IDSFB).

The Client has indicated they wish to implement the upgraded OSMS progressively as budgeting allows, with full installation prior to opening of the conference centre. Further engineering design for sewer reticulation and treatment system is required as well as preparation of treatment system and irrigation area operation and maintenance plans.

Please do not hesitate to contact Whitehead & Associates if you have any questions or comments about the contents of this WWA.

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1 Introduction

Whitehead & Associates Environmental Consultants Pty Ltd ("W&A") has been engaged by Byron Venue Management Pty Ltd ("the Client") to prepare a Wastewater Assessment (WWA) for proposed upgrades to the North Byron Parklands property, 126 Tweed Valley Way, Yelgun ("the Site") (Figure 1). The Site is made up of multiple Lots, being:

- Lots 46, 402, 403, 404, 410 DP 755687;
- Lots 10, 12, 14 DP 875112;
- Lots 2, 12 DP 848618; Lot 101 DP 856767;
- Lots 30, 31 DP 880376;
- Lots 101, 102, 107 DP 1001878; and
- Lot 1 DP 1145020.

1.1 Purpose of WWA

The WWA was prepared to provide a proof of concept wastewater production, treatment and application solution for the purposes of an Environmental Impact Statement. (EIS). Further details and design solutions will be required for the actual s68 application to operate the On-Site Sewage Management System (OSMS) with Byron Shire Council, and a comprehensive WasteWater Management Plan (WWMP) will be prepared including:

- Engineering design of the treatment system and irrigation area;
- Irrigation Management Plan (IMP) on operational requirements for irrigation; and
- Compost Management Plan (CMP) on operational requirements for compost land application and reuse (if undertaken).

1.2 Existing Development Conditions

The Site is a significant property that has been set up to host cultural festival events. Approval for festival hosting was granted by the NSW Minster for Planning and Infrastructure in 24 April 2012 under Section 75O of the EP&A Act. The approval included use of the Site for:

- Cultural, educational and outdoor events with ancillary camping and car parking;
- A cultural centre (Stage 3); and
- A conference centre with associated accommodation (Stage 3).

The approval included ancillary facilities including a spine road, use of temporary event infrastructure, a water treatment plant, and a wastewater treatment plant.

The approval included outdoor events on a trial basis until the end of 2017 (extended until August 2019) (Table 1), with sizes of:

- Minor community events of up to 1,500 patrons/day for 10 days per year;
- Small events of up to 15,000 patrons/day;
- Medium events of up to 25,000 patrons/day; and
- Large trial events for up to 35,000 patrons/day.

The total of small-large event days approved was for 10 days/year (and up to 10 minor events per year), with campers allowed to arrive and leave on up to six days in addition to the 10 days.

Table 1: Trial Events Sizing Staging

Number of Trial	Large Event Patrons	Medium Event Patrons	Small Event Patrons
1 (2013)	25,000	15,000	10,000
2 (2014	27,500	17,500	12,000
3 (2015)	30,000	20,000	13,000
4 (2016)	32,500	22,500	14,000
5 (2017)	35,000	25,000	15,000

The concept plan allows for ongoing events after the trial period, subject to separate planning approval and the satisfactory performance of the trial events.

No effluent application was approved on the portion of the Site south of Jones Road.

Subsequent to the trial approval, an approval for an interim On-Site Sewage Management System (OSMS) was obtained for the Site through Byron Shire Council that includes use of batch compost toilets and partial greywater treatment and disposal on-site, with trade waste (catering) to a private recycling company Summerland Environmental. Excess wastewater is trucked offsite to Byron Bay STP.

This WWA document provides a revised design for a treatment and land application combination that will be able to treat wastewater from the approved 35,000 patrons/day plus an increase of event sizes and occurrence as detailed in Section 1.3 for the years following 2019.

A comprehensive operations, monitoring and maintenance plan is required to supplement this WWA for future operation of the OSMS.

1.3 Proposed Development

The proposed future use of NBP will include a mix of large through to minor events, with a planned staged expansion of large events (Table 2). A conference centre and ancillary structures (cabins, day spa and yoga building) is also proposed to be constructed on the southern and western sides of the main dam (Figure 2) (Section 1.3.1).

Table 2: Proposed Ongoing Events Usage at NBP

Event Type	Number of Day persons at Event	Number of Campers at Event	Number of Days per Event	Maximum Number of Event Type/ Year
Large (SITG)	Stage 1 35,000 Stage 2 35,000-42,500 Stage 3 42,500-50,000	Stage 1 25,000 Stage 2 25,000 Stage 3 25,000	5	1

Large (Falls)	Stage 1 35,000	Stage 1 30,000	5	1
Medium	>5,000 but <25,000	12,500	3	1
Small	<5,000	2,000	1	5
Minor	<1,500	0	1	2
Note: **Medium events may be three 1 day events or one 3 day event. W&A conservatively modelled one 3 day event to maximise storage requirements**				

As part of the upgrades of NBP 11 additional amenities blocks are also proposed around the Site to provide additional amenity to campers, and replace porta-loos in parts of the event area and the carparking / bus loading area (Figure 3).

1.3.1 Conference Centre

Designs for the conference centre have been prepared by Dominic Finlay Jones Architects P/L (Project Ref: DFJ148). The conference centre and associated structures will be constructed on the southern and western side of the feature dam at NBP and will include (Figure 4):

- A 180 person capacity conference centre building with staff and public toilets in the south-eastern corner. In the lower ground floor would be conference rooms and a small downstairs office. Ground floor would contain the dining area, kitchen/bar, office, amenities, and storage zones;
- 30 pods for conference centre and retreat guests (4 persons/pod maximum occupancy). Each pod will contain two separate accommodation rooms consisting of a bathroom (shower and toilet), small kitchenette, combined sleeping/lounge area and deck
- A small yoga pavilion that extends on a boardwalk over the dam. No wastewater generating features will be incorporated into this structure;
- A spa reception and six standalone treatment room pods. Toilets and showers will be located in the spa reception area plus office. Treatment pods will contain a small hand washing sink only; and
- 70 car parking spaces.

It is proposed to utilise wet composting toilets (WCT) for all pods and the day spa reception area, which operate with 500ml flushing mechanisms. Standard 4-star flushing toilets would be utilised in the conference centre amenities.

1.4 Regulatory Environment

The North Byron Parklands Site will service an event population >10EP, beyond the scope of AS/NZS1547:2012 and DLG (1998) standards and guidelines, but <750kL/day will be treated on-site and so less than licensing requirements covered by the NSW EPA under the POEO Act.

Any wastewater treatment and land application system operating at the Site must comply with the Local Government (General) Regulation 2005, specifically under Clause 44, whereby: "A system of sewage management must be operated in a manner that achieves the following performance standards:

(a) the prevention of the spread of disease by micro-organisms,

(b) the prevention of the spread of foul odours,

(c) the prevention of contamination of water,

(d) the prevention of degradation of soil and vegetation,

(e) the discouragement of insects and vermin,

(f) ensuring that persons do not come into contact with untreated sewage or effluent (whether treated or not) in their ordinary activities on the premises concerned,

(g) the minimisation of any adverse impacts on the amenity of the premises and surrounding lands, and

(h) if appropriate, provision for the re-use of resources (including nutrients, organic matter and water)".

And under Clause 45(3): "A sewage management facility used in the operation of the system must not discharge into any watercourse or onto any land other than its related effluent application area".

The NSW DECC Guidelines for Effluent Reuse by Irrigation (2004) were written to provide guidance on wastewater reclamation by irrigation for non-domestic situations, both where dual reticulation in subdivisions is provide, and for single domestic sources. Typically the irrigation water is sourced though from on offsite source (eg STP) and transported by pipeline to a reuse area such as a sports field etc. The NSW DPI (Office of Water) (2015) guidelines for Recycled Water Management Systems also do not directly apply to the proposed OSMS use at the Site, as it is a private OSMS treating and applying wastewater generated on-site, though both these documents provide useful guidance on site and soil constraints, reporting requirements, and risk assessment using log reduction values which we have adopted.

Given the lack of alternative comprehensive guidance, the investigation and report presented herein has utilised a process of conservative site assessment derived from AS/NZS1547:2012, NSW DECC (2004), NSW DLG (1998) and NSW DPI (2015) standards and guidelines.

2 Site Description

The Site is located on the eastern side of the Tweed Valley Way and straddles Jones Road, approximately 7km north-northwest of Brunswick Heads, NSW (Figure 1).

The total Site includes an area of 256ha composed of an amalgamation of approximately 17 land parcels and part parcels, all owned by Billinudgel Property Pty Ltd. The Site includes forested ridges along the north-western boundary and along Jones Road. With the remainder of the Site generally flat, with expansive cleared and forested areas.

The southern portion of the Site (south of Jones Road) is located within the lower catchments of Yelgun and Billinudgel Creeks and forms part of Marshalls Creek floodplain. The northern portion of the Site is generally within the Crabbes Creek floodplain (Figure 5).

Surrounding land use includes rural residential holdings, agricultural uses for sugarcane and beef cattle production, a national highway, and environmental reserves.

Historical vegetation clearing has been previously undertaken to facilitate the cultivation of sugarcane and grazing of cattle. Approximately 67% of the Site is pasture land used for events. Approximately 33% of the Site is covered by dense vegetation.

As site activities for the purpose of large cultural events have been happening on the Site over the last five years, considerable infrastructure including a road tunnel, sealed and unsealed gravel roads, sheds, amenities buildings, landscaping and drainage swales have been constructed on the Site.

3 Existing NBP Wastewater Management

Currently only two events (plus some minor community events) are hosted at NBP and these are serviced by a series of wastewater management streams generated in separate locations within the Site and either treated on-site or trucked off-site. The wastewater management streams for Splendour in the Grass (SITG) July 2016 event were explained in the Draft wastewater strategy document prepared by the Client (NBP 2017) (Table 3). A similar management of wastewater was undertaken at the Falls Festival in December 2016, but with lower total volumes given the smaller size of that event.

Table 3: Existing Wastewater Streams General Management

Portable toilets	177 kL	BYRON STP
WCT & Urinals	mixed*	
Shower Waste	920 kL	GREYWATER ON-SITE
Shower Waste **	131kL	BYRON STP
Kitchen Waste	259 kL	BALLINA STP

* WCT leachate and urinal waste volumes are not measured separately, these wastes are mixed with shower waste and portable toilet waste and disposed at Byron STP and Parklands.

** Mixed waste from no public areas (performers and staff facilities).

Currently about 1/3 of generated wastewater, sourced from porta-loos, kitchen sullage and non-public wastewater sources, such as laundries and showers, is trucked offsite to a public Sewage Treatment Plant (STP) and a private recycling company. The remaining 2/3 of wastewater consisting of mainly shower greywater, but mixed with urinals and compost seep water is trucked to holding tanks in the wastewater treatment area for on-site land application (Figure 3).

The existing wastewater management infrastructure and operation consists of a combination of permanent and temporarily infrastructure. As such there is a mix of environmental controls and operational expectations for the infrastructure. With the implementation of a permanent and reticulated OSMS, environmental and operational improvements above the existing will be achieved.

3.1 Portable Toilets and Performer Amenities

Portable toilets and performer amenities, which are self-contained portable toilet and shower units with an on-board storage tank, are used within the event area, for staff and performer amenities and the bus/ taxi area. Waste is pumped out and trucked to Byron STP.

3.2 Amenities

The event amenities blocks are made up of either:

- In the camping grounds, 12 composting toilets on one side and 12 shower cubicles on the other with a hand washing and a men's urinal area at one end (Figure 6);
- In the event area, 12 composting toilets on one side and 12 composting toilets on the other side with a hand washing and a men's urinal area at one end;
- For single blocks, 12 composting toilets only.

There are currently eight double camping amenities blocks and two single compost toilet blocks, being a total of 246 composting toilets and 192 low flow gas fired showers. The amenities buildings are made out of modified shipping containers on footings, with an overarching roof structure and gates at the end. The space between the containers is used for servicing the composting toilets and showers and for storage of spare wheelie bins and storage of servicing supplies and gas water heaters for showers.

Toilet solid waste is stored in wheelie bins, which are swapped out of the active area during the event and kept in the roofed space between the blocks. Compost seep, men's urinal wastewater and shower greywater are directed to an in-ground 3kL concrete pump well and then pumped with a grinder pump up to two 23kL poly storage tanks that the vacuum trucks evacuate from.

The proposed additional eleven amenities blocks will be constructed as per the original seven amenities blocks, though vacuum trucks will progressively be replaced with permanent rising mains to the NBP treatment plant.

3.2.1 Composting Toilets

A total of 400 wheelie bins are currently used on the Site for each large event. The composting toilet wheelie bins are placed under the composting seat, with a flexible chute from the toilet seat to an attached wheelie bin lid. This lid is placed over the new wheelie bin to seal the unit. A seepage tube is connected to the base of the wheelie bin and the base of the wheelie bin is filled with straw to reduce solids reaching the drain hole. A piece of Ag pipe is bolted on the inside of each bin to allow liquids to reach the base of the bin and to aerate the compost pile.

The area surrounding each wheelie bin under the toilet chamber is ventilated by a single 150mm PVC pipe. Further ventilation and operational improvements will be incorporated into the final works. 90mm flexible pipes with couplings will be attached to the existing vent lines that terminate in each bay, and attach to each wheelie bin through a coupling near the top side wall of each bin during use. This will create negative air pressure in the wheelie bin, reducing odour emitted during use and increasing oxygen available to the compost pile. When the bins are stored the flexible coupling will be removed and a mesh cover placed over the vent to allow air into the bin during composting. The mesh cover will be vermin proof like the type used on rainwater tank overflows and be attached to each wheelie bin by a chain or line, so it is less likely to be lost.

To reduce the risk of flooding impacting the composting process the wheelie bins will be stored in a covered storage area above the 1:100 year flood height to complete the composting process before being emptied. The previous application area for the compost solids has been nominated for this location.

3.2.2 Men's Urinals

The men's urinals consist of an area at the end of each amenities block which is fenced off and the ground covered with woodchips. The area has no roof and the urinal is a galvanised iron splashback with a galvanised iron gutter for the trough. A tap is at the upslope end of the trough for periodic flushing and cleaning. The urine is drained to one end of the trough and into the pump well. The hand basins are of the same design, but with taps positioned above the collection gutter.

As part of the final works, it is recommended that this area will be roofed to limit rainfall infiltration into the urine troughs and OSMS, and possible runoff generation from the urinal.

3.2.3 Showers

Each amenities shower consists of a stall with a water saving shower head and a 15 second push button for limited water supply. The water is heated using instant gas hot water heaters to 41°C. All water from the showers is drained to the pump well and pumped to the storage tanks.

3.2.4 Catering and Laundry Wastewater

The staff and performer's catering areas, patron's restaurants, mobile laundry and performer's toilet blocks are serviced by multiple small sumps then pumped up to on-ground storage tanks. Effluent is then pumped out by tankers during the event and taken to the STP.

It is proposed to install larger, permanent sump pumps and wastewater storage tanks for emergency storage volumes as part of the final works.

3.2.5 Long Term Greywater Holding Tanks and EMA

The wastewater from the amenities compost seep, shower water and urinals is trucked to four 230kL galvanised iron holding tanks in the north-western corner of the Site. Each tank has an external volume indicator and the tanks are filled sequentially from number one to number four as they fill up. The tanks have a single outlet flange at the base with a gate valve connected through a Netafim branded 120 mesh stainless steel filter, then a Class C water meter, followed by a K-Rain Hydrotek 6000 indexing valve (6 ports).

Each tank is connected via the indexing valve to a field of six Intermittently Dosed Bottomless Sand Filter (IDBSF) beds of 20m long by 1.25m wide.

During the inspection of the system it was noted that stormwater drainage from upslope areas passes between the bed fields, which may introduce additional moisture to the area. Stormwater diversion and rectification works will be undertaken as part of final upgrades.

3.3 Existing Operations

3.3.1 Composting Toilets

During operations additional sawdust is added by the staff through the service area. When a bin is full it is replaced with a new bin and the full bin is stored in the service area between the amenities blocks for the next four months before the composted contents is buried in an area in the northwest portion of the Site (Figures 2 and 7).

3.3.2 During an Event

During a large event a fleet of eight vacuum trucks is used to transfer wastewater from the amenities storage tanks to the long term greywater storage tanks in the north-western corner of the Site (Figure 7) and from the non-patron zones to the Byron STP and Summerland Environmental, 24 hours a day. A team of staff manually identify which storage tanks need pumping out before calling in the pump trucks.

Following each event, effluent is manually released to each EMA by a staff member opening the holding tank valve and taking a reading of the water meter, then returning and closing the valve and taking a second reading of the meter. About 3,000L of effluent is released from each tank per day into a single IDBSF bed. The indexing valve should reset to the next bed when the flow is stopped at the end of each day's release but there is no indicator to confirm this transition. The filter is cleaned on a scheduled basis.

Photograph 1: Amenities 8, consisting of shower cubicles on RH side and compost toilets on LH (far side of amenities). Green poly tanks on LH side are rainwater collection tanks.

Photograph 2: Wheelie bins in action. Seepage pipe at the base, with flexible collar to separate lid while in operation.

Photograph 3: Wheelie bins internal venting pipe, and storage area.

Photograph 4: Men's urinal at amenities block, and back of compost toilet door information.

Photograph 5: Vacuum extraction of wastewater from temporary poly storage tanks at an amenities block.

Photograph 6: Wastewater long-term 230kL holding tanks with transfer hose connected.

Photograph 7: Long-term holding tanks on ridge, and existing IDBSF beds downslope of tanks. Taller grass is location of inspection points.

Photograph 8: Indexing valves in irrigation boxes.

Photograph 9: Compost from the wheelie bins is buried after three months.

4 Site Constraints Analysis

A site and soil assessment has been undertaken for the Site as expanded effluent management areas are required. The purpose of the site and soil assessment is to assess constraints to effluent application so that the appropriate mitigation strategies can be developed. The thorough site and soil assessment will ensure that treated effluent application can be undertaken in a sustainable manner, reducing the risks to on-site users and neighbours, as well as downgradient environmental effects.

4.1 Site Assessment

The existing Effluent Management Areas (EMA) (EMA 1) are located in the upper north-western corner of the Site. With improvements to permanent infrastructure including additional effluent loads, effluent is to be treated and applied in an additional EMA on the northeast low-lying plains (EMA 2) (Figure 3), while the treatment system will be located upslope of the existing EMA 1 (Photograph 10).

A detailed site and soil investigation was undertaken by Gilbert and Sutherland as part of the Integrated Water Cycle Assessment and Management Plan, dated July 2010 (Gilbert and Sutherland 2010) (Appendix A). This baseline investigation and report is utilised in the current WWA to assess the upgraded EMAs, and additional confirmation site and soil investigation were undertaken by W&A on the 22 June and 22 July 2017, and 19 June 2018 (Figure 5).

The investigations followed the procedures recommended by the respective AS/NZS1547:2000 and 2012 and DLG (1998). Table 4 summarises the Site constraints as they apply to the proposed EMA 1 and EMA 2. Physical features are discussed in terms of the degree of limitation they present (i.e. minor, moderate or large limitation) for OSMS. Reference is made to the rating scale described in Table 4 of DLG (1998).

Photograph 10: Proposed treatment system location upslope of EMA 1.

Photograph 11: Proposed EMA 2 in eastern portion of the Site.

Table 4: Site Constraints

Parameter	Constraint EMA 1	Constraint EMA 2
Climate: Yelgun experiences a sub-tropical-temperate climate, typical of south eastern Australia. Total average annual rainfall 1,805mm/year and evaporation 1,504mm/year (Data Drill from 1970 to 2016). Average rainfall exceeds evaporation for seven (7) months of the year (January to July). Climate is expected to pose a moderate to major limitation for effluent management.	**Moderate to Major**	**Moderate to Major**
Aspect and Exposure: EMA 1 – North-northeast to east facing moderate slope with an access road and associated cleared margins upslope and to the southwest and dense forest downhill and to the east and west. Some shading from the forest in early morning and late afternoons in winter. EMA 2 - The site consists of a very gently undulating, cleared alluvial plain. Generally, the land surface slopes very slightly towards the northeast. Aspect and exposure is therefore expected to pose a minor constraint for effluent management.	**Minor**	**Minor**
Vegetation: EMA 1 – The EMA is grassed. Some partial shading from the forest in early mornings and late afternoons in winter is expected. EMA 2 – Grassed.	**Minor**	**Minor**
Landform: EMA 1 – Linear and slightly convergent lower midslope. EMA 2 – Linear planar on an extensive alluvial plain. This is expected to provide a major constraint for effluent management due to low slopes and flooding/stormwater issues that will be managed by timing of irrigation.	**Moderate**	**Major**
Slope: EMA 1 – 14-28% to the north-northeast to east. EMA 2 – The surface slopes at around 1%. Slope is expected to pose a minor constraint for effluent management, mainly in stormwater control.	**Moderate to Major**	**Minor**
Rocks and Rock Outcrops: No rock or rock outcrops were encountered during the Site investigation.	**Minor**	**Minor**
Fill: No filling was present in the proposed EMAs.	**Minor**	**Minor**
Erosion Potential:	**Major**	**Moderate**

<table>
<tr><th rowspan="2">Parameter</th><th colspan="2">Constraint</th></tr>
<tr><th>EMA 1</th><th>EMA 2</th></tr>
<tr><td>EMA 1 – The moderate to steep slopes and erodible nature of the soils provides a major risk of erosion if the soil is disturbed. Where soil needs to be disturbed sediment and erosion controls are recommended.

EMA 2 – The Site is well vegetated, a very low slope and with no signs of erosion observed. Erosion could pose a constraint to effluent management if the soil is exposed as the soil landscape has highly erodible soils.</td><td></td><td></td></tr>
<tr><td>Site Drainage:

The nearest waterways are Billinudgel Creek about 1km to the east and Crabbe Creek about 1km to the north, but the alluvial plain across the Site has a network of historical agricultural drainage channels that feed to these creeks.

EMA 1 – The moderate to steep slopes have good drainage. Surface flows will be to the northeast more than 100m towards a farm dam on the neighbouring property.

EMA 2 – The low lying areas have poor drainage with a very gently undulating ground surface causing seasonal waterlogging of subsoils in the southeast portion. Constructed drains from previous farming provide a wicking effect to dry out near surface soils across the northern portion of the Site and limit general surface ponding.</td><td>Minor</td><td>Moderate</td></tr>
<tr><td>Groundwater:

A check of the Office of Water Groundwater Register noted that no registered groundwater bores were present within 500m of the proposed EMAs on the Site.

A group of groundwater monitoring bores were installed in the southwest portion of the Site, south of Jones Road. GW302027-GW302029 to 3-6m depth with standing water at 1.5-4m.

A domestic bore is also present (GW300497) in this area that is 26.5m deep, with standing water level at 8m and a water bearing zone at 21-24m in bedrock. A fifth bore was present on the Site in the southwest corner, but the licence has been cancelled.

A registered bore is located at least 600m to the west of the northwest corner of the Site (GW301158). The bore is 60m deep in clay soil with weathered and fractured bedrock below with a standing water level at 2.5m but no water bearing zone recorded. The bore is noted as having been capped and abandoned due to insufficient water for irrigation.

Bore water is not used for domestic use on the Site.

Groundwater was assessed as part of the Gilbert & Sutherland investigation in 2010 and by W&A in 2018. Groundwater was encountered from around 0.6m depth in the northeast portion (at</td><td>Minor</td><td>Minor for contamination to domestic supplies.

Major for risk of groundwater impacts</td></tr>
</table>

Parameter	Constraint	
	EMA 1	EMA 2
EMA 2), and further details are provided in Section 4.3 of this report.		
Flood Potential: Flood extents are displayed on Figure 7. EMA 1 – The elevated EMAs are located well above identified flood levels. EMA 2 – The lower portions of the Site are impacted by flooding as the ground surface is below 3m AHD (Australian Height Datum) Flood levels for the 100 year Annual Recurrence Interval (ARI) are about 3.94m AHD, the 20 year ARI is about 3.62m AHD. The 5 year ARI is about 3.3m AHD. The upgraded OSMS has been designed such that irrigation on EMA 2 can be a beneficial reuse of effluent during drier periods and months, but that EMA 2 will not be used during significant rain or flood events, and short term use of EMA 1 will be undertaken during those times.	**Minor**	**Major**

4.2 Soil Assessment

4.2.1 Soil Landscape

Five soil landscapes have been identified on the Site (Morand (1996)) (Figure 5). These included:

- The central and northern hills are part of the Billinudgel erosional soil landscape, being formed over the Neranleigh Fernvale metamorphics. Soils are moderately deep to deep, moderately well-drained red and yellow podzolic soils and yellow earths on slopes and crests. Limitations include hard-setting, strongly acid and stony soils with high erodibility and low fertility. The existing EMA 1 is located on this soil landscape;
- A small section of valley in-fill between the hills is part of the Ophir Glen transferal soil landscape, which has deep, poorly to moderately well-drained, yellow to brown podzolic soils to minimal prairie soils. Soil limitations are similar to Billinudgel with the inclusion of waterlogging, high water tables and dispersive soils;
- The northern low lying portion of the Site is part of the Kingscliff Aeolian soil landscape (b variant), which is located on extremely low, level to gently undulating Pleistocene-aged sand sheets. The b variant is sand sheets overlying peat and alluvium of the Cobaki estuarine soil landscape, which are mixed estuarine and aeolian materials. Soils are deep, generally well-drained podzols that are non-cohesive, highly erodible and permeable soils with low fertility. The recommended EMA 2 is located on this soil landscape;
- The southern low lying areas are split between Crabbes Creek alluvial soil landscape in the west and Pottsville Aeolian/swamp soil landscape in the east. Crabbes Creek is located on level to gently undulating mid to upper alluvial plains. Soils are deep, well-drained brown alluvial clays to clay loams with strongly acid, erodible, stony soils; and
- Pottsville soil landscape is located on poorly drained depressions within Pleistocene sand sheets and dunes. Soils are deep, poorly drained podzols, humus podzols, humic gleys and acid peats. Limitations include permanently high water tables and waterlogging. Soils are non-cohesive, highly erodible and permeable soils of low fertility.

4.2.2 Soil Physical Constraints

The soils across the Site were observed by examining soil data from the 24 boreholes drilled in the previous site assessment report (Gilbert and Sutherland 2010) (GSBH1-GSBH24). Two additional boreholes were drilled by W&A at recommended EMA 1 (WABH1 and WABH2), and six (6) additional across recommended EMA 2. Borehole locations shown in Figure 5 and logs in Appendix A and Appendix B.

A review of Gilbert and Sutherland 2010 report on the Site indicates that three general soil types were present on the Site, being Podosols, Hydrosols and Kurosols. The definition of each in Morand (2001) is:

- Podosols: Soils that possess a B horizon containing a dominance of iron and/ or organic aluminium compounds.
- Hydrosol: Soils where the greater part of the profile is saturated for at least 2-3 months in most years.
- Kurosol: Soils with strong texture contrast between A horizons and strongly acid B horizons.

The Site soils were grouped into three main areas, being the hills in the northwest and centre of the Site as Kurosols, the footslopes of the hills as being Hydrosols and the low-lying areas in the northeast and southeast of the Site being Podosols.

Generally, the soils consisted of a light topsoil horizon of loam to clay loam over either a dense clay based subsoil in the hills and footslopes, and a sandy subsoil on the low-lying plains to the northeast and southeast.

Table 5 summarises the key soil physical constraints. Reference is made to the rating scale described in Table 2.2 of DEC (2004) guidelines.

Table 5: Soil Physical Constraints

Parameter	Constraint	
	EMA 1	EMA 2
Soil Depth EMA 1 – Boreholes were terminated at 0.9-1m (GSBH12-14) and 1.2m (WABH1-2) in medium clay. Soil depth is expected to be to 0.7-1m for Billinudgel Soil Landscape on slopes. EMA 2 – Boreholes were terminated at 1-2.2m depth, encountering a clay loam over sand/clayey sand profile (GSBH16-18, GSBH20-24, and ASCTBH1-12). Soil depth is expected to be greater than 2m for Kingscliff variant b Soil Landscape.	**Moderate**	**Minor**
Depth to Seasonal Watertable EMA 1 – The depth to the watertable is >1.5m based on boreholes drilled. The closest registered groundwater bore is at least 600m to the west and was dug to 60m. EMA 2 – The low-lying areas of the Site are impacted by seasonal waterlogging and periodic flooding. Effluent application will only be undertaken when soils are not waterlogged beyond their Available Water Holding Capacity (AWC).	**Minor**	**Major**

Parameter	Constraint	
	EMA 1	EMA 2
Coarse Fragments (%) EMA 1 – Up to 15% coarse fragments were encountered in the boreholes (GSBH12-14) and no coarse fragments in WABH1-2. EMA 2 – No coarse fragments were encountered in the boreholes (GSBH15-24).	**Minor**	**Minor**

4.2.3 Soil Permeability

Insitu soil permeability was assessed at three locations by Gilbert & Sutherland in 2010 (Table 6)(Appendix A) using a permeameter and a constant head test. None of the locations tested included at proposed EMA 2 which typically has a clay loam over a sand and clayey sand subsoil profile. The permeability reading for BH15 most closely approximates the expected insitu permeability at proposed EMA 2 given the similar loam and clay loam surface soils.

Table 6: Insitu Permeability Results

Borehole	Location	Soil Type	Permeability (m/day)	Comment
BH2	South portion of NBP	Shallow clay loam over medium heavy clay	0.032	Permeability values within expected light to medium clay range of <0.06-0.5m/day
BH14	On hillside at treatment plant	Silty Clay Loam over Light Medium Clay	0.6	Permeability values within expected clay loam to light range of 0.12-1.5m/day
BH15	At footslopes in northern portion	Deep loam and clay loam over medium heavy clay	0.36	Permeability affected by deep clay loam profile as values within expected clay loam range of 0.12-1.5m/day

4.2.4 Soil Chemical Constraints

Some chemical analyses were undertaken in the Gilbert and Sutherland report, and additional data from the Billinudgel (bi) and Kinglake variant b (ki) Soil Landscapes was obtained by W&A. The results are included in Appendix A and summarised in Table 7.

Table 7: Soil Chemical Constraints

Constraint	Degree of Limitation	
	EMA 1	EMA 2
pH: EMA 1 – Soil landscape testing for bi3 gave a 3.6pH for 1:5 soil in calcium suspension, which is considered to be extremely acidic. EMA 2 – Soil landscape testing for ki2 gave a 4.4pH for 1:5 soil in calcium suspension, which is considered to be extremely acidic. Soil pH can be related to localised management, test equipment/ methodology and presence of acid sulfate soils. Soil pH can be ameliorated by the addition of lime.	**Major**	**Major**
Electrical Conductivity (EC_e): Electrical Conductivity of the saturated extract (ECe) is calculated by first measuring the electrical conductivity of 1:5 soil in water suspension and using appropriate multiplying factors to convert EC (1:5) to ECe. EMA 1 – Soil landscape testing for bi3 gave a 0.53dS/m, which is non-saline. EMA 2 – Soil landscape testing for ki2 gave a 0.45 dS/m, which is non-saline.	**Minor**	**Minor**
Modified Emerson Aggregate Class (EAT Class): The Emerson Aggregate Test is a measure of soil stability and susceptibility to erosion and structural degradation. It assesses the physical changes that occur in a single ped of soil when immersed in water, specifically whether the soil slakes and falls apart or disperses and clouds the water. EMA 1 – Soils were found to have an EAT class of 2-3 and 4/7, which are moderately dispersive to slightly dispersive. EMA 2 – Soils were found to have an EAT class of 2, which are moderately dispersive. This result means that the aggregates dispersed and the soils are dispersive. Addition of lime and gypsum will aid in soil retention.	**Moderate**	**Moderate**
Cation Exchange Capacity: The CEC is the capacity of the soil to hold and exchange cations. It is a major controlling agent for soil structural stability, nutrient availability for plants and the soils' reaction to fertilisers and other ameliorants. EMA 1 – Soil landscape testing for bi3 gave a CEC of 14.7 cmol+/kg, which is a moderate rating.	**Minor**	**Major**

Constraint	Degree of Limitation EMA 1	EMA 2
EMA 2 – Soil landscape testing for ki2 gave a CEC of 1.1 cmol+/kg, which is a very low rating. It is recommended to add lime and gypsum to improve soil fertility.		
Exchangeable Sodium Percentage: The ESP is an important indicator of sodicity, which affects soil structural stability and susceptibility to dispersion. EMA 1 – Soil landscape testing for bi3 gave an ESP value of 3%, which is non-sodic. EMA 2 – Soil landscape testing for ki2 gave an ESP value of 27%, strongly sodic, increasing the risk of soil dispersion.	**Minor**	**Major**
Phosphorus Sorption Capacity: EMA 1 – Soil landscape testing for bi3 gave a P-sorb value of 717mg/kg, which is very high. EMA 2 – Soil landscape testing for ki2 gave a P-sorb value of 111 mg/kg, which is low.	**Minor**	**Major**

4.3 Groundwater

4.3.1 Groundwater Depths

Groundwater levels were assessed by Gilbert & Sutherland in March 2010. Groundwater was variably encountered from around 0.33m-0.9m depth (at EMA 2) (Table 8).

An additional six boreholes were drilled across the northeastern portion of the Site in June 2018 by W&A to confirm groundwater levels (Figure 5). Groundwater was encountered typically at 1-1.5m depth in the boreholes, with only one recording groundwater at 0.7m depth.

W&A have compared the 2010 and 2018 dataset and there is no discernible groundwater flow direction based on groundwater intercepts below ground surface levels. Given the very flat nature of the groundsurface, groundwater hydraulic gradient would be expected to be very low. The presence of the drains suggests that seasonal shallow groundwater would flow to the drains with localised mounding (<0.05m) in the centre of paddocks midway between the drains.

The regional groundwater flow direction would be expected from the southwest to the northeast in the general direction of the landscape and river system discharge direction.

The two datasets suggest that permanent groundwater is present beneath recommended EMA 2, and is at a shallow depth that may be seasonally variable to 1-1.5m depth, rising to around 0.6m depth across the EMA during wetter months.

Table 8: Groundwater Depths

Borehole	Date	GW Encountered (mBGL)	Comment
BH15	March 2010	1	At footslope to west of EMA 2
BH16		0.6	At southern edge of EMA 2
BH17		0.9	At northern edge of EMA 2
BH18		0.4	To south of EMA 2
BH19		>1	At footslope to west of EMA 2
BH20		0.3	On western portion of EMA 2 in sand
BH21		0.5	At EMA 2 in sand
BH22		0.75	At EMA 2 in sand
BH23		0.85	At NE corner of EMA 2
BH24		0.6	At NW corner of EMA 2
H18-606/1	June 2018	1.3	On southern edge of EMA 2
H18-606/2		0.65	On SE corner of EMA 2
H18-606/3		1.5	On SW corner of EMA 2
H18-606/4		1.45	NE corner of EMA 2
H18-606/5		1.7	Centre of EMA 2
H18-606/6		1	NW corner of EMA 2
mbgl = metres below ground level			

4.3.2 Groundwater Chemistry

Groundwater chemistry was assessed by Gilbert & Sutherland in March 2010, including a review of 1997 data (Table 9) (Appendix A). The 1997 locations were not shown by Gilbert & Sutherland but were piezometers located one in the southern and one in the northern portion of the Site. The remaining piezometer locations are shown in Figure 5 of this report. GW4 and GW5 are located at proposed EMA 2.

As groundwater guidelines are not available, the data was compared by Gilbert & Sutherland to ANZECC (2000) Freshwater and Lowland River guidelines as these would be the receiving bodies for any groundwater seepage. But the use of these guidelines does not account for further retardation of pollutants or chemistry in the groundwater and the actual received body, and as such they are a guide only to provide a point of discussion and comparison.

The groundwater chemistry indicates that groundwater at the Site has already been impacted by land clearing and groundwater lowering and historical sugarcane (agricultural production) including low pH levels (4.59-4.75 in GW1-2), the groundwater is generally fresh with a low electrical conductivity, has a slightly elevated total phosphorus (0.02-0.3mg/L) and elevated total nitrogen (0.08-2.03mg/L (1.52mg/L in GW4))) concentrations possibly the result of fertiliser application, and is naturally elevated in soluble aluminium.

Given the elevated phosphorus and nitrogen, any future irrigation regimes would not be required to meet a zero addition, but to show no increase beyond baseline concentrations.

Table 9: Groundwater Chemistry

Analyte	Units	WQG	Site 1	Site 2	GW1	GW2	GW3	GW4	GW5
Sample date			1997	1997	31/03/10	31/03/10	31/03/10	31/03/10	31/03/10
Depth to GW	m				0.33	0.41	2	0.6	0.61
Electrical conduct (insitu)	µS/cm	125 - 2200			1460	997	n/a	791	775
Electrical conductivity	µScm-1		0.89	0.14	2,361	769	--	575	--
Turbidity	NTU		58	21	400+	400+	400+	400+	400+
pH - insitu	pH units	6.5 – 8.0	6.89	**5.2**	**4.59**	**4.75**	**6.31**	**5.65**	**5.42**
pH - laboratory	pH units	6.5 – 8.0	--	--	**2.5**	**4.3**	--	**5.7**	--
Dissolved Oxygen	ppm	-	--	--	5.65	3.61	4.18	2.92	3.04
TDS by calculation	mg/L	-			1,460	480	--	360	--
Bicarbonate HC03	mg/L	-	246	6	NP	NP	--	29	--
Chloride C2O	mg/L	-	135	25.9	750	110	--	65	--
Suspended Solids	mg/L	-	48	41	4,023	24,772	--	10,797	--
Total Phosphorus	mg/L	0.05 (50µg)	0.02	**0.07**	**0.3**	**0.2**	--	**0.2**	--
Ortho Phosphate-P	mg/L	0.02 (20µg)	0.02	0.01	**0.12**	<0.05	--	<0.05	--
Total nitrogen	mg/L	0.5 (500µg)	0.08	**0.55**	**2.03**	**1.62**	--	**1.52**	--
Ammonia	mg/L	0.02 (20µg)	**0.028**	**0.1**	**0.33**	**0.34**	--	**0.11**	--
Nitrate-N	mg/L	NOx 0.04	<0.005	**0.085**	**0.18**	**0.13**	--	<0.05	--
Nitrite-N	mg/L	(40µg)	0.02	<0.005	<0.05	<0.05	--	0.06	--
Calcium	mg/L	-	54.3	2.1	8.8	30	--	15	--
Magnesium	mg/L	-	10.7	2.8	15	22	--	20	--
Sodium	mg/L	-	138.9	19.2	224	100	--	80	--
Sulphur as Sulphate	mg/L		44.2	17.6	244	309	--	176	--
Potassium	mg/L	-	1.8	2	<5.0	<5.0	--	5	--
Aluminium (soluble)	mg/L	pH>6.5: 0.055 (55µg) pH<6.5: ID*	**0.111**	**1.512**	**0.99**	**0.6**	--	**1.47**	--
Copper (soluble)	mg/L	0.0014 (1.4µg)	0.001	**0.195**	0.01	<0.01	--	0.01	--
Iron (soluble)	mg/L	ID*	9.78	0.873	2.12	9.75	--	14	--
Manganese (soluble)	mg/L	1.9 (1900µg)	0.444	0.041	0.61	0.97	--	0.5	--
Zinc	mg/L	0.008 (8.0µg)	0.004	**0.307**	**0.2**	**0.51**	--	**0.37**	--
Arsenic	mg/L	0.024 (24µg)	0.002	0.001	0.006	<0.005	--	<0.005	--
Cadmium	mg/L	0.0002 (0.2µg)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	--
Lead	mg/L	0.0034 (3.4µg)	0.003	**0.024**	<0.01	<0.01	--	**0.01**	--
Biochemical oxygen demand	mg/L 02	-	4	0.8	--	--	--	--	--
Total Kjeldahl Nitrogen	mg/L N	-	0.06	0.47	--	--	--	--	--
Water Hardness (CaCO3 equiv)	mg/L	-	179	17	--	--	--	--	--
Chloride/suphate ratio		-	3.1	1.5	--	--	--	--	--
Total coliforms	cfu/100ml	-	<10	2280	2,178--	--	--	20	--
Faecal coliforms	cfu/100ml	-	<10	1480	--	--	--	--	--
Organochlorine Pesticides	mg/L	ID*	<0.0003	<0.0003	--	--	--	--	--
Organophosphorus Pesticides	mg/L	ID*	<0.001	<0.001	--	--	--	--	--
Polychlorinated Biphenyls (PCBs)	mg/L	ID*	<0.003	<0.003	--	--	--	--	--

*ID – insufficient data to establish guidelines

WQG = Water Quality Guideline of ANZECC (2000) Freshwater and Lowland Rivers

Site 1 = Southern carpark area

Site 2 = Main event area in northern part of NBP

4.4 Summary of Site and Soil Constraints

The NBP is located across a number of site and soil zones, with unique conditions requiring specific management strategies to ensure sustainable effluent application. In summary the site and soil conditions include:

- EMA 1 is located on moderately sloping elevated position underlain by medium clays, with downslope native vegetation. These soils have good nutrient uptake abilities but could become oversaturated if effluent application is undertaken beyond their capability, with the risk of effluent runoff. The northern boundary of the Site is located downslope and protection for surface runoff is a priority; and
- EMA 2 is located on a sandy alluvial plain that is flood prone. The natural hydrogeological conditions have been modified by installation of surface drains, thereby improving the ability of the soils to accept additional moisture. Groundwater is already impacted by historical farming practices. The area is a generally unused portion of the Site used for camping at the two main events only, and is ideal for surface irrigation to water the expansive grass area at times when the soils are not waterlogged.

5 Wastewater Generation

As discussed in Section 1.3, it is proposed to stage the growth of the SITG and Falls events as appropriate management of previous numbers has been shown to be successful. In addition, a number of medium, minor and small events are proposed, as well as construction of a conference facility including day spa treatment rooms. This will result in a modification to the timing and volume of wastewater generation, with a small baseload throughout the year, and 2-3 larger spikes as the medium-large events are held.

The conference facility would cease activities for a period prior to and following large and medium events to allow preparation for these. The conference centre and pods though may be utilised by the festival organising staff as a base of operations and accommodation during these events.

In accordance with the pre-existing approvals, it is proposed to convert the temporary wastewater treatment into a permanent solution, such that the volume of wastewater stored and treated on-site will be increased, reducing significantly the volumes being trucked to Byron and Ballina STPs for treatment.

Due to the differences and risks associated with storing and treating trade waste quality effluent from kitchen sullage during the medium-large events compared to the blackwater/greywater mix that is/will be generated from the amenities and conference centre, it is proposed to continue to remove all medium-large event kitchen waste off-site. The smaller kitchen volumes generated at the conference centre will be stored and treated on-site.

5.1 Offsite Approvals

NBP management met with Byron Shire Councils' Director of Infrastructure Services and the General Manager on the 12th of April 2018 to discuss wastewater quality issues. It was determined that a blending rate of 50% "black water" to 50% "greywater" would guarantee an acceptable receiving strength of wastewater directed to Council's STPs. This requirement was not clearly articulated in past trade waste agreements with only the term "acceptable blending" being documented.

NBP management and the events organisers have adopted the following policy measures to ensure these blending rates are complied with in the short term prior to construction of the permanent OSMS:

- All wastewater loads to be delivered to Council's STP to be diluted at a ratio of 50:50;
- Including the above blending requirements into a one-year contract with our wastewater management contractor (including penalties for non-compliance with Council' wastewater quality limits);
- Including the above blending requirements into the engagement letter of our potable water and liquid waste compliance consultant;
- Offering the Council Trade Waste Officer the mobile and email contacts of SITG's Event Manager (where the buck stops) to communicate any concerns during the event period; and
- Parklands to develop a concise procedure covering the above blending requirements and audit the implementation (or otherwise) of this procedure.

Once the OSMS is constructed, disposal to BSCs STP will not be required as greywater and blackwater will be treated onsite.

W&A understand that events held at NBP have ongoing agreements in place with Summerland Environmental located in Ballina Shire for treatment and disposal of trade (catering) waste. No trade waste is disposed of to Ballina or Byron Shire Council STP's. Following construction of the upgraded OSMS, trade waste will continue to be disposed offsite for treatment by Summerland Environmental.

5.2 Sources of Wastewater

Given that NBP's wastewater management system is largely 'off-grid', limited metered data is available on water supply and wastewater production.

Elite Waste are the provider of water supplies and wastewater movement at the SITG/Falls Festivals and have provided summaries of the carted in and out of liquids at these events. Elite Waste provided production tallies for the majority of festivals conducted to date. Elite Waste provided water supply total volumes, water usage not feeding to wastewater generation, wastewater production total volumes including breakdown into waste streams, as well as totals for a number of events (Table 10). Based on that W&A in conjunction with NBP staff estimated packaged (bottled) liquid supply volumes at the festivals plus other non wastewater generating water usage volumes such as dust suppression, fire tanks resupply, and incidental water losses.

W&A were provided detailed unit production values per person for portable toilet/compost toilets/urinals, shower greywater, food preparation and cleaning (Table 11) used by the festival organisers for planning purposes. The estimates have been successively refined after each year's events and following introduction of compost toilets, with the 2017 estimates providing the most realistic current rates.

The unit values are very low compared to published figures, and reflect the excellent water use reduction measures employed by NBP and the large event organisers with use of timed showers, dry compost toilets, and minimal water kitchen hygiene practices.

The water supply values correspond well with that modelled by W&A for the wastewater generated at the current SITG festival of 1.4ML (ratio of 0.6 wastewater to water) and JED Civil's current estimate of 2.34ML water demand (Appendix C), and provide W&A with confidence in the design for future expanded capacity.

The data shows that as compost toilets have been installed and water reduction practices implemented, wastewater production has decreased well below published values. The unique nature of wastewater production at NBP is common for commercial enterprises which usually do not fit neatly into published generation rates.

In any case new flow meters were recommended in the WWA for the treatment train of the OSMS. If during the initial establishment of the OSMS, unusual inflows are recorded, the OSMS design can be modified by adding additional storage or treatment tanks and/or increasing the irrigation area.

W&A utilised these unit and total production values (Table 12 and Graph 1) as a basis for further modelling of large, medium, small and minor events over a maximum 7 day event cycle (including camper in and camper out days), festival staff setup flows and pack down, and conference centre flows over a full 365 days per year total generation and storage. See Appendix C for the full 365 day modelling.

In estimating wastewater production at the conference centre as we do not have site specific data, we conservatively utilised published wastewater production values from AS/NZS1547:2012 for tank water, and in the case of overnight accommodation adjusted for compost toilet usage as water saving to model the expected daily wastewater total production.

An estimate of the sources and peak volumes of wastewater production calculated by W&A for the Site for the combination of events and conference centre with large event limited to 35,000 patrons (Stage 1) is presented in Table 13, for 42,500 patrons (Stage 2) is presented Table 14, and for maximum of 50,000 patrons in Table 15 and Graph 2.

It is planned to combine all greywater and compost seep liquid wastewater streams from each event and the conference centre in a series of holding tanks, and to treat and apply the wastewater at a throttled daily rate, gradually reducing the storage volume in the holding tanks between the two large events each year.

As can be seen:

- The design peak daily wastewater generation at SITG (large festival) is 475kL/day, increasing to 534kL/day with a capped 50,000 patronage;
- The design daily peak wastewater generation at The Falls (large festival) at Stage 1 through Stage 3 would be 540kL/day;
- Smaller wastewater generation rates of 266kL/day for medium festival days, 47kL/day for small festival days, and 6kL/day for minor festival days are calculated; and
- The conference centre could generate up to 17kL/day during full capacity and up to 9.6kL/day as accommodation for festival staff.

Total annual volumes also depend on the timing, duration and frequency of events throughout the year. This has been modelled in detail to assess storage and treatment requirements (Section 5.3) (Appendix C), and indicates that the total annual estimated wastewater generation for NBP for Stage 3 is 9,235kL.

Table 10: Provided Large Event Peak Water Balance (Supply Versus Demand)

Event	Year	Water Supply (kL)			Wastewater Production (kL)			Non-Wastewater Gen Uses (kL)*				Water Lost (kL) (11)	Total Wastewater Gen and Non Wastewater Gen (kL) (4+5+6+7+8+9+10+11 = 12)	WW:W**	WU:WD***
		"Trucked and Harvested Potable Water Supply (1)	Pre-packaged beverages consumed (2)	Total water consumed (1+2 = 3)	Greywater (4)	Black (5)	Catering (6)	Dust Suppression (7)	Equipment washdown (8)	Pools (9)	Fire Tanks (10)				
Falls	2015-2016	2,540,500	387,200	2,927,700	1,206,201	146,400	133,100	385,000	46,000	134,000	184,000	116,160	2,350,861	0.5	0.9
	2016-2017	2,178,500	387,200	2,565,700	1,100,600	164,900	65,950	229,000	46,000	134,000	184,000	116,160	2,040,610	0.6	0.9
	2017-2018	2,425,500	387,200	2,812,700	1,210,635	159,200	60,200	362,000	46,000	134,000	184,000	116,160	2,272,195	0.6	0.9
SITG	2014	2,460,100	612,000	3,072,100	1,338,500	272,400	177,100	286,000	46,000	0	184,000	196,560	2,500,560	0.7	1.0
	2015	2,090,500	612,000	2,702,500	1,217,700	269,200	161,400	165,000	46,000	0	184,000	196,560	2,239,860	0.7	1.1
	2016	2,346,500	612,000	2,958,500	1,135,000	354,000	209,600	253,000	46,000	0	184,000	196,560	2,378,160	0.6	1.0
	2017	2,341,000	612,000	2,953,000	1,173,500	269,000	167,500	271,000	46,000	0	184,000	196,560	2,307,560	0.6	1.0

*** Includes dust suppression, fire tanks, medics, urinals, showers, catering, laundry, main stage**

**** Ratio of wastewater production to water supply**

***** Ratio of total water in to water out (includes wastewater and other water outs)**

(1) This figure includes water harvested onsite, purchased and transported to site AND water that may have been stored in various tanks from the previous festival.

(2) Nominally 4L of beverages/p/day x32,500 STIG visitors and 5,750 staff, or 22,500 Falls visitors and 1,700 staff. 3 days main, 2 shoulder days at 50%.

(4) Greywater system capacity of 920kl plus some greywater for each event is stored in various Amenity Block greywater tanks. This greywater is transferred to the GWMS as storage space becomes available.

(5) Blackwater generated from temporary port-a-loos sent to Byron Shire Council STP under a trade waste agreement. Port-a-loos will be replaced by composting toilets as part of this proposal meaning no blackwater being sent offsite.

(7) Potable water used to suppress dust along 11km of internal gravel roads. Quantities vary depending on meteorological conditions. Falls tends to be drier and dustier than SITG.

(8) Potable water used to wash down 1,100 walkboards, outdoor tables, tents and other festival infrastructure.

(9) Falls has 8 x 10,000 litre pools and 2 x 27,000 litre pools for their summer event (approved by Byron Shire Council). This figure does not include top up water.

(10) The events each have 8 fire fighting tanks (23,000 litres) which are filled and emptied for each event. The fire tank water is utilised between events for general site watering.

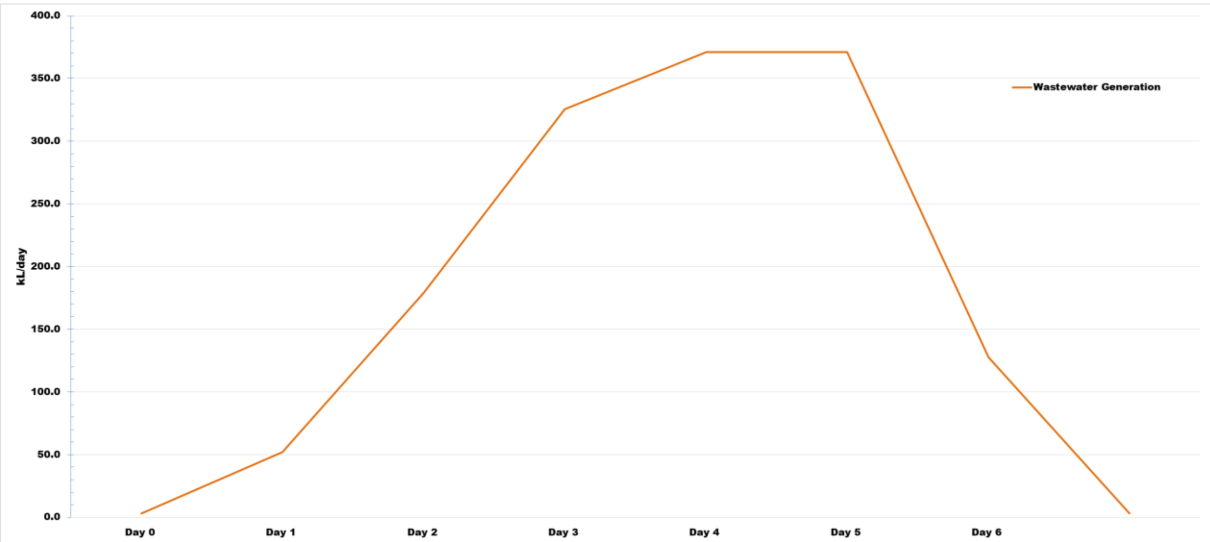
(11) Water losses due to spillage from trucks during refills, catering from sinks, bars onto the ground and sweating of patrons/staff (0.1L/p/hr over 12 hours). 3 day main event and 2 shoulder days at 50%.

Table 11: Provided Unit Wastewater Production Values

Source	Rate (L/p/day) Day only Event Users	Rate (L/p/day) Campers	Rate (L/p/day) Staff
Blackwater	2.5	0	1.5
Greywater	0	13.0	1
Food prep/cleaning	1.25	0	1.25
Total wastewater	4.75	13.0	3.75

Table 12: Sources and Unit Volumes of Wastewater Existing (32.5K people)

Source	Typical Wastewater Flow Design Allowance (L/p/day)*	Unit	Number	Design Wastewater Flow (L/day)
Splendour in the Grass (Large)				
Staff	2.5	Number	5750	14,375
Day Visitors	2.5	Number	32500	81,250
Campers	13	Number	17500	227,500
Food Prep	1.25	Number	38250	47,813
Wastewater Generation			Total	370,938
Falls Festival (Large)				
Staff	2.5	Number	1700	4,250
Day Visitors	2.5	Number	22500	56,250
Campers	13	Number	20000	260,000
Food Prep	1.25	Number	24200	30,250
			Total	350,750



Graph 1: Existing Wastewater Production Cycle SITG

Table 13: Sources and Unit Volumes of Wastewater Stage 1

Source	Typical Wastewater Flow Design Allowance (L/p/day)*	Unit	Number	Design Wastewater Flow (L/day)
Splendour in the Grass (Large)				
Staff	2.5	Number	4888	12,220
Day Visitors	2.5	Number	35000	87,500
Campers	13	Number	25000	325,000
Food Prep	1.25	Number	39888	49,860
			Total	474,580
Falls Festival (Large)				
Staff	2.5	Number	4888	12,220
Day Visitors	2.5	Number	35000	87,500
Campers	13	Number	30000	390,000
Food Prep	1.25	Number	39888	49,860
			Total	539,580
Regional Festival (Medium)				
Staff	2.5	Number	2500	6,250
Day Visitors	2.5	Number	25000	62,500
Campers	13	Number	12500	162,500
Food Prep	1.25	Number	27500	34,375
			Total	265,625
Regional Festival (Small)				
Staff	2.5	Number	500	1,250
Day Visitors	2.5	Number	5000	12,500
Campers	13	Number	2000	26,000
Food Prep	1.25	Number	5500	6,875
			Total	46,625
Regional Festival (Minor)				
Staff	2.5	Number	150	375
Day Visitors	2.5	Number	1500	3,750
Campers	13	Number	0	0
Food Prep	1.25	Number	1650	2,063
			Total	6,188
Conference Centre				
Staff	15	Number	15	225
Day Visitors	21	Number	180	3,780
Spa Staff	15	Number	10	150
O/N Patrons	106.5	Number	120	12,780
			Total	16,935
Conference Centre + Minor Festival				
Conference festival accom	106.5	number	90	9,585

Note: Staff numbers are estimated full-time equivalents on site per day, averaged over the event.

Table 14: Sources and Unit Volumes of Wastewater Stage 2

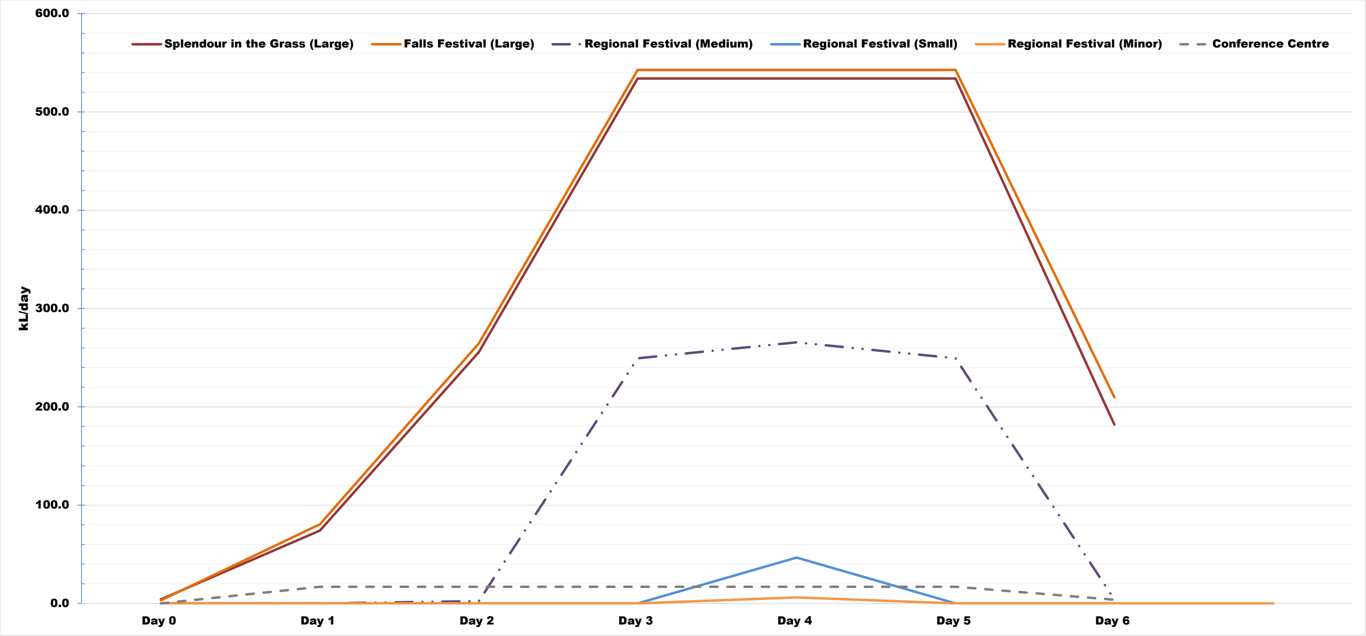
Source	Typical Wastewater Flow Design Allowance (L/p/day)*	Unit	Number	Design Wastewater Flow (L/day)
Splendour in the Grass (Large)				
Staff	2.5	Number	4888	12,220
Day Visitors	2.5	Number	42500	106,250
Campers	13	Number	25000	325,000
Food Prep	1.25	Number	47388	59,235
			Total	502,705
Falls Festival (Large)				
Staff	2.5	Number	4888	12,220
Day Visitors	2.5	Number	35000	87,500
Campers	13	Number	30000	390,000
Food Prep	1.25	Number	39888	49,860
			Total	539,580
Regional Festival (Medium)				
Staff	2.5	Number	2500	6,250
Day Visitors	2.5	Number	25000	62,500
Campers	13	Number	12500	162,500
Food Prep	1.25	Number	27500	34,375
			Total	265,625
Regional Festival (Small)				
Staff	2.5	Number	500	1,250
Day Visitors	2.5	Number	5000	12,500
Campers	13	Number	2000	26,000
Food Prep	1.25	Number	5500	6,875
			Total	46,625
Regional Festival (Minor)				
Staff	2.5	Number	150	375
Day Visitors	2.5	Number	1500	3,750
Campers	13	Number	0	0
Food Prep	1.25	Number	1650	2,063
			Total	6,188
Conference Centre				
Staff	15	Number	15	225
Day Visitors	21	Number	180	3,780
Spa Staff	15	Number	10	150
O/N Patrons	106.5	Number	120	12,780
			Total	16,935
Conference Centre + Minor Festival				
Conference festival accom	106.5	number	90	9,585

Note: Staff numbers are estimated full-time equivalents on site per day, averaged over the event.

Table 15: Sources and Unit Volumes of Wastewater Stage 3

Source	Typical Wastewater Flow Design Allowance (L/p/day)*	Unit	Number	Design Wastewater Flow (L/day)
Splendour in the Grass (Large)				
Staff	2.5	Number	5750	14,375
Day Visitors	2.5	Number	50000	125,000
Campers	13	Number	25000	325,000
Food Prep	1.25	Number	55750	69,688
			Total	534,063
Falls Festival (Large)				
Staff	2.5	Number	4888	12,220
Day Visitors	2.5	Number	35000	87,500
Campers	13	Number	30000	390,000
Food Prep	1.25	Number	39888	49,860
			Total	539,580
Regional Festival (Medium)				
Staff	2.5	Number	2500	6,250
Day Visitors	2.5	Number	25000	62,500
Campers	13	Number	12500	162,500
Food Prep	1.25	Number	27500	34,375
			Total	265,625
Regional Festival (Small)				
Staff	2.5	Number	500	1,250
Day Visitors	2.5	Number	5000	12,500
Campers	13	Number	2000	26,000
Food Prep	1.25	Number	5500	6,875
			Total	46,625
Regional Festival (Minor)				
Staff	2.5	Number	150	375
Day Visitors	2.5	Number	1500	3,750
Campers	13	Number	0	0
Food Prep	1.25	Number	1650	2,063
			Total	6,188
Conference Centre				
Staff	15	Number	15	225
Day Visitors	21	Number	180	3,780
Spa Staff	15	Number	10	150
O/N Patrons	106.5	Number	120	12,780
			Total	16,935
Conference Centre + Minor Festival				
Conference festival accom	106.5	number	90	9,585

Note: Staff numbers are estimated full-time equivalents on site per day, averaged over the event.



Graph 2: Maximum Wastewater Production /Day / Event (Stage 3)

5.3 Wastewater Characteristics NBP

Influent testing data was provided to W&A from SITG and Falls festival events in 2016 (SITG data reproduced in Table 16). This shows that the large events generally provide a low strength influent of similar to weaker strength effluent compared to a domestic system as the inputs only include amenities (compost toilets seep and showers).

The wastewater characteristics will vary with expected wastewater loads form the conference centre kitchen and laundry, but given the use of commercial grease arrestors sized to DWE (2009) trade waste requirements, general domestic nature of accommodation, and the small volumes, it is expected that the above influent concentrations from The Falls and SITG festivals are the dominant chemistry for influent to the NBP treatment system.

Table 16: Existing SITG Influent Quality

Parameter	Units	FALLS Greywater	SITG Shower	SITG Compost Seep	SITG Tank 1	SITG Tank 2	Falls Tank 1	Falls Tank 2	Adopted Conc. To Treat	Typical Domestic Quality*
Date		12/5/16	25/7/16	25/7/16	25/7/16	25/7/16	2/1/17	2/1/17		
Oil & Grease		4	-	-	-	--		-		
BOD	mg/L	6	147	5,520	580	480	440	540	450	200-300
TSS	mg/L	4	58	400	140	93	160	120		200-300
EColi	cfu/100 ml	10	$8x10^3$	$1.6x10^4$	921	$2.4x10^4$	9.2×10^6	5.4×10^6	1×10^7	10^3-10^{10}
Total N	mg/L	60.4	2	4740	480	374	236	311	380	20-100
Total P	mg/L	25	47	358	38	27	23.2	26.1	38	10-25

Note:

Compost seep is the raw concentrated liquid prior to shandying in the holding tanks and is diluted by greywater.

Tank 1 and 2 are two of the main holding tanks and contain the mixed liquor of shower water and compost seep.

***	Domestic values from DLG (1998)**

6 Recommended On-Site Sewage Management System

6.1 Options Analysis for NBP

W&A assessed a number of wastewater treatment and land application combinations for the Site. The options for compost solids, wastewater treatment systems, disinfection and EMAs were considered. The use of two separate EMAs, one being subsurface absorption beds in the hills and the other seasonal surface spray irrigation on the low-lying areas that experience seasonal flooding were considered for effluent application. The options assessed are included in Table 17.

Table 17: Options Analysis

Option	Description	Pro	Con
C1	Compost solids to be incorporated into tree planting operations.	Beneficial reuse of the nutrients and organic matter in the compost solids.	Additional costs of additional handling and time to be able to reuse and handle the compost solids.
C2	Compost solids continue to be buried on-site.	No additional costs.	No beneficial reuse of resources.
T1	Secondary treatment in a recirculating textile packed bed filter.	High effluent quality. Minimal power use. Small treatment system footprint. Modular systems.	Slightly 'high-tech' solution. Not completely passive system as a pump operates periodically to recirculate the effluent.
T2	Secondary treatment through the use of septic tanks and reed beds for polishing.	Good effluent quality. Passive system. Custom sized.	Larger footprint. Minimal phosphorus reduction.
T3	Secondary treatment in a commercial aerated wastewater treatment system	Consistent good effluent quality. Many local service agents available for maintenance and repairs.	High energy consumption for blowers and pumps. Would be a 'high-tech' solution, not in keeping with the NBP ethos.
D1	Ultra Violet Light disinfection	No chemicals added to effluent. Effective disinfection method.	Power use of running UV lights. If not maintained or effluent turbidity becomes high is not effective.
D2	Chlorine disinfection (liquid or tablet)	Simple to manage. Minimal costs. Effective disinfection method.	Introduction of chlorine to the environment. Staff safety in handling chemicals. If effluent turbidity becomes high is not as effective.

Option	Description	Pro	Con
E1	Effluent application into absorption beds as the only EMA.	In soil storage allows for year round application of effluent regardless of rainfall or seasonal flooding.	The cost of an EMA that relies only on absorption beds is high as the beds must be able to accept effluent over a long period, which reduces the application rate suitable.
E2	Effluent application via surface spray irrigation on the low-lying plains used for camping.	Cheaper effluent application system. Beneficial reuse of the water and nutrients to maintain the camping area.	Area unable to be used during rain and flood events and in the lead-up to Site events, meaning effluent would need to be stored for longer periods and may not be all applied during a withholding period before the next large event.
E3	Effluent application via surface spray irrigation when available and a combination of storage and bed application when the surface spray area is not available.	Beneficial reuse of the water and nutrients to maintain the camping area. Reuse of the existing EMA as the bed application area.	Additional cost of having two separate EMAs. Staff need to be trained to operate and monitor two different EMAs.

6.2 Selected NBP Master OSMS Combination

Based on the options analysis, W&A recommend that the OSMS combination best suited for the Site at reasonable expected CAPEX and OPEX cost/benefit is (Graph 3):

- Option C1 - Reuse of compost solids for tree planting on the Site;
- Option T2 - Treatment of wastewater to a secondary level in a reed bed system;
- Option D1 - Disinfection of secondary treated effluent using chlorine disinfection; and
- Option E3 - Application by surface spray irrigation with reserve storage and IDBSF beds.

W&A built on the foundation work performed by Gilbert & Sutherland for the original NBP wastewater treatment system. The OSMS proposed under the Stage 2 works of the original approval consisted of a technological, resource (electricity) and capital intensive (infrastructure and media) treatment system including:

- Initial grit screening then addition of flocculent and clarification prior to:
- Primary and secondary treatment via aeration with air pumped through bottom mounted diffusers;
- Secondary to tertiary polishing by pumping through Zeolite and sand media filters;
- Disinfection through chlorine dosing;
- Storage in a large open dam in the middle of the festival precinct;
- Gravity flow through a series of surface wetland ponds; and

- Surface irrigation of an average 50.9kL/day onto 28,000m^2 forest plantation and 30,000m^2 grass, with proposed minimum 20m buffers to boundaries.

The above treatment system is similar to that installed and operated at the Woodford Folk Festival Site in Queensland. As part of the OSMS design for the Parklands project W&A discussed the operation of this plant with a member of the management team who confirmed that the treatment system is problematic in the install and operational cost, as well as requiring specialist input during operation. A client of the Woodford Folk Festival Site that we discussed the OSMS with, whom hired the site for a small festival, also separately commented on the high water usage of the flushing toilet type inputs into the OSMS and the resultant cost of utilising the venue.

NBP requested W&A to develop an OSMS that allowed the venue to maintain its triple bottom line of financial responsibility, as well as social and environmental credentials and aspirations. That is, a low energy and water use OSMS based around compost toilets. The OSMS design by W&A achieves a balance of utilising existing proven technologies (reed beds and surface irrigation), that operate mainly in a passive and biological manner, and that are suitably robust and easy to maintain/operate. Reed beds have a high acceptance rate and maintenance/installation contractors in the Northern Rivers of NSW with proven BOD/TSS/TN/FC retardation rates.

The design by W&A is partially a reconfiguration of the original design to:

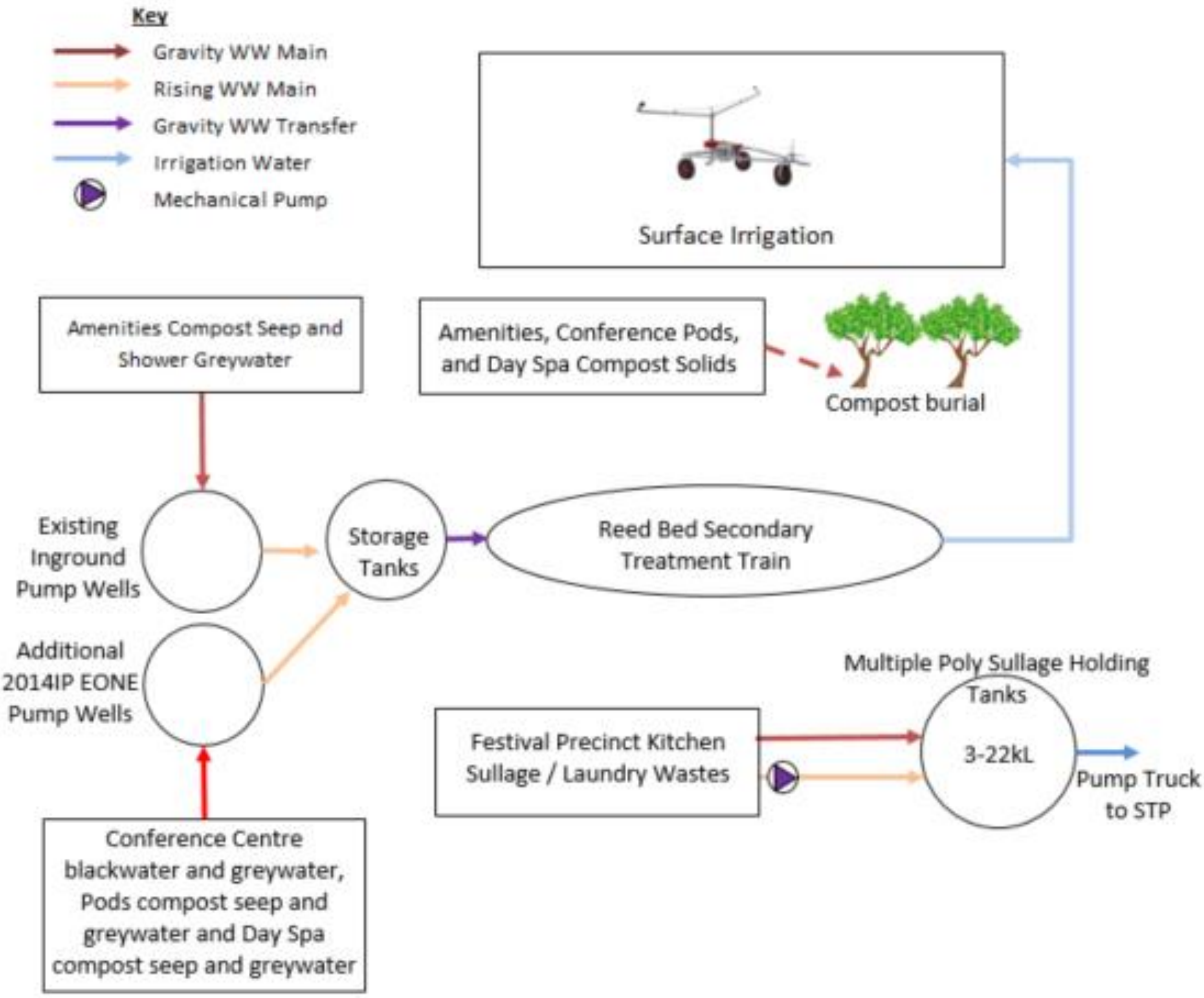
- Maximize distance of the treatment system to site users and reduce the risk of odour and complaints and health risks. The original design based the treatment system around the large dam adjacent to the main amphitheatre and secondary amphitheatre entertainment areas. The revised design places the treatment area over the forested ridgeline, well away from the public zone and off-site receivers;
- Maximize upfront storage during the peak short term rather than post treatment storage in the original design that requires a very large treatment system that is oversized for the majority of the year;
- Utilises reed beds rather than wetland polishing, providing similar treatment mechanisms;
- Is more robust and reliable in having parallel treatment trains rather than a single treatment train;
- Does not require use of oxidising chemicals (hydrogen peroxide) and the associated human health and environmental risks of spillage, plus environmental impact of production;
- Is more robust in that it utilises surface spray irrigation rather than a mix of drip/surface spray, given that drip irrigation can have maintenance and longevity issues; and
- Provides for a similar application rate of 35kL/day over 36,000m^2 disposal area (1mm/m^2), than 50.9kL/day over 58,000m^2 area (0.9mm/m^2).

7 Sewer Reticulation

To reduce the risk of vehicle/person interactions it is proposed to install reticulated sewer lines from each of the amenities pump wells up to the master distribution tank. Each pump well will have twin grinder pumps (duty and standby) with an automated and alternating pump controller with audio/visual high level alarm.

A series of 2014ip EONE pump wells will be installed downslope of the conference centre structures to capture the compost seep, blackwater, greywater and kitchen sullage, and pump up to the master distribution tank.

Further engineering designs are required to confirm pump sizing, route and pipe selection.



Graph 3: NBP Master OSMS Schematic

8 Recommended Treatment System

The Client has indicated they wish to implement the upgraded OSMS progressively as budgeting allows, with full installation prior to opening of the conference centre. In the short term the existing mix of compost toilets and storage tanks with limited IDSFB effluent application, coupled with festival vacuum truck off-site disposal will be maintained. It is expected that by August 2019 plans will be realised for the conference centre such that a permanent OSMS can be constructed.

8.1 Amenities Compost Toilets

Compost toilets are a mainstream solution for wastewater management that are efficient in that waste is separated into a blackwater component at the source. This leaves a lower strength greywater stream from hand basins and showers, and medium strength from food preparation to be dealt with separately.

There are two main types of compost systems, continuous and batch. Batch systems are increasing in popularity as they can be completely free standing and mobile. The individual batch bins can be much smaller than continuous flow composters, and because compost does not need to be progressively removed as in a continuous flow system there is less interaction with the pre-compost material to adjust and shape the “pile”. Once a bin fills up, it is removed and replaced with an empty bin, the full bin is stored for a period of months, then the compost material reincorporated into/onto the ground later and the bin recycled for reuse in the process. The NSW NP&WS on the mid and north coast favours batch compost toilets at their parks due to reliability, ease of operation, and WH&S features.

Batch compost units are excellent for festivals, as in the intervening period between festivals microbial and macro organism action reduces the volume of compost in the bin substantially such that a bin can take multiple festivals to fill up. Compost toilets are popular at festivals the world over, see Boom Festival in Portugal and Glastonbury in UK to name two international festivals, and Rainbow Serpent Festival in Victoria. SITG and Falls Festival have been operating batch style compost systems for at least three years with great success.

Boom festival in Portugal (Photograph 12) installed compost toilets in 2006. Compost is managed using time (6 months retention) and pile temperature (50° for 3 months). Glastonbury Festival is known for long drop style toilet systems, but these are being phased out and now has over 1,300 compost toilets, and four male only urinal locations.

Photograph 12: Boom Festival compost toilets.

NSW Health Advisory Note 1 (October 2016) for Exemption of Sewage Management Facilities (SMF) from Accreditation Application of Clause 41(2) of LG Regulation, allow for an exemption to accreditation for compost toilets if the SMF is specifically designed by a person other than the owner, specifically and uniquely for those premises. This approach has been undertaken for NBP.

Use of a pre-constructed batch bin is a practical solution that allows for bins to be easily and cheaply replaced if damaged. 240L wheelie bins are ideal in that they:

- Are fully sealed on the base and sides, are constructed of recycled plastic and are UV treated for long life;
- Have a set of wheels and handle for moving in and out of pickup bays and storage areas;
- Have a built in flippable lid that is watertight and relatively vermin free when closed; and
- Have commercially available trailer mounted bin haulage systems.

The amenities block buildings were designed to fit wheelie bin units by quicksmarthomes (Figure 6), with a row of 12 bins down one side of a block.

Sizing of wheelie bins to ensure sufficient volume is not required with a batch system, instead if bins become >3/4 full they are pulled out of line and a fresh bin wheeled in. One is only limited by the number of bins present. Currently 400 bins have been sufficient for 2 large festivals of maximum 32,500 persons per annum (1 bin/81.25 persons), and only a 3 month storage window. It is recommended to increase the storage window to 4 months with verification testing, and coupled with the additional persons proposed for large events plus with the medium, small and minor events additional bins will be required. W&A calculate that up to 1,000 bins will be required by Stage 3 expansion at NBR (Table 18). The second large event/annum will not generate additional bin numbers as the bins will be reset by the commencement of the second festival.

Table 18: Annual Compost Batch Bin Requirements

Use	Number of Bins
1x Large (50k)	615
1x Medium	307
5x Small	61
2x Minor	36
Total	1,019

As full bins are pulled out of use, they will be sealed and tagged, vermin proof venting pipe attached, relocated to the bin storage area (current compost burial zone), seepage taps connected to a storage tank to allow short term seepage. A compost bin plan of management will be required.

8.2 Conference Centre Pods and Day Spa Compost Toilets

Compost toilets require a more hands on approach to waste management that in a commercial environment requires good staff training and management and user education. Micro-flush compost units supplied by Ecoflo (Centrex 2000NE) (Photograph 13) are a good in-between solution as they incorporate a ceramic or plastic pedestal with a water trap, and multiple pedestals are able to be located up to 6m distance from the single composter unit. Plus, these are a rotating drum type unit that means minimal contact with the wastes until the treated product is emptied into the outlet bin. Such units provide a more usual flush type toilet, with the benefits a low water flow and compost solids generation.

Photograph 13: Sun-Mar Centrex 2000.

The Centrex 2000 has capacity for 4-6 persons fulltime, and a single unit will be shared between two pods, with a single unit located at the day spa reception. Compost seep will be collected in the pump well along with greywater for processing at the NBP Master OSMS.

8.3 Compost Solids

A Compost Management Plan (CMP) will be required to ensure the safe handling and burial of compost solids. Compost solids will be buried in the compost burial zone (Figure 3 and Figure 7) that covers 575m^2 area in a flood free elevated portion of the Site. Compost may also be buried during tree planting activities as part of the vegetation rehabilitation plan.

Compost is required to be buried at 100mm below the surface, and given the ability to choose the day of burial, non-raining conditions can be chosen. As such stormwater diversion is not considered applicable for small compost (tree planting and maintenance) locations. The compost burial location will have a stormwater diversion berm installed (Figure 7). Compost management and any stormwater management measures would be detailed in the CMP.

The amenities wheelie bins will be moved from the amenities buildings to a flood free covered storage area after each large event and composted for at least 5 months in the bins before being emptied out for tree planting activities. To confirm the quality of the conditioned compost the compost will be visually inspected to the general standards set out in Table A1 of Appendix A of AS/NZS1546.2 2008 (SAI 2008), which requires:

- The sample shall contain no recognisable faecal material;
- The material is to be brown colour with no yellow visible;
- There shall be no offensive odours from the composted end product immediately following removal from the chamber; and
- The material is not to be over wet (<75% by weight moisture).

Use of the compost solids at the surface as a soil/compost blend for landscaping may be possible if verification laboratory testing is undertaken to Table A1 of Appendix A of AS/NZS1546.2 2008 (SAI 2008).

8.4 Conference Centre Amenities

Standard 4 star flushing toilets and waterless urinals will be installed at the conference centre amenities. Low flow, timed, hand washing facilities will be provided at all amenities and at the day spa reception area and rooms.

8.5 Conference Centre Kitchen

Final details are not yet available on food preparation at the conference centre, but it is assumed that basic food preparation will be undertaken. As such a commercial grease arrestor will be required, to be sized up for the facility once a caterer is selected and applications made to operate to DWE (2009) trade waste requirements.

8.6 North Byron Parkland Master Storage System

Wastewater from each event will be stored in holding tanks before being incrementally treated over the following five to six months. W&A have undertaken detailed storage calculations over a 423 day cycle to confirm the ideal treatment rate required to minimise storage (Appendix C), whilst providing at least 1 months reset period between the two large festivals. The modelling is an iterative process with the ideal treatment rate identified as the storage volume plateaus.

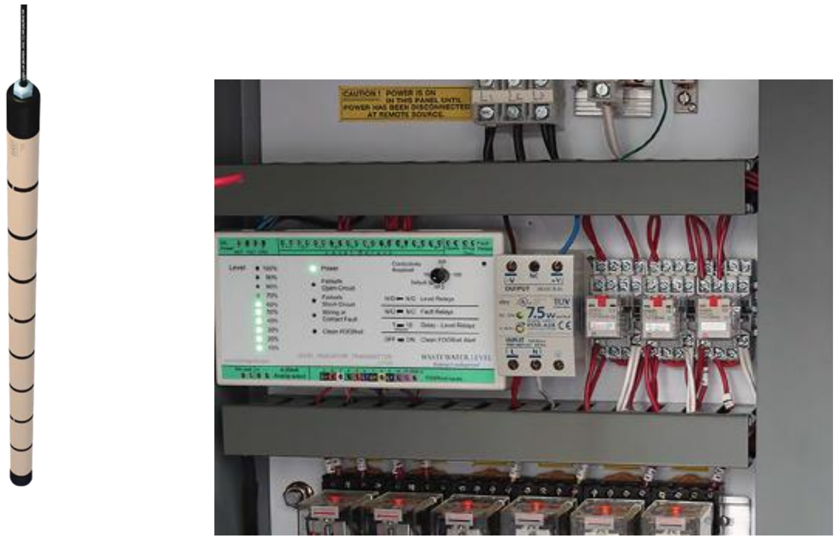
The storage volumes required for Stage 1-3 expansions are shown in Table 19. Given the minimal increase in treatment and irrigation requirements and maximum storage volumes between Stage 1 and 3 (32kL/day v 35kL/day treatment and 1,984kL v 2,384kL), the infrastructure installation and operating cost differences between the three stages are negligible and further discussions/designs are based on the Stage 3 scenario only. The storage volumes over 365 days are presented in Graph 5 below.

Currently 920kL of storage is available in 4 above ground holding tanks. It is proposed to replace this with 8 above ground storage tanks totalling a minimum of 2,400kL, and split into pairs for 4 parallel treatment streams. Parallel treatment streams will provide for a more robust operation as individual streams can be switched off for maintenance whilst maintaining temporary 75% treatment capacity.

Actual storage volume will be confirmed during final engineering design and will account for sludges accumulation into the tanks during holding, and buffer capacity in case of higher than expected wastewater flows. A final storage volume of around 2,800kL would be expected to allow for emergency flow conditions and sludge accumulation.

In addition to ensure safe operation of the treatment system, the distribution tank, storage tanks, septic tanks, reed beds and irrigation tanks would be reset to close to zero volume prior to a major festival to provide additional emergency storage volume if required. In the event that volumes are still increasing beyond acceptable levels, contracts are in place with Byron Shire Council for receiving emergency volumes. Though this is very unlikely and any volumes would be small.

It is expected that sensors will be placed in the storage tanks with continuous level monitoring and SMS messaging capability for pre-set high level and extreme level conditions such as that employed by the FOG-Rod system (Graph 4).



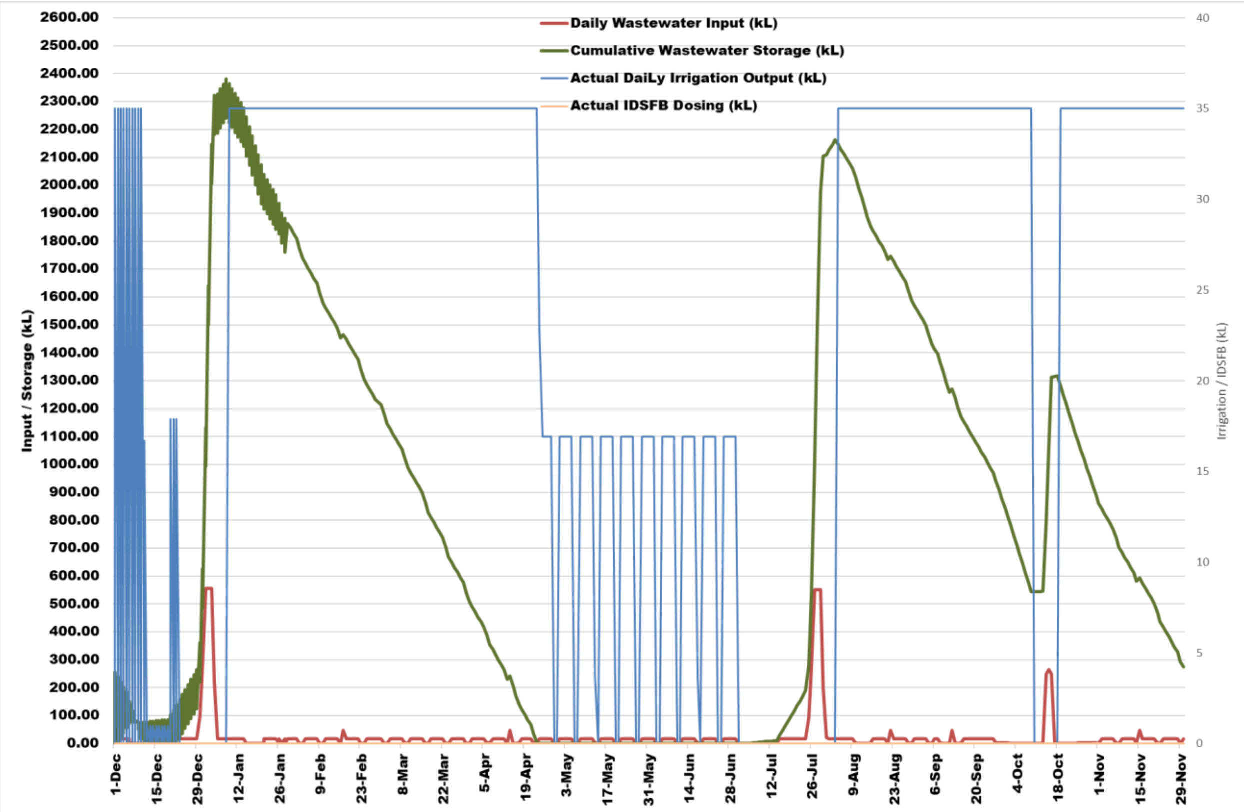
Graph 4: Storage Level Monitoring

As can be seen from Graph 5, the storage resets to 0kL such that there is three months of excess storage and irrigation capacity between The Falls and SITG festivals and at least four weeks between SITG and The Falls festivals. This excess storage/time provides reserve capacity in case of excess wastewater inputs into the storage tanks or as wet weather/saturated soils reserve storage capacity.

The medium sized festival event held over three consecutive days was nominally placed in October as this provides a strong stress test of the storage capacity as it sits between the STIG and Falls festivals, and given the likely staging based on climate and public holidays.

Table 19: Staged Storage and Irrigation Requirements

Stage	Sullage Removed Offsite (kL/annum)	Treatment and Irrigation Rate (kL/day)	Maximum Storage Volume (kL)
Stage 1	547	32	1,984
Stage 2	540	32	1,995
Stage 3	544	35	2,384



Graph 5: Wastewater Daily Input and Cumulative Storage Stage 3

8.7 North Byron Parkland Master Treatment System

The sizing of the required holding tank capacities, primary treatment tanks and reed beds for Stage 3 are compiled in Table 24. The pictographic of the NBP master treatment system for Stage 3 is shown in Graph 6, and location in Figure 9.

W&A recommend four reed bed treatment systems are run in parallel, which combined are capable of treating at least the required volume of wastewater to a secondary standard and provide the option of closing off one stream whilst maintaining 75% throughput, and completing maintenance, if required, between large events.

W&A have specified the expected effluent quality following the treatment system that is suitable for surface spray irrigation, and the exact supplier will be determined by a commercial tendering process once approval to install has been gained. The reed bed pods will be custom made concrete, likely poured on-site. The final details, vegetation mix and layout of the treatment system will depend on the contractor selected, and detailed designs of the treatment system are beyond the scope of this WWA. It is expected further engineering design will be completed for s68 approval.

8.7.1 Septic Tanks

Preliminary septic tank sizing has been completed (Table 20) utilising the formula from SAHC (1995), using the formula

Tank Size = sludge accum rate * Avg persons per day * desludging frequency + max hydraulic load * maximum number of persons per day

This formula provides for a preliminary estimate of septic tank sizing based on 24hr Hydraulic Retention Time (HRT) based on typical BOD loading. Previous laboratory testing of BOD concentrations in influent water in the existing holding tanks suggests BOD concentrations and mass loading are generally within a domestic range; and given the volume and HRT within the storage tanks themselves further BOD reductions are expected. Septic tank sizing will be confirmed during final engineering design.

Table 20: Septic Tank Sizing

Parameter	Units	Value	Comment
Sludge accumulation rate	L/year	25	Based on mainly greywater source and allowing for pre-treatment in storage tanks
Average number persons	p/day	1648	over 365 days/annum
Maximum number persons	p/day	2397	35,000L/day total throughput and 14.6L/p/day
Desludging frequency	years	1	
Maximum hydraulic load	L/p/day	14.6	As provided by NBP
Total Septic Tank Size	L	77,000	Divided into 4 parallel treatment trains of 19,250

8.7.2 Reed Beds

Reed beds have been proven under numerous trial, research and actual operating conditions in the Northern Rivers area of NSW. Many peer reviewed research articles have been prepared on their efficiency including Crites, R and Tchobanoglous (1998), Davison etal (2002, Headley etal (2003a) and Headley etal (2003b).

Headley etal (2003a) reported that based on 28 separate studies of reed beds receiving greywater dominated wastewater for 5.2days HRT, had average treatment performance of 83.8% BOD reduction, 81.5% TSS reduction, 62% TN reduction, 46.8% TP reduction and 1.8log FC reduction (Table 21). Similar treatment performance where measured for combined wastewater streams.

An increase of HRT improves the performance of a reed bed in treating BOD, TSS, TN, TP and FC.

Table 21: Reed Bed Treatment Performance (from Headley etal 2003a)

Wastewater type		HRT days	BOD % reduction	TSS % reduction	TN % reduction	TP % reduction	FC log reduction
Combined*	Mean	8.9	92.5	88.7	60.2	25.0	2.5
Greywater	Mean	5.2	83.8	81.5	62.0	46.8	1.8
Laundry	Mean	6.1	61.2	82.7	62.4	31.9	0.8
School	Mean	11.5	74.9	79.3	38.1	33.7	1.7
All studies	Mean	8.3	81.3	82.9	56.5	34.9	1.9
	Min	3.7	34.7	55.9	8.1	−21.7	0.4
	Max	17	96.6	97.9	93.8	76.6	3.3
	n	32	28	23	24	26	27

*Combined wastewater = domestic blackwater and greywater

Reed bed sizing calculations were undertaken separately by W&A (Table 22 and Table 23) and were included in the waterbalance model approved by Byron Shire Council. W&A calculated a reed bed required area of 466m^2, whilst the alternative model approved by Byron Shire Council calculated an area required of 244m^2. W&A conservatively adopted the larger footprint, and there is potentially capacity within the reed beds to treat larger than design hydraulic flows.

The W&A's modelling indicates that there would be no reed bed overloading. The treatment train has been designed to hold all wastewater for a total of 9 days prior to and following the two large events, with subsequent controlled 35kL/day release through the primary tanks and reed beds. If due to poor weather wastewater can be held for further days in the storage tanks or a smaller controlled treatment and discharge into the IDSFB.

Table 22: Reed Bed Modelling

Inputs	Value	Units	Description
Hydraulic load	35	kL/day	Daily max wastewater load
t	7	days	Hydraulic Residence Time
T	19	deg C	Water temperature
BOD C_{in}	150	mg/L	Influent pollutant concentration from onsite testing. Pre treatment 450mg/L reduced in septic tank to 150mg/L.
k_v	**0.546**	n/a	first-order volumetric reaction rate coefficient
BOD C*	**5**	mg/L	Background pollutant concentration
TN C_{in}	190	mg/L	Influent pollutant concentration from onsite testing. Pre treatment 380mg/L reduced in septic tank to 190mg/L.
TN k_v	**0.2**	n/a	first-order volumetric reaction rate coefficient
TN C*	**1.5**	mg/L	Background pollutant concentration

Inputs	Value	Units	Description
TP C_{in}	22.8	mg/L	Influent pollutant concentration from onsite testing. Pre treatment 38mg/L reduced in septic tank to 22.8mg/L.
TP k_v	**0.11**	n/a	first-order volumetric reaction rate coefficient
TP C*	**0.02**	mg/L	Background pollutant concentration
TSS C_{in}	26	mg/L	Influent pollutant concentration from onsite testing. Pre treatment 130mg/L reduced in septic tank to 26mg/L.
HLR	**0.066**	m/day	Hydraulic Loading Rate
FC C_{in}	100,000	cfu/100ml	Influent pollutant concentration from onsite testing. Pre treatment $1x10^7$mg/L reduced in septic tank to $1x10^5$mg/L.

Table 23: Reed Bed Sizing

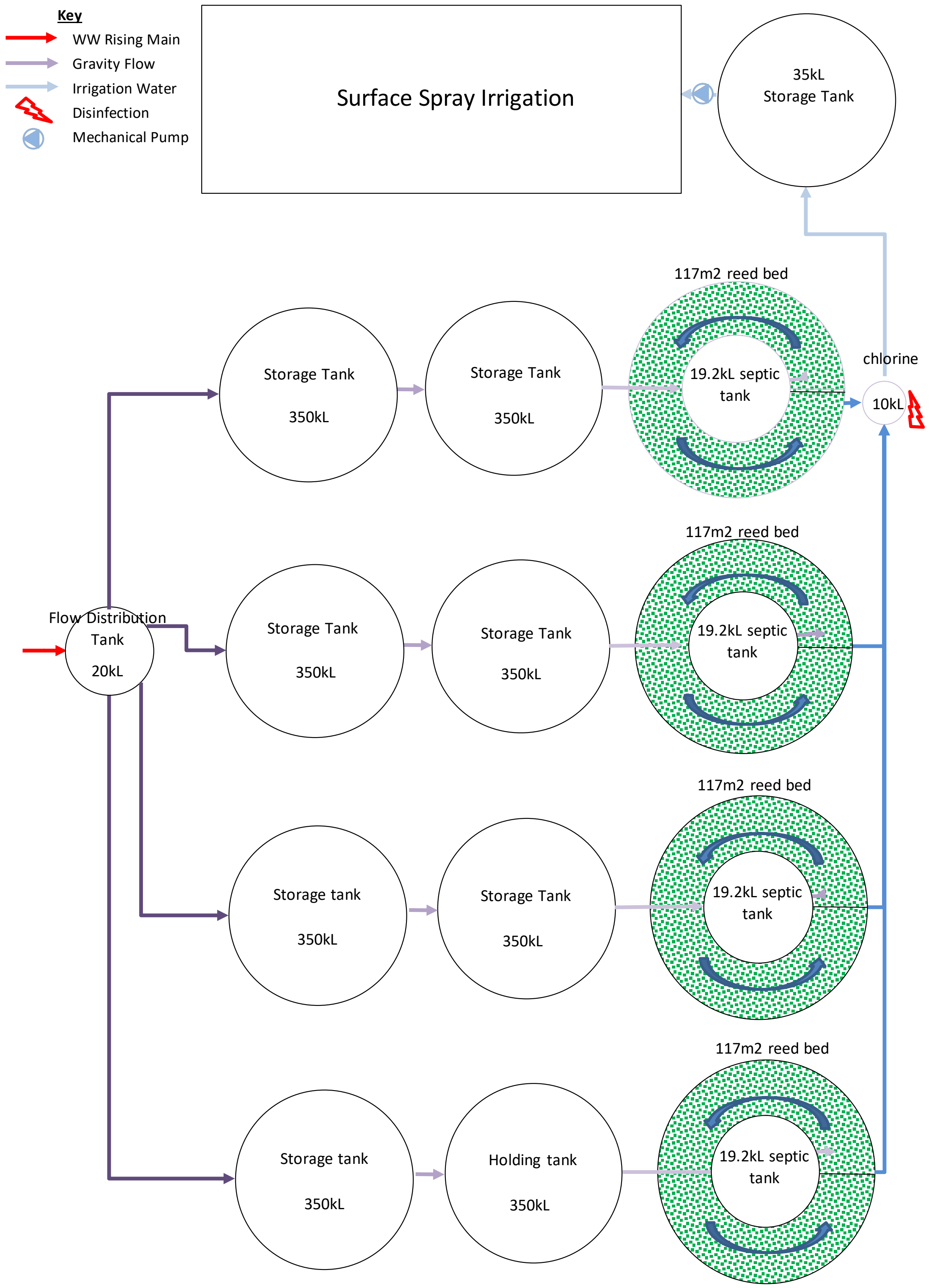
Parameter	Value	Unit	Description
Substrate depth	1.5	m	
Porosity	0.35	n/a	For 10-20mm aggregate
Surface area	**467**	m^2	Using nominated HRT
Minimum width	**15.2**	m	Based on preventing substrate clogging
Adopted width	12.0	m	Typically based on construction logistics but must be > minimum width
Length	**38.9**	m	
L:W Ratio	**3.2**		Ratios between 3:1 and 1:1 favoured.
BOD	**8**	mg/L	=((BOD Cin-BOD C*)*(EXP(-BOD*BOD Kv*t))+BOD C*)
TN	**48**	mg/L	=((TN Cin-TN C*)*(EXP(-TN Cin*TN Kv*t))+TN C*)
TSS	**3**	mg/L	=TSS Cin*(0.1058+(0.11*HLR))
TP	19.8	mg/L	=((TP Cin-TP C*)*(EXP(-TP Cin*TP Kv*t))+TP C*)
Faecal coliform	**100**	cfu/100ml	Indicative based on residence time and 2-4 log reduction.

8.7.3 Summary of Treatment Train

The preliminary sizing of the treatment train is presented in Table 24 below, and a schematic is presented in Graph 6.

Table 24: Summary of Treatment Tanks Sizing

Parameter	Units	Size
Stage	Person	Stage 3
Flow Distribution Tank	kL	30 (nominal)
Storage Tank	kL	2,200 (550 per stream)
Daily Treatment	kL/day	35 (8.75 per stream)
Septic Tank Size (1 year desludging frequency)	kL	77 (19.2 per stream)
Reed Bed Pod (1.5m deep)	m^2	467 (116.75m^2 per stream)
Disinfection Tank	kL	15 (nominal to allow minimum 0.5hr contact time based on 32.5kL/day treatment)
Irrigation Holding Tank	kL	35 (nominal 1 day storage)



Graph 6: Schematic of NBP OSMS Treatment System for Stage 3

8.7.4 NBP Treated Effluent Quality

The expected secondary effluent quality following treatment will meet as shown in Table 25 and is compared to the classification for low strength effluent from NSW DEC (2004). This will enable sustainable and safe irrigation application.

Table 25: Expected Effluent Quality

Parameter	Units	Effluent Value	Target Low Strength
BOD	mg/L	8	<40
TSS	mg/L	3	-
TDS	Mg/L	<650	<650
Faecal coliforms	cfu/100ml	<30*	<1,000
Residual Chlorine	mg/L	0.2-2*	
Total N concentration	mg/L	<48	<50
Total P concentration	mg/L	<19.8	<10
* **Following chlorine disinfection**			

8.7.5 Disinfection

Disinfection by definition is removal of disease forming organisms such as virus and bacteria. The risk based approach built into the NSW DPI Guidelines for Recycled Water Management Systems (2015), provides for chlorination, ozonation or Ultraviolet (UV) as disinfection methods.

W&A have adopted chlorine for disinfection. Chlorine is the most common form of disinfection in decentralised (on-site) wastewater treatment and application systems. Chlorine was selected over UV for NBP as if applied in tablet form requires no electricity to operate, is robust with no moving parts or lamps, blockages or failures are rare and if present are easily rectified with minimal experience and tools, and disinfecting action (residual chlorine) can easily be measured onsite using residual chlorine DPD titrimetc test kits (swimming pool or more advanced ORP probes) and the results are immediate (unlike UV where bacteriological testing must be undertaken at a laboratory).

Disinfection was factored into the risk based approach to irrigation using the Log Reduction Values (LRV) method of the NSW DPI Guidelines (2015) (Section 10.1 of this WWA), and application of undisinfected effluent could have been possible for NBP given the lack of public access or sensitive adjacent receptors, that sufficient buffers to drains were provided plus vegetative uptake, and the constructed drains do not directly discharge into a waterway for some kilometres.

Disinfection though was felt appropriate given the irrigation method for protection of workers from spray drift and to the environment in case of runoff, and in accordance with the earlier approved wastewater treatment system for NBP.

Chlorine dosing of calcium hypochlorite tablets would be undertaken. Tablet form enables easy storage of the chlorine in 10-25kg tubs, that are easily replaced in small quantities thereby reducing the requirement for bulk storage facilities. Liquid chlorine dosing requires use of liquid chlorine that though more efficient poses higher safety risks and a mechanical dosing pump.

Tablet dosing inline in a channel ensures continuous contact with the wastewater, with the dosing automatically adjusted with more surface area contact if higher flows pass down the channel, so overcome some of the issues of liquid dosing.

Calculation of the actual volume of chlorine required is complicated due to the mixing, contact time, concentration within the tablet, turbidity/suspended solids of influent, temperature, pH, number of organisms prior to disinfection, and types of organisms.

The dosing of chlorine needs to overcome the breakpoint, where chlorine is consumed by ammonia and other oxidisable substances in the wastewater before disinfection will occur. Crites & Tchobanoglous (1998) provide equations 12-49 and 12-50 to calculate chlorine dosage requirements. Allowing following reedbed treatment, coliform concentrations will be in the order of $1x10^2$-$1x10^3$ coliforms; to disinfect effluent down to 30/100ml with a 30 minute contact time, we calculate that a dosage of 8.5mg/L is required.

Chlorine tablets contain about 65% chlorine, and allowing for 8.5mg/L dosing and 35,000L//day treated this equate to 0.46kg/day of tablets.

An example chlorine tablet dosing system that would be suitable is the Lonza 35kg Briquette Feeder System. This system can feed 0.2kg-35kg/day of their proprietary Constant Chlor Briquettes (0.15-24kg available chlorine dosage), enabling passive (no electricity) dosing of a treatment system through putting up to 8,000,000L/day.

Lonza briquette feeder system and bucket (not to scale)

A 10kg bucket (safe handling weight) would last 21.7days. Allowing for two months storage onsite that would be 2.86 (3) 10kg buckets. In is envisaged that a dedicated, rain proof and ventilated storage shed would be provided to house the feeder system and tablet buckets.

9 Recommended Irrigation Area

9.1 Irrigation Area Sizing

Water balance modelling was undertaken to determine sustainable effluent application rates for surface irrigation for 35kL/day, and from this estimate the necessary size of the EMA required for effluent to be applied from a secondary treatment system with disinfection to a surface irrigation area with the existing 24 bed IDSFB field as a back-up area.

Two models were run to confirm and doublecheck the sizing required for the irrigation area:

1. The Byron Shire Council OSMS Design Model was used for initial sizing of the irrigation area. This is a daily timestep model and non-default parameters were inputted to allow for compost toilet usage coupled with reduced wastewater production per person; and

2. Medli V2 was run for the irrigation area calculated by the Byron Shire Council OSMS Design Model to confirm suitability of this area for grass growth, leaching, nutrient impacts and pathogen impacts.

Both the Byron Shire Council OSMS Model and Medli V2 are daily balance models using extensive historical rainfall and evaporation data, and the concept of cascading bucket soil layers using the lower storage limit and drained upper limit of soil moisture to model the ability for soil profile layers to accept wastewater. The Byron Shire OSMS Model has been customised for domestic like OSMS scenarios, has local region specific soil input parameters, and has the ability to calculate reed bed sizing as well as absorption trench disposal area sizing.

The Medli V2 model is primarily a larger rural industries (eg. abattoir) type model, has limited treatment system modelling capability except for large facultative or anaerobic ponds, is primarily focussed on irrigation including cropping type systems, but has more comprehensive algorithms for assessing irrigation long term sustainability and crop health, nutrient and salt transport, groundwater contamination and pathogen contamination modules.

9.1.1 Byron Shire Council OSMS Model

The reader is referred to the user manual for the Byron Shire Council OSMS Model on the available parameters and assumptions (https://www.byron.nsw.gov.au). The Byron Shire Council model input data adopted by W&A and results of modelling are presented in Table 26, and modelling calculation sheets are presented in Appendix D.

Table 26: Byron OSMS Surface Irrigation Field Modelling

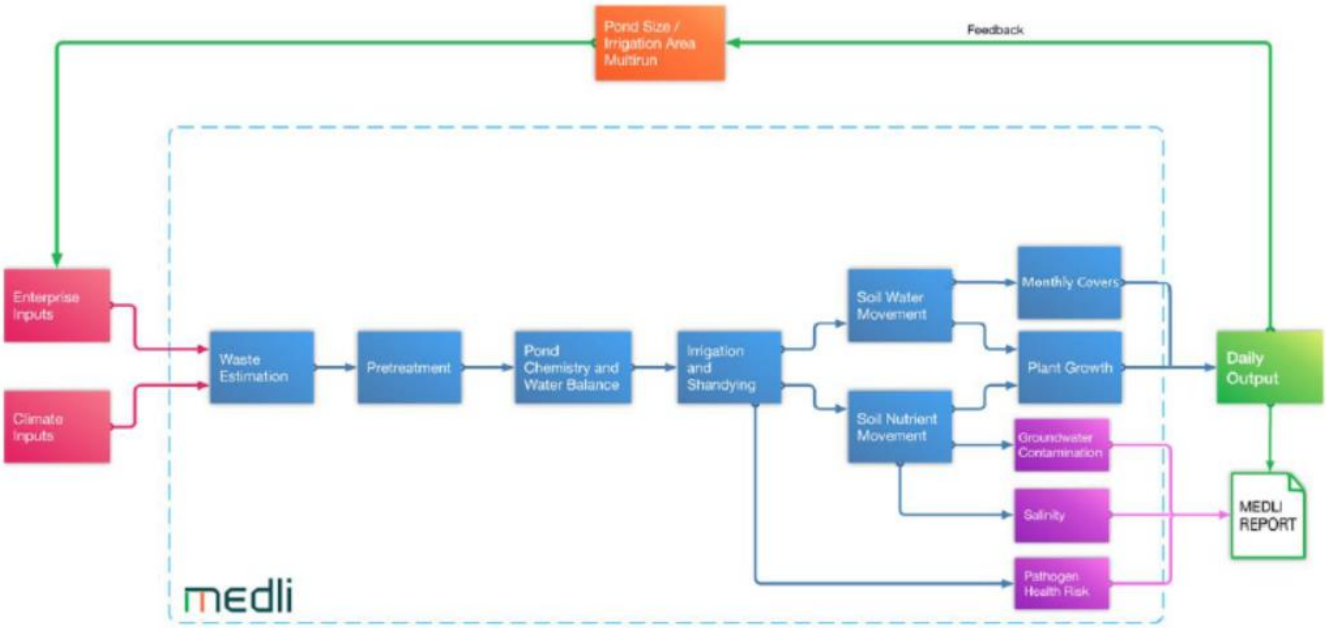
Data Parameter	Units	Value	Comments
Hydraulic load	kL/day	35	Daily treatment volume
Treatment Combination		Septic and reedbed	
N Production	kg/p/yr	3.36	
P Production	kg/p/yr	0.10	
Water Table Depth	m	0.6	
Soil Type		Podzol	1000kg/ha/m P sorption
Precipitation	mm/month	Byron	Byron data
Pan Evaporation	mm/month	Byron	Byron data
% Effective Rainfall		Level bed with grass	
Soil Texture in Root Zone		Loams	
Design Percolation Rate (DPR)	mm/day	5	Based on clay loam soil and secondary treated effluent from Byron Shire Council OSMS Design Model.
Area required for hydraulic sizing	m^2	14,377	Hydraulic limiting
Area required for water balance	m^2	36,008	
Area required for nitrogen	m^2	5,474	
Area required for phosphorus	m^2	2,871	

Effluent must be applied in a series of surface irrigation areas designed for peak hydraulic loading, being at least 36,000m^2 (Figure 8). Six zones of 6,000m^2 have been nominated to allow for rotation of the irrigation area. Actual irrigation will vary as storage levels are reduced and weather requirements dictate.

To reduce the risk of irrigation failure and effluent export, irrigation will be undertaken progressively across the area so that soils can dry out prior to re-application, thereby maximising the rate of oxygenation and nitrogen volatilisation.

9.1.2 Medli Modelling

The Medli model was updated in 2016 to V2. Detailed explanations of the Medli model are provided in the User Manual (QLD DE&S 2016a) and Technical Manual (QLD DE&S 2016b) (https://www.des.qld.gov.au/science/government/science-division/medli/). Figure 1-1 of the Technical Manual provides an overview of the Medli modules (see Graph 7 below), and Table 1-1 (see Table 27 below) provides a list of the models utilised in the overall Medli program.



Graph 7: Medli Model Overview of Modules

The Medli model was run by W&A assuming a number of site specific parameters for the 36,000m2 irrigation footprint. In particular the cropping regime was selected as non-cropping coastal couch grass. By comparison the Medli model was also run by Gilbert & Sutherland in 2010 to confirm irrigation suitability, but tree cropping was proposed at that time.

Unlike an irrigation regime for cropping where water supply is modelled to maximise crop yield, the input parameters where set by W&A to maximise irrigation volumes without generating runoff, causing grass die back, excessive deep drainage and migration of salts and nutrients to groundwater and the drains, or causing human health pathogen risks at the drains. A similar approach was utilised by Gilbert & Sutherland in 2010 and is standard for assessing wastewater irrigation regimes.

The notable assumptions and parameters selected by W&A are presented in Table 27 and Table 28.

Table 27: Models Utilised in Medli V2

Model Component	Algorithm
Waste estimation	Stormwater infiltration into the sewerage system by Anderson and Ruge (1994)
Pretreatment	Proportioning algorithm
Pond chemistry and water balance	Casey (1995), using mass balance algorithms
Irrigation and Shandying	Rules set by user
Soil water movement	SCS Curve Number (Knisel, 1980) for rainfall-runoff, PERFECT (Littleboy et al., 1992) for soil water balance of irrigation area
Soil nutrient movement	EPIC (Sharpley and Williams 1990) for plant N and P uptake, Freundlich isotherm HSPF (Johanson *et al.,* 1984) for inorganic P sink, CERES MAIZE (Jones and Kiniry 1986) and HSPF (Johanson *et al.,* 1984) for N cycling and leaching
Monthly Covers	Monthly green covers set by user
Plant Growth	GRASP (McKeon et al 1990) and EPIC (Sharpley and Williams 1990)
Salinity	SALF (Shaw and Thorburn, 1985a) for steady-state root zone salinity balance
Groundwater contamination	Dillon (1989) for Groundwater nitrate-N transport and dilution
Pathogen health risk	Regli et al. (1991) algorithms for Quantitative Microbial Risk Analysis.

Table 28: Medli Surface Irrigation Field Modelling

Data Parameter	Units	Value	Comments
Daily Irrigation Volume	kL/day	0-35	Min and max irrigation volume
Annual Total irrigation Volume	kL	8,780	Proportion of total 9,235kL, irrigated (See Appendix C). Remainder is trade waste trucked offsite to Summerland Treatment Facility.
Irrigation Chemistry	Various	TN 48mg/L, TP 19.8mg/L, TDS 650mg/L, Volatile Solids 6.3mg/L, TS 21	Based on reed bed outputs
Climate Data	Various	Brunswick Heads Bowling Club	60 years data from 1957-2017
Pond Size	kL	2,300	Based on modelled storage volume of tanks, excluding sludge storage and emergency volume. Modelling the ability of the OSMS to hold up wastewater during wet

Data Parameter	Units	Value	Comments
			weather or saturated soil conditions.
Irrigation Field	m^2	36,000	Non cropping couch grass
Irrigation triggering	mm	1	1mm soil water deficit (maximizes saturation)
	mm	50	Maximum daily rainfall before irrigation ceases
Soil Type	Various	Clay loam topsoil to 200mm depth underlain by sand dominated subsoil to 600mm depth	Though the soil profile extends to at least 2m depth and likely 5-15m depth, the high groundwater level was modelled as the soil boundary. Below that depth, groundwater movement and impacts complicate the modelling.
Pathogen Type	Cfu org/m^3	30 EColi	
Pathogen Risk		Accidental drinking whilst swimming	No swimming is expected in drains at NBP, and the nearest swimming location would be expected at some kilometers distance.
Groundwater Thickness	m	0.5	The aquifer is much deeper, but the drains are considered controlling features and would intercept about 0.5m of the upper layer of the aquifer.
Groundwater Flux	Mm/hr	0.004	Velocity of groundwater prior to irrigation (and mounding) calculated using groundsurface as the hydraulic gradient and Darceys Law.
Groundwater Buffer	m	15	Buffer distance from irrigation to nearest drain.
Modelled Duration	Years	50	Beyond the expected lifespan of the OSMS.

The model outputs are presented in Appendix E. In summary the model predicts:

- That for 365 days irrigation is able to occur for 79% (288 days), with rainfall impacts limited to 2% of the year;
- No wet weather overflow events would be expected from the storage tanks (95 days wet weather storage);
- There is 0mm/ year irrigation surface runoff. All irrigation water is transpired, evaporated or percolates;
- There is no predicted nitrogen or phosphorus runoff;

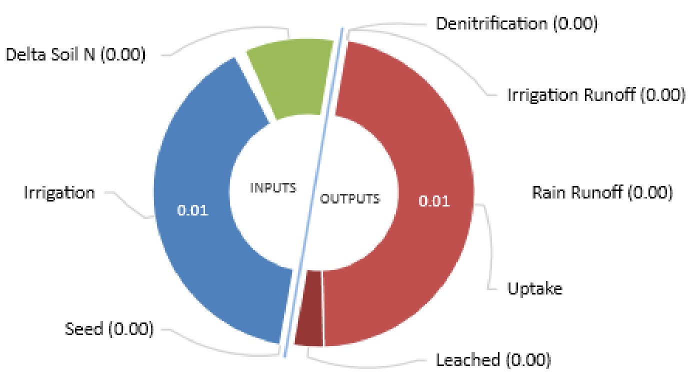
- Almost all nitrogen applied is taken up by crop and volatilisation (Graph 9), with only a very small amount leached to groundwater. The predicted groundwater concentration discharging to a drain at 15m distance is 0.8mg/L, less than the acceptable 1mg/L threshold;
- Almost half of the irrigated phosphorus is taken up by plants, with the remainder nearly all adsorbed into the soil profile (Graph 9). Only a very small amount is predicted to leach to groundwater. A 28 year soil storage lifespan is predicted;
- Crop (grass growth) yields are predicted to not be impacted by salts in the irrigation water; and
- Pathogen risk of drinking contaminated drain water is modelled as 0 infections for 12 monthly events, and below the 1 infection/10,000 persons health threshold.

All wastewater application systems that are land applied (including domestic and commercial) have a lifespan in relation to phosphorus as it is mainly sorbed onto soil with lesser plant uptake (unlike nitrogen which has much high plant uptake rates). The predicted 28 years is based on a number of conservative assumptions about phosphorus concentrations in the wastewater and the depth to groundwater, and the actual lifespan is expected to be longer. Twenty eight (28) years is a reasonable period given the commercial nature of the development, and phosphorus would be managed by regular checking of phosphorus concentrations as part of the Irrigation Management Plan. As phosphorus concentrations obtain saturation levels (and if the NBP development is still operational and irrigation is still occurring) then it would be expected that irrigation would be rotated onto the additional available area in the northeastern portion of the Site (Section 9.1.3), and/or resting of the area and planting out of cover crops for nitrogen and phosphorus removal.

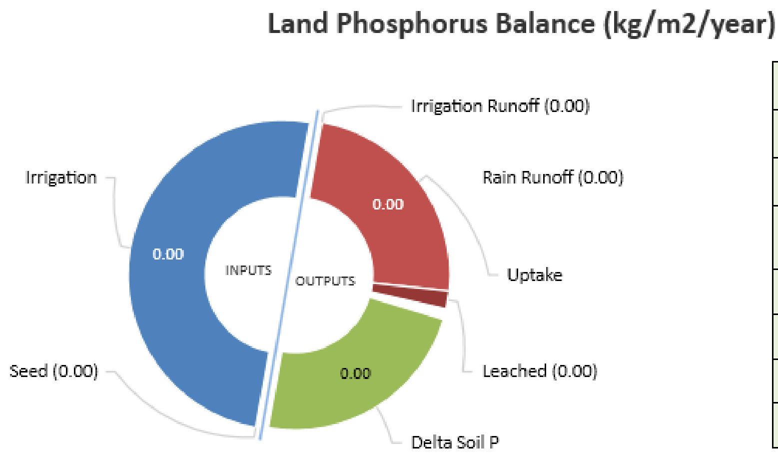
The Medli modelling confirms earlier modelling undertaken by Gilbert & Sutherland in 2010, and by the Byron Shire Council OSMS Model that there is sufficient land area available at NBP for effluent irrigation, and that the 36,000m^2 recommended EMA 2 is a sustainable and suitable irrigation area.

The modelling was based on conservative nutrient concentrations in the effluent and the shallow worst seasonal groundwater depths. It is expected that actual nutrient concentrations in the effluent will be lower, and that for substantial portions of the year during the winter-spring dry season that groundwater depths will be much lower (1-1.5m rather than ~0.6m). As such additional irrigation days will be possible, there will be less nutrients that percolate to groundwater and a longer lifespan of the soil profile is expected.

Land Nitrogen Balance (kg/m2/year)



Name	Value
Seed	1.41E-05
Irrigation	0.01
Denitrification	1.73E-05
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	0.01
Leached	8.62E-04
Delta Soil N	-2.62E-03



Name	Value
Seed	2.12E-06
Irrigation	4.83E-03
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	2.36E-03
Leached	1.85E-04
Delta Soil P	2.29E-03

Graph 8: Medli Land Nutrient balance

9.1.3 Available Irrigation Area

Though W&A have modelled for 36,000m^2 of irrigated area in the northeastern corner of NBP, the property is of such size that there is ample additional area for irrigation. Figure 10 presents additional available irrigation area in the northern portion of the Site and includes:

- 265,550m^2 on the broad grassed camping area; and
- 15,780m^2 in the grassed amphitheatre.

Additional areas are available in the southern portion of the Site.

Graph 9: Medli Land Nutrient balance

9.2 IDSFB Suitability for Short Term Application

The IDSFB are designed for intermittent dosing to allow wetting and drying effects to recharge the sand filter medium. The upgraded permanent EMA will utilise the IDSFB as backup land application when unfavourable conditions are present for surface spray irrigation.

Sizing of the beds is based on formula L1 of L4.2 of AS/NZS1547:2012

$$L=Q/(DLR*W)$$

The parameters and results of IDSFB calculations are presented in Table 29. The existing repaired IDSFB beds would be able to sustainably manage 4.8kL/day application without risk of oversaturation and surface surcharging.

Table 29: Parameters and Results of IDSFB Effluent Application Stage 3

Data Parameter	Units	Value	Comments
Existing Bed Basal Area	m^2	600	24 beds 1.25m wide and 20m long
Hydraulic Load	kL/day	32.5	Daily treatment volume.
Design Loading Rate (DLR)	mm/day	8	AS/NZS1547:2012 recommended rate based on medium clay is 8mm/day.
Maximum Applicable Hydraulic Load	kL/day	4.8	

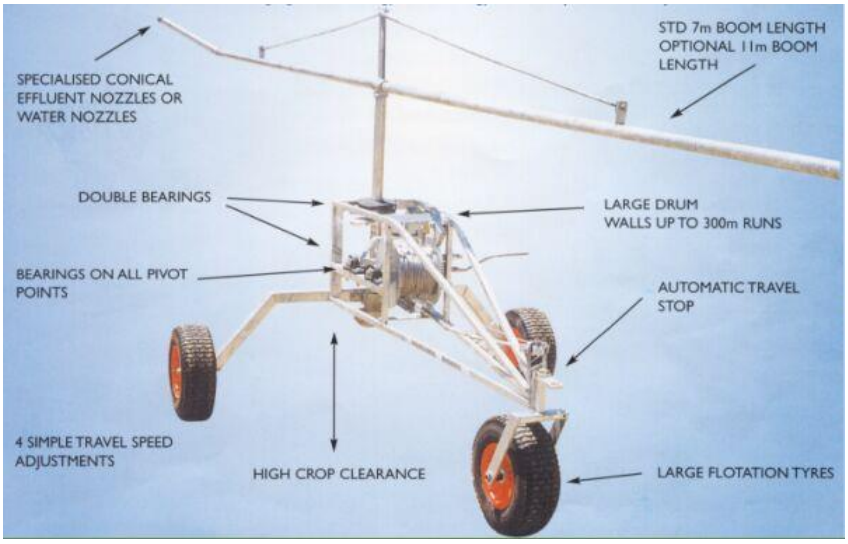
9.3 Surface Spray Irrigation Method

An Irrigation Management Plan (IMP) will be prepared for the irrigation zones that details daily checks, operational timing and withholding periods, step by step procedures, contingency measures and a review process.

A groundwater bore monitoring network will form part of the IMP including groundwater level monitoring and chemistry data collection to compare to baseline concentrations.

A travelling irrigator, such as the Vaughan Irrigators Standard model will be used to distribute effluent within the nominated EMA. These irrigators are used widely in the agricultural industry and are useful in that:

- Very little tailwater is generated limiting ponding;
- Effluent is evenly applied;
- Application rates can be adjusted on the fly;
- Effluent nozzles can be fitted to limit blockage of the emitter;
- They can be semi-automated, with the travelling line arranged to automatically break the irrigator at the end of a run, which can be set at any point on the travelling line; and
- They are light and sturdy and minimise further compaction of topsoils and ease of movement between runs.



Photograph 14: Vaughans Travelator "Standard"

The irrigator will be operated using 20m of gravity head from the treatment system plus an irrigation pump to provide sufficient operating head at each run of at least 138kpa (13.8m of head).

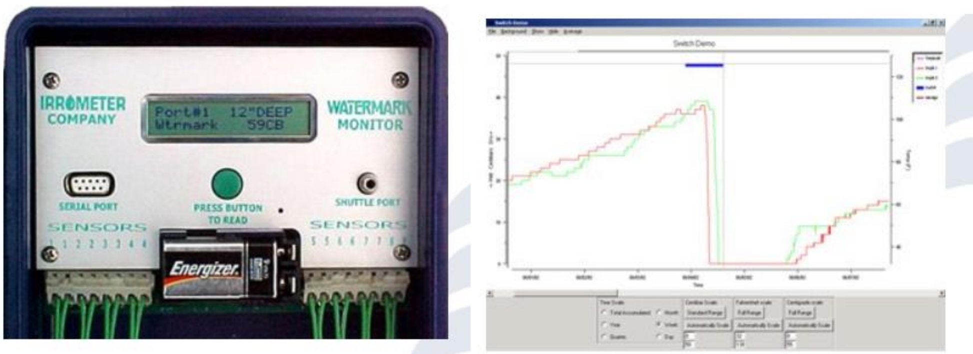
The irrigator with an 11m boom length is capable of distributing effluent over a 30m diameter and up to 300m runs using an effluent nozzle to minimise aerosol production.

To limit the risk of groundwater and surface water contamination and human contact from the surface irrigation the following will be considered before surface irrigation is undertaken:

- The EMA will not be flooded or have stormwater pooling on the ground surface;
- Rainfall on the day will not exceed 10mm (this occurs on average 2-4 days per month). An existing NBP weather station is present and useability will be assessed for connection

to the OSMS (http://new.mhl.nsw.gov.au/users/NorthByronParklands-CurrentConditions). Alternatively, a rain sensor (Hunter "Mini-Clik") on the treatment system connected by solenoid valves to the storage tanks will suspend further wastewater treatment by switching off treatment supply. An anemometer will also be connected to the same controls to suspend treatment on days where wind speeds exceeding 30km/h to limit the risk of spray drift;

- Effluent irrigation will be suspended at least two days before the area is to be used for camping and for the duration of time that persons are camping in or within 20m of the irrigation area;
- Monitoring of soil saturation will be undertaken under the guidance of the Irrigation Management Plan. Th specificity of this monitoring is beyond the scope of the concept WWA, but for example, monitoring locations may be installed using permanent sensor blocks, from which soil moisture suction can be monitored using an Irrometer Watermark Monitor or similar (Photograph 15). The unit pictured below can accommodate up to 7 sensors buried at any distance from the meter which can be permanently mounted in a vandal proof box on the side of an amenities building for easy reference;



Photograph 15: Watermark Monitor

- Once the wet weather storage capacity is exceeded, application into the existing 24 IDSFB or temporary trucking offsite of excess wastewater will be undertaken.

All areas irrigated with effluent will be marked with signage stating: "*RECLAIMED EFFLUENT – NOT SUITABLE FOR DRINKING"* or similar wording at spacing along the perimeter.

The use of each run will be recorded to ensure the cycling of the irrigation zones.

9.4 Vegetation Establishment

A complete vegetation cover is important on each EMA to reduce the erosion hazard and optimise water and nutrient uptake. Grass should be established on the absorption bed EMA immediately after installation due to the high risk of erosion within the area. Typically, EMAs are covered with grass, which is maintained in a well-mowed state to maximise uptake of effluent by evaporation and transpiration.

To maximise assimilation of effluent-borne nutrients within the EMA, clippings should be removed from and mulched elsewhere on-site for use in other landscaped areas that are not dedicated for wastewater application.

As a number of man-made drains are present in the vicinity of the irrigation area, it is recommended to plant the drain margins (not within the drain) with Vetiver grass. Vetiver grass is utilised for hydraulic and nutrient uptake in wastewater systems (Truong *et al.* 2016) as:

- It has a massive, deep, fine, and fast-growing root system capable of reaching 3.6m deep in 12 months (Photograph 16);
- Vetiver produces a thick dense groundcover between 1-1.5m high (Photograph 17);
- Nutrient uptake of Vetiver is very high, with nitrogen uptake of 1,140kg/ha/yr for vetiver versus 500kg/ha/yr for kikuyu and 50kg/ha/yr for eucalyptus, and phosphorus uptake of 140kg/ha/yr for vetiver versus 90kg/ha/yr for kikuyu and 15kg/ha/yr for eucalyptus;
- Each plant utilises between 2-6L/day, and at a recommended planting of 5/m^2, a 100m long strip of Vetiver grass can consume up to 3,000L/day;
- Vetiver is acidic and aluminium tolerant, and drought tolerant; and
- Vetiver grass is clumping and gets wider at the base but does not have stolons or rhizomes. The Monto variety utilised for wastewater treatment is available commercially on the North Coast of NSW, is sterile and therefore non-invasive.

At 5,250 plants, water consumption is predicted at around 31kL/day, which will result in partial removal of the effluent irrigation load plus groundwater consumption. The use of Vetiver grass has the potential to result in a reduction of the percolation of effluent to groundwater, and a reduction in the saturation of surface soils.

Photograph 16: Vetiver grass and root system.

Photograph 17: Vetiver cultivation in Australia

10 Buffers and Risk Assessment

10.1 Risk Assessment

A risk assessment was undertaken using the general procedures and criteria of the NSW DPI (2015) guideline. The risk assessment is included in Appendix F. In summary 17 risks were identified and assessed for likelihood and consequence, and control measures provided that have been included in the WWA as part of the design or assumed operational process.

A generally low risk has been assessed for the OSMS as designed and modelled including application of irrigated wastewater onto the broad floodplain. A residual moderate risk still applies to the manual handling of compost bins by staff.

The compost batch bin system implemented at NBP has been operating successfully at the Site for some years now and no significant human health impacts have been recorded. Vigilance in operation and training is key in this respect.

10.1 Log Reduction Targets

Table 4 of NSW DPI (2015) details Log Reduction Values (LRVs) targets for various end uses of wastewater. These guidelines are utilised for public effluent reuse schemes which is not applicable at the Site, but provide a useful indicator for the risk of public exposure to spray drift. The target LRVs and the LRVs achieved with the OSMS design herein are shown in Table 30 and confirm that the application of secondary treated and disinfected effluent by surface irrigation would provide appropriate human health protection against Protozoa, Viruses and Bacteria.

Table 30: Identification of LRVs

Treatment	Protozoa	Virus	Bacteria
Secondary	0.5	0.5	1
UV light disinfection	3	1	2
No public access during irrigation	2	2	2
Buffer zones	1	1	1
Withholding periods following irrigation	1	1	1
Total	**7.5**	**5.5**	**6**
Target LRV (Non-food crops - pasture)	**3.7**	**5.2**	**4**
LRV Target Met?	Yes	Yes	Yes

10.2 Buffer Distances

Buffer distances from land application areas are required to minimise risk to public health, maintain public amenity and protect sensitive environments. The adopted environmental buffers for surface spray irrigation are presented in Table 31. The adopted buffers will provide sufficient protection to public health and the environment.

Table 31: Adopted Environmental Buffers

Protected Item	Buffer	Comments
Domestic water supply bore	250m	Default
Town water supply bore	1000m	Default
Waterbodies (except drains)	50m	Default
Drains	15m	Site specific as per NSW DEC (2004)
Property boundaries to public areas	20m	Site specific adopted to limit spray drift.

11 Monitoring and Review

Regular monitoring and review is an important aspect of any effluent application scheme. Table 32 below presents the recommended minimum monitoring regime to provide assurance of continued operation.

Table 32: Monitoring Regime

Item	Description	Timing	Responsibility
OSMS	Preparation of an Operation & Monitoring Plan (O&M Plan) that includes details of the installed system, maintenance and monitoring schedule, failure indicators and emergency contact phone numbers.	With installation	Contractor or consultant.
Pump Wells and Storage Tanks	Any storage tanks will collect inorganic solids and settleable sludges that pass through the treatment system.	Annual inspection of any pump wells and storage tanks for sludge levels. Desludging as required.	Scheduled contractor.
Primary Treatment Tanks	The septic tanks will collect inorganic solids and settleable sludges that pass through the treatment system.	Annual inspection of the septic tanks for sludge and scum levels. Desludging as required.	Scheduled contractor.
Reed Bed Polishing	Vegetation within the reed bed/s will require at least annual maintenance and regular weeding.	Regular weeding. Annual cutting back of vegetation and replanting if required.	Scheduled contractor.
Irrigation Tank	The irrigation tank will collect fine inorganic solids and settleable	Annual inspection of chamber to assess	Scheduled contractor.

Item	Description	Timing	Responsibility
	sludges that pass through the treatment system.	sludge levels and pump-out as biosolids as required.	
	The irrigation pump is susceptible to clogging and wear/tear.	The pump will require inspection and maintenance as per manufactures requirements.	Scheduled contractor.
Effluent quality and quantity	To ensure that effluent quality meets the parameters as specified previously, regular water quality monitoring will be required.	Quarterly in first year then annually. Faecal coliforms, residual chlorine, total nitrogen, total phosphorus, BOD, and TSS.	Scheduled contractor or consultant.
	An irrigation meter is to be installed on the irrigation line.	Weekly recording of water meter.	Scheduled contractor or site manager.
ISDFB Bed Field	The application area requires a good vegetative cover that is well maintained.	Regular mowing to maintain suitable vegetative cover and for vegetative removal in winter and summer months. No tractors or heavy mowers.	Scheduled contractor.
	Protection of the beds from human and animal damage.	Annual inspections.	Scheduled contractor.
	Laterals may clog with fine sediment	Annual inspection and flushing of laterals.	Scheduled contractor.
Surface Spray Irrigation Field	The application area requires a good vegetative cover that is well maintained.	Regular maintenance of vegetation.	Scheduled contractor.
	Maintenance of travelling irrigator.	Daily inspection and maintenance as recommended by manufacturer.	Scheduled contractor as per the irrigation plan.
	Maintenance of warning signage.	Annual inspections.	Scheduled contractor.

12 References

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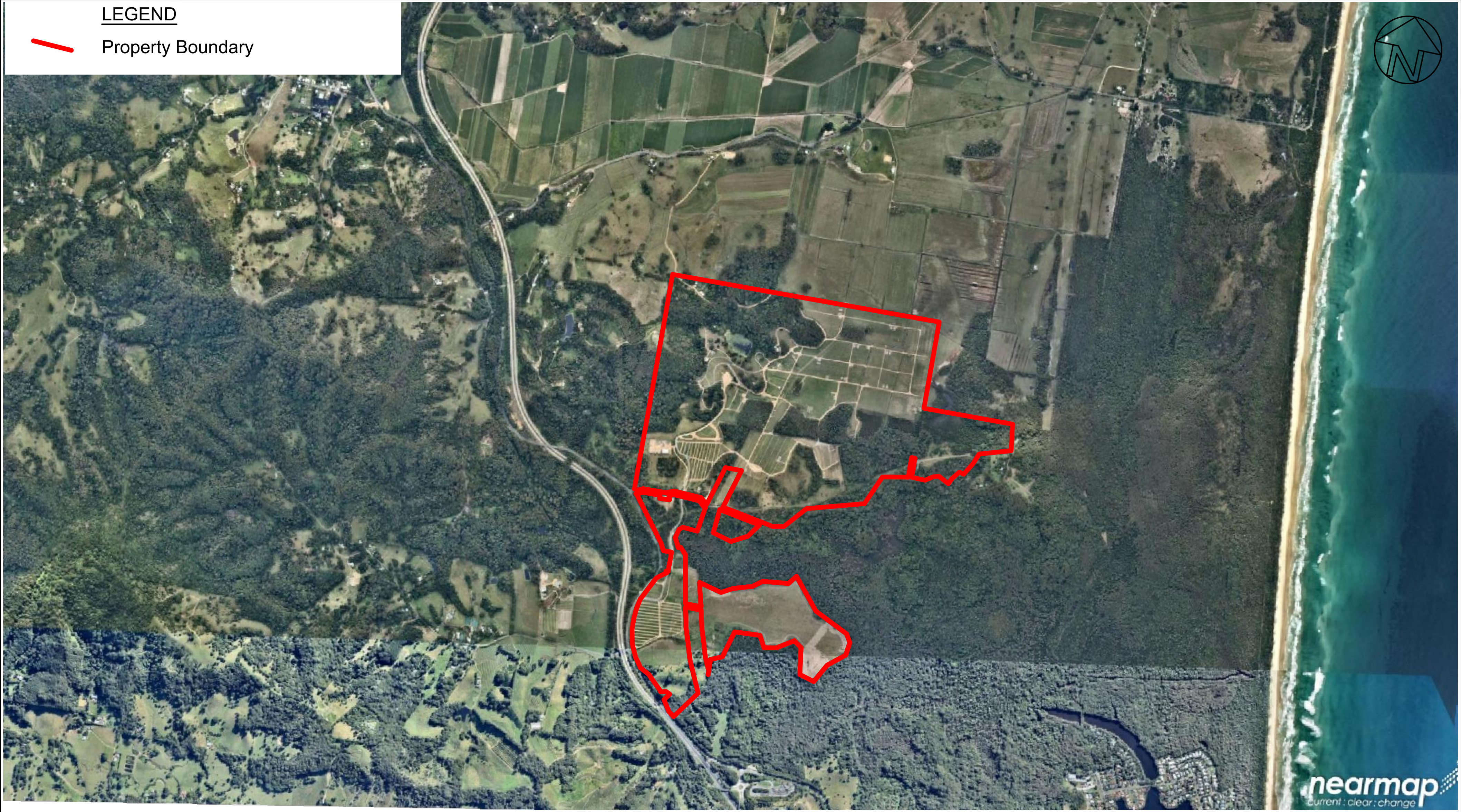
FIGURES



Whitehead & Associates
Environmental Consultants

Client:	BYRON VENUE MANAGEMENT P/L
Project:	WWMP FOR NORTH BYRON PARKLAND
Title:	SITE LOCATION
Source:	SITE LAYOUT OCTOBER 2016 & NEARMAP 24/4/2017
Note:	AERIAL PHOTOGRAPHS AND BOUNDARIES ARE INDICATIVE ONLY.

Drawn:	Reviewed:	Approved:	Date:	Scale: 1:30,000 Approx @ A4	
HM	SD	SD	05/10/17	Job No: 1912	Sheet: 1 of 1
All units in m unless otherwise specified				Drawing No: Figure 1	Revision No: 2

0 500 1000 1500

Horizontal Scale (metres) 1:30,000

0 250 500 750 1000 Horizontal Scale (metres) 1:10,000	Whitehead & Associates Environmental Consultants Note: AERIAL PHOTOGRAPHS ARE INDICATIVE ONLY.	Client: BYRON VENUE MANAGEMENT P/L Project: WWMP FOR NORTH BYRON PARKLANDS	Title: EXISTING FESTIVAL PRECINCT OVERVIEW Source: SITE LAYOUT OCTOBER 2016 & NEARMAP 24/4/2017	Drawn: HM	Reviewed: SD	Approved: SD	Date: 05/10/17
				All units in m unless otherwise specified			
Scale: 1:10,000 Approx @ A3	Job No: 1912	Sheet: 1 of 1	Drawing No: Figure 2	Revision No: 2			

0 100 200 400 600

Horizontal Scale (metres) 1:6,000

Whitehead & Associates
Environmental Consultants

Note: **AERIAL PHOTOGRAPHS ARE INDICATIVE ONLY.**

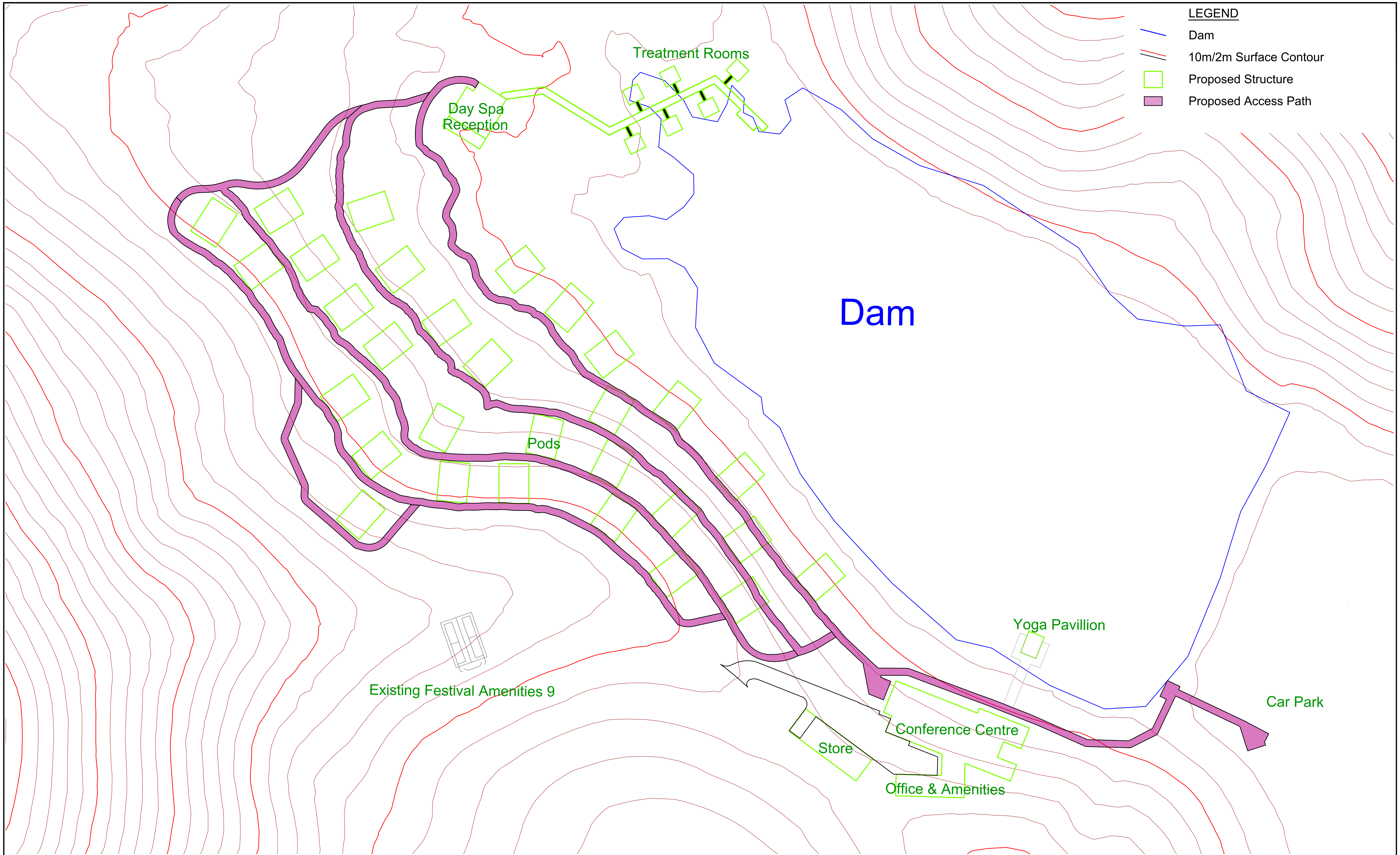
Client: **BYRON VENUE MANAGEMENT P/L**

Project: **WWMP FOR NORTH BYRON PARKLANDS**

Title: **NBP EXISTING WASTEWATER OVERVIEW**

Source: **SITE LAYOUT OCTOBER 2016 AND ARCHITECTS & NEARMAP 24/4/2017**

Drawn:	Reviewed:	Approved:	Date:	Scale: 1:6,000 Approx @ A3	
HM	SD	SD	13/11/17	Job No: 1912	Sheet: 1 of 1
All units in m unless otherwise specified				Drawing No: Figure 3	Revision No: 3



0 25 50 75 100

Horizontal Scale (metres) 1:1000

Whitehead & Associates
Environmental Consultants

Note: **AERIAL PHOTOGRAPHS ARE INDICATIVE ONLY.**

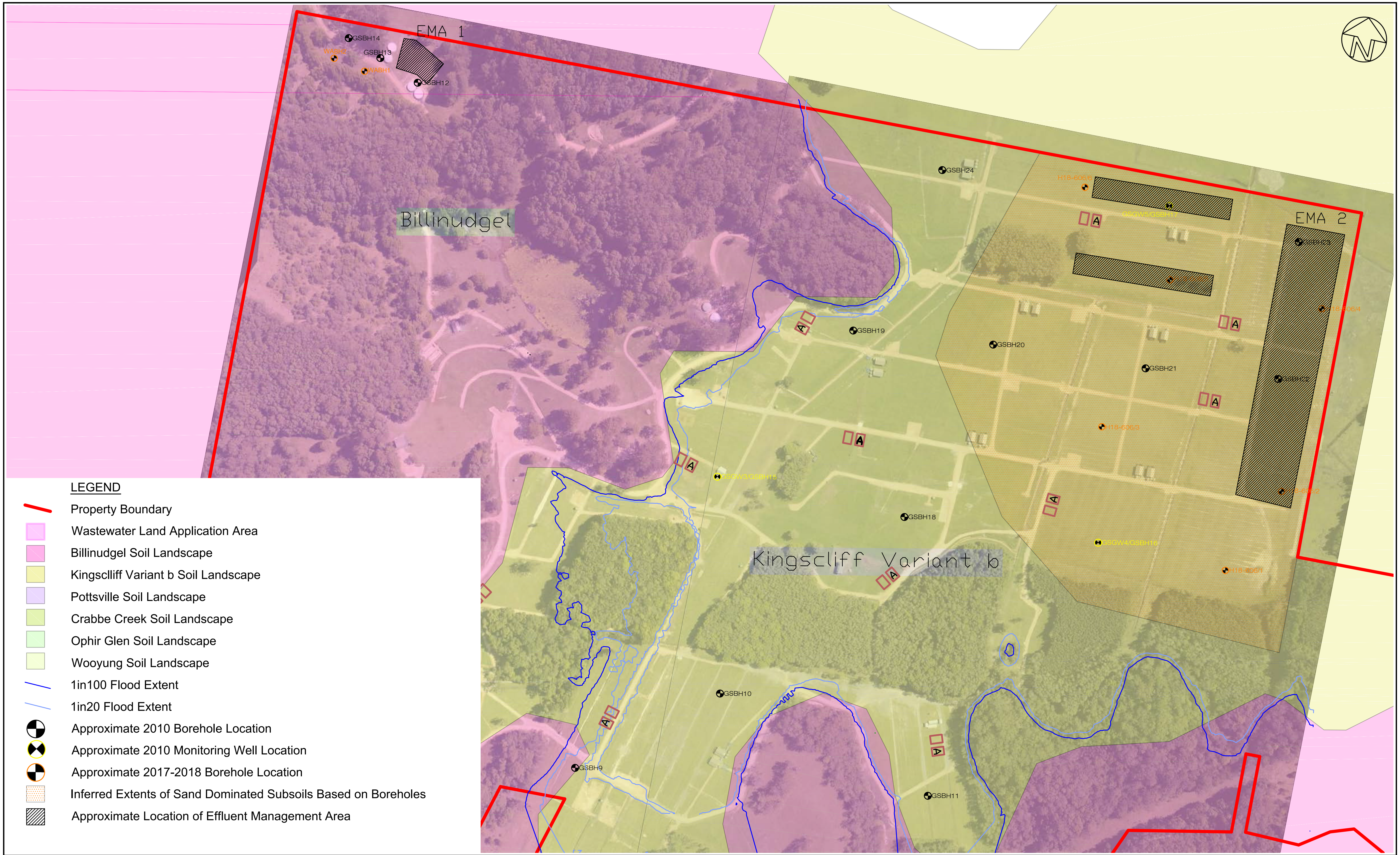
Client: **BYRON VENUE MANAGEMENT P/L**

Project: **WWMP FOR NORTH BYRON PARKLANDS**

Title: **CONFERENCE CENTRE LAYOUT**

Source: **DOMINIC FINLAY JONES P/L DFJ148**

Drawn:	Reviewed:	Approved:	Date:	Scale: 1:1000 Approx @ A3	
HM	SD	SD	18/7/17	Job No: 1912	Sheet: 1 of 1
All units in m unless otherwise specified				Drawing No: Figure 4	Revision No: 1



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Horizontal Scale (metres) 1:10,000

Whitehead & Associates Environmental Consultants

Note: **AERIAL PHOTOGRAPHS ARE INDICATIVE ONLY.**

Client:	**BYRON VENUE MANAGEMENT P/L**
Project:	**WWMP FOR NORTH BYRON PARKLANDS**
Title:	**FLOOD PLANNING EXTENTS & SOIL LANDSCAPES**
Source:	**SITE LAYOUT OCTOBER 2016 & NEARMAP 24/4/2017**

Drawn:	Reviewed:	Approved:	Date:	Scale: 1:10,000 Approx @ A3	
HM	SD	SD	22/6/18	Job No: 1912	Sheet: 1 of 1
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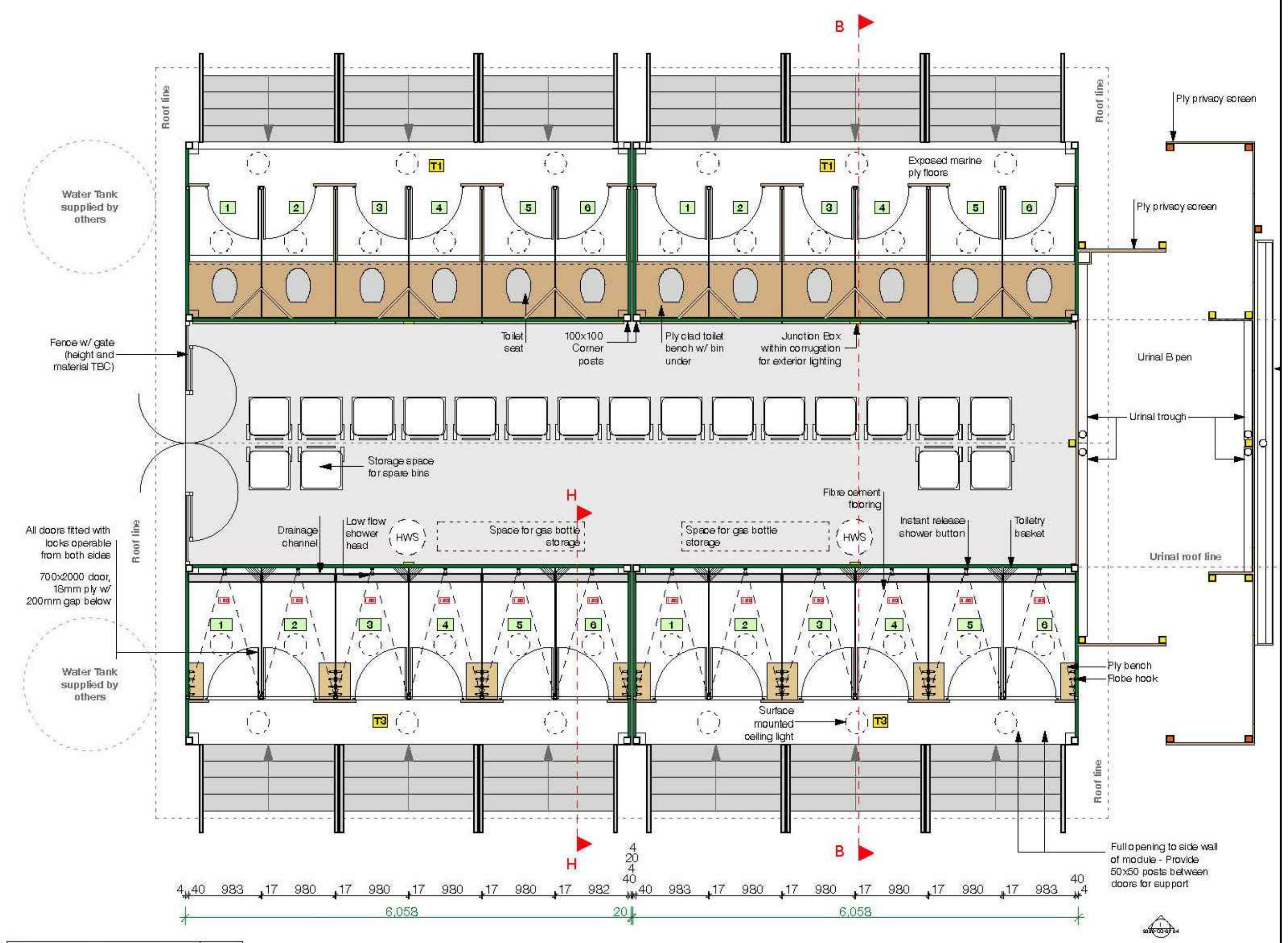
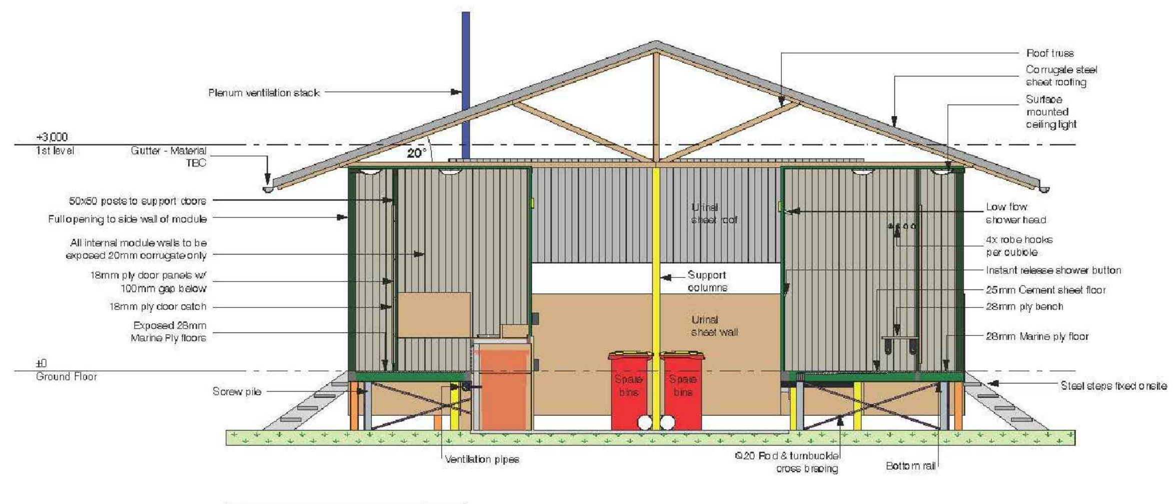


FLOOR PLAN: BUILDING B

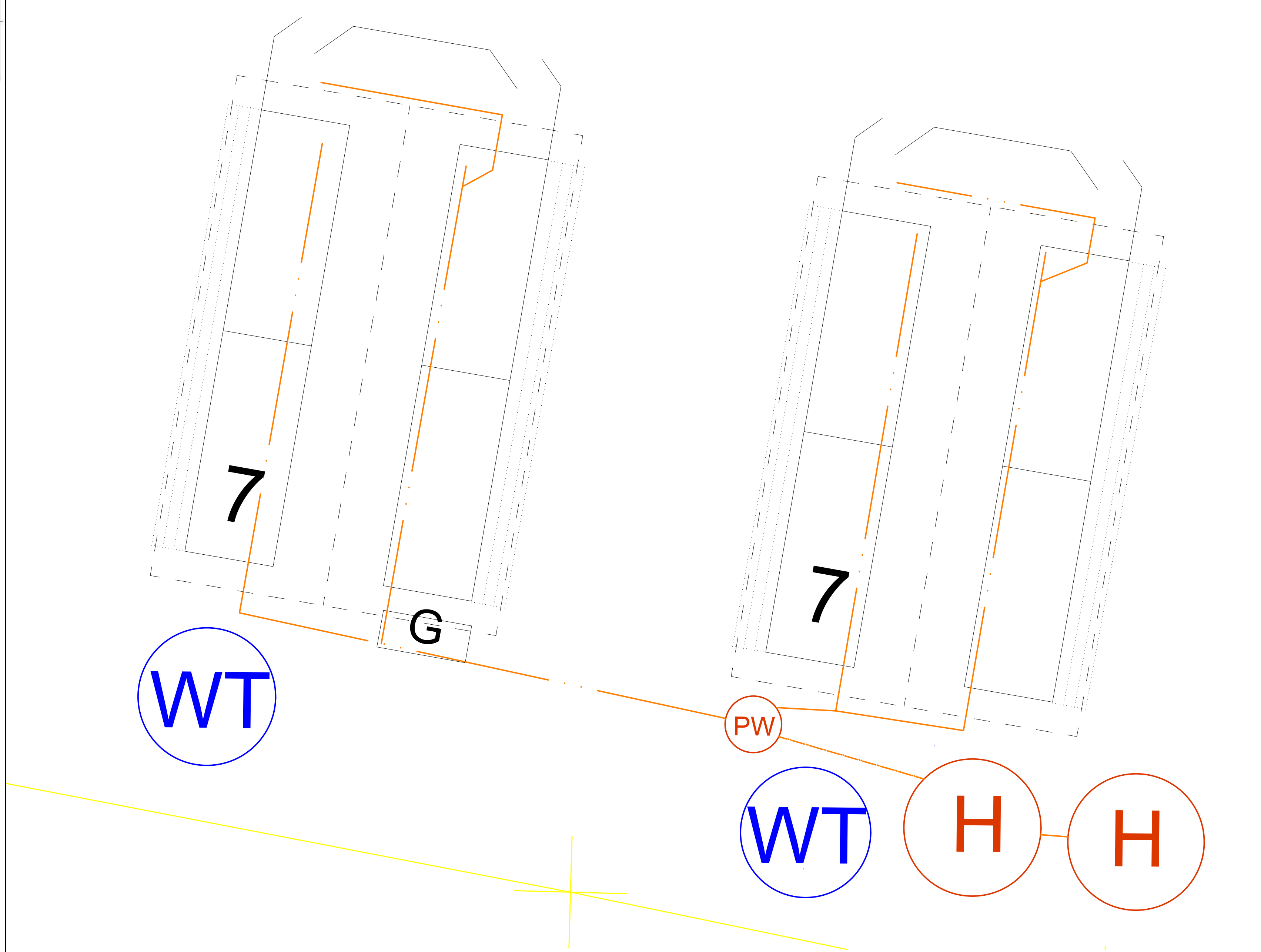


SECTION: B-B BUILDING B

Inset Scale 1:100

LEGEND

- Amenities Block
- Roof line
- Poly Water Tank
- Poly Wastewater Holding Tank
- Wastewater Pump Well
- Wastewater Gravity Piping
- Wastewater Rising Main



0 2.5 5 10 15

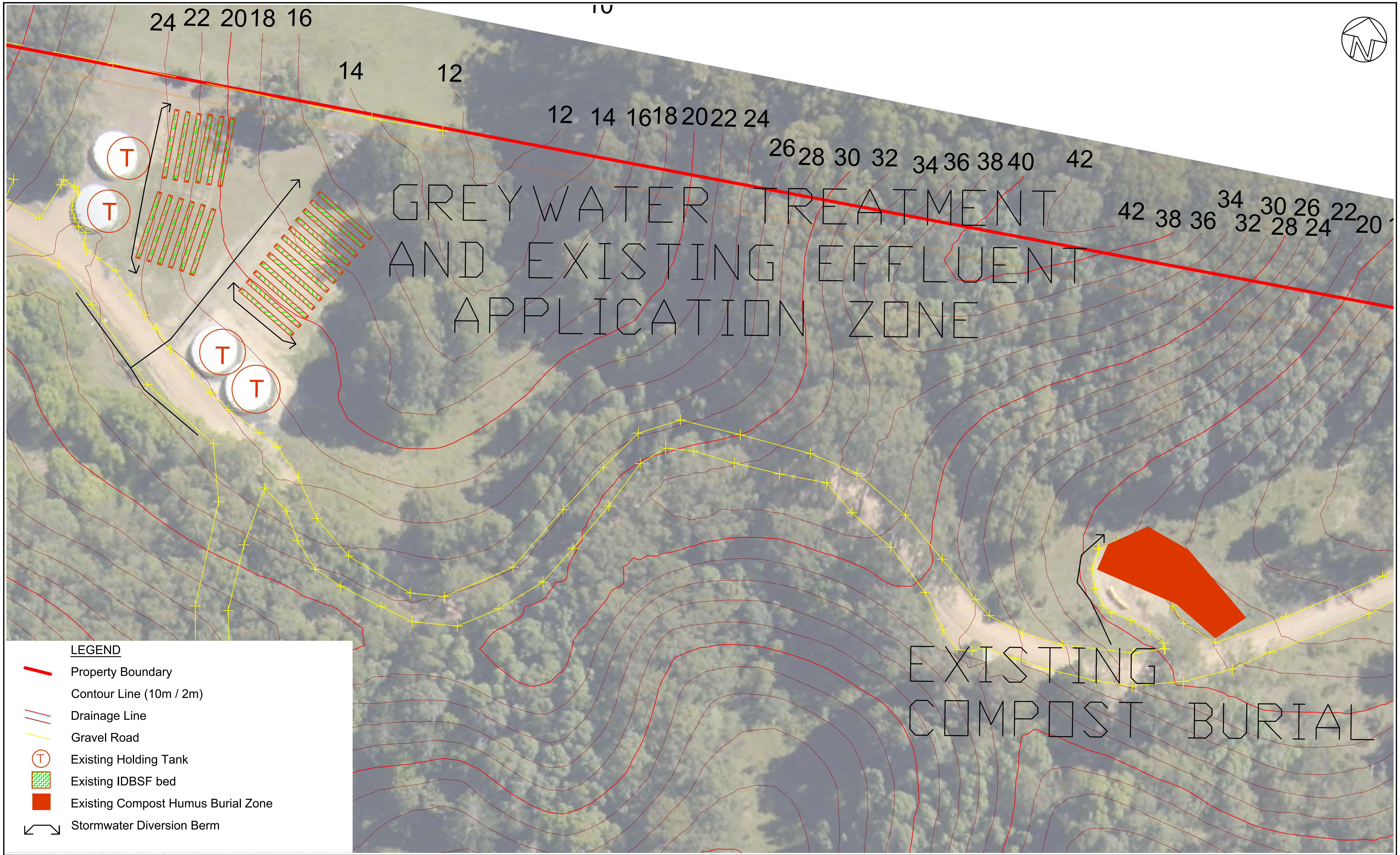
Horizontal Scale (metres) 1:150

Whitehead & Associates Environmental Consultants

Note: AERIAL PHOTOGRAPHS ARE INDICATIVE ONLY.

Client:	BYRON VENUE MANAGEMENT P/L
Project:	WWMP FOR NORTH BYRON PARKLANDS
Title:	AMENITIES BLOCK DETAIL
Source:	SITE LAYOUT OCTOBER 2016 AND QUICKSMART HOMES 9382-00

Drawn:	Reviewed:	Approved:	Date:	Scale: 1:150 Approx @ A3	
HM	SD	SD	18/7/17	Job No: 1912	Sheet: 1 of 1
All units in m unless otherwise specified				Drawing No: Figure 6	Revision No: 1



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Horizontal Scale (metres) 1:1000

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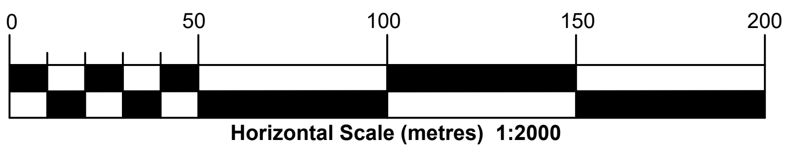
Note: **AERIAL PHOTOGRAPHS ARE INDICATIVE ONLY.**

Client: **BYRON VENUE MANAGEMENT P/L**	Title: **EXISTING GREYWATER TREATMENT AND EMA AND HUMUS DUMP**	Drawn: HM	Reviewed: SD	Approved: SD	Date: 22/6/18	Scale: 1:1,000 Approx @ A3
Project: **WWMP FOR NORTH BYRON PARKLANDS**	Source: **SITE LAYOUT OCTOBER 2016**	All units in m unless otherwise specified				Job No: 1912 / Sheet: 1 of 1
						Drawing No: Figure 7 / Revision No: 2

LEGEND

- Property Boundary
- Surface Drain
- Existing Amenities
- Proposed Amenities
- Recommended Surface Spray 6000m2 Irrigation Zone 30x200



W Whitehead & Associates Environmental Consultants

Note: AERIAL PHOTOGRAPHS ARE INDICATIVE ONLY.

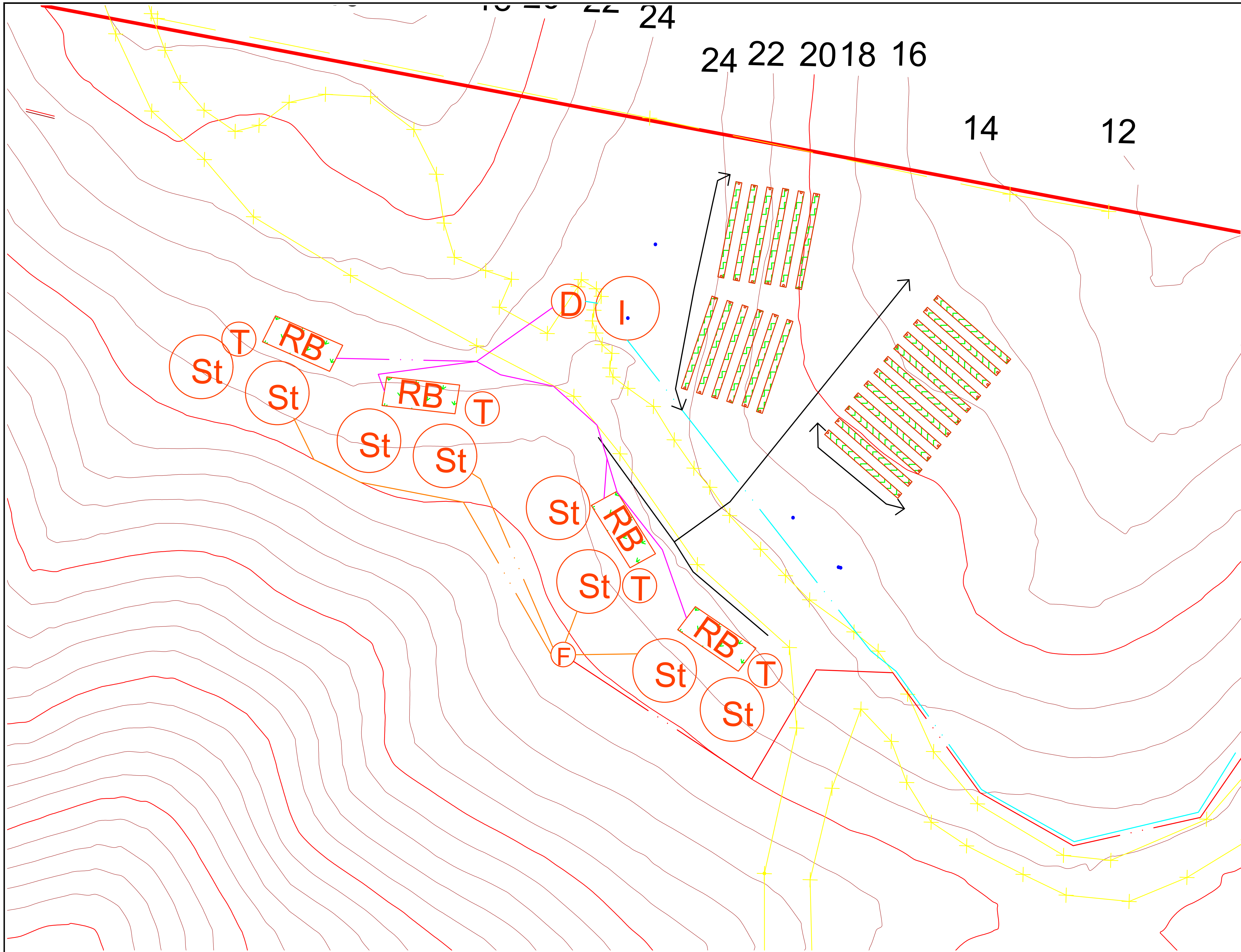
Client: BYRON VENUE MANAGEMENT P/L

Project: WWMP FOR NORTH BYRON PARKLANDS

Title: RECOMMENDED EFFLUENT MANAGEMENT AREA

Source: SITE LAYOUT OCTOBER 2016 & NEARMAP 24/4/2017

Drawn:	Reviewed:	Approved:	Date:	Scale: 1:2,000 Approx @ A3	
HM	SD	SD	7/12/17	Job No: 1912	Sheet: 1 of 1
All units in m unless otherwise specified				Drawing No: Figure 8	Revision No: 2



LEGEND

- Property Boundary
- Contour Line (10m / 2m)
- Drainage Line
- Gravel Road
- Existing IDBSF bed
- F Proposed Flow Distribution Tank
- St Proposed Storage Tank
- T Proposed Septic Tank
- RB Proposed Reed Bed
- D Proposed Disinfection Tank
- I Proposed Irrigation Tank

0 20 40 60 80

Horizontal Scale (metres) 1:800

Whitehead & Associates
Environmental Consultants

Note: **AERIAL AND BOUNDARIES PHOTOGRAPHS ARE INDICATIVE ONLY.**

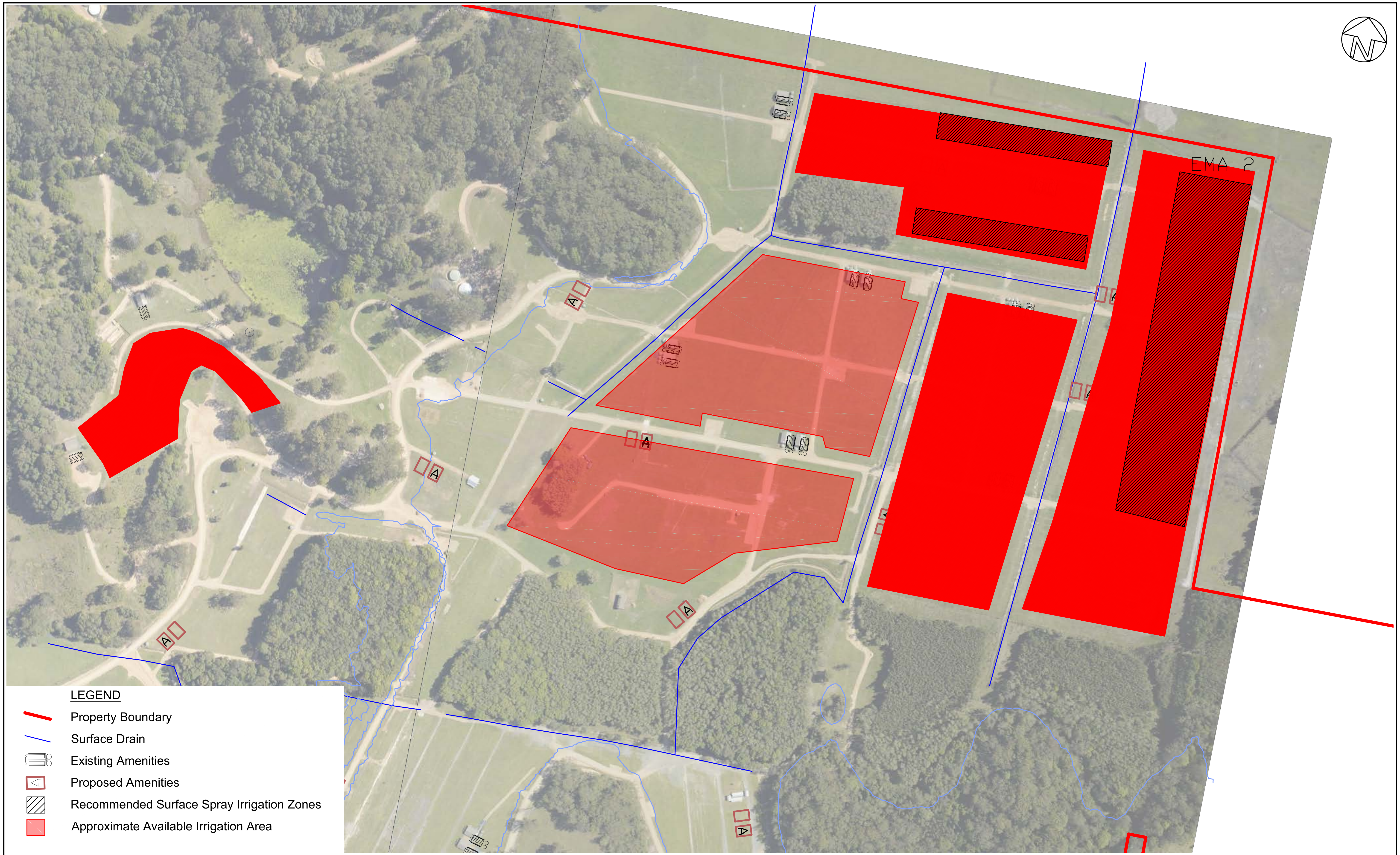
Client: **BYRON VENUE MANAGEMENT P/L**

Project: **WWMP FOR NORTH BYRON PARKLANDS**

Title: **RECOMMENDED NBP MASTER TREATMENT SYSTEM**

Source: **SITE LAYOUT OCTOBER 2016**

Drawn:	Reviewed:	Approved:	Date:	Scale: 1:600 Approx @ A3	
HM	SD	SD	26/6/18	Job No: 1912	Sheet: 1 of 1
All units in m unless otherwise specified				Drawing No: Figure 9	Revision No: 3



Whitehead & Associates Environmental Consultants	Client: **BYRON VENUE MANAGEMENT P/L**	Title: **AVAILABLE EFFLUENT MANAGEMENT AREA**	Drawn: HM; Reviewed: SD; Approved: SD; Date: 22/6/18; Scale: 1:2,000 Approx @ A3
Note: **AERIAL PHOTOGRAPHS ARE INDICATIVE ONLY.**	Project: **WWA FOR NORTH BYRON PARKLANDS**	Source: **SITE LAYOUT OCTOBER 2016 & NEARMAP 24/4/2017**	Job No: 1912; Sheet: 1 of 1
			All units in m unless otherwise specified; Drawing No: Figure 10; Revision No: 1

Appendix A
Gilbert & Sutherland Report

Borehole: BH1

GILBERT+SUTHERLAND
agriculture - water - environment

Project:	GJ0926	Depth (m):	1
Client:	Splendour Pty Ltd	Logged by:	RJ
Latitude	28.29.103	Drilled by:	Gilbert & Sutherland
Longitude	153.30.807	Start date:	
RL(m):	_____	Completion date:	

Soil Description

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			SILTY CLAY LOAM, 7.5YR 3/3 , Moderate, coarse crumb peds, organic matter, roots, traces of fine sand		7.5YR 3/3		
			MEDIUM HEAVY CLAY, 10YR 3/3, 5YR 4/6, Strong, medium subangular, 5% mottles		10YR 3/3, 5YR 4/6		
.5			HEAVY CLAY, 7.5YR 2.5/2 , Massive		7.5YR 2.5/2		.5
			HEAVY CLAY, 7.5YR 3/2, 5YR 5/8, Massive, orange mottles		7.5YR 3/2, 5YR 5/8		
			SILTY CLAY, 5YR 5/1 , Massive, traces of fine sand		5YR 5/1		
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH2

Project: GJ0926

Client: Splendour Pty Ltd

Latitude 28.28.564

Longitude 153.30.991

RL(m): _____

GILBERT+SUTHERLAND
agriculture - water - environment

Depth (m): 1

Logged by: RJ

Drilled by: Gilbert & Sutherland

Start date:

Completion date:

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			SILTY CLAY LOAM, 7.5YR 3/3 , Moderate pedality, coarse crumb structure, mod plasticity, moist, organic matter (roots)		7.5YR 3/3	2M	
.5			MEDIUM HEAVY CLAY, 7.5YR 3/2 , Medium blocky peds, 10% orange mottles at 450-600 depth, charcoal at 450-800		7.5YR 3/2	2M	.5
			SILTY CLAY, 5YR 5/2 , Massive, minor fines, moderate plasticity, moist, 15% orange mottles, pH 5.0		5YR 5/2		
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH3

GILBERT+SUTHERLAND
agriculture - water - environment

Project: GJ0926
Client: Splendour Pty Ltd
Latitude 28.28.992
Longitude 153.30.905
RL(m): _____

Depth (m): 1
Logged by: RJ
Drilled by: Gilbert & Sutherland
Start date:
Completion date:

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			SILTY CLAY LOAM, 7.5YR 4/1 , Moderate pedality, polyhedral, Organic matter (roots), pH 5.5		7.5YR 4/1	2M	
			HEAVY CLAY, 10YR 2/1 , Massive, moist, pH 5.5		10YR 2/1	4/7M	
.5							.5
			HEAVY CLAY, 10YR 2/1, 10YR 3/3, Massive, moist, 5% mottles		10YR 2/1, 10YR 3/3	4/7M	
			SILTY CLAY, 7.5YR 4/2 , Massive, moist, mod plasticity, pH 5.0		7.5YR 4/2		
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH4

Project: GJ0926

Client: Splendour Pty Ltd

Latitude 28.29.183

Longitude 153.31.421

RL(m): _____

GILBERT+SUTHERLAND
agriculture - water - environment

Depth (m): 1

Logged by: RJ

Drilled by: Gilbert & Sutherland

Start date:

Completion date:

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			SILTY CLAY LOAM, 5YR 2.5/1 , Moderate pedality, 50% medium blocky peds, Organic matter (roots), moist,		5YR 2.5/1	4/7M	
			SANDY CLAY LOAM, 2.5YR 3/1 , Weak pedality, fine crumb structure, Wet		2.5YR 3/1		
.5							.5
			SANDY CLAY LOAM, 2.5YR 5/1 , Massive, saturated		2.5YR 5/1	3M	
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH5

GILBERT+SUTHERLAND
agriculture - water - environment

Project:	GJ0926	Depth (m):	1
Client:	Splendour Pty Ltd	Logged by:	RJ
Latitude	28.29.053	Drilled by:	Gilbert & Sutherland
Longitude	153.31.2.87	Start date:	
RL(m):	_____	Completion date:	

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			SILTY CLAY LOAM, 7.5YR 3/2 , Moderate pedality, 50% crumb, 50% medium blocky peds, organic matter		7.5YR 3/2		
			CLAYEY SAND, 2.5YR 4/1 , Fine crumb structure, gradual change to:		2.5YR 4/1	2M	
.5							.5
			CLAYEY SAND, 2.5YR 5/1 , Fine to v.fine structure, Fine sand saturated, C is gradual change to fine sands,		2.5YR 5/1		
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH6

Project: GJ0926

Client: Splendour Pty Ltd

Latitude 28.29.031

Longitude 153.31.135

RL(m): _____

GILBERT+SUTHERLAND
agriculture - water - environment

Depth (m): 1

Logged by: RJ

Drilled by: Gilbert & Sutherland

Start date:

Completion date:

Soil Description

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			MEDIUM CLAY, 2.5YR 3/1 , Moderate, polyhedral (4), Organic matter (roots), moist		2.5YR 3/1	2M	
.5			MEDIUM HEAVY CLAY, 5YR 4/1 , Moderate, polyhedral, 3% orange mottles, charcoal 300-450mm, gradual change to		5YR 4/1		.5
			SANDY CLAY, 5YR 5/1 , Moderate, polyhedral		5YR 5/1	2M	
1.0			SAND, 5YR 5/1 , Massive, fine wet sand		5YR 5/1		1.0
			, End of bore				
1.5							1.5
2.0							2.0

Borehole: BH7

GILBERT+SUTHERLAND
agriculture - water - environment

Project:	GJ0926	Depth (m):	1
Client:	Splendour Pty Ltd	Logged by:	RJ
Latitude	28.29.208	Drilled by:	Gilbert & Sutherland
Longitude	153.30.863	Start date:	
RL(m):	_____	Completion date:	

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			LIGHT CLAY, 7.5YR 3/3 , Moderate, subangular, Moist, Organic matter		7.5YR 3/3		
			LIGHT CLAY, 7.5YR 3/3, 5YR 5/8, Moderate, subangular, Moist, Organic matter, pH 6.5		7.5YR 3/3, 5YR 5/8	4/7M	
.5			MEDIUM CLAY, 10YR 3/4 , Massive, Moist, pH 6		10YR 3/4	2M	.5
			SILTY CLAY, Greyish yellow brown, 10YR 6/6, Massive, Light clay with silt, 50% mottles		10YR 4/2, 10YR 6/6		
			SILTY CLAY, Greyish yellow brown , Massive, 50% mottles, charcoal & silt fines		10YR 4/2		
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH8

GILBERT+SUTHERLAND
agriculture - water - environment

Project:	GJ0926
Client:	Splendour Pty Ltd
Latitude	28.28.564
Longitude	153.30.991
RL(m):	_____

Depth (m):	1
Logged by:	RJ
Drilled by:	Gilbert & Sutherland
Start date:	
Completion date:	

Soil Description

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			LIGHT CLAY, 10YR 4/3 , Moderate pedality, moist		10YR 4/3	2M	
			LIGHT MEDIUM CLAY, 10YR 4/3, 2.5Y 5/6, Massive, 7% orange mottles		10YR 4/3, 2.5Y 5/6	2M	
			LIGHT MEDIUM CLAY, 10YR 5/4, 2.5Y 5/6, Massive, 30% orange mottles		10YR 5/4, 2.5Y 5/6		
.5							.5
			LIGHT MEDIUM CLAY, 2.5Y 5/6, 2.5Y 5/2, Massive, Moderate plasticity, 40% mottles		2.5Y 5/6, 2.5Y 5/2	1M	
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH9

Project: GJ0926

Client: Splendour Pty Ltd

Latitude 28.28.636

Longitude 153.31.145

RL(m): _____

GILBERT+SUTHERLAND
agriculture - water - environment

Depth (m): 1

Logged by: RJ

Drilled by: Gilbert & Sutherland

Start date:

Completion date:

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			CLAY LOAM, 7.5YR 2.5/1 , Weak pedality, medium crumb peds, Organic matter (roots), moist, pH 5		7.5YR 2.5/1		
			CLAY LOAM, 7.5YR 2.5/2 , Weak pedality, medium crumb structure, Moist, abrupt boundary to next layer		7.5YR 2.5/2	4/7M	
.5							.5
			HEAVY CLAY, 7.5YR 4/2 , Massive, Charcoal present at 550mm, water seeping into hole at 800mm, pH 4.5		7.5YR 4/2	2M	
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH10

GILBERT+SUTHERLAND
agriculture - water - environment

Project:	GJ0926	Depth (m):	1
Client:	Splendour Pty Ltd	Logged by:	RJ
Latitude	28.28.5511	Drilled by:	Gilbert & Sutherland
Longitude	153.31.25	Start date:	
RL(m):	_____	Completion date:	

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			LOAM, 10YR 2/1 , Weak pedality, medium crumb structure, Organic matter, pH 4.5		10YR 2/1		
			LOAM, 10YR 2/1, 10YR 4/6, Weak pedality, coarse blocky peds, 20% mottles, pH 4.5		10YR 2/1, 10YR 4/6	4/7M	
			CLAY LOAM, Brownish black , Moist, horizon to next layer		10YR2/2		
.5							.5
			HEAVY CLAY, 10YR 3/2 , Massive, wet, water in hole at 900, pH 5.0		10YR 3/2	2M	
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH11

GILBERT+SUTHERLAND
agriculture - water - environment

Project:	GJ0926
Client:	Splendour Pty Ltd
Latitude	28.28.645
Longitude	158.31.442
RL(m):	_____

Depth (m):	1
Logged by:	RJ
Drilled by:	Gilbert & Sutherland
Start date:	
Completion date:	

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			LOAM, 7.5YR 3/2 , weak pedality, medium subangular peds, organic matter (roots), pH 5.0, gradual boundary to:		7.5YR 3/2	2M	
			LOAM, 7.5 3/1, 7.5YR 7/8, weak pedality, medium subangular peds, 20% charcoal, 10% mottles		7.5 3/1, 7.5YR 7/8	2M	
.5			LIGHT CLAY, 10YR 2/2 , Massive		10YR 2/2		.5
			CLAYEY SILT, 7.5YR 4/2 , Weak pedality, fine crumb structure, 10% orange mottles, pH 5.5		7.5YR 4/2	4/7M	
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH12

GILBERT+SUTHERLAND
agriculture - water - environment

Project:	GJ0926	Depth (m):	1
Client:	Splendour Pty Ltd	Logged by:	RJ
Latitude	28.28.077	Drilled by:	Gilbert & Sutherland
Longitude	153.30.996	Start date:	
RL(m):	_____	Completion date:	

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			SILTY CLAY LOAM, 2.5YR 2.5/2 , Moderate pedality, polyhedral peds, moist		2.5YR 2.5/2		
			SILTY CLAY LOAM, 2.5YR 2.5/2, 10R 4/8, Moderate pedality, polyhedral peds, moist, 3% red mottles		2.5YR 2.5/2, 10R 4/8	4/7M	
.5			LIGHT CLAY, 10YR 5/2, 10R 4/8, Massive (moist), moist, 5% red mottles, charcoal present		10YR 5/2, 10R 4/8	2M	.5
			MEDIUM CLAY, 10YR 6/4, 2.5YR 3/6, Massive (moist), Gravel present, mottles		10YR 6/4, 2.5YR 3/6		
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH13

Project: GJ0926

Client: Splendour Pty Ltd

Latitude 28.28.056

Longitude 153.30.967

RL(m): _____

GILBERT+SUTHERLAND
agriculture - water - environment

Depth (m): 1

Logged by: RJ

Drilled by: Gilbert & Sutherland

Start date:

Completion date:

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			LIGHT CLAY, 7.5YR 3/4 , Weak fine crumb, Dry, organic matter (roots)		7.5YR 3/4	3M	
			LIGHT CLAY, 7.5YR 3/4 , Weak fine crumb, Dry, 15% medium/coarse angular gravel		7.5YR 3/4	3M	
.5							.5
			MEDIUM CLAY, 7.5YR 3/4 , Moderate, medium subangular, dry, silt fines		7.5YR 3/4	4/7M	
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH14

Project: GJ0926

Client: Splendour Pty Ltd

Latitude 28.28.0

Longitude 153.30.928

RL(m): _____

GILBERT+SUTHERLAND
agriculture - water - environment

Depth (m): 0.9

Logged by: RJ

Drilled by: Gilbert & Sutherland

Start date:

Completion date:

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			SILTY CLAY LOAM, 7.5YR 2/5 , Medium polyhedral peds, minor coarse angular gravels, 5% orange mottles, organic matter (roots), biota, silt crumbs 2 - 4mm, gradual change to		7.5YR 2/5	4/7M	
			LIGHT MEDIUM CLAY, 10YR 5/4 , Massive (moist), 15% orange mottles, charcoal, cobbles, gradual change to		10YR 5/4		
.5							.5
			MEDIUM CLAY, 10YR 5/6 , Massive (moist), orange mottles, cobbles, weathered rock		10YR 5/6	2M	
			, End of bore				
1.0							1.0
1.5							1.5
2.0							2.0

Borehole: BH15

GILBERT+SUTHERLAND
agriculture - water - environment

Project: GJ0926
Client: Splendour Pty Ltd
Latitude 28.28.352
Longitude 153.31.276
RL(m): _____

Depth (m): 2.2
Logged by: RJ
Drilled by: Gilbert & Sutherland
Start date:
Completion date:

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			LOAM, 7.5YR 2.5/3 , Moderate structure, crumb peds, Organic matter (roots), moist, pH 5		7.5YR 2.5/3	4/7M	
			LOAM, 7.5YR 2.5/3, 10YR 7/8, 8/2, Moderate structure, crumb peds, Mottles, moist, pH 5		7.5YR 2.5/3, 10YR 7/8, 8/2	4/7M	
			CLAY LOAM, 7.5YR 2.5/3, 10YR 7/8, 8/2, Moderate structure, crumb & subangular peds, Charcoal, 50% mottles , moist, pH 5		7.5YR 2.5/3, 10YR 7/8, 8/2		
.5			MEDIUM HEAVY CLAY, 7.5YR 3/1 , Massive, 10% charcoal fines, pH 5		7.5YR 3/1	2M	.5
			HEAVY CLAY, 10YR 4/3, 10YR 4/6, Massive, 30% mottles 10YR 4/6 + charcoal, pH 5		10YR 4/3, 10YR 4/6		
1.0							1.0
1.5			HEAVY CLAY, Gley 2.4/5PB, 10YR 6/8, Massive, 10% mottles (dry iron oxide fines), wet, pH 4		Gley 2.4/5PB, 10YR 6/8		1.5
2.0							2.0
			MEDIUM HEAVY CLAY, Gley 2 6/5PB , Massive, Sand fines, wet		Gley 2 6/5PB		
			, End of bore				

Borehole: BH16

GILBERT+SUTHERLAND
agriculture - water - environment

Project: GJ0926

Client: Splendour Pty Ltd

Latitude 28.28.406

Longitude 153.31.606

RL(m): _____

Depth (m): 2

Logged by: RJ

Drilled by: Gilbert & Sutherland

Start date:

Completion date:

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			SANDY LOAM, 10YR 2/1 , Weak structure, medium crumb peds, organic matter (roots), moist		10YR 2/1	2M	
			SANDY LOAM, 10YR 2/1, 10YR 4/4, Weak structure, medium subangular peds, Charcoal fines, mulch layer @ 20mm		10YR 2/1, 10YR 4/4	2M	
			CLAY LOAM, 10YR 3/2 , Moderate structure, medium subangular peds, moist		10YR 3/2		
.5			SANDY CLAY , Massive				.5
1.0			SAND, Greyish yellow brown , Massive, wet		10YR 4/2	2M	1.0
1.5			HEAVY CLAY, Gley 1 6/N , Marine clay, massive, wet, sand fines, high plasticity		Gley 1 6/N		1.5
			SAND, 7.5YR 7/1 , Massive, wet		7.5YR 7/1		
2.0			, End of bore				2.0

Borehole: BH17

GILBERT+SUTHERLAND
agriculture - water - environment

Project: GJ0926
Client: Splendour Pty Ltd
Latitude 28.28.133
Longitude 153.31.678
RL(m): _____

Depth (m): 1.6
Logged by: RJ
Drilled by: Gilbert & Sutherland
Start date:
Completion date:

Soil Description

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			CLAY LOAM, 2.5YR 2.5/1 , Moderate structure, coarse crumb peds, organic matter, moist		2.5YR 2.5/1	2M	
			CLAY LOAM, 5YR 2.5/1 , Moderate structure, coarse crumb peds, mulch pieces and sand fines		5YR 2.5/1	2M	
			SANDY CLAY LOAM, 7.5YR 3/1 , Moderate structure, medium polyhedral peds		7.5YR 3/1		
.5							.5
			SAND, 7.5YR 5/2 , Massive, moist		7.5YR 5/2	2M	
1.0							1.0
			SAND, 7.5YR 5/2 , Massive, wet		7.5YR 5/2		
1.5							1.5
			, End of bore				
2.0							2.0

Borehole: BH18

Project: GJ0926

Client: Splendour Pty Ltd

Latitude 28.28.398

Longitude 153.31.427

RL(m): _____

GILBERT+SUTHERLAND
agriculture - water - environment

Depth (m): 1

Logged by: RJ

Drilled by: Gilbert & Sutherland

Start date:

Completion date:

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			SILTY CLAY LOAM, 7.5YR 2.5/1 , Moderate structure, medium crumb & polyhedral peds		7.5YR 2.5/1	2M	
			SILTY CLAY LOAM, 7.5YR 2.5/1 , Moderate structure, coarse polyhedral peds, pH 5		7.5YR 2.5/1	2M	
			MEDIUM CLAY, 5YR 4/1 , Massive, wet		5YR 4/1		
.5							.5
			MEDIUM CLAY, 5YR 4/1, 5YR 5/8, Massive, wet, sand fines, 10% mottles at .80, pH 5		5YR 4/1, 5YR 5/8	2M	
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH19

GILBERT+SUTHERLAND
agriculture - water - environment

Project:	GJ0926
Client:	Splendour Pty Ltd
Latitude	28.28.260
Longitude	153.31.352
RL(m):	_____

Depth (m):	1
Logged by:	RJ
Drilled by:	Gilbert & Sutherland
Start date:	
Completion date:	

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			LOAM, 7.5YR 3/1 , Moderate structure, coarse crumb peds, organic matter (roots)		7.5YR 3/1	2M	
			LOAM, 10YR 6/6, 10YR 6/6, Moderate, coarse crumb, 40% mottles (silt fines), pH 5		10YR 6/6, 10YR 6/6	2M	
			LOAM, 10YR 6/6 , Moderate, coarse crumb, organics (bark mulch)		10YR 6/6		
.5							.5
			MEDIUM CLAY, 10YR 6/2 , Massive, 10% orange mottles, 5% charcoal traces, pH 4.5		10YR 6/2	2M	
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH20

GILBERT+SUTHERLAND
agriculture - water - environment

Project: GJ0926
Client: Splendour Pty Ltd
Latitude 28.26.41
Longitude 153.30.19
RL(m): _____

Depth (m): 1
Logged by: RJ
Drilled by: Gilbert & Sutherland
Start date:
Completion date:

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			LOAM, 7.5YR 2.5/1 , Moderate structure, fine/med crumb, organic matter (roots), moist		7.5YR 2.5/1	2M	
			CLAY LOAM, 7.5YR 2.5/1 , Moderate structure, subangular blocky, sand fines, organic matter		7.5YR 2.5/1	2M	
			SANDY CLAY LOAM, 5YR 4/1 , Massive, wet		5YR 4/1		
.5							.5
			SAND, 5YR 5/2 , Massive, wet		5YR 5/2		
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH21

Project: GJ0926
Client: Splendour Pty Ltd
Latitude 28.26.46
Longitude 153.30.19
RL(m): _____

GILBERT+SUTHERLAND
agriculture - water - environment

Depth (m): 1
Logged by: RJ
Drilled by: Gilbert & Sutherland
Start date:
Completion date:

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			SILTY LOAM, 10YR 2/2 , Medium crumb/polyhedral, organic matter (roots)		10YR 2/2		
			CLAY LOAM, 2.5Y 2.5/1 , Moderate structure, medium subangular peds, moist		2.5Y 2.5/1	2M	
			SAND, 10YR 5/2 , Massive, moist		10YR 5/2	2M	
.5							.5
			CLAYEY SAND, 7.5YR 2.5/3 , Massive, wet		7.5YR 2.5/3		
			SAND, 10YR 5/2 , Massive, wet		10YR 5/2		
			CLAYEY SAND, 7.5YR , Coherent sand, wet		7.5YR		
1.0			, End of bore				1.0
1.5							1.5
2.0							2.0

Borehole: BH22

GILBERT+SUTHERLAND
agriculture - water - environment

Project:	GJ0926	Depth (m):	0.9
Client:	Splendour Pty Ltd	Logged by:	RJ
Latitude	28.29.50	Drilled by:	Gilbert & Sutherland
Longitude	153.32.1	Start date:	
RL(m):	_____	Completion date:	

Drilling / Soil Description

Depth NSL(m)	Depth (RL) m	Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			SILTY LOAM, 10YR 2/2 , Moderate struct, coarse crumb/med polyhedral peds, organics & biota		10YR 2/2		
			CLAY LOAM, 10YR 2/2 , Moderate, medium polyhedral peds, tree bark mulch (orange) & charcoal		10YR 2/2	2M	
.5			SAND, 7.5YR 6/2 , Massive structure, moist		7.5YR 6/2	2M	.5
			SAND, 7.5YR 4/2 , Massive structure, wet		7.5YR 4/2		
			, End of bore				
1.0							1.0
1.5							1.5
2.0							2.0

Borehole: BH23

GILBERT+SUTHERLAND
agriculture - water - environment

Project: GJ0926
Client: Splendour Pty Ltd
Latitude ____________
Longitude ____________
RL(m): _____

Depth (m): 1
Logged by: RJ
Drilled by: Gilbert & Sutherland
Start date:
Completion date:

Soil Description

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			LOAM, 5YR 2.5/1 , Mod/strong structure, medium crumb peds, organics & biota		5YR 2.5/1	2M	
			SILTY LOAM, 5YR 2.5/1 , Coarse crumb peds, Red bark mulch, clear boundary to:		5YR 2.5/1	2M	
			SANDY CLAY LOAM, 5YR 2.5/1 , Subangular peds, sand fines		5YR 2.5/1	2M	
.5							.5
			SAND, 5YR 6/1 , Massive, moist, 5% charcoal, clay pieces		5YR 6/1		
			SAND, 5YR 4/2 , Massive, wet		5YR 4/2		
1.0							1.0
1.5							1.5
2.0							2.0

Borehole: BH24

Project: GJ0926

Client: Splendour Pty Ltd

Latitude ____________

Longitude ____________

RL(m): _____

GILBERT+SUTHERLAND
agriculture - water - environment

Depth (m): 0.9

Logged by: RJ

Drilled by: Gilbert & Sutherland

Start date:

Completion date:

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			SILTY LOAM, 10YR 2/1 , Moderate structure, fine crumb peds, organics, pH 5.5		10YR 2/1	2M	
			SILTY LOAM, 10YR 3/2 , Medium subangular peds		10YR 3/2		
.5			SILTY CLAY LOAM, 2.5Y 3/1 , Massive,wet/moist, mulch 2%, sand fines, pH 5		2.5Y 3/1	2M	.5
			MEDIUM CLAY, 5YR 2.5/1 , Massive, wet		5YR 2.5/1		
			, End of bore				
1.0							1.0
1.5							1.5
2.0							2.0

Borehole: BH25

Project: GJ0926

Client: Splendour Pty Ltd

Latitude ____________

Longitude ____________

RL(m): _____

GILBERT+SUTHERLAND
agriculture - water - environment

Depth (m): 1.1

Logged by: RJ

Drilled by: Gilbert & Sutherland

Start date:

Completion date:

Depth NSL(m)	Drilling: Depth (RL) m	Drilling: Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			SILTY CLAY LOAM, 10YR 6/4 , Weak medium crumb		10YR 6/4		
.5			LIGHT CLAY, 7.5YR 6/6 , Moderate, polyhedral 4		7.5YR 6/6		.5
1.0			LIGHT CLAY, 2.5Y 7/6 , Massive, 20% orange mottles		2.5Y 7/6		1.0
			, End of bore				
1.5							1.5
2.0							2.0

SILTY CLAY LOAM, 10YR 6/4 , Weak structure, crumb peds, dry
LIGHT CLAY, 7.5YR 6/6 , Medium structure, med polyhedral peds, dry
LIGHT CLAY, 2.5 7/6 , Massive structure, 20-25% orange mottles, dry

10YR 6/4
7.5YR 6/6
2.5 7/6

SGS

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Report of Analysis

TW10-03320

Client:
GILBERT & SUTHERLAND ROBINA
PO BOX 4115

ROBINA
4230

Order Number: GJ0870-1
Report Date: 12-May-2010
Received Date: 21-April-2010

Analysis	U.M.	TW10-03320.001 BH 0-0.2 Soil	TW10-03320.002 BH1 0.2-1.0 Soil	TW10-03320.003 BH2 0-0.2 Soil	TW10-03320.004 BH2 0.2-1.0 Soil
Phosphate Phosphorus	mg/kg	<65	<65	<65	<65
Nitrite Nitrogen	mg/kg	<1	<1	<1	<1
Total Kjeldahl Nitrogen	mg/kg	4178	1590	4826	3469
ACIDITY					
pH - CaCl2	pH units	4.67	4.62	4.96	4.78
pH - Water	pH units	5.19	4.99	5.65	5.50
MAJOR ELEMENTS					
Potassium	mg/kg	140	50	185	74
Phosphorus - Colwell extr	mg/kg	6	4	6	4
Nitrate Nitrogen	mg/kg	6	1	5	3
Nitrogen	mg/kg	4184	1591	4831	3472
SECONDARY ELEMENTS					
Calcium	mg/kg	243	49	958	172
Magnesium	mg/kg	120	59	263	92
Aluminium	mg/kg	68	33	-	49
SALINITY					
Electrical Conductivity	dS/m	0.08	0.05	0.08	0.05
Sodium	mg/kg	27	11	34	25
EXCHANGEABLE CATIONS					
Calcium/Magnesium Ratio		1.22	0.50	2.19	1.12
Cation Exchange	meq/100g	3.45	1.28	7.60	2.47
Exchangeable Aluminium	meq/100g	0.76	0.37	Not Applicable	0.55
Exchangeable Aluminium Percent	%	22.0	28.8	Not Applicable	22.2
Exchangeable Calcium	meq/100g	1.21	0.25	4.79	0.86
Exchangeable Calcium Percent	%	35.2	19.2	63.0	34.7
Exchangeable Magnesium	meq/100g	1.00	0.49	2.19	0.77
Exchangeable Magnesium Percent	%	28.9	38.1	28.8	31.1
Exchangeable Potassium	meq/100g	0.36	0.13	0.48	0.19
Exchangeable Potassium Percent	%	10.4	10.0	6.3	7.7
Exchangeable Sodium	meq/100g	0.12	0.05	0.15	0.11
Exchangeable Sodium Percent	%	3.4	3.9	2.0	4.3
OTHER					
Equilibrium P Concentration	µg/mL	-	-	-	-
P Buffer Capacity		-	-	-	-
Phosphorus	%	0.092	0.067	0.097	0.083

Report of Analysis

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TW10-03320

Analysis	U.M.	TW10-03320.005 BH3 0-0.2 Soil	TW10-03320.006 BH3 0.2-0.70 Soil	TW10-03320.007 BH4 0.1-0.25 Soil	TW10-03320.008 BH4 0.25-0.65 Soil
Phosphate Phosphorus	mg/kg	<65	<65	<65	<65
Nitrite Nitrogen	mg/kg	<1	<1	<1	<1
Total Kjeldahl Nitrogen	mg/kg	4890	2353	2407	1394
ACIDITY					
pH - CaCl2	pH units	4.89	4.75	4.90	5.02
pH - Water	pH units	5.36	5.63	5.60	5.65
MAJOR ELEMENTS					
Potassium	mg/kg	194	68	113	47
Phosphorus - Colwell extr	mg/kg	11	3	3	3
Nitrate Nitrogen	mg/kg	4	2	2	1
Nitrogen	mg/kg	4894	2355	2409	1396
SECONDARY ELEMENTS					
Calcium	mg/kg	1061	214	478	355
Magnesium	mg/kg	176	93	111	64
Aluminium	mg/kg	22	-	-	-
SALINITY					
Electrical Conductivity	dS/m	0.33	0.05	0.04	0.03
Sodium	mg/kg	47	31	21	24
EXCHANGEABLE CATIONS					
Calcium/Magnesium Ratio		3.62	1.38	2.60	3.30
Cation Exchange	meq/100g	7.72	2.15	3.69	2.54
Exchangeable Aluminium	meq/100g	0.25	Not Applicable	Not Applicable	Not Applicable
Exchangeable Aluminium Percent	%	3.2	Not Applicable	Not Applicable	Not Applicable
Exchangeable Calcium	meq/100g	5.30	1.07	2.39	1.77
Exchangeable Calcium Percent	%	68.7	49.7	64.8	70.0
Exchangeable Magnesium	meq/100g	1.46	0.78	0.92	0.54
Exchangeable Magnesium Percent	%	19.0	36.1	24.9	21.2
Exchangeable Potassium	meq/100g	0.50	0.17	0.29	0.12
Exchangeable Potassium Percent	%	6.5	8.0	7.8	4.7
Exchangeable Sodium	meq/100g	0.21	0.13	0.09	0.10
Exchangeable Sodium Percent	%	2.7	6.2	2.5	4.1
OTHER					
Equilibrium P Concentration	µg/mL	-	-	-	-
P Buffer Capacity		-	-	-	-
Phosphorus	%	0.13	0.076	0.089	0.078

Results are on an 'air dried' basis.
Remaining results to follow

Analysed Between 21/04/2010 - 11/05/2010

SGS

Report of Analysis

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TW10-03320

Method of Analysis

Analysis	U.M.	Det.Lim.	Method
Electrical Conductivity	dS/m	0.01	SOL003/SOL001/2
pH - CaCl2	pH units	0.01	SOL003/SOL001/2
pH - Water	pH units	0.01	SOL003/SOL001/2
Calcium	mg/kg	1	SOL044
Calcium/Magnesium Ratio		0.01	SOL044
Cation Exchange	meq/100g	0.01	SOL044
Exchangeable Aluminium	meq/100g	0.01	SOL044
Exchangeable Aluminium Percent	%	0.1	SOL044
Exchangeable Calcium	meq/100g	0.01	SOL044
Exchangeable Calcium Percent	%	0.1	SOL044
Exchangeable Magnesium	meq/100g	0.01	SOL044
Exchangeable Magnesium Percent	%	0.1	SOL044
Exchangeable Potassium	meq/100g	0.01	SOL044
Exchangeable Potassium Percent	%	0.1	SOL044
Exchangeable Sodium	meq/100g	0.01	SOL044
Exchangeable Sodium Percent	%	0.1	SOL044
Magnesium	mg/kg	1	SOL044
Potassium	mg/kg	1	SOL044
Sodium	mg/kg	1	SOL044
Equilibrium P Concentration	µg/mL	20.0	SOL027
P Buffer Capacity		0.50	SOL027
Phosphorus - Colwell extr	mg/kg	1	SOL005/001/4
Phosphate Phosphorus	mg/kg	65	ANL001
Nitrite Nitrogen	mg/kg	1	ANL001
Nitrate Nitrogen	mg/kg	1	SOL030
Nitrogen	mg/kg	10	PRN002
Total Kjeldahl Nitrogen	mg/kg	1	
Phosphorus	%	0.010	MIN001
Aluminium	mg/kg	1	SOL002/1-2

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Report of Analysis

TW10-03320

The analyses presented in the report refer exclusively to the samples analysed.

The presented report can only be reproduced in its entirety.

TDelFabbro

Tabatha Del Fabbro - Section Head

For and on behalf of SGS Australia Pty Ltd

P ISOTHERM RESULTS

Client: Gilbert & Sutherland Robina
Laboratory No: TW10-03320.001 **Marking:** BH 0-0.2

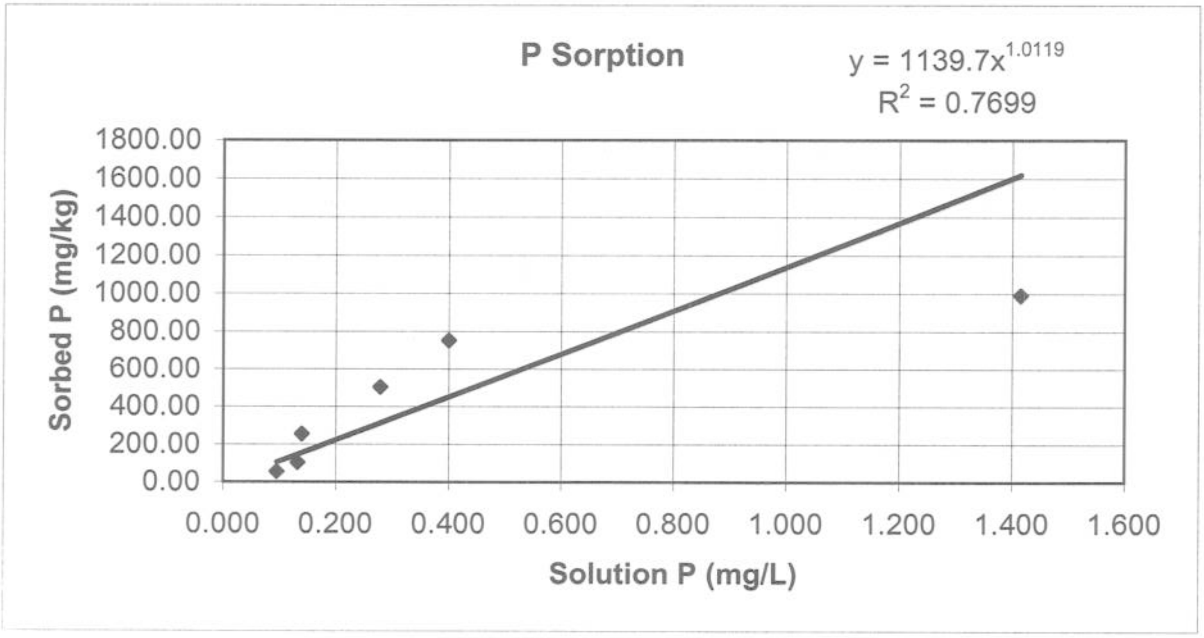
Colwell P mg/kg	5.86

P Sorbed = a x Equilibrium P Conc.^{b}

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
50	0.948	5	0.095	54.91	105.09
100	1.319	10	0.132	104.54	146.78
250	1.396	25	0.140	254.46	155.46
500	2.785	50	0.279	503.07	312.64
750	4.002	75	0.400	751.86	451.17
1000	14.155	100	1.415	991.71	1619.96

a	1139.740
b	1.012
R^2	0.877

Equilibrium P Concentration mg/L					
0.5	1	5	10	20	50
P Sorbed mg/kg Estimated					
565	1140	5809	11715	23623	59707



P ISOTHERM RESULTS

Client: Gilbert & Sutherland Robina
Laboratory No: TW10-03320.002 **Marking:** BH1 0.2-1.0

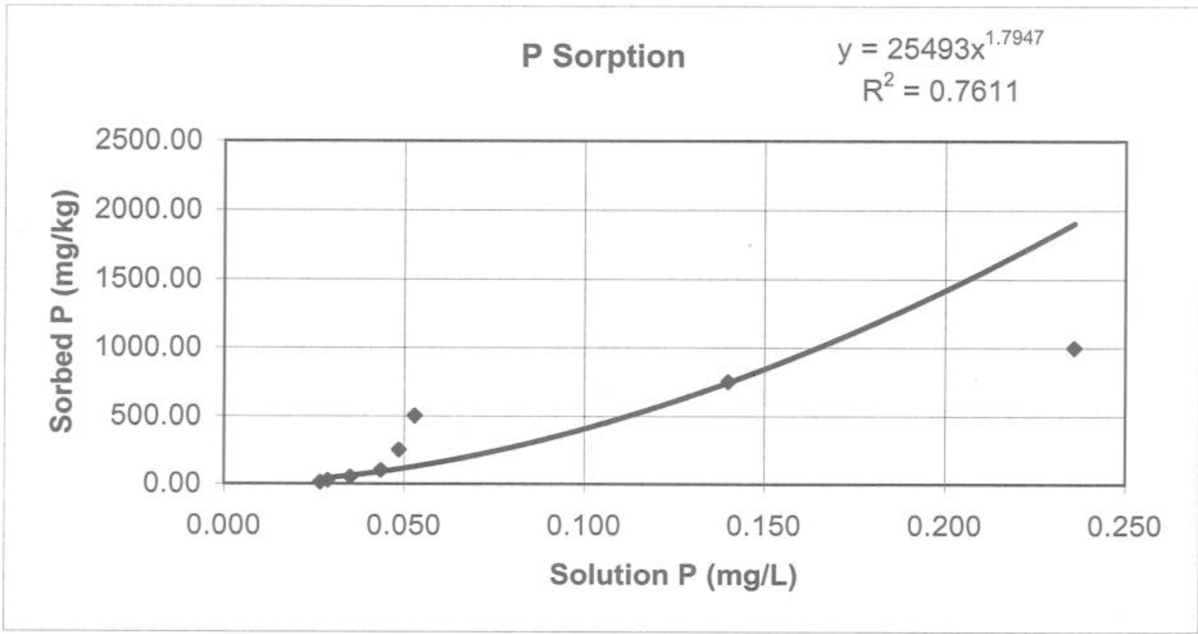
Colwell P mg/kg	3.59

P Sorbed = a x Equilibrium P Conc.^{b}

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
10	0.267	1	0.027	13.32	38.23
25	0.288	2.5	0.029	28.30	43.76
50	0.350	5	0.035	53.24	62.20
100	0.436	10	0.044	103.15	92.09
250	0.485	25	0.049	253.10	111.78
500	0.528	50	0.053	503.06	130.13
750	1.399	75	0.140	752.19	747.15
1000	2.358	100	0.236	1001.23	1906.71

a	25492.824
b	1.795
R^2	0.872

Equilibrium P Concentration mg/L					
0.5	1	5	10	20	50
P Sorbed mg/kg Estimated					
7348	25493	457999	1589006	5512978	28547768



P ISOTHERM RESULTS

Client: Gilbert & Sutherland Robina
Laboratory No: TW10-03320.003 **Marking:** BH2 0-0.2

Colwell P mg/kg	6.14

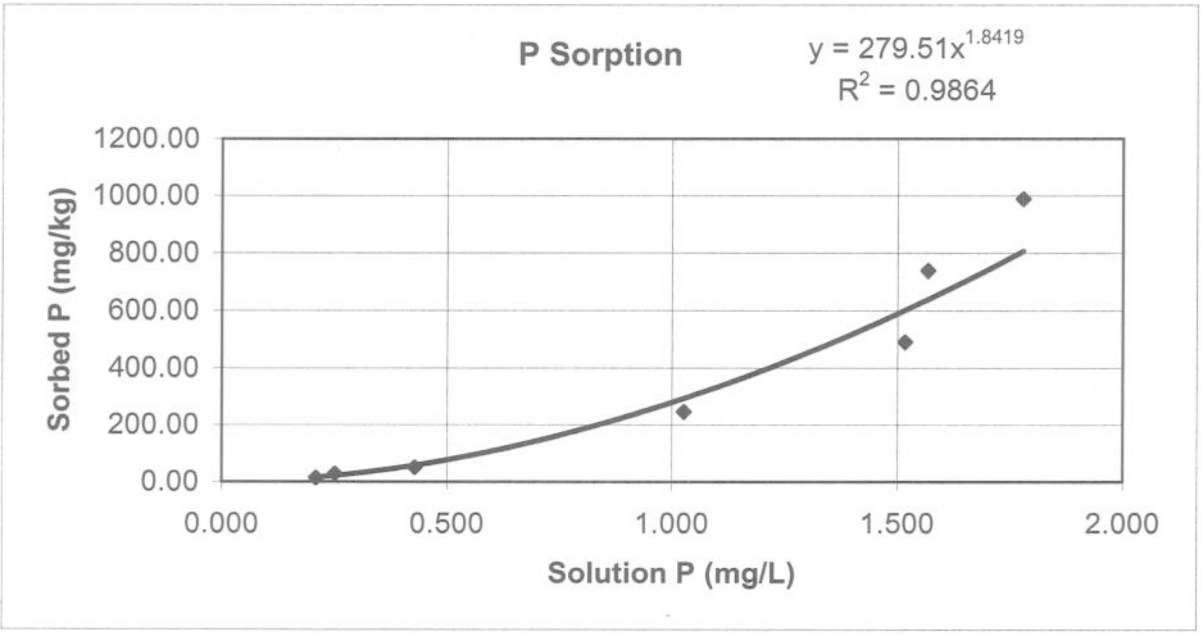
P Sorbed = a x Equilibrium P Conc.^{b}

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
10	2.094	1	0.209	14.05	15.69
25	2.510	2.5	0.251	28.63	21.91
50	4.284	5	0.428	51.86	58.65
250	10.271	25	1.027	245.87	293.62
500	15.173	50	1.517	490.97	602.41
750	15.677	75	1.568	740.46	639.80
1000	17.787	100	1.779	988.35	807.30

a	279.510
b	1.842
R^2	0.993

Equilibrium P Concentration mg/L

0.5	1	5	10	20	50
P Sorbed mg/kg Estimated					
78	280	5418	19421	69619	376427



P ISOTHERM RESULTS

Client: Gilbert & Sutherland Robina
Laboratory No: TW10-03320.004 **Marking:** BH2 0.2-1.0

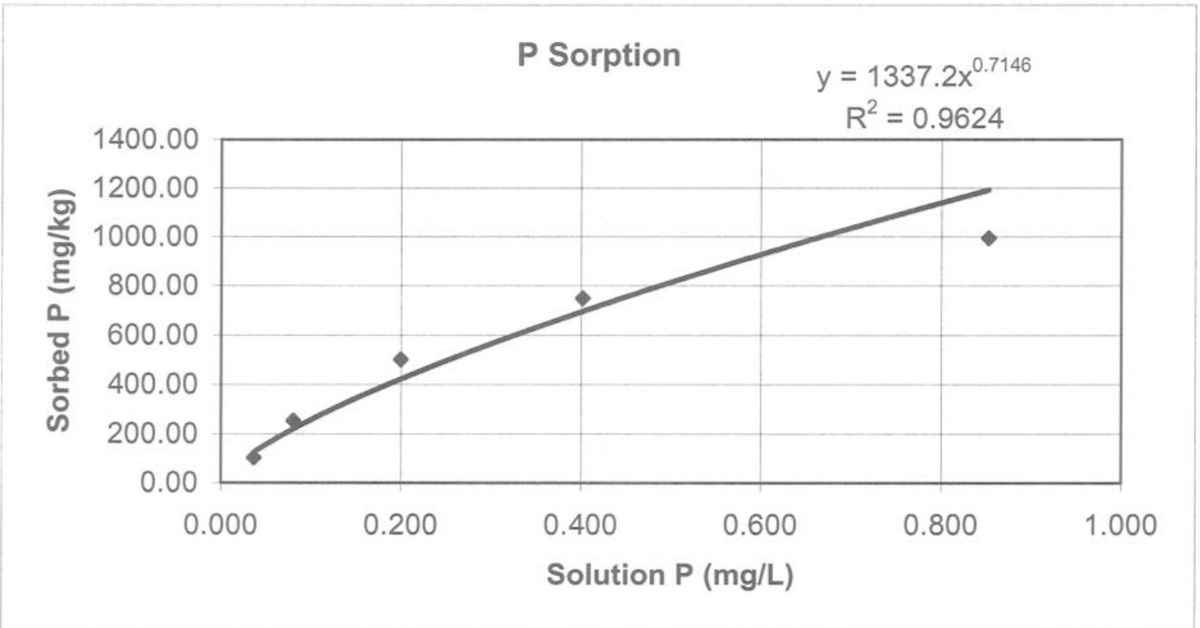
Colwell P mg/kg	3.59

P Sorbed = a x Equilibrium P Conc.^{b}

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
100	0.366	10	0.037	103.22	125.75
250	0.805	25	0.081	252.78	221.00
500	1.994	50	0.199	501.60	422.42
750	4.017	75	0.402	749.57	696.88
1000	8.527	100	0.853	995.06	1193.28

a	1337.174
b	0.715
R^2	0.981

Equilibrium P Concentration mg/L					
0.5	1	5	10	20	50
P Sorbed mg/kg Estimated					
815	1337	4224	6931	11374	21893



P ISOTHERM RESULTS

Client: Gilbert & Sutherland Robina
Laboratory No: TW10-03320.005 **Marking:** BH3 0-0.2

Colwell P mg/kg	10.69

P Sorbed = a x Equilibrium P Conc.^{b}

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
50	0.755	5	0.076	59.93	83.73
100	1.014	10	0.101	109.68	113.08
250	1.479	25	0.148	259.21	166.34
500	3.827	50	0.383	506.86	439.58
750	7.680	75	0.768	753.01	895.92
1000	8.972	100	0.897	1001.72	1050.21

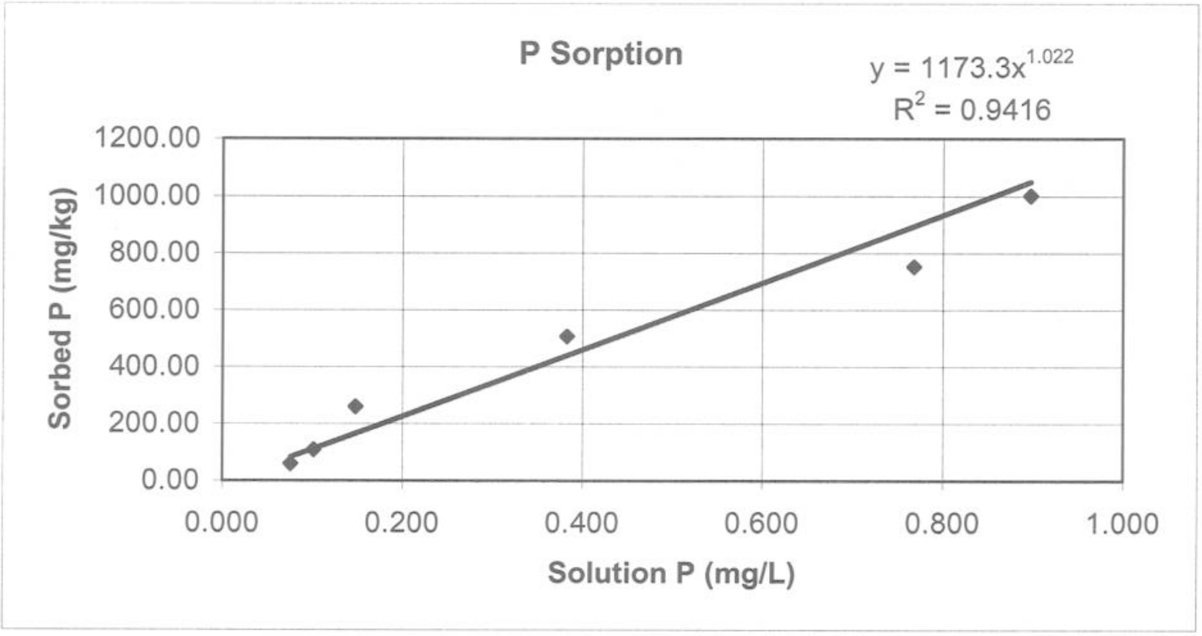
a	1173.281
b	1.022
R^2	0.970

Equilibrium P Concentration mg/L

0.5	1	5	10	20	50

P Sorbed mg/kg Estimated

578	1173	6078	12342	25062	63928



P ISOTHERM RESULTS

Client: Gilbert & Sutherland Robina
Laboratory No: TW10-03320.006 **Marking:** BH3 0.2-0.70

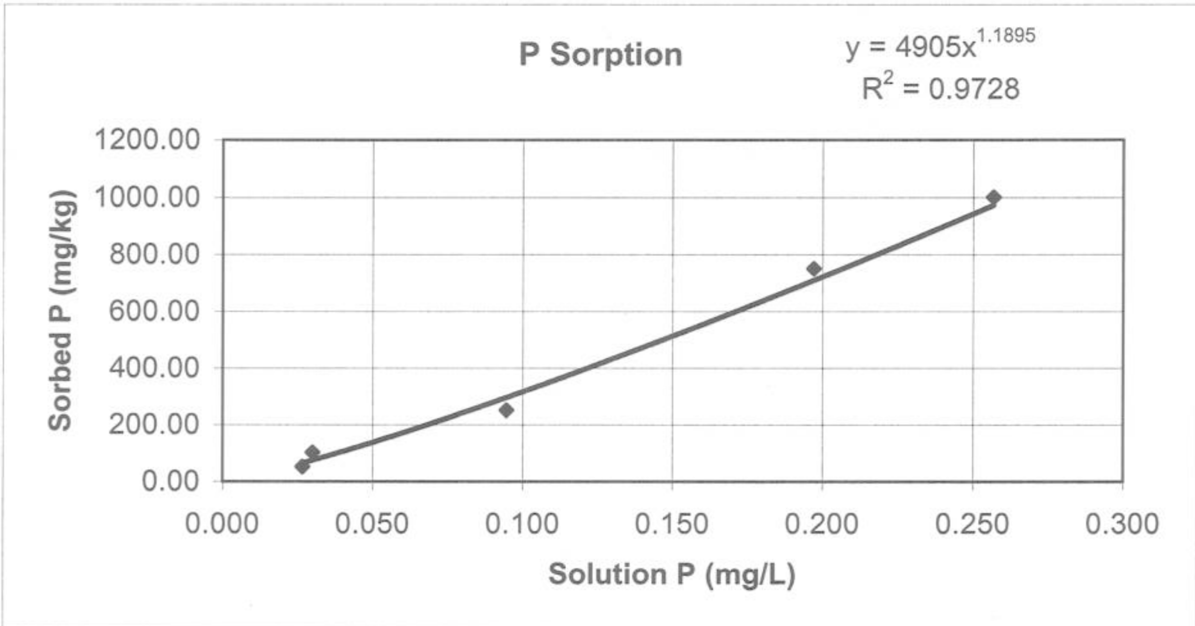
Colwell P mg/kg	2.86

P Sorbed = a x Equilibrium P Conc.^{b}

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
50	0.266	5	0.027	52.59	65.70
100	0.300	10	0.030	102.56	75.64
250	0.947	25	0.095	251.91	296.97
750	1.971	75	0.197	750.89	710.49
1000	2.568	100	0.257	1000.29	973.32

a	4905.003
b	1.190
R^2	0.986

Equilibrium P Concentration mg/L					
0.5	1	5	10	20	50
P Sorbed mg/kg Estimated					
2151	4905	33272	75887	173081	514766



P ISOTHERM RESULTS

Client: Gilbert & Sutherland Robina
Laboratory No: TW10-03320.007 **Marking:** BH4 0.1-0.25

Colwell P mg/kg	2.89

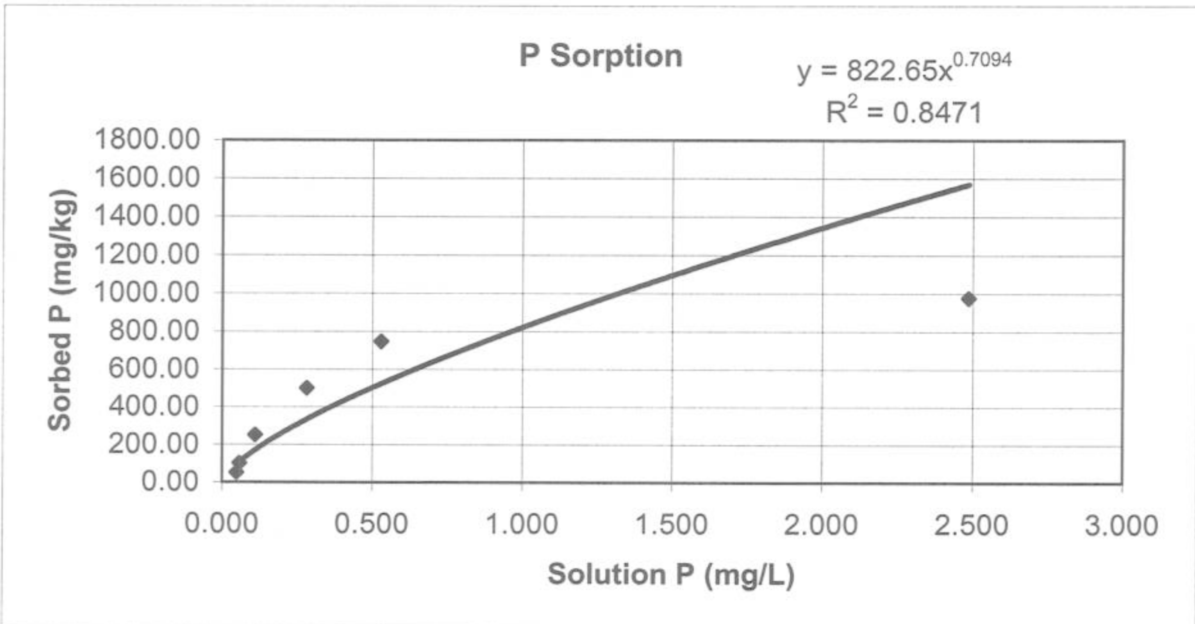
P Sorbed = a x Equilibrium P Conc.^{b}

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
50	0.481	5	0.048	52.41	95.63
100	0.580	10	0.058	102.31	109.18
250	1.101	25	0.110	251.79	172.00
500	2.810	50	0.281	500.08	334.29
750	5.292	75	0.529	747.60	523.76
1000	24.868	100	2.487	978.02	1569.91

a	822.645
b	0.709
R^2	0.920

Equilibrium P Concentration mg/L

0.5	1	5	10	20	50
P Sorbed mg/kg Estimated					
503	823	2577	4213	6889	13196



P ISOTHERM RESULTS

Client: Gilbert & Sutherland Robina
Laboratory No: TW10-03320.008 **Marking:** BH4 0.25-0.65

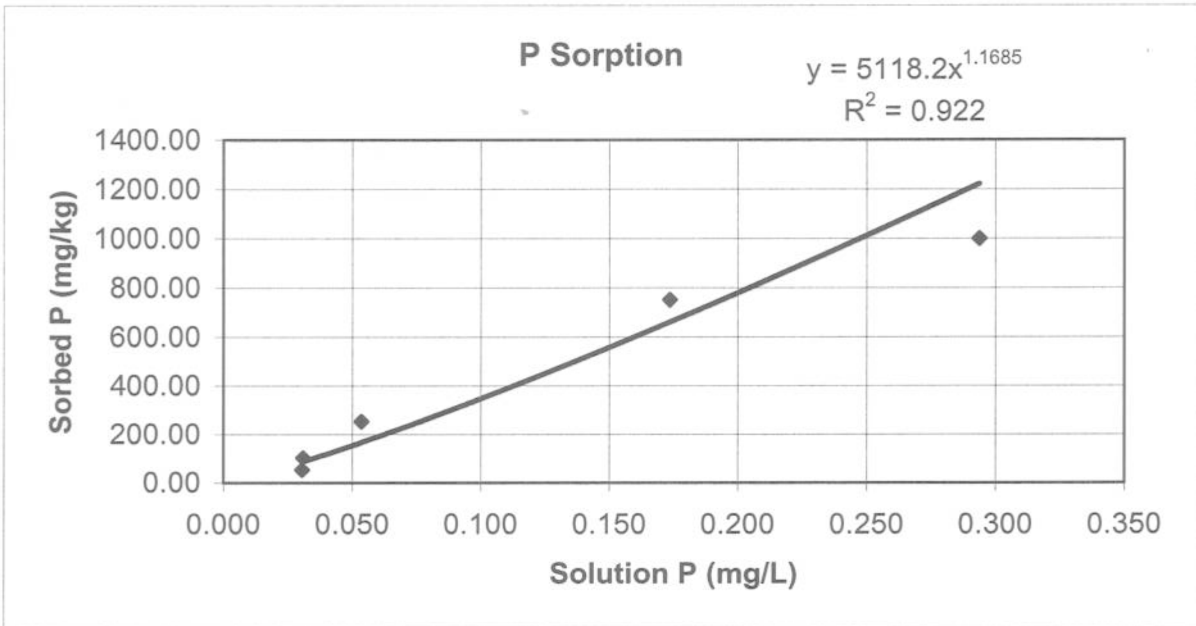
Colwell P mg/kg	3.37

P Sorbed = a x Equilibrium P Conc.^{b}

Initial P mg/kg	Final P mg/kg	Initial P mg/L	Final P mg/L	P Sorbed mg/kg	P Sorbed Estimated
50	0.306	5	0.031	53.06	86.94
100	0.309	10	0.031	103.06	88.14
250	0.536	25	0.054	252.83	167.71
750	1.736	75	0.174	751.63	661.48
1000	2.937	100	0.294	1000.43	1223.03

a	5118.231
b	1.168
R^2	0.960

Equilibrium P Concentration mg/L					
0.5	1	5	10	20	50
P Sorbed mg/kg Estimated					
2277	5118	33562	75438	169563	494666



Appendix B
Borehole Logs

Whitehead & Associates
Environmental Consultants

Key to Soil Borelogs

Symbols

W	Watertable depth	**S**	Sample collected
X	Depth of refusal		

Moisture condition

D	Dry
SM	Slightly moist
M	Moist
VM	Very moist
W	Wet / saturated

Graphic Log and Textures

S - Sand
LS - Loamy sand
CS - Clayey sand

SCL - Sandy clay loam
FSCL - Fine sandy CL
CL - Clay loam
SiCL - Silty clay loam

Gravel (G)

SL - Sandy loam

LC - Light clay
SC - Sandy clay
SiC - Silty clay

Parent material (stiff)

L - Loam
LFS - Loam fine sandy
SiL - Silty loam

MC - Medium clay
HC - Heavy clay

Parent material (weathered)

Soil Bore Log

Whitehead & Associates
Environmental Consultants

Project	1912	**Borehole No.:**	**WABH1**
Client:	North Byron Parkland	Logged by:	Strider Duerinckx
Site:	North Byron Parkland, Yelgun	Excavation method:	Hand Auger
Loc:	-28.46610, 153.51694	Date:	22 June 2017

PROFILE DESCRIPTION

Samples	Depth (m)	Graphic Log	Texture	Structure	Colour	Mottles	Coarse Fragments	Moisture	Comments
	0.1		Sandy clay loam	Moderately pedal earthy fabric	Black	Nil	Nil	M	Topsoil (A1) good organic matter many roots
	0.2–0.8		Medium clay	Moderate	Pale yellow brown	Yellow brown and pale grey	Nil	SM	Residual (B1)
	0.9–1.2		Medium clay	Moderate - good	Pale yellow brown	Slight pale grey	Nil	SM	Residual (B2)
	1.3–1.5		Borehole terminated at 1.2m						

Soil Bore Log

Whitehead & Associates
Environmental Consultants

Project	1912	**Borehole No.:**	**WABH2**
Client:	North Byron Parkland	Logged by:	Strider Duerinckx
Site:	North Byron Parkland, Yelgun	Excavation method:	Hand Auger
Loc:	-28.46637, 153.51679	Date:	22 June 2017

PROFILE DESCRIPTION

Samples	Depth (m)	Graphic Log	Texture	Structure	Colour	Mottles	Coarse Fragments	Moisture	Comments
s	0.1–0.2		Sandy clay loam	Moderately pedal earthy fabric	Black	Nil	Nil	M	Topsoil (A1) good organic matter many roots
	0.2–0.8		Medium clay	Moderate	Pale yellow brown	Yellow brown and pale grey	Nil	SM	Residual (B1)
	0.9–1.2		Medium clay	Moderate - good	Pale yellow brown	Slight pale grey	Nil	SM	Residual (B2)
	1.3–1.5		Borehole terminated at 1.2m						

BOREHOLE LOG SHEET - 1

Client:	Whitehead & Associates Environmental Consultants	**ASCT Ref No:**	H18-606
Project:	- North Byron Parklands,	**Client Ref No:**	NA
Borehole Position:	See Site Sketch	**Drilling Method:**	Power Auger
Surface Elevation:	Exisiting Surface Level	**Drill Bit:**	100mm Ø TC

Depth (m)	Graphic Symbol	Group Symbol	Soil Description (AS 1726)	Consistency / Relative Density / Rock Strength	DCP Blows/300mm *Cone Tip*	Test Sample
0.0		OL	**CLAYEY SILT, NATURAL:** black, medium plasticity,			
0.1			medium dry strength, some organics, moist.			
0.2						
0.3		SP	**SAND, NATURAL:** grey, non plastic, no dry strength,			
0.4			fine to medium grained sand, moist.			
0.5						
0.6						
0.7						
0.8						
0.9						
1.0		SC	**SILTY CLAYEY SAND, NATURAL:** black, low plasticity,			
1.1			low dry strength, moist.			
1.2		SP	**SILTY GRAVELLY SAND, NATURAL:** brown, low			
1.3			plasticity, low dry strength, moist.			
1.4		SC	**CLAYEY SAND, NATURAL:** dark brown, low plasticity,			
1.5			low dry strength, wet.			
1.6		SC	**SILTY CLAYEY SAND, NATURAL:** brown, low plasticity,			
1.7			plasticity, low dry strength, fine to medium grained sand,			
1.8			sand, some fine to coarse grained gravel, wet.			
1.9						
2.0						
2.1						
2.2			**DRILLING TERMINATED:** target depth reached.			
2.3						
2.4			Standing water level at 1.4m			
2.5						
2.6						
2.7						
2.8						
2.9						
3.0						
3.1						
3.2						
3.3						
3.4						
3.5						
3.6						
3.7						
3.8						
3.9						
4.0						
4.1						
4.2						
4.3						
4.4						
4.5						
4.6						
4.7						
4.8						
4.9						
5.0						

BOREHOLE LOG SHEET - 2

Client:	Whitehead & Associates Environmental Consultants	**ASCT Ref No:**	H18-606
Project:	- North Byron Parklands,	**Client Ref No:**	NA
Borehole Position:	See Site Sketch	**Drilling Method:**	Power Auger
Surface Elevation:	Exisiting Surface Level	**Drill Bit:**	100mm Ø TC

Depth (m)	Graphic Symbol	Group Symbol	Soil Description (AS 1726)	Consistency / Relative Density / Rock Strength	DCP Blows/300mm *Cone Tip*	Test Sample
0.0		OL	**CLAYEY SILT, NATURAL:** black, medium plasticity,			
0.1			medium dry strength, some organics, moist.			
0.2						
0.3		SP	**SAND, NATURAL:** grey, non plastic, no dry strength, fine			
0.4			to medium grained sand, moist.			
0.5						
0.6						
0.7		SP	**SAND, NATURAL:** dark grey, non plastic, no dry			
0.8			strength, fine to medium grained sand, wet.			
0.9						
1.0						
1.1						
1.2		SC	**SILTY CLAYEY SAND, NATURAL:** brown, low			
1.3			plasticity, low dry strength, fine to medium grained			
1.4			sand, wet.			
1.5						
1.6						
1.7						
1.8						
1.9						
2.0						
2.1						
2.2			**DRILLING TERMINATED:** target depth reached.			
2.3						
2.4			Standing water level at 0.7m			
2.5						
2.6						
2.7						
2.8						
2.9						
3.0						
3.1						
3.2						
3.3						
3.4						
3.5						
3.6						
3.7						
3.8						
3.9						
4.0						
4.1						
4.2						
4.3						
4.4						
4.5						
4.6						
4.7						
4.8						
4.9						
5.0						

BOREHOLE LOG SHEET - 3

Client:	Whitehead & Associates Environmental Consultants	**ASCT Ref No:**	H18-606
Project:	- North Byron Parklands,	**Client Ref No:**	NA
Borehole Position:	See Site Sketch	**Drilling Method:**	Power Auger
Surface Elevation:	Exisiting Surface Level	**Drill Bit:**	100mm Ø TC

Depth (m)	Graphic Symbol	Group Symbol	Soil Description (AS 1726)	Consistency / Relative Density / Rock Strength	DCP Blows/300mm *Cone Tip*	Test Sample
0.0		OL	**CLAYEY SILT, NATURAL:** black, medium plasticity,			
0.1			medium dry strength, some organics, moist.			
0.2						
0.3		SP	**SAND, NATURAL:** grey, non plastic, no dry strength, fine			
0.4			to medium grained sand, moist.			
0.5						
0.6		SC	**CLAYEY SAND, NATURAL:** brown, low plasticity,			
0.7			low dry strength, fine to medium grained sand,			
0.8			some fine to coarse grained gravel, moist.			
0.9						
1.0						
1.1						
1.2		SM	**SILTY SAND, NATURAL:** grey, no plasticity, no dry			
1.3			strength, fine to medium grianed sand, moist.			
1.4						
1.5		SM	**SILTY SAND, NATURAL:** grey, no plasticity, no dry			
1.6			strength, fine to medium grained sand, wet.			
1.7						
1.8						
1.9						
2.0						
2.1						
2.2			**DRILLING TERMINATED:** target depth reached.			
2.3						
2.4			Standing water level at 1.5m			
2.5						
2.6						
2.7						
2.8						
2.9						
3.0						
3.1						
3.2						
3.3						
3.4						
3.5						
3.6						
3.7						
3.8						
3.9						
4.0						
4.1						
4.2						
4.3						
4.4						
4.5						
4.6						
4.7						
4.8						
4.9						
5.0						

BOREHOLE LOG SHEET - 4

Client:	Whitehead & Associates Environmental Consultants	**ASCT Ref No:**	H18-606
Project:	- North Byron Parklands,	**Client Ref No:**	NA
Borehole Position:	See Site Sketch	**Drilling Method:**	Power Auger
Surface Elevation:	Exisiting Surface Level	**Drill Bit:**	100mm Ø TC

Depth (m)	Graphic Symbol	Group Symbol	Soil Description (AS 1726)	Consistency / Relative Density / Rock Strength	DCP Blows/300mm *Cone Tip*	Test Sample
0.0		OL	**CLAYEY SILT, NATURAL:** black, medium plasticity,			
0.1			medium dry strength, some organics, moist.			
0.2						
0.3		SP	**SAND, NATURAL:** grey, non plastic, no dry strength, fine			
0.4			to medium grained sand, moist.			
0.5						
0.6		SP	**SAND, NATURAL:** dark grey, non plastic, no dry strength,			
0.7			fine to medium grained sand, very moist.			
0.8						
0.9		SC	**SILTY CLAYEY SAND, NATURAL:** black, low plasticity,			
1.0			low dry strength, fine to medium grained sand, moist.			
1.1			moist.			
1.2		OL	**CLAYEY SANDY SILT, NATURAL:** black, low plasticity,			
1.3			low dry strength, fine to medium grained sand, moist.			
1.4			some fine to coarse grained gravel, moist.			
1.5		SC	**SILTY CLAYEY SAND, NATURAL:** brown, low plasticity,			
1.6			plasticity, low dry strenght, fine to medium grained sand,			
1.7			sand, wet.			
1.8						
1.9						
2.0						
2.1						
2.2			**DRILLING TERMINATED:** target depth reached.			
2.3						
2.4						
2.5			Standing water level at 1.5m			
2.6						
2.7						
2.8						
2.9						
3.0						
3.1						
3.2						
3.3						
3.4						
3.5						
3.6						
3.7						
3.8						
3.9						
4.0						
4.1						
4.2						
4.3						
4.4						
4.5						
4.6						
4.7						
4.8						
4.9						
5.0						

BOREHOLE LOG SHEET - 5

Client:	Whitehead & Associates Environmental Consultants	**ASCT Ref No:**	H18-606
Project:	- North Byron Parklands,	**Client Ref No:**	NA
Borehole Position:	See Site Sketch	**Drilling Method:**	Power Auger
Surface Elevation:	Exisiting Surface Level	**Drill Bit:**	100mm Ø TC

Depth (m)	Graphic Symbol	Group Symbol	Soil Description (AS 1726)	Consistency / Relative Density / Rock Strength	DCP Blows/300mm *Cone Tip*	Test Sample
0.0		OL	**CLAYEY SILT, NATURAL:** black, medium plasticity,			
0.1			medium dry strength, some organics, moist.			
0.2						
0.3		SP	**SAND, NATURAL:** grey, non plastic, no dry strength, fine			
0.4			to medium grained sand, moist.			
0.5						
0.6		SC	**CLAYEY SAND, NATURAL:** dark brown, medium plasticity,			
0.7			plasticity, medium dry strength, fine to medium grained			
0.8			grained sand, moist.			
0.9		SC	**CLAYEY SAND, NATURAL:** brown, low plasticity,			
1.0			low dry strength, fine to medium grained sand,			
1.1			moist.			
1.2						
1.3						
1.4		SM	**SILTY CLAY, NATURAL:** pale grey, high plasticity,			
1.5			high dry strength, moist.			
1.6						
1.7		SM	**SILTY SAND, NATURAL:** pale grey, non plastic, no			
1.8			dry strength, fine to medium grained sand, wet.			
1.9						
2.0						
2.1						
2.2			**DRILLING TERMINATED:** target depth reached.			
2.3						
2.4			Standing water level at 1.7m			
2.5						
2.6						
2.7						
2.8						
2.9						
3.0						
3.1						
3.2						
3.3						
3.4						
3.5						
3.6						
3.7						
3.8						
3.9						
4.0						
4.1						
4.2						
4.3						
4.4						
4.5						
4.6						
4.7						
4.8						
4.9						
5.0						

BOREHOLE LOG SHEET - 6

Client:	Whitehead & Associates Environmental Consultants	**ASCT Ref No:**	H18-606
Project:	- North Byron Parklands,	**Client Ref No:**	NA
Borehole Position:	See Site Sketch	**Drilling Method:**	Power Auger
Surface Elevation:	Exisiting Surface Level	**Drill Bit:**	100mm Ø TC

Depth (m)	Graphic Symbol	Group Symbol	Soil Description (AS 1726)	Consistency / Relative Density / Rock Strength	DCP Blows/300mm *Cone Tip*	Test Sample
0.0		OL	**CLAYEY SILT, NATURAL:** black, medium plasticity,			
0.1			medium dry strength, some organics, moist.			
0.2						
0.3		SP	**SAND, NATURAL:** grey, non plastic, no dry strength, fine			
0.4			to medium grained sand, moist.			
0.5						
0.6						
0.7						
0.8						
0.9						
1.0		SC	**CLAYEY SAND, NATURAL:** dark grey, low plasticity,			
1.1			low dry strength, fine to medium grained sand,			
1.2			wet.			
1.3						
1.4						
1.5		SC	**SILTY CLAYEY SAND, NATURAL:** dark brown, low			
1.6			plasticity, low dry strength, fine to medium grianed			
1.7			sand, wet.			
1.8		SC	**CLAYEY SAND, NATURAL:** dark grey, non plastic,			
1.9			no dry strenth, fine to medium grained sand, wet.			
2.0						
2.1						
2.2			**DRILLING TERMINATED:** target depth reached.			
2.3						
2.4			Standing water level at 1.2m			
2.5						
2.6						
2.7						
2.8						
2.9						
3.0						
3.1						
3.2						
3.3						
3.4						
3.5						
3.6						
3.7						
3.8						
3.9						
4.0						
4.1						
4.2						
4.3						
4.4						
4.5						
4.6						
4.7						
4.8						
4.9						
5.0						

Appendix C
Storage Calculations

Max Storage	2,381	kL

Source	Day 0 (kL/day)	Day 1 (kL/day)	Day 2 (kL/day)	Day 3 (kL/day)	Day 4 (kL/day)	Day 5 (kL/day)	Day 6 (kL/day)	Day 7 (kL/day)	Total (kL)
Splendour in the Grass (Large)	4.2	74.1	255.6	534.1	534.1	534.1	181.9	4.2	2122.3
Falls Festival (Large)	3.1	80.0	262.3	539.6	539.6	539.6	209.2	0.6	2174.0
Regional Festival (Medium)	0.0	0.0	2.3	249.4	265.6	249.4	4.1	0.0	770.8
Regional Festival (small)	0.0	0.0	0.0	0.0	46.6	0.0	0.0	0.0	46.6
Regional festival (minor)	0.0	0.0	0.0	0.0	6.2	0.0	0.0	0.0	
Conference Centre	0.0	16.9	16.9	16.9	16.9	16.9	3.8	0.0	
Conference Centre + Minor Fest	0.0	16.9	16.9	16.9	23.1	16.9	3.8	0.0	
Conference Centre festival accom	1.0	4.8	9.6	9.6	9.6	9.6	9.6	9.6	
Baseline No Activity	0.000								

Conf Days Nil	52
Conf Days Peak	167
Conf Days Mid	33
Conference Total	200

STP Disposal SITG Day 1	20.90625			
STP Disposal SITG Day 2	69.6875			
STP Disposal SITG Day 3	69.6875			
STP Disposal SITG Day 4	69.6875			
STP Disposal SITG Day 5	69.6875	subtotal		
STP Disposal SITG Day 6	17.421875	317.078125		
STP Disposal Falls Day 1	14.958			
STP Disposal Falls Day 2	49.86			
STP Disposal Falls Day 3	49.86			
STP Disposal Falls Day 4	49.86			
STP Disposal Falls Day 5	49.86	subtotal	total	
STP Disposal Falls Day 6	12.465	226.863	543.94	kL

		Falls total prod	2289.40	kL
Greywater Irrigation Rate (kL/day)	35	SITG total prod	2236.60	kL

Max Daily Gen (kL)	35.0
Average Daily Gen (kL)	25.3
Annual Total Gen (kL)	9,205

	Month Gen Total (kL)	gation Total (kL)	y Irrigation Avg (kL)
Dec	641	518	17
Jan	2,168	805	26
Feb	453	980	35
Mar	343	1,085	35
Apr	404	773	26
May	377	377	12
Jun	377	377	12
Jul	2,444	0	0
Aug	406	980	32
Sep	348	1,050	35
Oct	814	770	25
Nov	448	1,050	35
Dec	428	518	17
Jan	1,628	805	26
		Avg Daily Irrig (L	25.3
		Annual Total Irri	9,234.8
		Max Irrig (L)	35

Annual Flow Calculations for NBP Stage 3

Date	Day	Daily Wastewater Input (kL)	MonthLy Avg (kL/month)	Monthly Total (kL/month)	Max Daily Irrigation Output (kL)	Max ISFB Output) (kL)	Trucked WW Offsite (kL)	Wastewater to Storage (kL)	Stored Wastewater from Previous Day (kL)	Actual IDSFB Dosing (kL)	Actual DaiLy Irrigation Output (kL)	Cumulative Wastewater Storage (kL)	Monthly Avg (kL/day)	Monthly Total (kL/month)
1-Dec	1	**0.02**	21	641	35	0		0.0	0	0	0	0	0	0
2-Dec	2	**3.80**			0	0		3.8	0	0	0	4		
3-Dec	3	**16.94**			0	0		16.9	4	0	0	21		
4-Dec	4	**16.94**			0	0		16.9	21	0	0	38		
5-Dec	5	**16.94**			0	0		16.9	38	0	0	55		
6-Dec	6	**16.94**			0	0		16.9	55	0	0	72		
7-Dec	7	**3.80**			0	0		3.8	72	0	0	75		
8-Dec	8	**0.02**			0	0		0.0	75	0	0	75		
9-Dec	9	**0.98**			0	0		1.0	75	0	0	76		
10-Dec	10	**0.98**			0	0		1.0	76	0	0	77		
11-Dec	11	**0.98**			0	0		1.0	77	0	0	78		
12-Dec	12	**0.98**			0	0		1.0	78	0	0	79		
13-Dec	13	**0.98**			0	0		1.0	79	0	0	80		
14-Dec	14	**0.98**			0	0		1.0	80	0	0	81		
15-Dec	15	**0.98**			0	0		1.0	81	0	0	82		
16-Dec	16	**0.98**			0	0		1.0	82	0	0	83		
17-Dec	17	**0.98**			0	0		1.0	83	0	0	84		
18-Dec	18	**0.98**			0	0		1.0	84	0	0	85		
19-Dec	19	**0.98**			0	0		1.0	85	0	0	86		
20-Dec	20	**17.89**			0	0		17.9	86	0	0	104		
21-Dec	21	**17.89**			0	0		17.9	104	0	0	122		
22-Dec	22	**17.89**			0	0		17.9	122	0	0	140		
23-Dec	23	**17.89**			0	0		17.9	140	0	0	158		
24-Dec	24	**17.89**			0	0		17.9	158	0	0	176		
25-Dec	25	**17.89**			0	0		17.9	176	0	0	194		
26-Dec	26	**17.89**			0	0		17.9	194	0	0	211		
27-Dec	27	**17.89**			0	0		17.9	211	0	0	229		
28-Dec	28	**17.89**			0	0		17.9	229	0	0	247		
29-Dec	29	**17.89**			0	0		17.9	247	0	0	265		
30-Dec	30	**96.92**			0	0		96.9	265	0	0	362		
31-Dec	31	**279.28**			0	0	15	264.3	362	0	0	626		
1-Jan	32	**556.52**	77	2,168	0	0	50	506.7	626	0	0	1,133	25	700
2-Jan	33	**556.52**			0	0	50	506.7	1,133	0	0	1,640		
3-Jan	34	**556.52**			0	0	50	506.7	1,640	0	0	2,146		
4-Jan	35	**226.11**			0	0	50	176.3	2,146	0	0	2,323		
5-Jan	36	**17.55**			0	0	12	5.1	2,323	0	0	2,328		
6-Jan	37	**17.89**			0	0		17.9	2,328	0	0	2,346		
7-Jan	38	**17.89**			0	0		17.9	2,346	0	0	2,363		
8-Jan	39	**17.89**			0	0		17.9	2,363	0	0	2,381		
9-Jan	40	**17.89**			35	0		17.9	2,381	0	35	2,364		
10-Jan	41	**17.89**			35	0		17.9	2,364	0	35	2,347		
11-Jan	42	**17.89**			35	0		17.9	2,347	0	35	2,330		
12-Jan	43	**17.89**			35	0		17.9	2,330	0	35	2,313		
13-Jan	44	**17.89**			35	0		17.9	2,313	0	35	2,296		
14-Jan	45	**17.89**			35	0		17.9	2,296	0	35	2,279		
15-Jan	46	**0.98**			35	0		1.0	2,279	0	35	2,245		
16-Jan	47	**0.98**			35	0		1.0	2,245	0	35	2,211		
17-Jan	48	**0.98**			35	0		1.0	2,211	0	35	2,177		
18-Jan	49	**0.98**			35	0		1.0	2,177	0	35	2,143		
19-Jan	50	**0.98**			35	0		1.0	2,143	0	35	2,109		
20-Jan	51	**0.02**			35	0		0.0	2,109	0	35	2,074		
21-Jan	52	**0.02**			35	0		0.0	2,074	0	35	2,039		
22-Jan	53	**16.94**			35	0		16.9	2,039	0	35	2,021		
23-Jan	54	**16.94**			35	0		16.9	2,021	0	35	2,003		
24-Jan	55	**16.94**			35	0		16.9	2,003	0	35	1,984		
25-Jan	56	**16.94**			35	0		16.9	1,984	0	35	1,966		
26-Jan	57	**3.80**			35	0		3.8	1,966	0	35	1,935		
27-Jan	58	**0.02**			35	0		0.0	1,935	0	35	1,900		
28-Jan	59	**16.94**			35	0		16.9	1,900	0	35	1,882		
29-Jan	60	**16.94**	14	453	35	0		16.9	1,882	0	35	1,864	35	1,085
30-Jan	61	**16.94**			35	0		16.9	1,864	0	35	1,846		
31-Jan	62	**16.94**			35	0		16.9	1,846	0	35	1,828		
1-Feb	63	**16.94**			35	0		16.9	1,828	0	35	1,810		
2-Feb	64	**0.02**			35	0		0.0	1,810	0	35	1,775		
3-Feb	65	**0.02**			35	0		0.0	1,775	0	35	1,740		
4-Feb	66	**16.94**			35	0		16.9	1,740	0	35	1,722		
5-Feb	67	**16.94**			35	0		16.9	1,722	0	35	1,704		
6-Feb	68	**16.94**			35	0		16.9	1,704	0	35	1,686		
7-Feb	69	**16.94**			35	0		16.9	1,686	0	35	1,668		
8-Feb	70	**16.94**			35	0		16.9	1,668	0	35	1,650		
9-Feb	71	**0.02**			35	0		0.0	1,650	0	35	1,615		
10-Feb	72	**0.02**			35	0		0.0	1,615	0	35	1,580		
11-Feb	73	**16.94**			35	0		16.9	1,580	0	35	1,562		
12-Feb	74	**16.94**			35	0		16.9	1,562	0	35	1,544		
13-Feb	75	**16.94**			35	0		16.9	1,544	0	35	1,525		
14-Feb	76	**16.94**			35	0		16.9	1,525	0	35	1,507		
15-Feb	77	**16.94**			35	0		16.9	1,507	0	35	1,489		
16-Feb	78	**0.02**			35	0		0.0	1,489	0	35	1,454		
17-Feb	79	**46.63**			35	0		46.6	1,454	0	35	1,466		
18-Feb	80	**16.94**			35	0		16.9	1,466	0	35	1,448		
19-Feb	81	**16.94**			35	0		16.9	1,448	0	35	1,430		
20-Feb	82	**16.94**			35	0		16.9	1,430	0	35	1,412		
21-Feb	83	**16.94**			35	0		16.9	1,412	0	35	1,394		
22-Feb	84	**16.94**			35	0		16.9	1,394	0	35	1,376		
23-Feb	85	**0.02**			35	0		0.0	1,376	0	35	1,341		
24-Feb	86	**0.02**			35	0		0.0	1,341	0	35	1,306		
25-Feb	87	**16.94**			35	0		16.9	1,306	0	35	1,288		
26-Feb	88	**16.94**			35	0		16.9	1,288	0	35	1,270		
27-Feb	89	**16.94**			35	0		16.9	1,270	0	35	1,252		
28-Feb	90	**16.94**			35	0		16.9	1,252	0	35	1,233		
1-Mar	91	**16.94**	11	343	35	0		16.9	1,233	0	35	1,215	35	1,050
2-Mar	92	**0.02**			35	0		0.0	1,215	0	35	1,180		
3-Mar	93	**0.02**			35	0		0.0	1,180	0	35	1,145		
4-Mar	94	**16.94**			35	0		16.9	1,145	0	35	1,127		
5-Mar	95	**16.94**			35	0		16.9	1,127	0	35	1,109		
6-Mar	96	**16.94**			35	0		16.9	1,109	0	35	1,091		
7-Mar	97	**16.94**			35	0		16.9	1,091	0	35	1,073		
8-Mar	98	**16.94**			35	0		16.9	1,073	0	35	1,055		
9-Mar	99	**3.80**			35	0		3.8	1,055	0	35	1,024		

Annual Flow Calculations for NBP Stage 3

Date	Day	Daily Wastewater Input (kL)	MonthLy Avg (kL/month)	Monthly Total (kL/month)	Max Daily Irrigation Output (kL)	Max ISFB Output) (kL)	Trucked WW Offsite (kL)	Wastewater to Storage (kL)	Stored Wastewater from Previous Day (kL)	Actual IDSFB Dosing (kL)	Actual DaiLy Irrigation Output (kL)	Cumulative Wastewater Storage (kL)	Monthly Avg (kL/day)	Monthly Total (kL/month)
10-Mar	100	0.02			35	0		0.0	1,024	0	35	989		
11-Mar	101	16.94			35	0		16.9	989	0	35	971		
12-Mar	102	16.94			35	0		16.9	971	0	35	953		
13-Mar	103	16.94			35	0		16.9	953	0	35	935		
14-Mar	104	16.94			35	0		16.9	935	0	35	917		
15-Mar	105	16.94			35	0		16.9	917	0	35	899		
16-Mar	106	0.02			35	0		0.0	899	0	35	864		
17-Mar	107	0.02			35	0		0.0	864	0	35	829		
18-Mar	108	16.94			35	0		16.9	829	0	35	811		
19-Mar	109	16.94			35	0		16.9	811	0	35	793		
20-Mar	110	16.94			35	0		16.9	793	0	35	774		
21-Mar	111	16.94			35	0		16.9	774	0	35	756		
22-Mar	112	16.94			35	0		16.9	756	0	35	738		
23-Mar	113	0.02			35	0		0.0	738	0	35	703		
24-Mar	114	0.02			35	0		0.0	703	0	35	668		
25-Mar	115	16.94			35	0		16.9	668	0	35	650		
26-Mar	116	16.94			35	0		16.9	650	0	35	632		
27-Mar	117	16.94			35	0		16.9	632	0	35	614		
28-Mar	118	16.94			35	0		16.9	614	0	35	596		
29-Mar	119	16.94			35	0		16.9	596	0	35	578		
30-Mar	120	0.02			35	0		0.0	578	0	35	543		
31-Mar	121	0.02	13	404	35	0		0.0	543	0	35	508	30	931
1-Apr	122	16.94			35	0		16.9	508	0	35	490		
2-Apr	123	16.94			35	0		16.9	490	0	35	472		
3-Apr	124	16.94			35	0		16.9	472	0	35	454		
4-Apr	125	16.94			35	0		16.9	454	0	35	436		
5-Apr	126	16.94			35	0		16.9	436	0	35	418		
6-Apr	127	3.80			35	0		3.8	418	0	35	387		
7-Apr	128	3.80			35	0		3.8	387	0	35	355		
8-Apr	129	16.94			35	0		16.9	355	0	35	337		
9-Apr	130	16.94			35	0		16.9	337	0	35	319		
10-Apr	131	16.94			35	0		16.9	319	0	35	301		
11-Apr	132	16.94			35	0		16.9	301	0	35	283		
12-Apr	133	16.94			35	0		16.9	283	0	35	265		
13-Apr	134	0.02			35	0		0.0	265	0	35	230		
14-Apr	135	46.63			35	0		46.6	230	0	35	242		
15-Apr	136	0.02			35	0		0.0	242	0	35	207		
16-Apr	137	0.02			35	0		0.0	207	0	35	172		
17-Apr	138	3.80			35	0		3.8	172	0	35	141		
18-Apr	139	16.94			35	0		16.9	141	0	35	122		
19-Apr	140	16.94			35	0		16.9	122	0	35	104		
20-Apr	141	16.94			35	0		16.9	104	0	35	86		
21-Apr	142	16.94			35	0		16.9	86	0	35	68		
22-Apr	143	3.80			35	0		3.8	68	0	35	37		
23-Apr	144	3.80			35	0		3.8	37	0	35	6		
24-Apr	145	16.94			35	0		16.9	6	0	23	0		
25-Apr	146	16.94			35	0		16.9	0	0	17	0		
26-Apr	147	16.94			35	0		16.9	0	0	17	0		
27-Apr	148	16.94			35	0		16.9	0	0	17	0		
28-Apr	149	16.94			35	0		16.9	0	0	17	0		
29-Apr	150	0.02			35	0		0.0	0	0	0	0		
30-Apr	151	0.02			35	0		0.0	0	0	0	0		
1-May	152	16.94	13	377	35	0		16.9	0	0	17	0	13	377
2-May	153	16.94			35	0		16.9	0	0	17	0		
3-May	154	16.94			35	0		16.9	0	0	17	0		
4-May	155	16.94			35	0		16.9	0	0	17	0		
5-May	156	16.94			35	0		16.9	0	0	17	0		
6-May	157	0.02			35	0		0.0	0	0	0	0		
7-May	158	0.02			35	0		0.0	0	0	0	0		
8-May	159	16.94			35	0		16.9	0	0	17	0		
9-May	160	16.94			35	0		16.9	0	0	17	0		
10-May	161	16.94			35	0		16.9	0	0	17	0		
11-May	162	16.94			35	0		16.9	0	0	17	0		
12-May	163	16.94			35	0		16.9	0	0	17	0		
13-May	164	3.80			35	0		3.8	0	0	4	0		
14-May	165	0.02			35	0		0.0	0	0	0	0		
15-May	166	16.94			35	0		16.9	0	0	17	0		
16-May	167	16.94			35	0		16.9	0	0	17	0		
17-May	168	16.94			35	0		16.9	0	0	17	0		
18-May	169	16.94			35	0		16.9	0	0	17	0		
19-May	170	16.94			35	0		16.9	0	0	17	0		
20-May	171	0.02			35	0		0.0	0	0	0	0		
21-May	172	0.02			35	0		0.0	0	0	0	0		
22-May	173	16.94			35	0		16.9	0	0	17	0		
23-May	174	16.94			35	0		16.9	0	0	17	0		
24-May	175	16.94			35	0		16.9	0	0	17	0		
25-May	176	16.94			35	0		16.9	0	0	17	0		
26-May	177	16.94			35	0		16.9	0	0	17	0		
27-May	178	0.02			35	0		0.0	0	0	0	0		
28-May	179	0.02			35	0		0.0	0	0	0	0		
29-May	180	16.94			35	0		16.9	0	0	17	0		
30-May	181	16.94			35	0		16.9	0	0	17	0		
31-May	182	16.94	13	377	35	0		16.9	0	0	17	0	13	393
1-Jun	183	16.94			35	0		16.9	0	0	17	0		
2-Jun	184	16.94			35	0		16.9	0	0	17	0		
3-Jun	185	0.02			35	0		0.0	0	0	0	0		
4-Jun	186	0.02			35	0		0.0	0	0	0	0		
5-Jun	187	16.94			35	0		16.9	0	0	17	0		
6-Jun	188	16.94			35	0		16.9	0	0	17	0		
7-Jun	189	16.94			35	0		16.9	0	0	17	0		
8-Jun	190	16.94			35	0		16.9	0	0	17	0		
9-Jun	191	16.94			35	0		16.9	0	0	17	0		
10-Jun	192	0.02			35	0		0.0	0	0	0	0		
11-Jun	193	0.02			35	0		0.0	0	0	0	0		
12-Jun	194	16.94			35	0		16.9	0	0	17	0		
13-Jun	195	16.94			35	0		16.9	0	0	17	0		
14-Jun	196	16.94			35	0		16.9	0	0	17	0		
15-Jun	197	16.94			35	0		16.9	0	0	17	0		
16-Jun	198	16.94			35	0		16.9	0	0	17	0		
17-Jun	199	3.80			35	0		3.8	0	0	4	0		
18-Jun	200	0.02			35	0		0.0	0	0	0	0		
19-Jun	201	16.94			35	0		16.9	0	0	17	0		
20-Jun	202	16.94			35	0		16.9	0	0	17	0		
21-Jun	203	16.94			35	0		16.9	0	0	17	0		
22-Jun	204	16.94			35	0		16.9	0	0	17	0		

Annual Flow Calculations for NBP Stage 3

Date	Day	Daily Wastewater Input (kL)	MonthLy Avg (kL/month)	Monthly Total (kL/month)	Max Daily Irrigation Output (kL)	Max ISFB Output) (kL)	Trucked WW Offsite (kL)	Wastewater to Storage (kL)	Stored Wastewater from Previous Day (kL)	Actual IDSFB Dosing (kL)	Actual DaiLy Irrigation Output (kL)	Cumulative Wastewater Storage (kL)	Monthly Avg (kL/day)	Monthly Total (kL/month)
23-Jun	205	16.94			35	0		16.9	0	0	17	0		
24-Jun	206	0.02			35	0		0.0	0	0	0	0		
25-Jun	207	0.02			35	0		0.0	0	0	0	0		
26-Jun	208	16.94			35	0		16.9	0	0	17	0		
27-Jun	209	16.94			35	0		16.9	0	0	17	0		
28-Jun	210	16.94			35	0		16.9	0	0	17	0		
29-Jun	211	16.94			35	0		16.9	0	0	17	0		
30-Jun	212	16.94			35	0		16.9	0	0	17	0		
1-Jul	213	0.00	78	2,444	35	0		0.0	0	0	0	0	0	0
2-Jul	214	0.00			35	0		0.0	0	0	0	0		
3-Jul	215	0.00			35	0		0.0	0	0	0	0		
4-Jul	216	0.98			0	0		1.0	0	0	0	1		
5-Jul	217	0.98			0	0		1.0	1	0	0	2		
6-Jul	218	0.98			0	0		1.0	2	0	0	3		
7-Jul	219	0.98			0	0		1.0	3	0	0	4		
8-Jul	220	0.98			0	0		1.0	4	0	0	5		
9-Jul	221	0.98			0	0		1.0	5	0	0	6		
10-Jul	222	0.98			0	0		1.0	6	0	0	7		
11-Jul	223	0.98			0	0		1.0	7	0	0	8		
12-Jul	224	0.98			0	0		1.0	8	0	0	9		
13-Jul	225	0.98			0	0		1.0	9	0	0	10		
14-Jul	226	0.98			0	0		1.0	10	0	0	11		
15-Jul	227	17.89			0	0		17.9	11	0	0	29		
16-Jul	228	17.89			0	0		17.9	29	0	0	47		
17-Jul	229	17.89			0	0		17.9	47	0	0	64		
18-Jul	230	17.89			0	0		17.9	64	0	0	82		
19-Jul	231	17.89			0	0		17.9	82	0	0	100		
20-Jul	232	17.89			0	0		17.9	100	0	0	118		
21-Jul	233	17.89			0	0		17.9	118	0	0	136		
22-Jul	234	17.89			0	0		17.9	136	0	0	154		
23-Jul	235	17.89			0	0		17.9	154	0	0	172		
24-Jul	236	17.89			0	0		17.9	172	0	0	190		
25-Jul	237	91.04			0	0		91.0	190	0	0	281		
26-Jul	238	272.56			0	0	21	251.7	281	0	0	532		
27-Jul	239	551.00			0	0	70	481.3	532	0	0	1,014		
28-Jul	240	551.00			0	0	70	481.3	1,014	0	0	1,495		
29-Jul	241	551.00			0	0	70	481.3	1,495	0	0	1,976		
30-Jul	242	198.87			0	0	70	129.2	1,976	0	0	2,106		
31-Jul	243	21.14			0	0	17	3.7	2,106	0	0	2,109		
1-Aug	244	17.89	14	406	0	0		17.9	2,109	0	0	2,127	32	945
2-Aug	245	17.89			0	0		17.9	2,127	0	0	2,145		
3-Aug	246	17.89			0	0		17.9	2,145	0	0	2,163		
4-Aug	247	17.89			35	0		17.9	2,163	0	35	2,146		
5-Aug	248	17.89			35	0		17.9	2,146	0	35	2,129		
6-Aug	249	17.89			35	0		17.9	2,129	0	35	2,112		
7-Aug	250	17.89			35	0		17.9	2,112	0	35	2,095		
8-Aug	251	17.89			35	0		17.9	2,095	0	35	2,077		
9-Aug	252	17.89			35	0		17.9	2,077	0	35	2,060		
10-Aug	253	0.98			35	0		1.0	2,060	0	35	2,026		
11-Aug	254	0.98			35	0		1.0	2,026	0	35	1,992		
12-Aug	255	0.98			35	0		1.0	1,992	0	35	1,958		
13-Aug	256	0.98			35	0		1.0	1,958	0	35	1,924		
14-Aug	257	0.98			35	0		1.0	1,924	0	35	1,890		
15-Aug	258	0.02			35	0		0.0	1,890	0	35	1,855		
16-Aug	259	16.94			35	0		16.9	1,855	0	35	1,837		
17-Aug	260	16.94			35	0		16.9	1,837	0	35	1,819		
18-Aug	261	16.94			35	0		16.9	1,819	0	35	1,801		
19-Aug	262	16.94			35	0		16.9	1,801	0	35	1,783		
20-Aug	263	16.94			35	0		16.9	1,783	0	35	1,765		
21-Aug	264	3.80			35	0		3.8	1,765	0	35	1,734		
22-Aug	265	46.63			35	0		46.6	1,734	0	35	1,745		
23-Aug	266	16.94			35	0		16.9	1,745	0	35	1,727		
24-Aug	267	16.94			35	0		16.9	1,727	0	35	1,709		
25-Aug	268	16.94			35	0		16.9	1,709	0	35	1,691		
26-Aug	269	16.94			35	0		16.9	1,691	0	35	1,673		
27-Aug	270	16.94			35	0		16.9	1,673	0	35	1,655		
28-Aug	271	3.80			35	0		3.8	1,655	0	35	1,624		
29-Aug	272	0.02			35	0		0.0	1,624	0	35	1,589		
30-Aug	273	16.94			35	0		16.9	1,589	0	35	1,571		
31-Aug	274	16.94	12	348	35	0		16.9	1,571	0	35	1,553	35	1,085
1-Sep	275	16.94			35	0		16.9	1,553	0	35	1,535		
2-Sep	276	16.94			35	0		16.9	1,535	0	35	1,517		
3-Sep	277	16.94			35	0		16.9	1,517	0	35	1,498		
4-Sep	278	3.80			35	0		3.8	1,498	0	35	1,467		
5-Sep	279	0.02			35	0		0.0	1,467	0	35	1,432		
6-Sep	280	16.94			35	0		16.9	1,432	0	35	1,414		
7-Sep	281	16.94			35	0		16.9	1,414	0	35	1,396		
8-Sep	282	3.80			35	0		3.8	1,396	0	35	1,365		
9-Sep	283	0.02			35	0		0.0	1,365	0	35	1,330		
10-Sep	284	0.02			35	0		0.0	1,330	0	35	1,295		
11-Sep	285	0.02			35	0		0.0	1,295	0	35	1,260		
12-Sep	286	46.63			35	0		46.6	1,260	0	35	1,272		
13-Sep	287	0.02			35	0		0.0	1,272	0	35	1,237		
14-Sep	288	0.02			35	0		0.0	1,237	0	35	1,202		
15-Sep	289	3.80			35	0		3.8	1,202	0	35	1,171		
16-Sep	290	16.94			35	0		16.9	1,171	0	35	1,152		
17-Sep	291	16.94			35	0		16.9	1,152	0	35	1,134		
18-Sep	292	16.94			35	0		16.9	1,134	0	35	1,116		
19-Sep	293	16.94			35	0		16.9	1,116	0	35	1,098		
20-Sep	294	16.94			35	0		16.9	1,098	0	35	1,080		
21-Sep	295	16.94			35	0		16.9	1,080	0	35	1,062		
22-Sep	296	16.94			35	0		16.9	1,062	0	35	1,044		
23-Sep	297	16.94			35	0		16.9	1,044	0	35	1,026		
24-Sep	298	16.94			35	0		16.9	1,026	0	35	1,008		
25-Sep	299	16.94			35	0		16.9	1,008	0	35	990		
26-Sep	300	16.94			35	0		16.9	990	0	35	972		
27-Sep	301	3.80			35	0		3.8	972	0	35	941		
28-Sep	302	3.80			35	0		3.8	941	0	35	909		
29-Sep	303	3.80			35	0		3.8	909	0	35	878		
30-Sep	304	3.80			35	0		3.8	878	0	35	847		
1-Oct	305	3.80	27	814	35	0		3.8	847	0	35	816	25	735
2-Oct	306	0.96			35	0		1.0	816	0	35	782		
3-Oct	307	0.96			35	0		1.0	782	0	35	748		
4-Oct	308	0.96			35	0		1.0	748	0	35	714		
5-Oct	309	0.96			35	0		1.0	714	0	35	680		

Annual Flow Calculations for NBP Stage 3

Date	Day	Daily Wastewater Input (kL)	MonthLy Avg (kL/month)	Monthly Total (kL/month)	Max Daily Irrigation Output (kL)	Max ISFB Output) (kL)	Trucked WW Offsite (kL)	Wastewater to Storage (kL)	Stored Wastewater from Previous Day (kL)	Actual IDSFB Dosing (kL)	Actual DaiLy Irrigation Output (kL)	Cumulative Wastewater Storage (kL)	Monthly Avg (kL/day)	Monthly Total (kL/month)
6-Oct	310	0.96			35	0		1.0	680	0	35	646		
7-Oct	311	0.96			35	0		1.0	646	0	35	612		
8-Oct	312	0.96			35	0		1.0	612	0	35	578		
9-Oct	313	0.96			35	0		1.0	578	0	35	544		
10-Oct	314	0.96			0	0		1.0	544	0	0	544		
11-Oct	315	0.96			0	0		1.0	544	0	0	545		
12-Oct	316	0.00			0	0		0.0	545	0	0	545		
13-Oct	317	2.34			0	0		2.3	545	0	0	548		
14-Oct	318	249.38			0	0		249.4	548	0	0	797		
15-Oct	319	265.63			0	0		265.6	797	0	0	1,063		
16-Oct	320	249.38			0	0		249.4	1,063	0	0	1,312		
17-Oct	321	4.06			0	0		4.1	1,312	0	0	1,316		
18-Oct	322	0.96			0	0		1.0	1,316	0	0	1,317		
19-Oct	323	0.96			35	0		1.0	1,317	0	35	1,283		
20-Oct	324	0.96			35	0		1.0	1,283	0	35	1,249		
21-Oct	325	0.96			35	0		1.0	1,249	0	35	1,215		
22-Oct	326	0.96			35	0		1.0	1,215	0	35	1,181		
23-Oct	327	0.96			35	0		1.0	1,181	0	35	1,147		
24-Oct	328	0.96			35	0		1.0	1,147	0	35	1,113		
25-Oct	329	3.80			35	0		3.8	1,113	0	35	1,082		
26-Oct	330	3.80			35	0		3.8	1,082	0	35	1,051		
27-Oct	331	3.80			35	0		3.8	1,051	0	35	1,019		
28-Oct	332	3.80			35	0		3.8	1,019	0	35	988		
29-Oct	333	3.80			35	0		3.8	988	0	35	957		
30-Oct	334	3.80			35	0		3.8	957	0	35	926		
31-Oct	335	3.80	14	448	35	0		3.8	926	0	35	895	35	1,085
1-Nov	336	0.02			35	0		0.0	895	0	35	860		
2-Nov	337	16.94			35	0		16.9	860	0	35	841		
3-Nov	338	16.94			35	0		16.9	841	0	35	823		
4-Nov	339	16.94			35	0		16.9	823	0	35	805		
5-Nov	340	16.94			35	0		16.9	805	0	35	787		
6-Nov	341	16.94			35	0		16.9	787	0	35	769		
7-Nov	342	3.80			35	0		3.8	769	0	35	738		
8-Nov	343	0.02			35	0		0.0	738	0	35	703		
9-Nov	344	16.94			35	0		16.9	703	0	35	685		
10-Nov	345	16.94			35	0		16.9	685	0	35	667		
11-Nov	346	16.94			35	0		16.9	667	0	35	649		
12-Nov	347	16.94			35	0		16.9	649	0	35	631		
13-Nov	348	16.94			35	0		16.9	631	0	35	613		
14-Nov	349	3.80			35	0		3.8	613	0	35	582		
15-Nov	350	46.63			35	0		46.6	582	0	35	593		
16-Nov	351	16.94			35	0		16.9	593	0	35	575		
17-Nov	352	16.94			35	0		16.9	575	0	35	557		
18-Nov	353	16.94			35	0		16.9	557	0	35	539		
19-Nov	354	16.94			35	0		16.9	539	0	35	521		
20-Nov	355	16.94			35	0		16.9	521	0	35	503		
21-Nov	356	3.80			35	0		3.8	503	0	35	472		
22-Nov	357	0.02			35	0		0.0	472	0	35	437		
23-Nov	358	16.94			35	0		16.9	437	0	35	419		
24-Nov	359	16.94			35	0		16.9	419	0	35	401		
25-Nov	360	16.94			35	0		16.9	401	0	35	382		
26-Nov	361	16.94			35	0		16.9	382	0	35	364		
27-Nov	362	16.94			35	0		16.9	364	0	35	346		
28-Nov	363	16.94			35	0		16.9	346	0	35	328		
29-Nov	364	0.02			35	0		0.0	328	0	35	293		
30-Nov	365	16.94			35	0		16.9	293	0	35	275		
1-Dec	366	16.94	21	1,194	35	0		16.9	275	0	35	257	14	428
2-Dec	367	16.94			35	0		16.9	257	0	35	239		
3-Dec	368	16.94			35	0		16.9	239	0	35	221		
4-Dec	369	16.94			35	0		16.9	221	0	35	203		
5-Dec	370	16.94			35	0		16.9	203	0	35	185		
6-Dec	371	3.80			35	0		3.8	185	0	35	154		
7-Dec	372	0.02			35	0		0.0	154	0	35	119		
8-Dec	373	0.02			35	0		0.0	119	0	35	84		
9-Dec	374	0.98			35	0		1.0	84	0	35	50		
10-Dec	375	0.98			35	0		1.0	50	0	35	16		
11-Dec	376	0.98			35	0		1.0	16	0	17	0		
12-Dec	377	0.98			35	0		1.0	0	0	1	0		
13-Dec	378	0.98			35	0		1.0	0	0	1	0		
14-Dec	379	0.98			35	0		1.0	0	0	1	0		
15-Dec	380	0.98			35	0		1.0	0	0	1	0		
16-Dec	381	0.98			35	0		1.0	0	0	1	0		
17-Dec	382	0.98			35	0		1.0	0	0	1	0		
18-Dec	383	0.98			35	0		1.0	0	0	1	0		
19-Dec	384	0.98			35	0		1.0	0	0	1	0		
20-Dec	385	17.89			35	0		17.9	0	0	18	0		
21-Dec	386	17.89			35	0		17.9	0	0	18	0		
22-Dec	387	17.89			35	0		17.9	0	0	18	0		
23-Dec	388	17.89			0	0		17.9	0	0	0	18		
24-Dec	389	17.89			0	0		17.9	18	0	0	36		
25-Dec	390	17.89			0	0		17.9	36	0	0	54		
26-Dec	391	17.89			0	0		17.9	54	0	0	72		
27-Dec	392	17.89			0	0		17.9	72	0	0	89		
28-Dec	393	17.89			0	0		17.9	89	0	0	107		
29-Dec	394	17.89			0	0		17.9	107	0	0	125		
30-Dec	395	96.92			0	0		96.9	125	0	0	222		
31-Dec	396	279.28			0	0	15	264.3	222	0	0	486		
1-Jan	397	556.52	78	1,628	0	0	50	506.7	486	0	0	993	25	700
2-Jan	398	556.52			0	0	50	506.7	993	0	0	1,500		
3-Jan	399	556.52			0	0	50	506.7	1,500	0	0	2,006		
4-Jan	400	226.11			0	0	50	176.3	2,006	0	0	2,183		
5-Jan	401	17.55			0	0	12	5.1	2,183	0	0	2,188		
6-Jan	402	17.89			0	0		17.9	2,188	0	0	2,206		
7-Jan	403	17.89			0	0		17.9	2,206	0	0	2,224		
8-Jan	404	17.89			0	0		17.9	2,224	0	0	2,241		
9-Jan	405	17.89			35	0		17.9	2,241	0	35	2,224		
10-Jan	406	17.89			35	0		17.9	2,224	0	35	2,207		
11-Jan	407	17.89			35	0		17.9	2,207	0	35	2,190		
12-Jan	408	17.89			35	0		17.9	2,190	0	35	2,173		
13-Jan	409	17.89			35	0		17.9	2,173	0	35	2,156		
14-Jan	410	17.89			35	0		17.9	2,156	0	35	2,139		
15-Jan	411	0.98			35	0		1.0	2,139	0	35	2,105		
16-Jan	412	0.98			35	0		1.0	2,105	0	35	2,071		
17-Jan	413	0.98			35	0		1.0	2,071	0	35	2,037		
18-Jan	414	0.98			35	0		1.0	2,037	0	35	2,003		

Annual Flow Calculations for NBP Stage 3

Date	Day	Daily Wastewater Input (kL)	MonthLy Avg (kL/month)	Monthly Total (kL/month)	Max Daily Irrigation Output (kL)	Max ISFB Output) (kL)	Trucked WW Offsite (kL)	Wastewater to Storage (kL)	Stored Wastewater from Previous Day (kL)	Actual IDSFB Dosing (kL)	Actual DaiLy Irrigation Output (kL)	Cumulative Wastewater Storage (kL)	Monthly Avg (kL/day)	Monthly Total (kL/month)
19-Jan	415	**0.98**			35	0		1.0	2,003	0	35	1,969		
20-Jan	416	**0.02**			35	0		0.0	1,969	0	35	1,934		
21-Jan	417	**16.94**			35	0		16.9	1,934	0	35	1,916		
22-Jan	418	**16.94**			35	0		16.9	1,916	0	35	1,898		
23-Jan	419	**16.94**			35	0		16.9	1,898	0	35	1,880		
24-Jan	420	**16.94**			35	0		16.9	1,880	0	35	1,862		
25-Jan	421	**16.94**			35	0		16.9	1,862	0	35	1,843		
26-Jan	422	**16.94**			35	0		16.9	1,843	0	35	1,825		
27-Jan	423	**3.80**			35	0		3.8	1,825	0	35	1,794		
28-Jan	424	**0.02**			35	0		0.0	1,794	0	35	1,759		
29-Jan	425	**16.94**	14	453	35	0		16.9	1,759	0	35	1,741	35	1,085
30-Jan	426	**16.94**			35	0		16.9	1,741	0	35	1,723		
31-Jan	427	**16.94**			35	0		16.9	1,723	0	35	1,705		
1-Feb	428	**16.94**			35	0		16.9	1,705	0	35	1,687		
2-Feb	429	**0.02**			35	0		0.0	1,687	0	35	1,652		
3-Feb	430	**0.02**			35	0		0.0	1,652	0	35	1,617		
4-Feb	431	**16.94**			35	0		16.9	1,617	0	35	1,599		
5-Feb	432	**16.94**			35	0		16.9	1,599	0	35	1,581		
6-Feb	433	**16.94**			35	0		16.9	1,581	0	35	1,563		
7-Feb	434	**16.94**			35	0		16.9	1,563	0	35	1,545		
8-Feb	435	**16.94**			35	0		16.9	1,545	0	35	1,527		
9-Feb	436	**0.02**			35	0		0.0	1,527	0	35	1,492		
10-Feb	437	**0.02**			35	0		0.0	1,492	0	35	1,457		
11-Feb	438	**16.94**			35	0		16.9	1,457	0	35	1,439		
12-Feb	439	**16.94**			35	0		16.9	1,439	0	35	1,421		
13-Feb	440	**16.94**			35	0		16.9	1,421	0	35	1,403		
14-Feb	441	**16.94**			35	0		16.9	1,403	0	35	1,384		
15-Feb	442	**16.94**			35	0		16.9	1,384	0	35	1,366		
16-Feb	443	**0.02**			35	0		0.0	1,366	0	35	1,331		
17-Feb	444	**46.63**			35	0		46.6	1,331	0	35	1,343		
18-Feb	445	**16.94**			35	0		16.9	1,343	0	35	1,325		
19-Feb	446	**16.94**			35	0		16.9	1,325	0	35	1,307		
20-Feb	447	**16.94**			35	0		16.9	1,307	0	35	1,289		
21-Feb	448	**16.94**			35	0		16.9	1,289	0	35	1,271		
22-Feb	449	**16.94**			35	0		16.9	1,271	0	35	1,253		
23-Feb	450	**0.02**			35	0		0.0	1,253	0	35	1,218		
24-Feb	451	**0.02**			35	0		0.0	1,218	0	35	1,183		
25-Feb	452	**16.94**			35	0		16.9	1,183	0	35	1,165		
26-Feb	453	**16.94**			35	0		16.9	1,165	0	35	1,147		
27-Feb	454	**16.94**			35	0		16.9	1,147	0	35	1,129		
28-Feb	455	**16.94**			35	0		16.9	1,129	0	35	1,110		
1-Mar	456	**16.94**	11	343	35	0		16.9	1,110	0	35	1,092	35	1,050
2-Mar	457	**0.02**			35	0		0.0	1,092	0	35	1,057		
3-Mar	458	**0.02**			35	0		0.0	1,057	0	35	1,022		
4-Mar	459	**16.94**			35	0		16.9	1,022	0	35	1,004		
5-Mar	460	**16.94**			35	0		16.9	1,004	0	35	986		
6-Mar	461	**16.94**			35	0		16.9	986	0	35	968		
7-Mar	462	**16.94**			35	0		16.9	968	0	35	950		
8-Mar	463	**16.94**			35	0		16.9	950	0	35	932		
9-Mar	464	**3.80**			35	0		3.8	932	0	35	901		
10-Mar	465	**0.02**			35	0		0.0	901	0	35	866		
11-Mar	466	**16.94**			35	0		16.9	866	0	35	848		
12-Mar	467	**16.94**			35	0		16.9	848	0	35	830		
13-Mar	468	**16.94**			35	0		16.9	830	0	35	812		
14-Mar	469	**16.94**			35	0		16.9	812	0	35	794		
15-Mar	470	**16.94**			35	0		16.9	794	0	35	776		
16-Mar	471	**0.02**			35	0		0.0	776	0	35	741		
17-Mar	472	**0.02**			35	0		0.0	741	0	35	706		
18-Mar	473	**16.94**			35	0		16.9	706	0	35	688		
19-Mar	474	**16.94**			35	0		16.9	688	0	35	670		
20-Mar	475	**16.94**			35	0		16.9	670	0	35	651		
21-Mar	476	**16.94**			35	0		16.9	651	0	35	633		
22-Mar	477	**16.94**			35	0		16.9	633	0	35	615		
23-Mar	478	**0.02**			35	0		0.0	615	0	35	580		
24-Mar	479	**0.02**			35	0		0.0	580	0	35	545		
25-Mar	480	**16.94**			35	0		16.9	545	0	35	527		
26-Mar	481	**16.94**			35	0		16.9	527	0	35	509		
27-Mar	482	**16.94**			35	0		16.9	509	0	35	491		
28-Mar	483	**16.94**			35	0		16.9	491	0	35	473		
29-Mar	484	**16.94**			35	0		16.9	473	0	35	455		
30-Mar	485	**0.02**			35	0		0.0	455	0	35	420		
31-Mar	486	**0.02**	13	404	35	0		0.0	420	0	35	385	26	808
1-Apr	487	**16.94**			35	0		16.9	385	0	35	367		
2-Apr	488	**16.94**			35	0		16.9	367	0	35	349		
3-Apr	489	**16.94**			35	0		16.9	349	0	35	331		
4-Apr	490	**16.94**			35	0		16.9	331	0	35	313		
5-Apr	491	**16.94**			35	0		16.9	313	0	35	295		
6-Apr	492	**3.80**			35	0		3.8	295	0	35	264		
7-Apr	493	**3.80**			35	0		3.8	264	0	35	232		
8-Apr	494	**16.94**			35	0		16.9	232	0	35	214		
9-Apr	495	**16.94**			35	0		16.9	214	0	35	196		
10-Apr	496	**16.94**			35	0		16.9	196	0	35	178		
11-Apr	497	**16.94**			35	0		16.9	178	0	35	160		
12-Apr	498	**16.94**			35	0		16.9	160	0	35	142		
13-Apr	499	**0.02**			35	0		0.0	142	0	35	107		
14-Apr	500	**46.63**			35	0		46.6	107	0	35	119		
15-Apr	501	**0.02**			35	0		0.0	119	0	35	84		
16-Apr	502	**0.02**			35	0		0.0	84	0	35	49		
17-Apr	503	**3.80**			35	0		3.8	49	0	35	18		
18-Apr	504	**16.94**			35	0		16.9	18	0	35	0		
19-Apr	505	**16.94**			35	0		16.9	0	0	17	0		
20-Apr	506	**16.94**			35	0		16.9	0	0	17	0		
21-Apr	507	**16.94**			35	0		16.9	0	0	17	0		
22-Apr	508	**3.80**			35	0		3.8	0	0	4	0		
23-Apr	509	**3.80**			35	0		3.8	0	0	4	0		
24-Apr	510	**16.94**			35	0		16.9	0	0	17	0		
25-Apr	511	**16.94**			35	0		16.9	0	0	17	0		
26-Apr	512	**16.94**			35	0		16.9	0	0	17	0		
27-Apr	513	**16.94**			35	0		16.9	0	0	17	0		
28-Apr	514	**16.94**			35	0		16.9	0	0	17	0		
29-Apr	515	**0.02**			35	0		0.0	0	0	0	0		
30-Apr	516	**0.02**			35	0		0.0	0	0	0	0		
1-May	517	**16.94**	13	377	35	0		16.9	0	0	17	0	13	377
2-May	518	**16.94**			35	0		16.9	0	0	17	0		
3-May	519	**16.94**			35	0		16.9	0	0	17	0		

Annual Flow Calculations for NBP Stage 3

Date	Day	Daily Wastewater Input (kL)	MonthLy Avg (kL/month)	Monthly Total (kL/month)	Max Daily Irrigation Output (kL)	Max ISFB Output) (kL)	Trucked WW Offsite (kL)	Wastewater to Storage (kL)	Stored Wastewater from Previous Day (kL)	Actual IDSFB Dosing (kL)	Actual DaiLy Irrigation Output (kL)	Cumulative Wastewater Storage (kL)	Monthly Avg (kL/day)	Monthly Total (kL/month)
4-May	520	**16.94**			35	0		16.9	0	0	17	0		
5-May	521	**16.94**			35	0		16.9	0	0	17	0		
6-May	522	**0.02**			35	0		0.0	0	0	0	0		
7-May	523	**0.02**			35	0		0.0	0	0	0	0		
8-May	524	**16.94**			35	0		16.9	0	0	17	0		
9-May	525	**16.94**			35	0		16.9	0	0	17	0		
10-May	526	**16.94**			35	0		16.9	0	0	17	0		
11-May	527	**16.94**			35	0		16.9	0	0	17	0		
12-May	528	**16.94**			35	0		16.9	0	0	17	0		
13-May	529	**3.80**			35	0		3.8	0	0	4	0		
14-May	530	**0.02**			35	0		0.0	0	0	0	0		
15-May	531	**16.94**			35	0		16.9	0	0	17	0		
16-May	532	**16.94**			35	0		16.9	0	0	17	0		
17-May	533	**16.94**			35	0		16.9	0	0	17	0		
18-May	534	**16.94**			35	0		16.9	0	0	17	0		
19-May	535	**16.94**			35	0		16.9	0	0	17	0		
20-May	536	**0.02**			35	0		0.0	0	0	0	0		
21-May	537	**0.02**			35	0		0.0	0	0	0	0		
22-May	538	**16.94**			35	0		16.9	0	0	17	0		
23-May	539	**16.94**			35	0		16.9	0	0	17	0		
24-May	540	**16.94**			35	0		16.9	0	0	17	0		
25-May	541	**16.94**			35	0		16.9	0	0	17	0		
26-May	542	**16.94**			35	0		16.9	0	0	17	0		
27-May	543	**0.02**			35	0		0.0	0	0	0	0		
28-May	544	**0.02**			35	0		0.0	0	0	0	0		
29-May	545	**16.94**			35	0		16.9	0	0	17	0		
30-May	546	**16.94**			35	0		16.9	0	0	17	0		
31-May	547	**16.94**	13	377	35	0		16.9	0	0	17	0	13	393
1-Jun	548	**16.94**			35	0		16.9	0	0	17	0		
2-Jun	549	**16.94**			35	0		16.9	0	0	17	0		
3-Jun	550	**0.02**			35	0		0.0	0	0	0	0		
4-Jun	551	**0.02**			35	0		0.0	0	0	0	0		
5-Jun	552	**16.94**			35	0		16.9	0	0	17	0		
6-Jun	553	**16.94**			35	0		16.9	0	0	17	0		
7-Jun	554	**16.94**			35	0		16.9	0	0	17	0		
8-Jun	555	**16.94**			35	0		16.9	0	0	17	0		
9-Jun	556	**16.94**			35	0		16.9	0	0	17	0		
10-Jun	557	**0.02**			35	0		0.0	0	0	0	0		
11-Jun	558	**0.02**			35	0		0.0	0	0	0	0		
12-Jun	559	**16.94**			35	0		16.9	0	0	17	0		
13-Jun	560	**16.94**			35	0		16.9	0	0	17	0		
14-Jun	561	**16.94**			35	0		16.9	0	0	17	0		
15-Jun	562	**16.94**			35	0		16.9	0	0	17	0		
16-Jun	563	**16.94**			35	0		16.9	0	0	17	0		
17-Jun	564	**3.80**			35	0		3.8	0	0	4	0		
18-Jun	565	**0.02**			35	0		0.0	0	0	0	0		
19-Jun	566	**16.94**			35	0		16.9	0	0	17	0		
20-Jun	567	**16.94**			35	0		16.9	0	0	17	0		
21-Jun	568	**16.94**			35	0		16.9	0	0	17	0		
22-Jun	569	**16.94**			35	0		16.9	0	0	17	0		
23-Jun	570	**16.94**			35	0		16.9	0	0	17	0		
24-Jun	571	**0.02**			35	0		0.0	0	0	0	0		
25-Jun	572	**0.02**			35	0		0.0	0	0	0	0		
26-Jun	573	**16.94**			35	0		16.9	0	0	17	0		
27-Jun	574	**16.94**			35	0		16.9	0	0	17	0		
28-Jun	575	**16.94**			35	0		16.9	0	0	17	0		
29-Jun	576	**16.94**			35	0		16.9	0	0	17	0		
30-Jun	577	**16.94**			35	0		16.9	0	0	17	0		
1-Jul	578	**0.00**	78	2,444	35	0		0.0	0	0	0	0	0	0
2-Jul	579	**0.00**			35	0		0.0	0	0	0	0		
3-Jul	580	**0.00**			35	0		0.0	0	0	0	0		
4-Jul	581	**0.98**			0	0		1.0	0	0	0	1		
5-Jul	582	**0.98**			0	0		1.0	1	0	0	2		
6-Jul	583	**0.98**			0	0		1.0	2	0	0	3		
7-Jul	584	**0.98**			0	0		1.0	3	0	0	4		
8-Jul	585	**0.98**			0	0		1.0	4	0	0	5		
9-Jul	586	**0.98**			0	0		1.0	5	0	0	6		
10-Jul	587	**0.98**			0	0		1.0	6	0	0	7		
11-Jul	588	**0.98**			0	0		1.0	7	0	0	8		
12-Jul	589	**0.98**			0	0		1.0	8	0	0	9		
13-Jul	590	**0.98**			0	0		1.0	9	0	0	10		
14-Jul	591	**0.98**			0	0		1.0	10	0	0	11		
15-Jul	592	**17.89**			0	0		17.9	11	0	0	29		
16-Jul	593	**17.89**			0	0		17.9	29	0	0	47		
17-Jul	594	**17.89**			0	0		17.9	47	0	0	64		
18-Jul	595	**17.89**			0	0		17.9	64	0	0	82		
19-Jul	596	**17.89**			0	0		17.9	82	0	0	100		
20-Jul	597	**17.89**			0	0		17.9	100	0	0	118		
21-Jul	598	**17.89**			0	0		17.9	118	0	0	136		
22-Jul	599	**17.89**			0	0		17.9	136	0	0	154		
23-Jul	600	**17.89**			0	0		17.9	154	0	0	172		
24-Jul	601	**17.89**			0	0		17.9	172	0	0	190		
25-Jul	602	**91.04**			0	0		91.0	190	0	0	281		
26-Jul	603	**272.56**			0	0	21	251.7	281	0	0	532		
27-Jul	604	**551.00**			0	0	70	481.3	532	0	0	1,014		
28-Jul	605	**551.00**			0	0	70	481.3	1,014	0	0	1,495		
29-Jul	606	**551.00**			0	0	70	481.3	1,495	0	0	1,976		
30-Jul	607	**198.87**			0	0	70	129.2	1,976	0	0	2,106		
31-Jul	608	**21.14**			0	0	17	3.7	2,106	0	0	2,109		
1-Aug	609	**17.89**	14	406	0	0		17.9	2,109	0	0	2,127	32	945
2-Aug	610	**17.89**			0	0		17.9	2,127	0	0	2,145		
3-Aug	611	**17.89**			0	0		17.9	2,145	0	0	2,163		
4-Aug	612	**17.89**			35	0		17.9	2,163	0	35	2,146		
5-Aug	613	**17.89**			35	0		17.9	2,146	0	35	2,129		
6-Aug	614	**17.89**			35	0		17.9	2,129	0	35	2,112		
7-Aug	615	**17.89**			35	0		17.9	2,112	0	35	2,095		
8-Aug	616	**17.89**			35	0		17.9	2,095	0	35	2,077		
9-Aug	617	**17.89**			35	0		17.9	2,077	0	35	2,060		
10-Aug	618	**0.98**			35	0		1.0	2,060	0	35	2,026		
11-Aug	619	**0.98**			35	0		1.0	2,026	0	35	1,992		
12-Aug	620	**0.98**			35	0		1.0	1,992	0	35	1,958		
13-Aug	621	**0.98**			35	0		1.0	1,958	0	35	1,924		
14-Aug	622	**0.98**			35	0		1.0	1,924	0	35	1,890		
15-Aug	623	**0.02**			35	0		0.0	1,890	0	35	1,855		
16-Aug	624	**16.94**			35	0		16.9	1,855	0	35	1,837		

Annual Flow Calculations for NBP Stage 3

Date	Day	Daily Wastewater Input (kL)	MonthLy Avg (kL/month)	Monthly Total (kL/month)	Max Daily Irrigation Output (kL)	Max ISFB Output) (kL)	Trucked WW Offsite (kL)	Wastewater to Storage (kL)	Stored Wastewater from Previous Day (kL)	Actual IDSFB Dosing (kL)	Actual DaiLy Irrigation Output (kL)	Cumulative Wastewater Storage (kL)	Monthly Avg (kL/day)	Monthly Total (kL/month)
17-Aug	625	16.94			35	0		16.9	1,837	0	35	1,819		
18-Aug	626	16.94			35	0		16.9	1,819	0	35	1,801		
19-Aug	627	16.94			35	0		16.9	1,801	0	35	1,783		
20-Aug	628	16.94			35	0		16.9	1,783	0	35	1,765		
21-Aug	629	3.80			35	0		3.8	1,765	0	35	1,734		
22-Aug	630	46.63			35	0		46.6	1,734	0	35	1,745		
23-Aug	631	16.94			35	0		16.9	1,745	0	35	1,727		
24-Aug	632	16.94			35	0		16.9	1,727	0	35	1,709		
25-Aug	633	16.94			35	0		16.9	1,709	0	35	1,691		
26-Aug	634	16.94			35	0		16.9	1,691	0	35	1,673		
27-Aug	635	16.94			35	0		16.9	1,673	0	35	1,655		
28-Aug	636	3.80			35	0		3.8	1,655	0	35	1,624		
29-Aug	637	0.02			35	0		0.0	1,624	0	35	1,589		
30-Aug	638	16.94			35	0		16.9	1,589	0	35	1,571		
31-Aug	639	16.94	12	348	35	0		16.9	1,571	0	35	1,553	35	1,085
1-Sep	640	16.94			35	0		16.9	1,553	0	35	1,535		
2-Sep	641	16.94			35	0		16.9	1,535	0	35	1,517		
3-Sep	642	16.94			35	0		16.9	1,517	0	35	1,498		
4-Sep	643	3.80			35	0		3.8	1,498	0	35	1,467		
5-Sep	644	0.02			35	0		0.0	1,467	0	35	1,432		
6-Sep	645	16.94			35	0		16.9	1,432	0	35	1,414		
7-Sep	646	16.94			35	0		16.9	1,414	0	35	1,396		
8-Sep	647	3.80			35	0		3.8	1,396	0	35	1,365		
9-Sep	648	0.02			35	0		0.0	1,365	0	35	1,330		
10-Sep	649	0.02			35	0		0.0	1,330	0	35	1,295		
11-Sep	650	0.02			35	0		0.0	1,295	0	35	1,260		
12-Sep	651	46.63			35	0		46.6	1,260	0	35	1,272		
13-Sep	652	0.02			35	0		0.0	1,272	0	35	1,237		
14-Sep	653	0.02			35	0		0.0	1,237	0	35	1,202		
15-Sep	654	3.80			35	0		3.8	1,202	0	35	1,171		
16-Sep	655	16.94			35	0		16.9	1,171	0	35	1,152		
17-Sep	656	16.94			35	0		16.9	1,152	0	35	1,134		
18-Sep	657	16.94			35	0		16.9	1,134	0	35	1,116		
19-Sep	658	16.94			35	0		16.9	1,116	0	35	1,098		
20-Sep	659	16.94			35	0		16.9	1,098	0	35	1,080		
21-Sep	660	16.94			35	0		16.9	1,080	0	35	1,062		
22-Sep	661	16.94			35	0		16.9	1,062	0	35	1,044		
23-Sep	662	16.94			35	0		16.9	1,044	0	35	1,026		
24-Sep	663	16.94			35	0		16.9	1,026	0	35	1,008		
25-Sep	664	16.94			35	0		16.9	1,008	0	35	990		
26-Sep	665	16.94			35	0		16.9	990	0	35	972		
27-Sep	666	3.80			35	0		3.8	972	0	35	941		
28-Sep	667	3.80			35	0		3.8	941	0	35	909		
29-Sep	668	3.80			35	0		3.8	909	0	35	878		
30-Sep	669	3.80			35	0		3.8	878	0	35	847		
1-Oct	670	3.80	27	814	35	0		3.8	847	0	35	816	25	735
2-Oct	671	0.96			35	0		1.0	816	0	35	782		
3-Oct	672	0.96			35	0		1.0	782	0	35	748		
4-Oct	673	0.96			35	0		1.0	748	0	35	714		
5-Oct	674	0.96			35	0		1.0	714	0	35	680		
6-Oct	675	0.96			35	0		1.0	680	0	35	646		
7-Oct	676	0.96			35	0		1.0	646	0	35	612		
8-Oct	677	0.96			35	0		1.0	612	0	35	578		
9-Oct	678	0.96			35	0		1.0	578	0	35	544		
10-Oct	679	0.96			0	0		1.0	544	0	0	544		
11-Oct	680	0.96			0	0		1.0	544	0	0	545		
12-Oct	681	0.00			0	0		0.0	545	0	0	545		
13-Oct	682	2.34			0	0		2.3	545	0	0	548		
14-Oct	683	249.38			0	0		249.4	548	0	0	797		
15-Oct	684	265.63			0	0		265.6	797	0	0	1,063		
16-Oct	685	249.38			0	0		249.4	1,063	0	0	1,312		
17-Oct	686	4.06			0	0		4.1	1,312	0	0	1,316		
18-Oct	687	0.96			0	0		1.0	1,316	0	0	1,317		
19-Oct	688	0.96			35	0		1.0	1,317	0	35	1,283		
20-Oct	689	0.96			35	0		1.0	1,283	0	35	1,249		
21-Oct	690	0.96			35	0		1.0	1,249	0	35	1,215		
22-Oct	691	0.96			35	0		1.0	1,215	0	35	1,181		
23-Oct	692	0.96			35	0		1.0	1,181	0	35	1,147		
24-Oct	693	0.96			35	0		1.0	1,147	0	35	1,113		
25-Oct	694	3.80			35	0		3.8	1,113	0	35	1,082		
26-Oct	695	3.80			35	0		3.8	1,082	0	35	1,051		
27-Oct	696	3.80			35	0		3.8	1,051	0	35	1,019		
28-Oct	697	3.80			35	0		3.8	1,019	0	35	988		
29-Oct	698	3.80			35	0		3.8	988	0	35	957		
30-Oct	699	3.80			35	0		3.8	957	0	35	926		
31-Oct	700	3.80	14	448	35	0		3.8	926	0	35	895	35	1,085
1-Nov	701	0.02			35	0		0.0	895	0	35	860		
2-Nov	702	16.94			35	0		16.9	860	0	35	841		
3-Nov	703	16.94			35	0		16.9	841	0	35	823		
4-Nov	704	16.94			35	0		16.9	823	0	35	805		
5-Nov	705	16.94			35	0		16.9	805	0	35	787		
6-Nov	706	16.94			35	0		16.9	787	0	35	769		
7-Nov	707	3.80			35	0		3.8	769	0	35	738		
8-Nov	708	0.02			35	0		0.0	738	0	35	703		
9-Nov	709	16.94			35	0		16.9	703	0	35	685		
10-Nov	710	16.94			35	0		16.9	685	0	35	667		
11-Nov	711	16.94			35	0		16.9	667	0	35	649		
12-Nov	712	16.94			35	0		16.9	649	0	35	631		
13-Nov	713	16.94			35	0		16.9	631	0	35	613		
14-Nov	714	3.80			35	0		3.8	613	0	35	582		
15-Nov	715	46.63			35	0		46.6	582	0	35	593		
16-Nov	716	16.94			35	0		16.9	593	0	35	575		
17-Nov	717	16.94			35	0		16.9	575	0	35	557		
18-Nov	718	16.94			35	0		16.9	557	0	35	539		
19-Nov	719	16.94			35	0		16.9	539	0	35	521		
20-Nov	720	16.94			35	0		16.9	521	0	35	503		
21-Nov	721	3.80			35	0		3.8	503	0	35	472		
22-Nov	722	0.02			35	0		0.0	472	0	35	437		
23-Nov	723	16.94			35	0		16.9	437	0	35	419		
24-Nov	724	16.94			35	0		16.9	419	0	35	401		
25-Nov	725	16.94			35	0		16.9	401	0	35	382		
26-Nov	726	16.94			35	0		16.9	382	0	35	364		
27-Nov	727	16.94			35	0		16.9	364	0	35	346		
28-Nov	728	16.94			35	0		16.9	346	0	35	328		
29-Nov	729	0.02			35	0		0.0	328	0	35	293		

Annual Flow Calculations for NBP Stage 3

Date	Day	Daily Wastewater Input (kL)	MonthLy Avg (kL/month)	Monthly Total (kL/month)	Max Daily Irrigation Output (kL)	Max ISFB Output) (kL)	Trucked WW Offsite (kL)	Wastewater to Storage (kL)	Stored Wastewater from Previous Day (kL)	Actual IDSFB Dosing (kL)	Actual DaiLy Irrigation Output (kL)	Cumulative Wastewater Storage (kL)	Monthly Avg (kL/day)	Monthly Total (kL/month)
30-Nov	730	16.94			35	0		16.9	293	0	35	275		
1-Dec	731	16.94	21	638	35	0		16.9	275	0	35	257	17	518
2-Dec	732	16.94			35	0		16.9	257	0	35	239		
3-Dec	733	16.94			35	0		16.9	239	0	35	221		
4-Dec	734	16.94			35	0		16.9	221	0	35	203		
5-Dec	735	16.94			35	0		16.9	203	0	35	185		
6-Dec	736	3.80			35	0		3.8	185	0	35	154		
7-Dec	737	0.02			35	0		0.0	154	0	35	119		
8-Dec	738	0.02			35	0		0.0	119	0	35	84		
9-Dec	739	0.98			35	0		1.0	84	0	35	50		
10-Dec	740	0.98			35	0		1.0	50	0	35	16		
11-Dec	741	0.98			35	0		1.0	16	0	17	0		
12-Dec	742	0.98			35	0		1.0	0	0	1	0		
13-Dec	743	0.98			35	0		1.0	0	0	1	0		
14-Dec	744	0.98			35	0		1.0	0	0	1	0		
15-Dec	745	0.98			35	0		1.0	0	0	1	0		
16-Dec	746	0.98			35	0		1.0	0	0	1	0		
17-Dec	747	0.98			35	0		1.0	0	0	1	0		
18-Dec	748	0.98			35	0		1.0	0	0	1	0		
19-Dec	749	0.98			35	0		1.0	0	0	1	0		
20-Dec	750	17.89			35	0		17.9	0	0	18	0		
21-Dec	751	17.89			35	0		17.9	0	0	18	0		
22-Dec	752	17.89			35	0		17.9	0	0	18	0		
23-Dec	753	17.89			35	0		17.9	0	0	18	0		
24-Dec	754	17.89			35	0		17.9	0	0	18	0		
25-Dec	755	17.89			35	0		17.9	0	0	18	0		
26-Dec	756	17.89			35	0		17.9	0	0	18	0		
27-Dec	757	17.89			35	0		17.9	0	0	18	0		
28-Dec	758	17.89			0	0		17.9	0	0	0	18		
29-Dec	759	17.89			0	0		17.9	18	0	0	36		
30-Dec	760	96.92			0	0		96.9	36	0	0	133		
31-Dec	761	279.28			0	0	15	264.3	133	0	0	397		
Annual Total (kL)		9,235	306	9,774	10,780		544		average	0	8,780			
Average daily (kL)		25.3	0.7	23.1	29.5					0.0	24.1			

Appendix D

Irrigation Hydraulic Sizing and Nutrient Balance Calculations

Byron OSMS Design Model -
version 1912 Byron OSMS_Design_Model- 35kl-day.xlsm Printed 07 Dec '17 12:01 PM

Head count by (1) bedrooms / (2) persons	1
Bedrooms (gp1)	3330
Bedrooms (gp2)	0
Persons (grp 1)	4995
Persons (grp 2)	0
Block size (ha)	100000
Setback type listbox	2
Setback distance (m)	40
Daily Effluent Flow per person (L/day)	15
Daily effluent water supply type listbox	4
toilet g1 tickbox	FALSE
bath g1 tickbox	TRUE
laundry g1 tickbox	FALSE
kitchen g1 tickbox	FALSE
toilet g2 tickbox	FALSE
bath g2 tickbox	FALSE
laundry g2 tickbox	FALSE
kitchen g2 tickbox	FALSE
Treatment system listbox	6
% black to total wastewater in a full system: Water	14%
N production per person per year (kg/person/yr)	3.36
% black to total wastewater in a full system: TN	86%
N loss in treatment system (% reduction)	50%
N loss in disposal bed (% reduction)	20%
N Plant Uptake rate (kg/ha/year)	250
P production per person per year (kg/person/yr)	0.1
% black to total wastewater in a full system: TP	40%
P uptake by plants (Hp) (kg/ha/yr)	10
P soil sorption (Ps) (kg/ha/m depth)	1000
P soil sorption according to soil type listbox	5
Water Table Depth (Wtd) (m)	0.6
Buffer to Water Table (Bwt) (m)	0.5
Time for accumulation of P(years)	50
Crop factor(grass = 0.74)	1
Crop coefficient (TRUE) / crop factor (FALSE) tickbox	TRUE
% Effective Rainfall	85%
Effective Rainfall listbox	2
Percolation (mm/day)	5
Soil texture and structure beneath system listbox	6
Depth of root zone (m)	0.3
Effective porosity of root zone	0.37
Avail.Water of root zone	0.15
Soil texture in rootzone listbox	3
Depth of trench below root zone (m)	0
Effective porosity of trench below root zone	0
Avail.Water of trench below root zone	0
Permissable percentile exceedence	5.0000%
Trench width (m)	0.6
Lateral seepage width (m)	0.3
Disposal Type SSI (1) / ETA (2) listbox	1
Number of trenches (spinner button)	3001
Hydraulic area (m2)	14376.51
Nitrogen area (m2)	5474.14
Phosphorus area (m2)	2870.69
Water balance area (m2) - Cntl-q (see text)	36008.07
Final area (m2)	36008.07

Appendix E

Medli Irrigation Modelling Outputs

MEDLI REPORT - FULL RUN

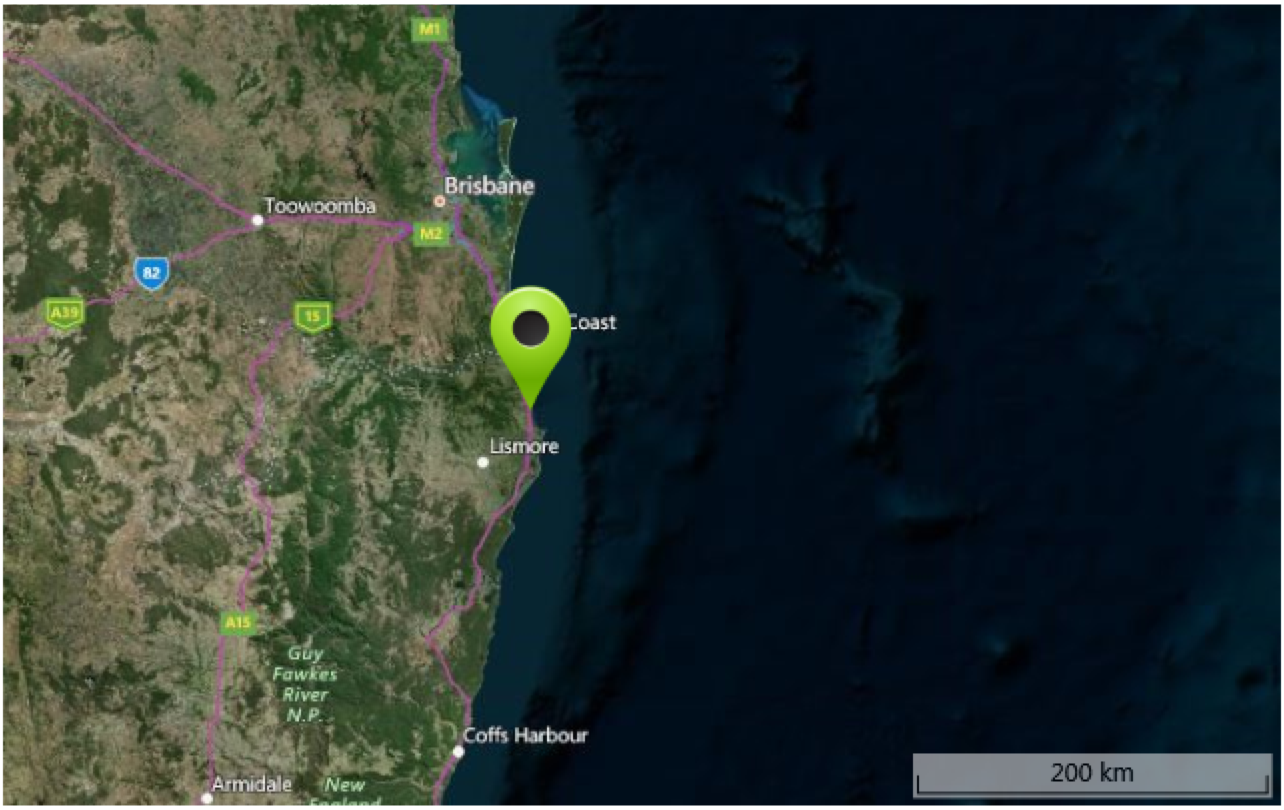
Enterprise: North Byron Parkland

Description:
Irrigation over floodplain

Client: NBP

MEDLI User: W&A

Scenario Details:
For fixed daily irrigation, it is important to ensure the irrigation area has active plant growth throughout the year in this location, to avoid nitrate leaching during slow growth in winter.



DESCRIPTION

Climate Data: Brunswick Heads, -28.55°, 153.55°

Run Period: 01/01/1967 to 31/12/2017 51 years, 0 days

Climate Statistics:

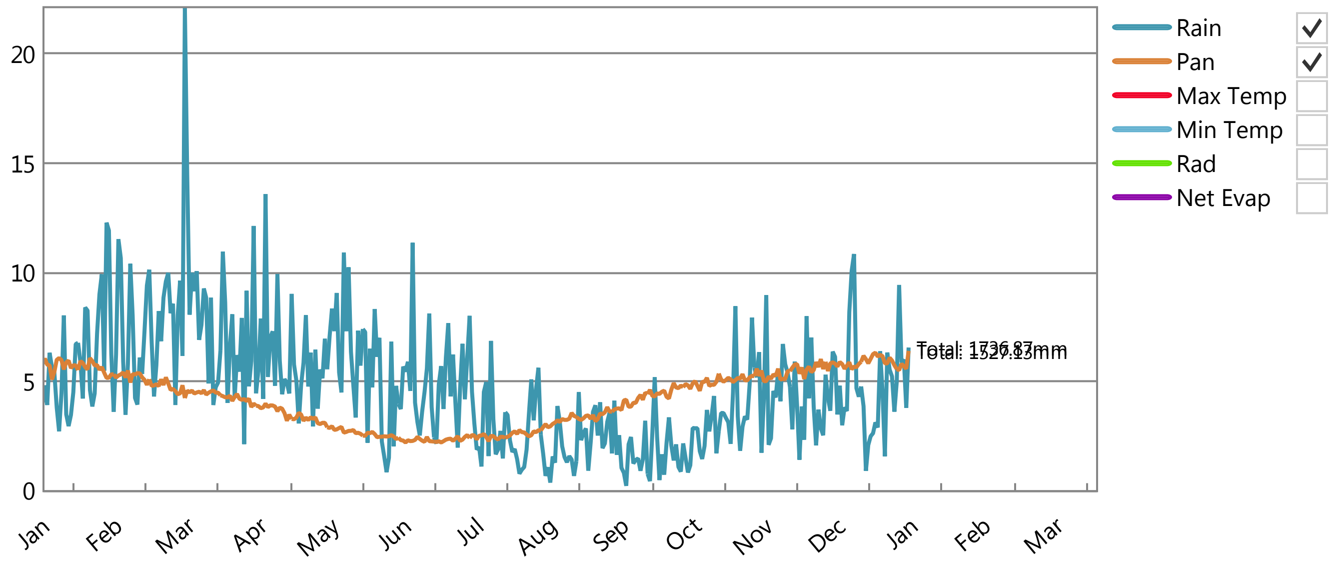
	5th Percentile	50th Percentile	95th Percentile
Rainfall (mm/year)	1163	1712	2514
Pan Evaporation (mm/year)	1373	1526	1695

Climate Data:

Chart Table

Monthly Daily

Daily Average Across Run Period



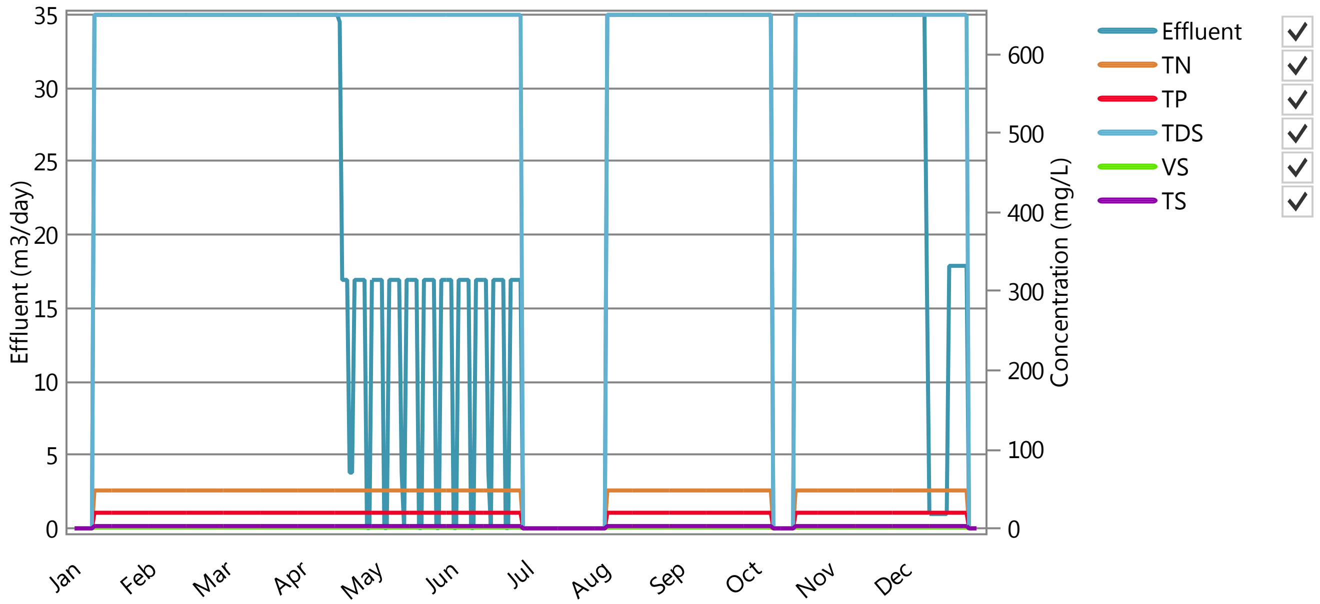
DESCRIPTION

Effluent type: NBP Onsite System

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:

Chart Table



Wastestream after any recycling and pretreatment if applicable

Effluent quantity: **8780.32 m3/year** or 24.04 m3/day (Min-Max: 0.00 - 35.00)

Flow-weighted average (minimum - maximum) daily effluent quality entering pond system:

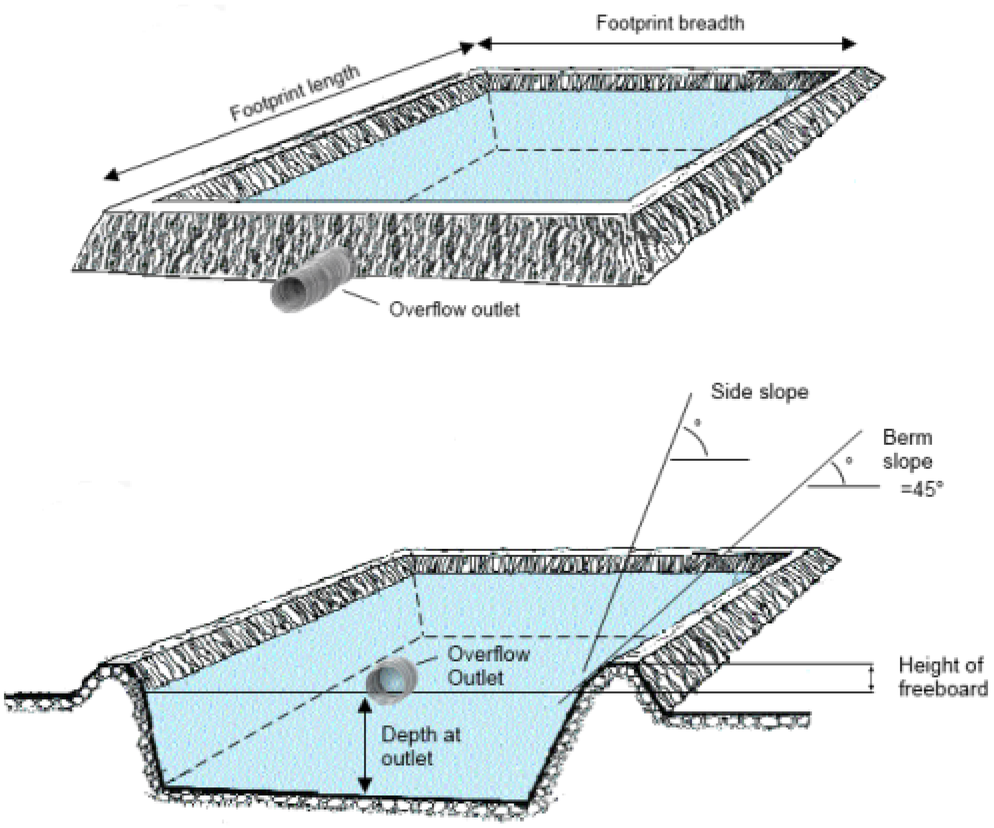
	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	48.00 (0.00 - 48.00)	421.46 (421.46 - 421.46)
Total Phosphorus	19.80 (0.00 - 19.80)	173.85 (173.85 - 173.85)
Total Dissolved Salts	650.00 (0.00 - 650.00)	5707.21 (5707.21 - 5707.21)
Volatile Solids	0.90 (0.00 - 0.90)	7.90 (7.90 - 7.90)
Total Solids	3.00 (0.00 - 3.00)	26.34 (26.34 - 26.34)

DESCRIPTION

Pond system: 1 closed storage tank

Pond system details:

	Pond 1
Maximum pond volume (m3)	2300.00
Minimum allowable pond volume (m3)	0.00
Pond depth at overflow outlet (m)	4.00
Maximum water surface area (m2)	575.00
Pond footprint length (m)	23.98
Pond footprint width (m)	23.98
Pond catchment area (m2)	575.00
Average active volume (m3)	98.74



Irrigation pump limits:

Minimum pump rate limit (L/day)	0.00
Maximum pump rate limit (L/day)	35000.00

Shandying water:

Annual allocation of fresh water available for shandying (m3/year)	0.00
Maximum rate of application of fresh water (L/day)	0.00
Nitrogen concentration (mg/L)	0.00
Salinity (dS/m)	0.00
Minimum shandy water is used	False

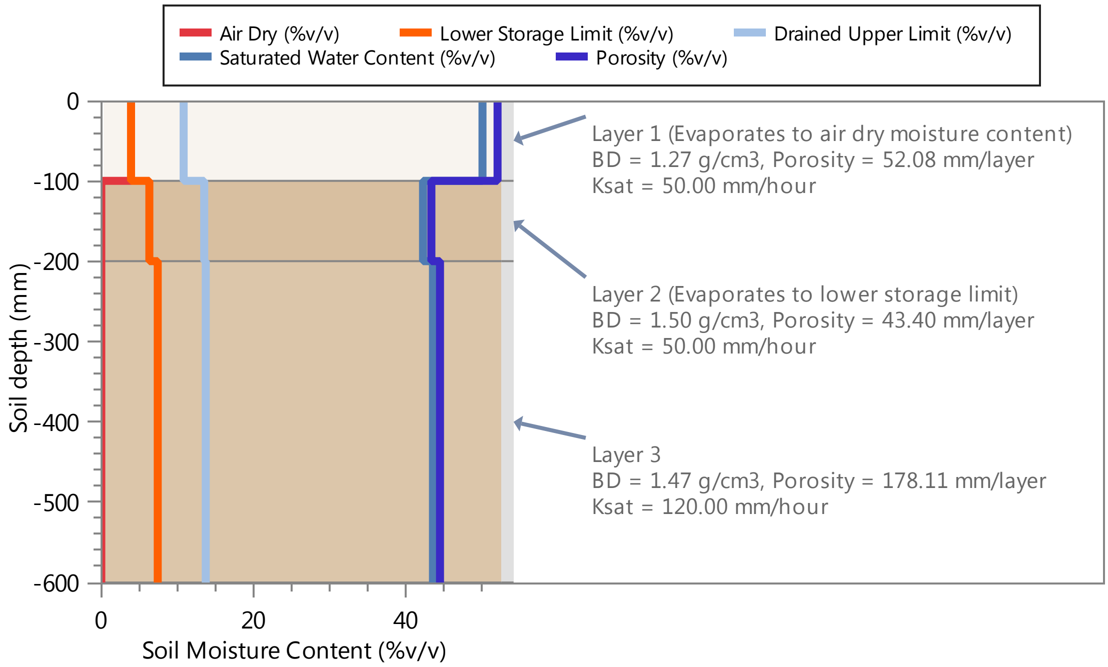
DESCRIPTION

Land: Grass Lawn

Area (m2): 36000.00

Soil Type: Sand modified for NBP, 600.00 mm defined profile depth

Profile Porosity (mm)	273.58
Profile saturation water content (mm)	266.80
Profile drained upper limit (or field capacity) (mm)	79.70
Profile lower storage limit (or permanent wilting point) (mm)	40.40
Profile available water capacity (mm)	39.30
Profile limiting saturated hydraulic conductivity (mm/hour)	50.00
Surface saturated hydraulic conductivity (mm/hour)	50.00
Runoff curve number II (coefficient)	70.00
Soil evaporation U (mm)	10.00
Soil evaporation Cona (mm/sqrt day)	4.50



Plant Data: Continuous Coastal Couch Grass (Cynodon dactylon) Pasture

Average monthly cover (fraction) (minimum - maximum)	0.79 (0.73 - 0.83)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 1)	0.80
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Maximum potential root depth in defined soil profile (mm)	600.00
Salt tolerance	Tolerant
Salinity threshold EC sat. ext. (dS/m)	6.90
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.06

DESCRIPTION

Pathogen Data: Direct ingestion of effluent with calculation of annual risk using monthly data

Risk: Annual Risk using Monthly Data

Pathogens Present:

Pathogen	Type	Irrigation Water Concentration (org/m3)	Organism Unit
Escherichia coli O111	Bacteria	30	cfu

Receptor attributes: (Accidental drinking whilst swi)

Maximum Volume Ingested per Event Resulting From Activity (mL)	100.00

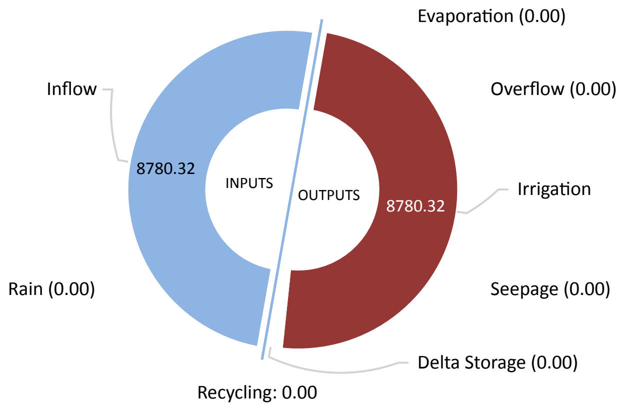
Exposures: Number of identical exposures for each month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Pond System Water Performance - Overflow: 1 closed storage tank

Capacity of wet weather storage pond: **2300 m3**

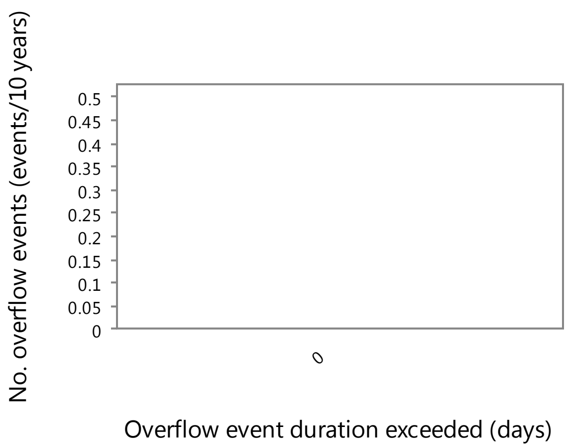
Pond System Water Balance (m3/year)

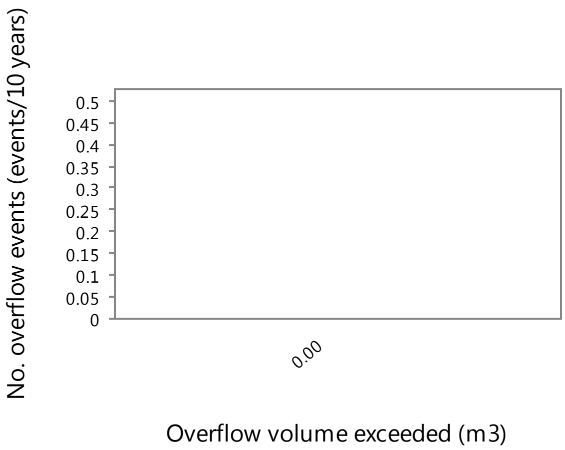


Name	Value
Rain	0.00
Inflow	8780.32
Recycling	0.00
Evaporation	0.00
Overflow	0.00
Irrigation	8780.32
Seepage	0.00
Delta Storage	0.00

Overflow Diagnostics

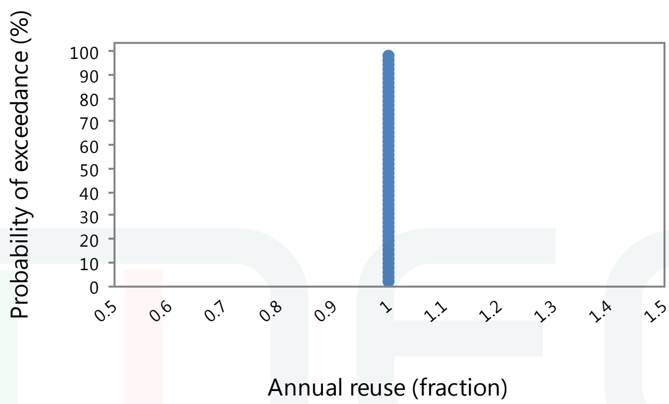
Volume of overflow (m3/year)	0.00
No. days pond overflows (days/year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	1.00
Probability of at least 90% reuse (fraction)	1.00





Export plot

Export plot



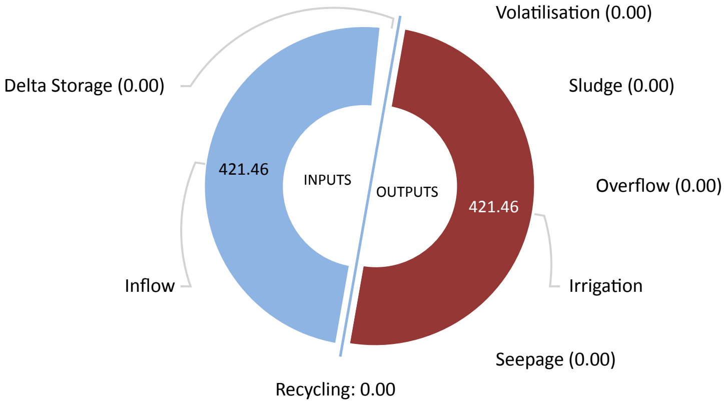
Export plot

PERFORMANCE

Pond System Performance - Nutrient: 1 closed storage tank

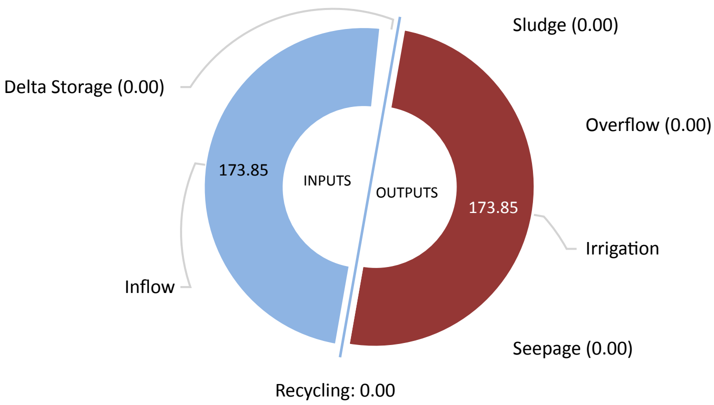
Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)



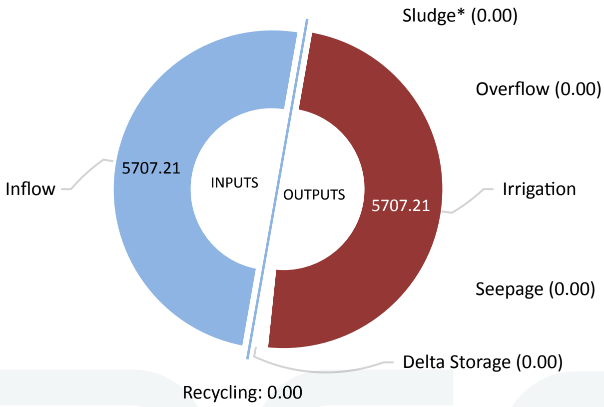
Name	Value
Inflow	421.46
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	0.00
Irrigation	421.46
Seepage	0.00
Delta Storage	0.00

Phosphorus Balance (kg/year)



Name	Value
Inflow	173.85
Recycling	0.00
Sludge	0.00
Overflow	0.00
Irrigation	173.85
Seepage	0.00
Delta Storage	0.00

Salt Balance (kg/year)



Name	Value
Inflow	5707.21
Recycling	0.00
Sludge*	0.00
Overflow	0.00
Irrigation	5707.21
Seepage	0.00
Delta Storage	0.00

* Salt removal in sludge is not calculated from the pond salt balance. However if salt could be assumed to be present in the sludge at the same concentration as in the pond supernatant (up to a maximum of salt added in inflow) - then salt accumulation in the sludge could be 0.00 kg/year

Pond System Sludge Accumulation: 0.00 kg dwt/year

PERFORMANCE

Pond System Performance - Nutrient: 1 closed storage tank

Pond Nutrient Concentrations and Salinity:

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	48.00
Average phosphorus concentration of pond liquid (mg/L)	19.80
Average salinity of pond liquid (dS/m)	1.02

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	N.D.*
Final phosphorus concentration of pond liquid (mg/L)	N.D.*
Final salinity of pond liquid (dS/m)	N.D.*

* Not determined. Pond is empty.

PERFORMANCE

Irrigation Performance:

Water Use: (assumes 100% Irrigation Efficiency)

Pond water irrigated (m3/year)	8780.32
Average Shandy water irrigation (m3/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (m3/year)	8780.32
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Proportion of years shandying water allocation of 0 m3/year is exceeded (fraction of years)	0.00
Average exceedance as a proportion of annual shandy water allocation (fraction of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)

Irrigation Quality:

Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L)	48.00
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	44.83
Average phosphorus concentration of irrigation water (mg/L)	19.80
Average salinity of irrigation water (dS/m)	1.02

Irrigation Diagnostics:

Proportion of Days rain prevents irrigation (fraction)	0.02
Proportion of Days water demand too small to trigger irrigation (fraction)	0.06
Proportion of Days pond volume below min. vol. for irrigation (fraction)	0.13
Proportion of Days irrigation occurs (fraction)	0.79

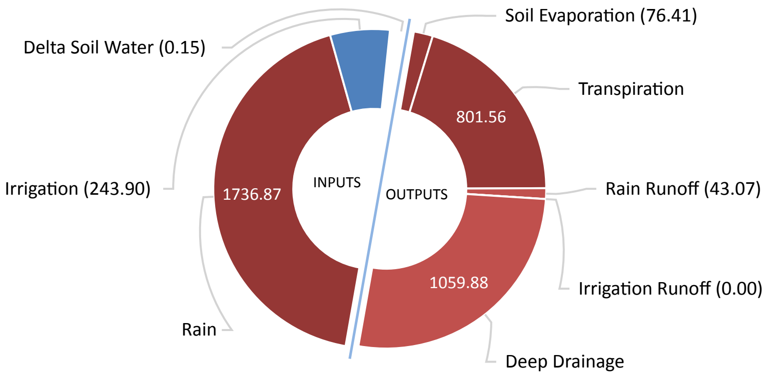
PERFORMANCE

Land Performance - Soil Water

Paddock: Grass Lawn, 36000 m2
Soil Type: Sand modified for NBP, 39.30 mm PAWC at maximum root depth

Land Water Balance (mm/year):

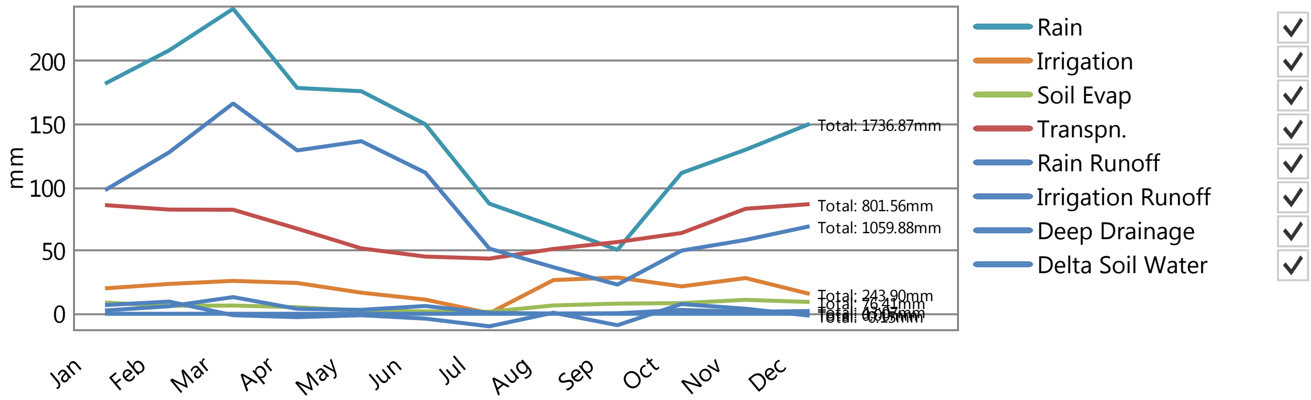
■ mm/year ☐ % Total inputs



Name	Value
Rain	1736.87
Irrigation	243.90
Soil Evaporation	76.41
Transpiration	801.56
Rain Runoff	43.07
Irrigation Runoff	0.00
Deep Drainage	1059.88
Delta Soil Water	-0.15

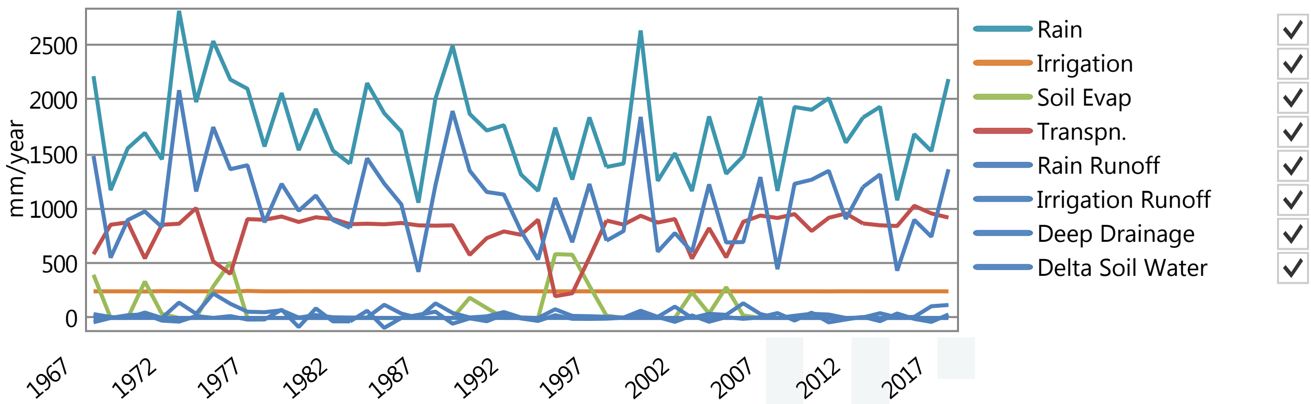
Average Monthly Totals (mm):

■ Chart ☐ Table



Average Annual Totals (mm/year):

■ Chart ☐ Table



PERFORMANCE

Land Performance - Soil Nutrient

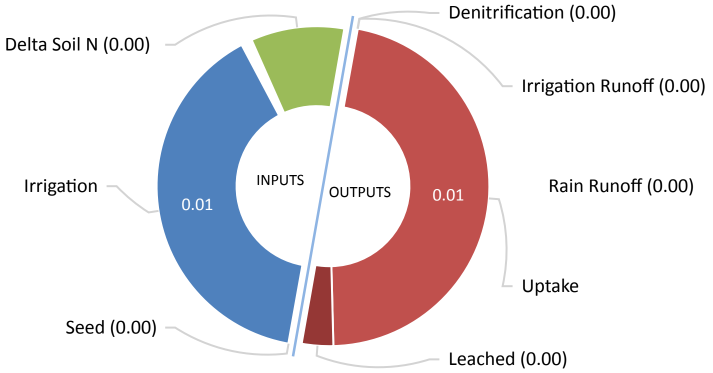
Paddock: Grass Lawn, 36000 m2

Soil Type: Sand modified for NBP

Irrigation ammonium volatilisation losses (kg/m2/year): 0.00

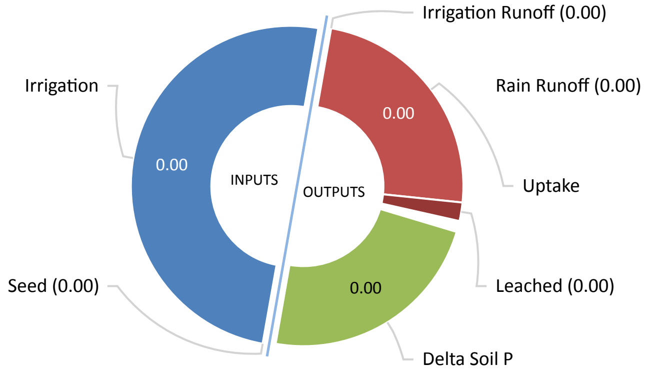
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.30

Land Nitrogen Balance (kg/m2/year)



Name	Value
Seed	1.41E-05
Irrigation	0.01
Denitrification	1.73E-05
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	0.01
Leached	8.62E-04
Delta Soil N	-2.62E-03

Land Phosphorus Balance (kg/m2/year)



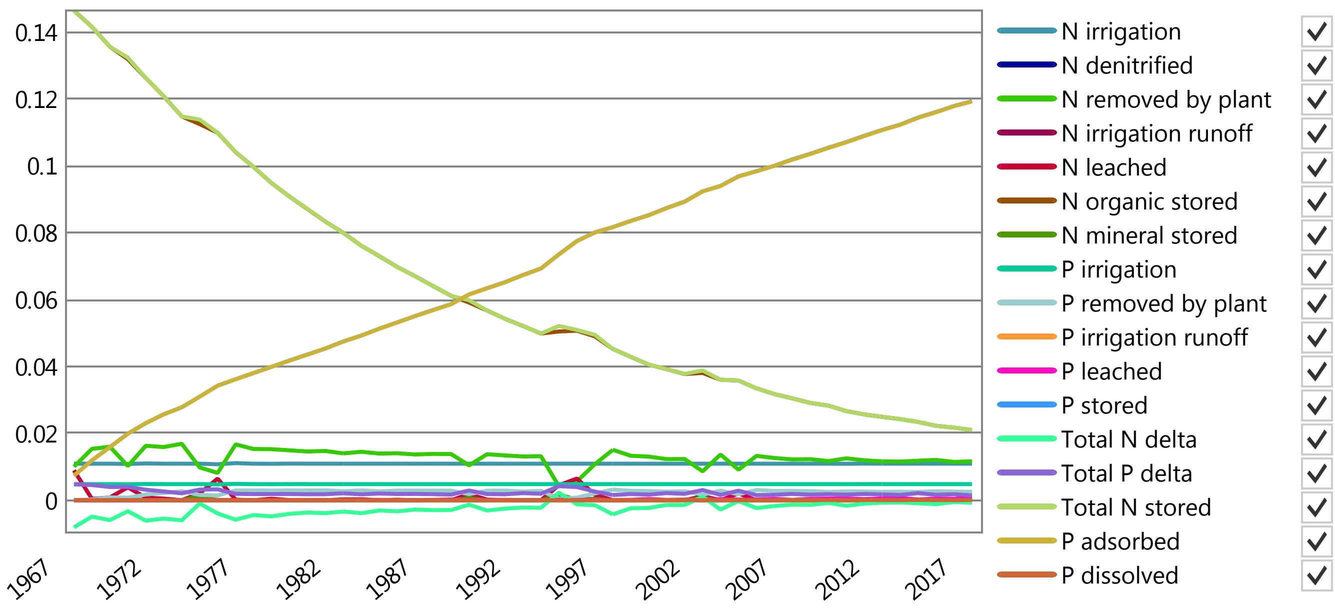
Name	Value
Seed	2.12E-06
Irrigation	4.83E-03
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	2.36E-03
Leached	1.85E-04
Delta Soil P	2.29E-03

PERFORMANCE

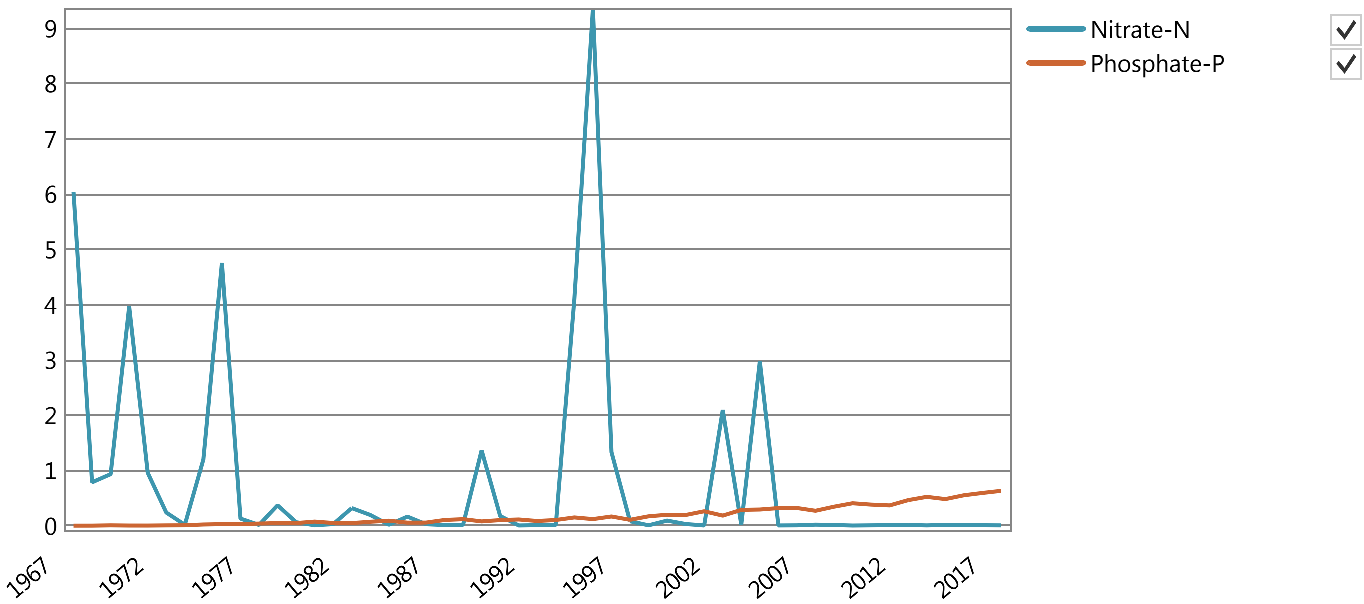
Land Performance - Soil Nutrient

Paddock: Grass Lawn, 36000 m2 **Soil Type**: Sand modified for NBP

Annual Nutrient Totals (kg/m2):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE

Plant Performance and Nutrients

Paddock: Grass Lawn, 36000 m2 **Soil Type**: Sand modified for NBP

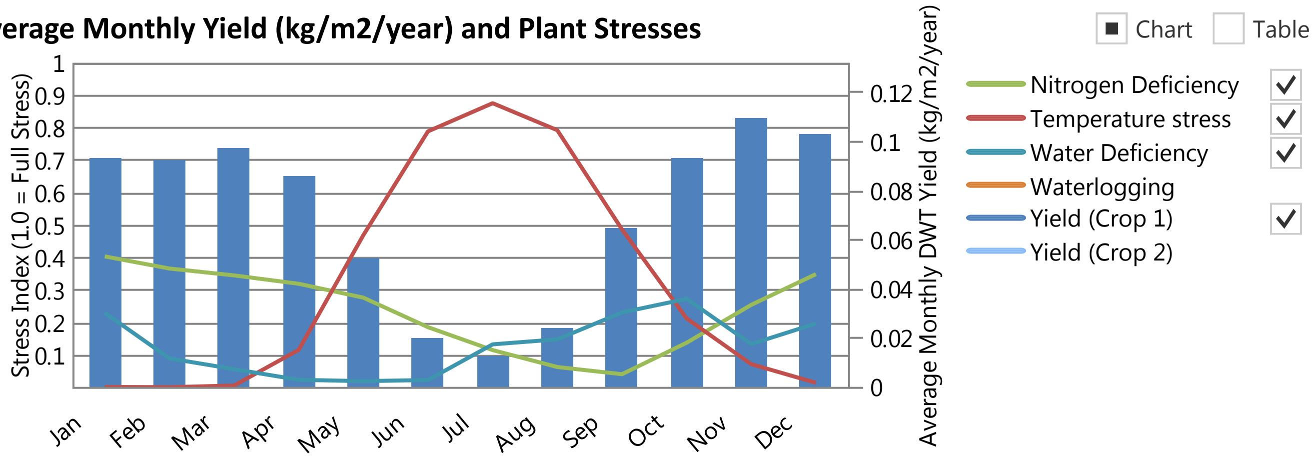
Plant: Continuous Coastal Couch Grass (Cynodon dactylon) Pasture

Average annual shoot dry matter yield (kg/m2/year)	0.85 (0.16 - 1.11)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.79 (0.73 - 0.83)
Average monthly root depth (mm) (minimum - maximum)	559.07 (528.08 - 590.80)

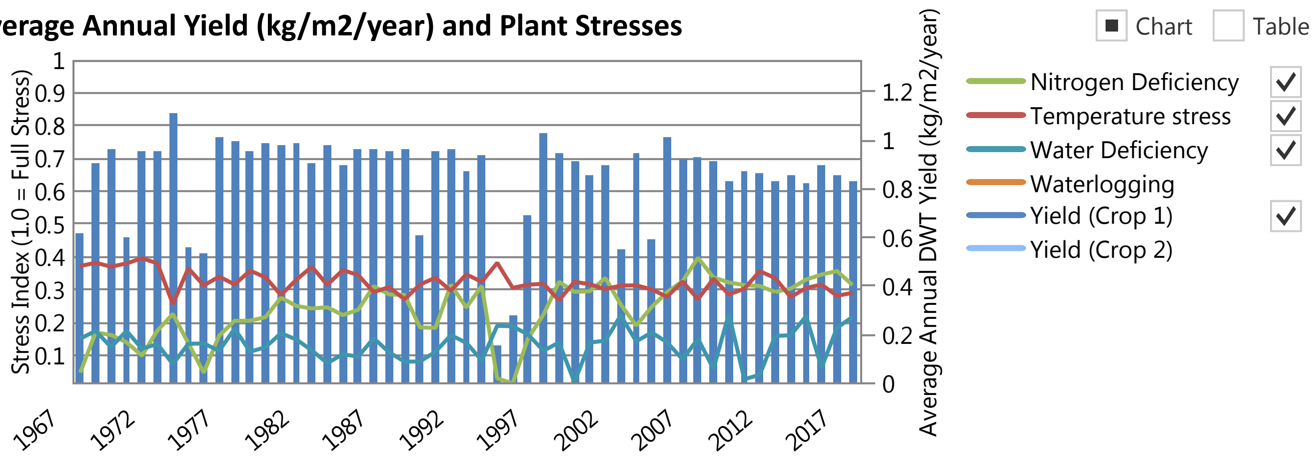
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/m2/year)	0.01 (0.00 - 0.02)
Average annual net phosphorus removed by plant uptake (kg/m2/year)	0.00 (0.00 - 0.00)
Average annual shoot nitrogen concentration (fraction dwt)	0.02 (0.01 - 0.02)
Average annual shoot phosphorus concentration (fraction dwt)	0.003 (0.000 - 0.003)

Average Monthly Yield (kg/m2/year) and Plant Stresses



Average Annual Yield (kg/m2/year) and Plant Stresses



No. of harvests/year: 5.69 (normal), 0.22 (forced by crop death due to water stress (0.22))
No. days without crop/year (days/year): 2.69 due to temperature stress - not frost (0.63), water stress (2.06)

PERFORMANCE

Land Performance

Paddock: Grass Lawn, 36000 m2

Soil Type: Sand modified for NBP

Plant: Continuous Coastal Couch Grass (Cynodon dactylon) Pasture

Salt tolerance	Tolerant
Salinity threshold EC sat. ext. (dS/m)	6.90
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.06
No. years assumed for leaching to reach steady-state (years)	10.00

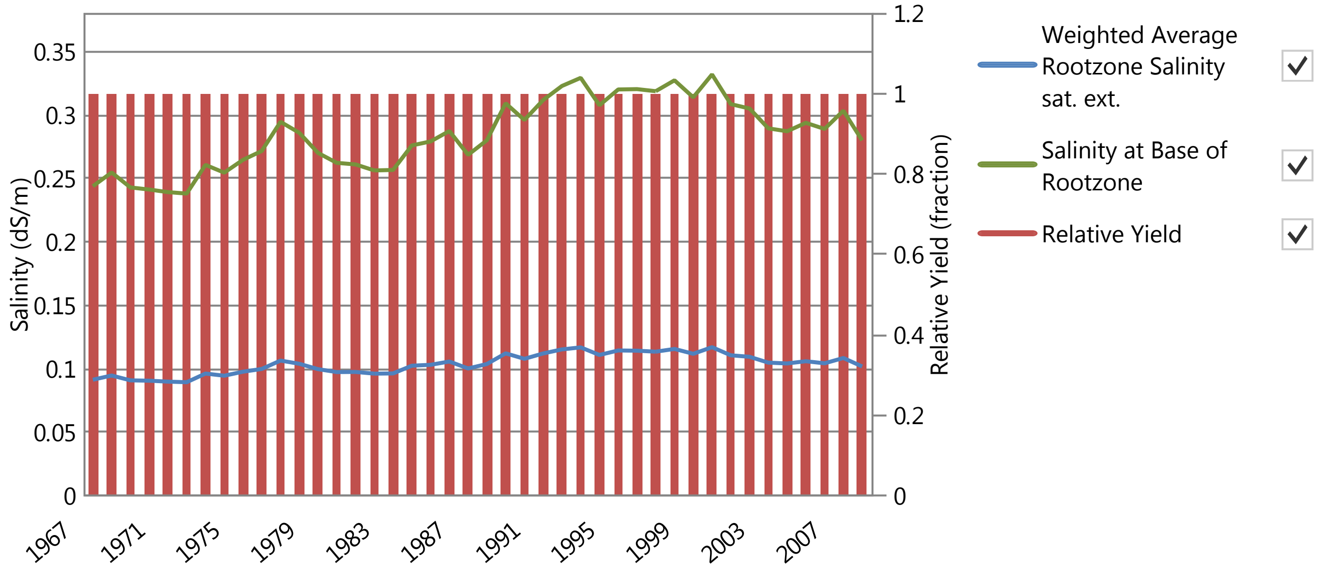
Soil Salinity:

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.16
Salt added by rainfall (kg/m2/year)	0.03
Average annual effluent salt added & leached at steady state (kg/m2/year)	0.19
Average leaching fraction based on 10 year running averages (fraction)	0.68
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.10
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.28
Relative crop yield expected due to salinity (fraction)	1.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (fraction)	0.00

Average Annual Rootzone Salinity and Relative Yield:

■ Chart ☐ Table

All values based on 10 year running averages



PERFORMANCE

Pathogen Data: Direct ingestion of effluent with calculation of annual risk using monthly data

Risk: Annual Risk using Monthly Data

Activity: Accidental drinking whilst swi **Liquid Ingested (mL):** 100

Health risk threshold: 1.0 extra infections/10000 persons/year

Pathogen Risk:

	Escherichia coli O111
Pathogen Type	Bacteria
No. Ingested per Event (Organisms) (minimum - maximum)	0.003 - 0.003
Infection Risk per Event (No. extra infections/10000 persons) (minimum - maximum)	0.00 - 0.00
Infection risk per year of 12 events (extra infections/10000 persons/ year)	0.00
Organism Unit	cfu

Monthly Infection Risk (No. extra infections/10000 persons/month):

Chart Table

Escherichia coli O111 (1) ✓

PERFORMANCE

Groundwater

Recharge:

Average groundwater recharge (m3/day): 104.46

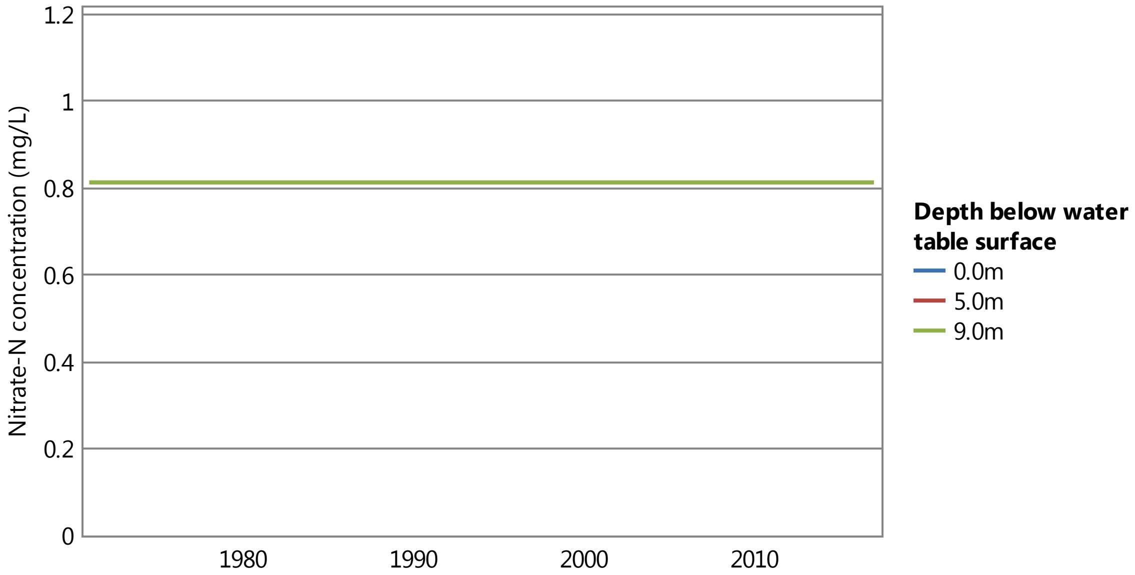
Average nitrate-N concentration of recharge (mg/L): 0.81

Aquifer characteristics:

Thickness (m)	0.5
Porosity (fraction)	0.1
Specific flux (mm/hour)	0.0
Vertical dispersion coefficient (m2/day)	0.5
Longitudinal dispersion coefficient (m2/day)	50.0
Retardation factor due to adsorption (multiplier)	0.8

Groundwater Nitrate-N concentration (mg/L) at property boundary, 15 m from effluent irrigation area:

■ Chart ☐ Table



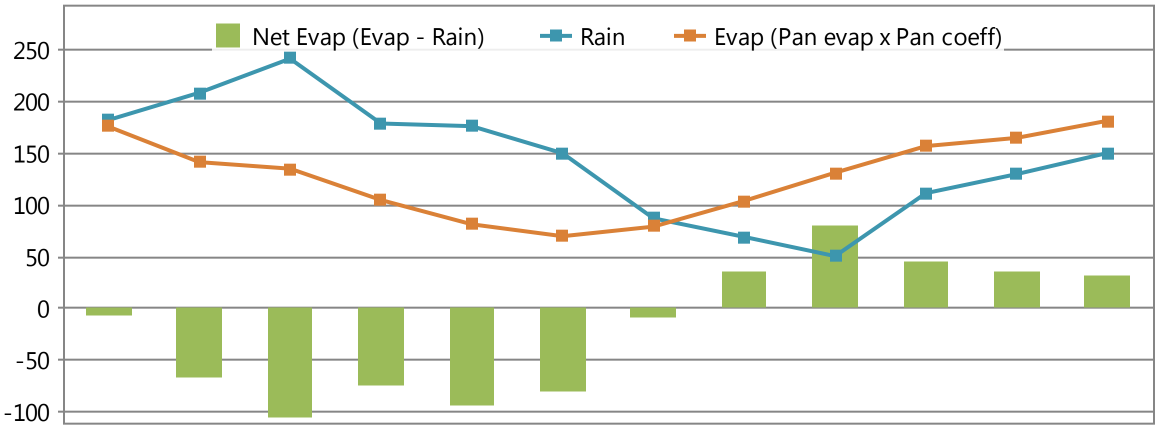
DIAGNOSTICS

Sustainability Diagnostics: North Byron Parkland

Averaged Historical Climate Data Used in Simulation (mm)

Location: Brunswick Heads, -28.55°, 153.55°

Run Period: 01/01/1967 to 31/12/2017 51 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	182.2	208.6	241.6	178.9	176.3	150.1	87.2	69.2	50.7	111.5	130.0	150.5	1736.9
Evap	175.9	141.5	135.2	104.9	81.4	69.9	79.2	104.1	131.3	157.1	165.0	181.6	1527.1
Net Evap	-6.3	-67.1	-106.4	-74.0	-94.9	-80.2	-8.1	34.9	80.7	45.5	35.0	31.1	-209.7
Net Evap/day	-0.2	-2.4	-3.4	-2.5	-3.1	-2.7	-0.3	1.1	2.7	1.5	1.2	1.0	-0.6

DIAGNOSTICS

Sustainability Diagnostics: North Byron Parkland

Pond System: 1 closed storage tank

NBP Onsite System - 8780.32 m3/year or 24.04 m3/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 310.00 non-zero flow days, after any pretreatment and recycling.

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	48.00 (0.00 - 48.00)	421.46 (421.46 - 421.46)
Total Phosphorus	19.80 (0.00 - 19.80)	173.85 (173.85 - 173.85)
Total Dissolved Salts	650.00 (0.00 - 650.00)	5707.21 (5707.21 - 5707.21)
Volatile Solids	0.90 (0.00 - 0.90)	7.90 (7.90 - 7.90)
Total Solids	3.00 (0.00 - 3.00)	26.34 (26.34 - 26.34)

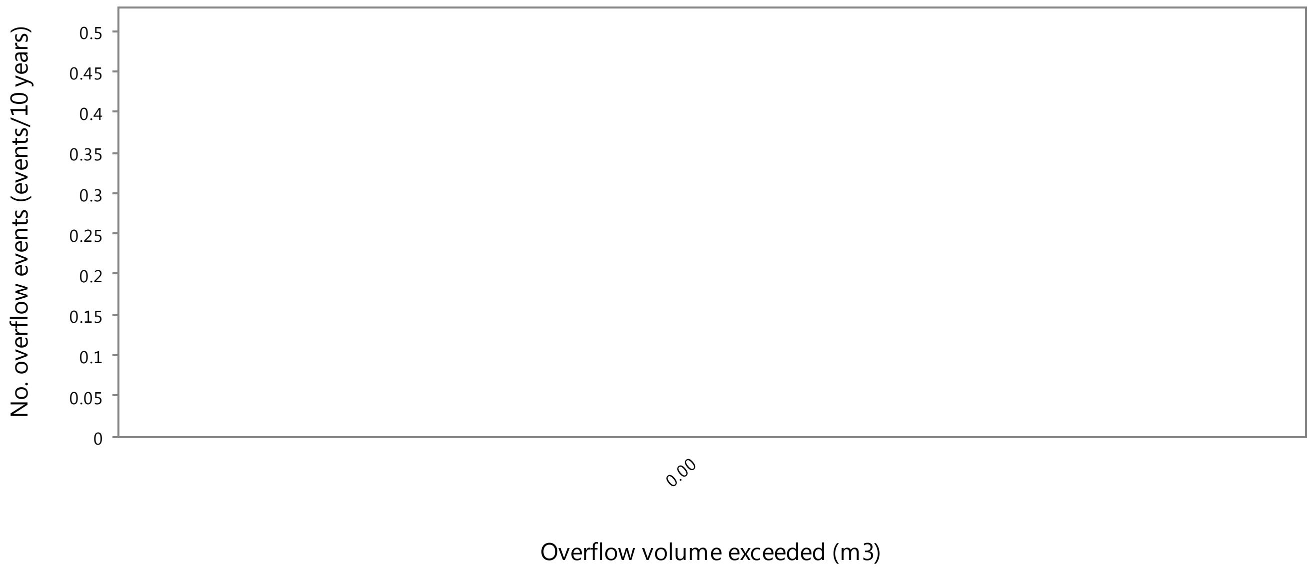
Last pond (Wet weather store): 2300.00 m3

Theoretical hydraulic retention time (days)	95.68
Average volume of overflow (m3/year)	0.00
No. overflow events per year exceeding threshold* of 0.57 m3 (no./year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	1.00
Probability of at least 90% effluent reuse (fraction)	1.00
Average salinity of last pond (dS/m)	1.02
Salinity of last pond on final day of simulation (dS/m)	1.02
Ammonia loss from pond system water area (kg/m2/year)	0.00

* The threshold is the volume equivalent to the top 1 mm depth of water of a full pond

Overflow exceedance:

■ Chart ☐ Table



Export plot

DIAGNOSTICS

Sustainability Diagnostics: North Byron Parkland

Irrigation Information

Irrigation: 36000 m2 total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/m2/year
Total irrigation applied (m3)	8780.32	0.24
Total nitrogen applied (kg)	393.64	0.01
Total phosphorus applied (kg)	173.85	0.00
Total salts applied (kg)	5707.21	0.16

Shandying

Annual allocation of fresh water for shandying (m3/year)	0.00
Average Shandy water irrigation (m3/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Minimum shandy water is used	False

Irrigation Issues

Proportion of Days irrigation is prevented when triggered (fraction)	0.15
Proportion of Days water demand is too small to trigger irrigation (fraction)	0.06
Proportion of Days irrigation occurs (fraction)	0.79

DIAGNOSTICS

Sustainability Diagnostics: North Byron Parkland

Paddock Land: Grass Lawn: 36000 m2

Irrigation: Low Travelling Irrigator with 0.22% ammonium loss during irrigation

Irrigation triggered when soil water deficit reaches 1.00 mm and rainfall is less than or equal to 50.00 mm
Irrigate a fixed amount of 600.00 mm each day
Irrigation window from 1/1 to 31/12 including the days specified
A minimum of 0 days must be skipped between irrigation events

Soil Water Balance (mm): Sand modified for NBP, 39.30 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	182.2	208.6	241.6	178.9	176.3	150.1	87.2	69.2	50.7	111.5	130.0	150.5	1736.9
Irrigation	20.1	23.7	26.1	24.4	16.7	11.2	0.5	26.7	28.7	21.7	28.3	15.7	243.9
Soil Evap	8.9	6.3	6.5	5.2	2.5	1.9	1.6	6.6	8.1	8.4	11.0	9.4	76.4
Transpn.	86.1	82.5	82.4	67.4	51.8	45.3	43.7	51.4	56.9	64.0	83.2	86.9	801.6
Rain Runoff	2.6	6.0	13.2	3.9	3.1	6.2	0.7	0.2	0.4	3.0	1.5	2.2	43.1
Irr. Runoff	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Drainage	97.9	127.9	166.6	129.4	136.7	111.8	51.6	36.9	23.1	50.0	58.5	69.3	1059.9
Delta	6.9	9.7	-1.1	-2.7	-1.1	-3.8	-9.9	0.9	-9.0	7.7	4.0	-1.5	-0.1

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/m2/year)	0.01
Average annual soil nitrogen removed by plant uptake (kg/m2/year)	0.01
Average annual soil nitrogen removed by denitrification (kg/m2/year)	1.73E-05
Average annual soil nitrogen leached (kg/m2/year)	8.62E-04
Average annual nitrate-N loading to groundwater (kg/m2/year)	8.62E-04
Soil organic-N kg/m2 (Initial - Final)	0.15 - 0.02
	0.01 - 6.63E-07
Average nitrate-N concentration of deep drainage (mg/L)	0.81
Max. annual nitrate-N concentration of deep drainage (mg/L)	9.35

Soil Phosphorus Balance

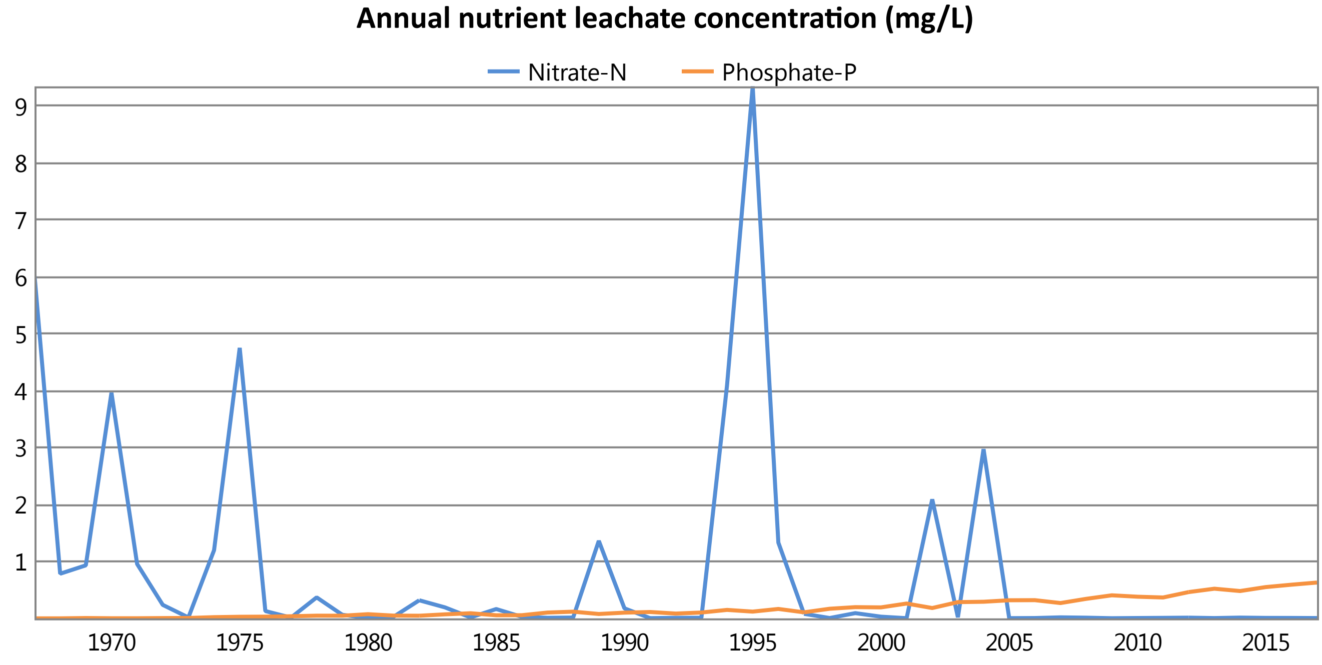
Average annual effluent phosphorus added (kg/m2/year)	4.83E-03
Average annual soil phosphorus removed by plant uptake (kg/m2/year)	2.36E-03
Average annual soil phosphorus leached (kg/m2/year)	1.85E-04
Dissolved phosphorus (kg/m2) (Initial - Final)	0.00 - 6.98E-05
Adsorbed phosphorus (kg/m2) (Initial - Final)	2.60E-03 - 0.12
Average phosphate-P concentration in rootzone (mg/L)	0.47
Average phosphate-P concentration of deep drainage (mg/L)	0.17
Max. annual phosphate-P concentration of deep drainage (mg/L)	0.63
Design soil profile storage life based on average infiltrated water phosphorus concn. of 2.49 mg/L (years)	28.33

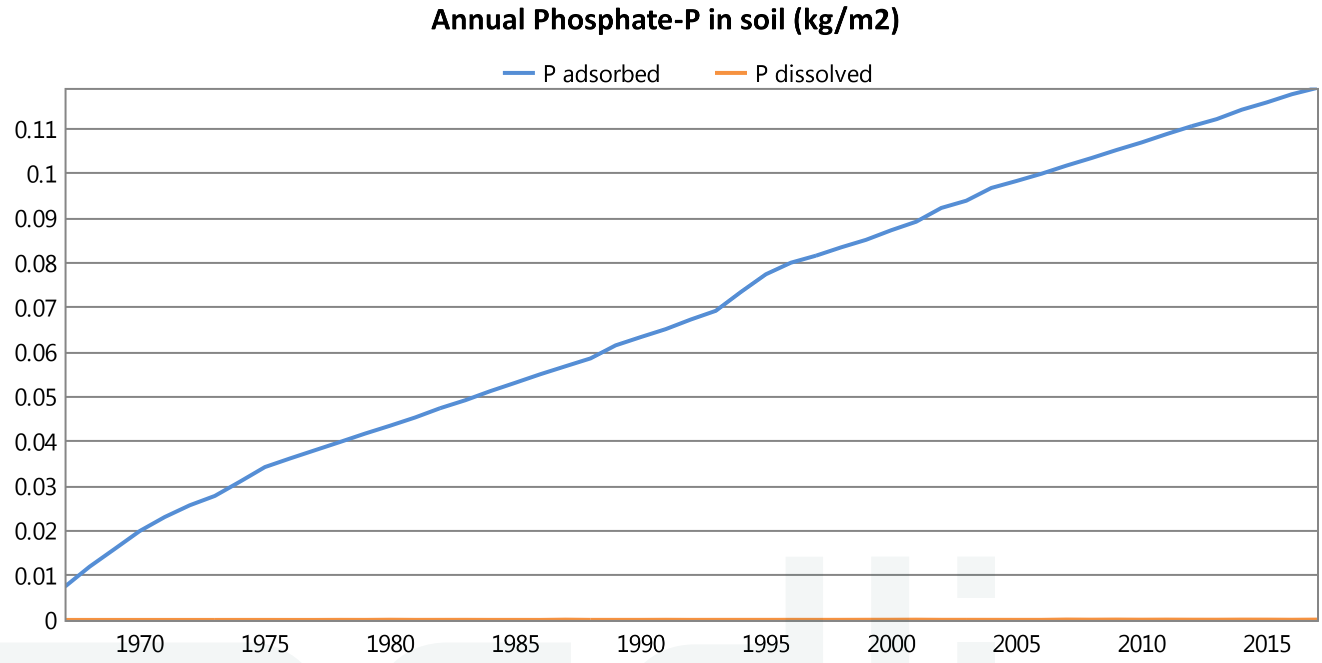
DIAGNOSTICS

Sustainability Diagnostics: North Byron Parkland

Paddock Land: Grass Lawn: 36000 m2

Irrigation: Low Travelling Irrigator with 0.22% ammonium loss during irrigation





DIAGNOSTICS

Sustainability Diagnostics: North Byron Parkland

Paddock Plant Performance: Grass Lawn: 36000 m2

Average Plant Performance (Minimum - Maximum): Continuous Coastal Couch Grass (Cynodon dactylon) Pasture

Average annual shoot dry matter yield (kg/m2/year)	0.85 (0.16 - 1.11)
Average monthly plant (green) cover (fraction)	0.79 (0.73 - 0.83)
Average monthly crop factor (fraction)	0.63 (0.58 - 0.67)
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Average monthly root depth (mm)	559.07 (528.08 - 590.80)
Average number of normal harvests per year (no./year)	5.69 (0.00 - 7.00)
Average number of normal harvests for last five years only (no./year)	6.00
Average number of crop deaths per year (no./year)	0.22 (0.00 - 2.00)
Average number of crop deaths for last five years only (no./year)	0.00
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.24 (0.01 - 0.40)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.02)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.88 (0.65 - 0.99)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.13 (0.02 - 0.27)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
No. days without crop/year (days)	2.69

Soil Salinity - Plant salinity tolerance: Tolerant

Assumes 1.0 dS/m Electrical Conductivity = 640 mg/L Total Dissolved Salts
All values based on 10 year running averages

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.16
Salt added by rainfall (kg/m2/year)	0.03
Average annual effluent salt added & leached at steady state (kg/m2/year)	0.19
Average leaching fraction based on 10 year running averages (fraction)	0.68
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.10
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.28
Relative crop yield expected due to salinity (fraction)	1.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (fraction)	0.00

DIAGNOSTICS

Sustainability Diagnostics: North Byron Parkland

Pathogen Data: Direct ingestion of effluent with calculation of annual risk using monthly data

Risk: Annual Risk using Monthly Data

Activity: Accidental drinking whilst swi **Liquid Ingested (mL):** 100

Health risk threshold: 1.0 extra infections/10000 persons/year

Pathogen infection risk for year of 12 exposures (**extra infections/10000 persons/year**)

Escherichia coli O111	0.00

Nitrate concentration in groundwater

Average Nitrate-N concentration of recharge (mg/L)	0.81
Maximum Groundwater Nitrate-N concentration at property boundary in final year of run (mg/L)	0.81

DIAGNOSTICS

Run Messages

Messages generated when the scenario was run:

Full run chosen

Appendix F
Risk Assessment

Table 2.5 Qualitative measures of likelihood

Level	Descriptor	Example description
A	Rare	May occur only in exceptional circumstances. May occur once in 100 years
B	Unlikely	Could occur within 20 years or in unusual circumstances
C	Possible	Might occur or should be expected to occur within a 5- to 10-year period
D	Likely	Will probably occur within a 1- to 5-year period
E	Almost certain	Is expected to occur with a probability of multiple occurrences within a year

Table 2.6 Qualitative measures of consequence or impact

Level	Descriptor	Example description
1	Insignificant	Insignificant impact or not detectable
2	Minor	Health — Minor impact for small population
		Environment — Potentially harmful to local ecosystem with local impacts contained to site
3	Moderate	Health — Minor impact for large population
		Environment — Potentially harmful to regional ecosystem with local impacts primarily contained to on-site
4	Major	Health — Major impact for small population
		Environment — Potentially lethal to local ecosystem; predominantly local, but potential for off-site impacts
5	Catastrophic	Health — Major impact for large population
		Environment — Potentially lethal to regional ecosystem or threatened species; widespread on-site and off-site impacts

Table 2.7 Qualitative risk estimation

	Consequences				
Likelihood	**1-Insignificant**	**2-Minor**	**3-Moderate**	**4-Major**	**5-Catastrophic**
A Rare	Low	Low	Low	High	High
B Unlikely	Low	Low	Moderate	High	Very high
C Possible	Low	Moderate	High	Very high	Very high
D Likely	Low	Moderate	High	Very high	Very high
E Almost certain	Low	Moderate	High	Very high	Very high

Note: Level of environmental risk is specific to definitions of likelihood and consequence defined in Tables 2.5 and 2.6

RISK ASSESSMENT											
			Latent Risk					Residual Risk			
No.	**Individual Activity**	**Risk/ Unwanted Events**	**Severity**	**Likelihood**	**Risk Rating**	**Risk Control Measures**	**Hierarchy of Controls**	**Severity**	**Likelihood**	**Risk Rating**	**Person responsible for implementing on site**
1	Patron Access to Waste bin or wastewater storage areas	GHD concern: Human contact with compost or wastewater.	4	C	VH	Existing "pass" system controls access of public to service areas of the NBP, and a staff member is present at all times for each amenities building. It is unlikely that public would have access to wastewater storage or treatment areas.	Engineering and administration	2	A	L	Management
2	Size and slope location of OSMS	GHD concern: Destruction of high conservation vegetation	3	D	H	The OSMS design by W&A did not propose the destruction of any conservation vegetation. The treatment area is located on cleared ground with only limited weed vegetation clearing, and irrigation onto grassed paddocks. The proposal is for compost to be placed in cleared areas and used for revegetation, thereby increasing the conservation value of the NBP.	Administration	1	A	L	Management
3	Pump failure at pump wells	GHD concern: Overflow and contamination, health and odour impacts	3	C	H	As per the WMA all pumpwells to have duty and standby pumps and audio/visual alarms, as well as inbuilt emergency storage. Therefore if there is a failure of a component the impact would be limited to that immediate area. Given onsite staff are present at each amenity, this would be quickly observed (by hearing and sight of alarms prior to overflows, and once overflowed responsed to.	Administration and engineering	B	2	L	Management
4	Floodplain irrigation onto camping area with contaminated drain water flowing offsite	GHD concern: Nutrient buildup, discharged into drainage channels	3	E	H	The WMA considered this is as a significant risk. The risk was reduced by providing for throttled treatment allowing for irrigation of smaller daily volumes, wet wetaher storage capability, emergency IDSFB EMA area, resetting the storage tanks by 4 weeks prior to the next large festival, use of vetiver grass buffer strips adjacent to drains, buffers of 15m to the drains, and modelling for hydraulic and nutrient requirements. Modelling indicated that the hydraulic required irrigation footprint is substantially smaller than the nutrient required, such that nutrient impacted water is unlikely to runoff to drains.	Design and administration	2	B	L	Management

RISK ASSESSMENT

No.	Individual Activity	Risk/ Unwanted Events	Latent Risk: Severity	Latent Risk: Likelihood	Latent Risk: Risk Rating	Risk Control Measures	Hierarchy of Controls	Residual Risk: Severity	Residual Risk: Likelihood	Residual Risk: Risk Rating	Person responsible for implementing on site
5	Floodplain camping irrigation causing health issues	GHD concern: Pathogens in treated effluent / human contact	4	E	VH	The WMA considered this. The irrigation will occur following vacatation fo the NBP by all campers and following cleanup of the irrigation zone of rubbish by staff. There are multiple irrigation zones nominated in the WMA for progressive irrigation, allowing for flexibility in staging. The irrigated wastewater is disinfected with effluent, such that the risk of pathogen contamination is reduced.	Design and administration	2	A	L	Management
6	Wet weather storage overflow	GHD concern: Environmental contamination and human health impact	2	B	L	The wet weather storage tank would be located up in the main treatment area in the northwest portion of the NBP. This area has no drains or creeks in the immediate vicinity, downslope to the north is farmland. The drains present in that area drain to the east and southeast back towards the northeast corner of the NBP, before tracking north for a total 3km distance to Crabbes Creek. Wet weather storage can be controlled by halting treatment in the reedbeds (ie storage in the storage tanks), pumping back through into the storage tanks, or discharge to the	Design and administration	2	A	L	Management
7	Weat weather charging of in-ground sand filter system under low evaporation conditions	GHD concern: Floodplain contamination	2	E	M	The OSMS design by W&A utilised the IDSFB as backup emergency disposal areas only for reduced loading of 4.8kL/day. The IDSFB are located up in the main treatment area in the northwest portion of the NBP. This area has no drains or creeks in the immediate vicinity, downslope to the north is farmland. The drains present in that area drain to the east and southeast back towards the northeast corner of the NBP, before tracking north for a total 3km distance to Crabbes Creek. Wet weather storage can be controlled by halting treatment in the reedbeds (ie storage in the storage tanks), pumping back through into the storage tanks, or discharge to the IDSFB	Design and administration	1	B	L	Management
8	Odours from storage / treatment vessels and tanks	GHD concern: Nuisance value to patrons	2	D	M	The OSMS design is for wastewater to be drained to pumpwells and pumped in a short time frame up to the storage tanks away from the public area. Given wastewater will be stored for <24hours (and likely 1-6 hours), odours will be negligable.	Design	1	B	L	Designer

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9	Nutrient build up in reed bed and stormwater overflow	GHD concern: Environmental contamination and human health risk	2	C	M	Reedbeds can buildup with sludges and fines that are trapped in the gravel voids. Typically nutrient buildup is not a concern, but it is expected that after some years the gravel would be excavated and washed, with sludges trucked offsite for disposal. Stormwater overflow is unusual in reed beds given the dpeth of wastewater is maintained at 100mm beneath the gravel surface and a lip is present above the gravel layer, both of which act as wet weather storage. Reed beds are left proud to llimit stormwater ingress. As per above, if there was an overflow event, the treatment system is in a low environmental and human health	Design	2	B	L	Designer
10	Surface irrigation of camping grounds	GHD concern: Human health risk	4	E	VH	Addressed in Item 5.	Design and administration	2	A	L	Management
11	Patron access to treatment areas	GHD concern: Human health risk, spillage risk	3	C	H	Addressed in Item 1	Engineering and administration	2	A	L	Management
12	Manual handlling of sewage bins	GHD concern: Human health risk	4	D	VH	The compost bins are wheelie bin style units that are fully sealed except for the drain pipe, and have handle, rear wheels, and lids that fold back over and close up the raw waste/bulking agent mix. There is a risk of spillage if the bins tip over during replacement with empty bins. Management practices and training to limit volumes in the bins, plus PPE are important practices to ensure reduced risks to workers. In addition, concrete of the ground beneath the amenities to ensure that the bins sit on a stable surface and are easily wheeled will be an improvement on the current grass surface, which can be implemented with a permanent OSMS	Engineering and administration	2	C	M	Management
13	Raw sewage to irrigation, subsurface discharge	GHD concern: Human and environmental health risk	4	E	VH	The OSMS treatment train has been designed to treat wastewater to a secondary (Class B) standard. That includes a minimum of 24hours HRT in a septic tank for anerobic digestion and 6 days HRT in a reedbed. In addition to these minimum detention times, there woudl be additional detention and anaerobic treatment in the storage tanks during a large festival (up to 8 days if counting wastewater inputted on day 1), and in the 4-5 months in storage prior to septic tank and reedbed processing. Finally effluent would be chlorinated prior to	Design and operation	2	B	L	Management

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14	Wastewater system flow and overload	GHD concern: Human and environmental health risk	3	C	H	The wastewater production is based on five years of inhouse data collection by both the SITG and Falls festivals. The data is used to order in water supplies as well as budget for offsite trucking of wastes. Once permanent approval is obtained, in the short term trucking will continue which will enable ongoing data collection and independant verificationn of volumes. As part of the management of the preparation for a large event, the wastewater level in the septic tanks and the reed bed swould be lowered to enable emergency storage capacity. In the event that the permanent OSMS is hydraulically overloaded during a large event, high level alarms will be present, and contingency planning to ensure that emergency offsite disposal is possible for the excess volume. This would then allow for a review prior to the next large event. The treatment system is located in an elevated area away from the nearest drains, and with a flow path of at least 3km to Crabbes Creek, reducing the potential	Design and operation	2	B	L	Management
15	Septic tank system maintenance	GHD concern: Human and environmental risk, sludge drying not allowed for in concept design	3	C	M	It is verry routine to maintain septic tanks and numerous contractors are present in the Yelgun area. Onsite sludge drying and processing is problematic from a physical and regulatory perspective, and it is most common to have a truck pump accumulated sludges for offsite processing. An annual inspection and desludging cycle was allowed for in the WMA, common for larger commercial operations.	Design and operation	2	B	L	Management
16	Insect and airborne disease spreading from amenities to drinking water bucket collection systems	GHD concern: Human health risk, large patronage in concentrated area	4	E	VH	Insect and airborne diseases can spread with concentration of human populations and waste systems. Compost toilets are not really more problematic than flushing toilets or portaloos in that respect. Appropriate cleaning regimes and public education is expected. The two large festivals have operated fo rthe past five years without disease outbreaks. It is our understanding that drinking water will not be supplied from tank water collection as this requires signficant treatment and management as part of a private water supply system.	Education and operation	2	B	L	Management

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17	Erosion	Topsoil, treated wastewater to floodplain	2	C	M	Erosion requires a number of factors to be present, including loss of cover (vegetation), slope (velocity), water application (rainfall and effluent) and erosive soils. The irrigation system designed by W&A reduces the risk of erosion by applciation onto nearly level land and at a very low rate (about 1mm/m2/day). In the short term, the natural grass vegetated cover will be disturbed by campers, but the disturbance is patchy and grass regrowth is epxected especially with nutrients in the effluent. In addition a buffer of 15m has been nominated to drains and a vegetative vetiver grass strip allowed for.	Operation	1	B	L	Management