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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 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 numerous 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 2,200kL storage capacity in eight storage tanks;
- Construction of a custom reed bed treatment system of 400m^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 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, 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

Number of Trial	Large Event Patrons	Medium Event Patrons	Small Event Patrons
5 (2017)	35,000	25,000	15,000

Following the end of the trial period, concept approval was given to continue outdoor events at the maximum 35,000 patrons/day size subject to satisfactory performance and completion of construction of the administration building, gatehouse, water treatment plant and wastewater treatment plant.

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 excess wastewater trucked offsite to Ballina and Byron Bay STPs.

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 1.2 for the years following 2019.

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

1.2 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 1.2.1).

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 modelled one 3 day event

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 the carparking / bus loading area (Figure 3).

1.2.1 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 into 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, with standard 4-star flushing toilets in the conference centre amenities.

1.3 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 DPI (Office of Water) (2015) guidelines for Recycled Water Management Systems 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 this document provides useful guidance on 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 and DLG (1998) 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. Seasonal flooding is a development constraint in these areas (Figure 5).

Surrounding land use includes rural residential holdings, agricultural uses for sugarcane and beef cattle production 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 identified as High Conservation Vegetation within Council mapping.

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 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 two public Sewage Treatment Plants (STPs). 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. 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 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. In some of the amenities buildings these pipes and wastewater storage tanks have been damaged by previous flood events and will be repaired as part of the permanent approval works.

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 and Ballina STPs, 24 hours a day. A team of staff manually identify which storage tanks need pumping out before calling in the pump trucks.

Pumping out of the storage tanks involves connecting the vacuum pipe to each tank. A small amount of wastewater can be spilled onto the ground during this process, as also happens when emptying into the long term greywater holding tanks.

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 an ad-hoc 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. A thorough site and soil assessment will ensure that 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). This baseline investigation and report is utilised in the current WWA to assess the upgraded EMAs, and additional confirmation site and soil investigation was undertaken by Strider Duerinckx of W&A on the 22 June and 22 July 2017 (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	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**

Parameter	Constraint	
	EMA 1	EMA 2
Erosion Potential: 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.	**Major**	**Moderate**
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.	**Minor**	**Moderate**
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 bores are present in the southwest portion of the Site, south of Jones Road. GW302027-GW302029 are monitoring bores of 3-6m depth with standing water at 1.5-4m. A domestic bore is also present (GW300497) 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.	**Minor**	**Minor**
Flood Potential: Flood extents are displayed on Figure 7.	**Minor**	**Major**

Parameter	Constraint	
	EMA 1	EMA 2
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.		

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 watertables 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 watertables 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). 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 sand 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 in medium clay to sand (GSBH15-24). 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 not known, however, no groundwater was encountered in the boreholes. 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.	**Minor**	**Major**
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**
Soil Permeability and Design Loading Rates	**Major**	**Major**

Parameter	Constraint	
	EMA 1	EMA 2
EMA 1 – Based on the observed soil texture, a hydraulic conductivity of <0.06m/day is estimated for a massive to moderate medium clay (Class 6b-c). A DLR of 8mm a day would be applicable for these soil layers for long term application into absorption beds for secondary treated effluent. Given only expected short term use a higher loading rate could be adopted if application and monitoring is managed appropriately. EMA 2 – Soils under the EMA are either a massive medium clay (Class 6c) or sand (Class 1), with sandy loam to clay loam (Classes 2-4) topsoils of up to 0.25-0.6m above the dominant subsoil. A DIR of 4mm/day would be applicable for these soils for long term surface spray irrigation and secondary treated effluent.		

4.2.3 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 6.

Table 6: 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**

Constraint	Degree of Limitation EMA 1	Degree of Limitation EMA 2
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. 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.	**Minor**	**Major**
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 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. 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 1.2, 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 Sources of Wastewater

W&A were provided detailed summaries of wastewater generation for the large Falls and SITG events, including estimated wastewater unit production values per person for portable toilet/compost toilets/urinals, shower greywater, food preparation and cleaning (Table 7), as well as totals for a number of events (Table 8). 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, compost toilets, and kitchen hygiene practices.

Table 7: 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 8: Provided Large Event Peak Wastewater Production Volumes

Event	Source	2015 (kL total)	2016 (kL total)	2017 (kL total)
Falls	Blackwater			115.7
	Greywater			1,108.9
	Food prep / Cleaning			175.7
	Total			1,400.3 (projected)
SITG	Blackwater	269.2	176.8	269.0
	Greywater	1,217.7	1,050.7	793.4
	Food prep / Cleaning	161.4	219.0	167.5
	Total	1,648.3	1,446.6	1,229.9

W&A utilised these unit and total production values (Table 9 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), and a full 365 days per year total generation and storage.

In estimating wastewater production at the conference centre we 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 10, for 42,500 patrons (Stage 2) is presented Table 11, and for maximum of 50,000 patrons in Table 12 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.

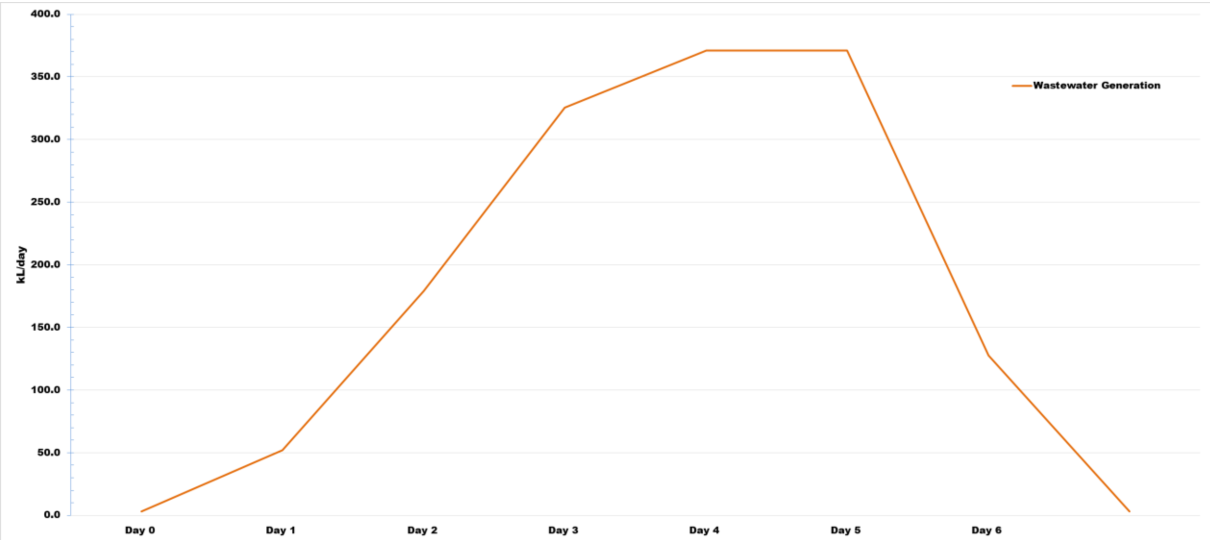
As can be seen:

- 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) is currently 475kL/day, increasing to 543kL/day by Stage 3;
- 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 5.2) (Appendix C), and indicates that the total annual estimated wastewater generation for NBP for Stage 3 is 9,187kL.

Table 9: 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 10: Sources and Unit Volumes of Wastewater Stage 1

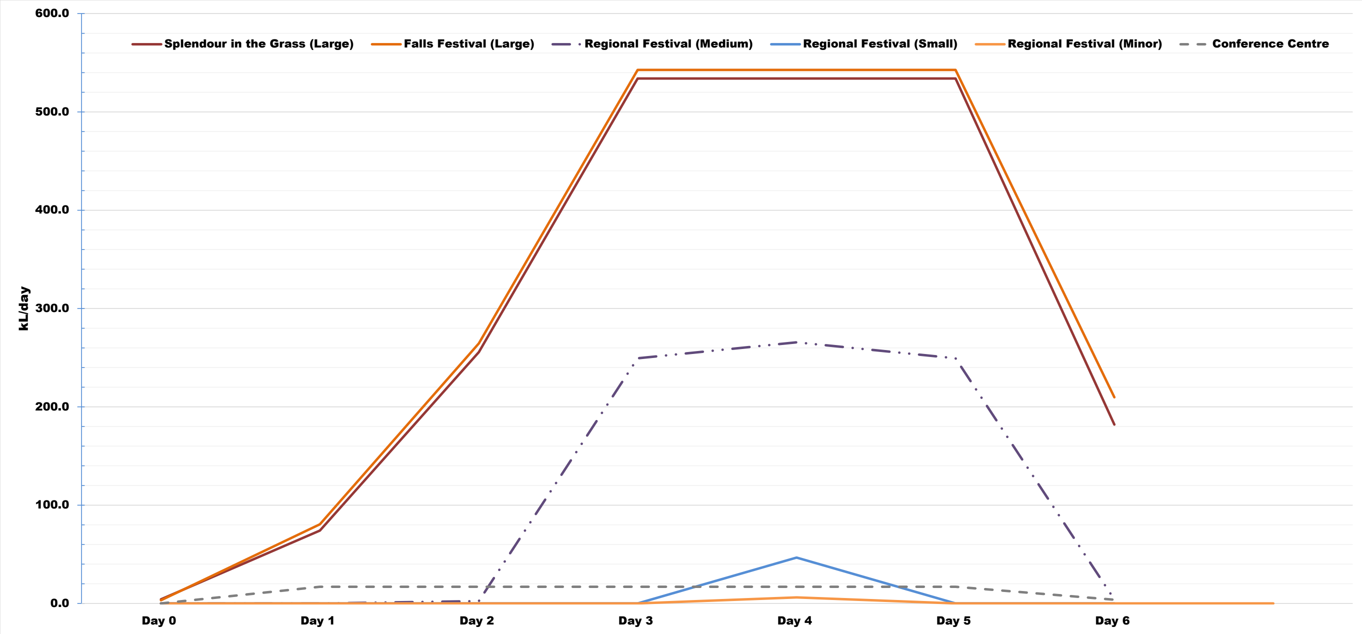
Source	Typical Wastewater Flow Design Allowance (L/p/day)*	Unit	Number	Design Wastewater Flow (L/day)
Splendour in the Grass (Large)				
Staff	2.5	Number	4888	12,220
Day Visitors	2.5	Number	35000	87,500
Campers	13	Number	25000	325,000
Food Prep	1.25	Number	39888	49,860
			Total	474,580
Falls Festival (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

Table 11: 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

Table 12: 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



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

5.2 Wastewater Characteristics NBP

Influent testing data was provided to W&A from SITG and Falls festival events in 2016 (SITG data reproduced in Table 13). 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).

Table 13: Existing SITG Influent Quality

Parameter	Units	SITG 2016 Shower	SITG Compost Seep	SITG 2016 Tank 1	SITG 2016 Tank 2	Typical Domestic Quality*
BOD	mg/L	147	5,520	580	480	200-300
TSS	mg/L	58	400	140	93	200-300
EColi	cfu/100ml	$8x10^3$	$1.6x10^4$	921	$2.4x10^4$	10^3-10^{10}
Total N	mg/L	2	4740	480	374	20-100
Total P	mg/L	47	358	38	27	10-25
Note: 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)						

The quality will vary with the additional 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, and the small volumes, it is expected that the above influent concentrations are realistic for influent to the NBP treatment system.

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 14.

Table 14: 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):

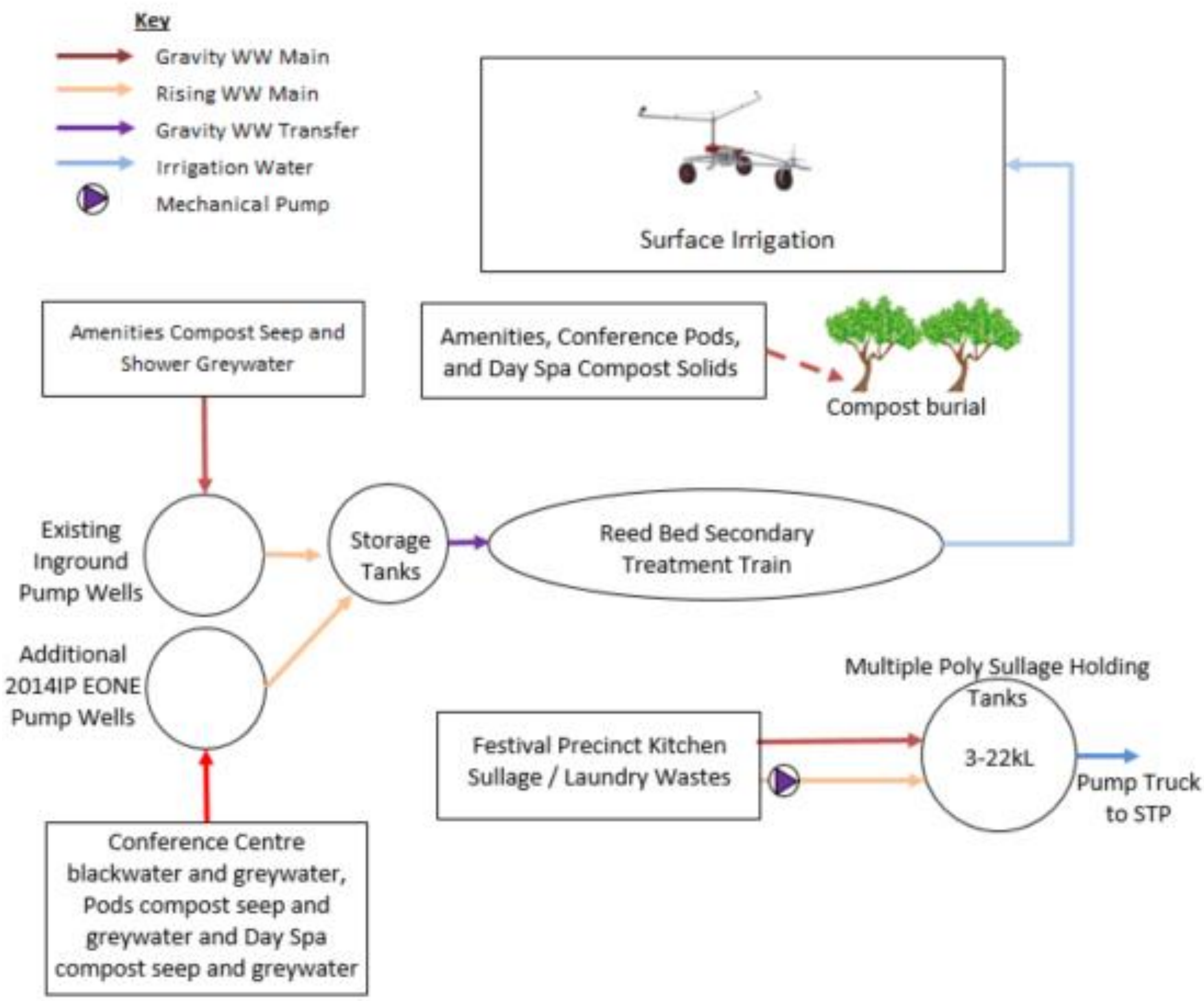
- Option C1 - Reuse of compost solids for tree planting on the Site;
- Option T2 - Treatment of wastewater to a secondary level in a reed bed system;
- Option D1 - Disinfection of secondary treated effluent using chlorine disinfection; and
- Option E3 - Application by surface spray irrigation with reserve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

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 5 months with verification testing, and coupled with the additional persons proposed for large events, coupled 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 15). 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 15: 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 will be required to ensure the safe handling and burial of compost solids. Compost solids will be buried during tree planting activities as part of the vegetation rehabilitation plan.

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

Minimal details are 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.

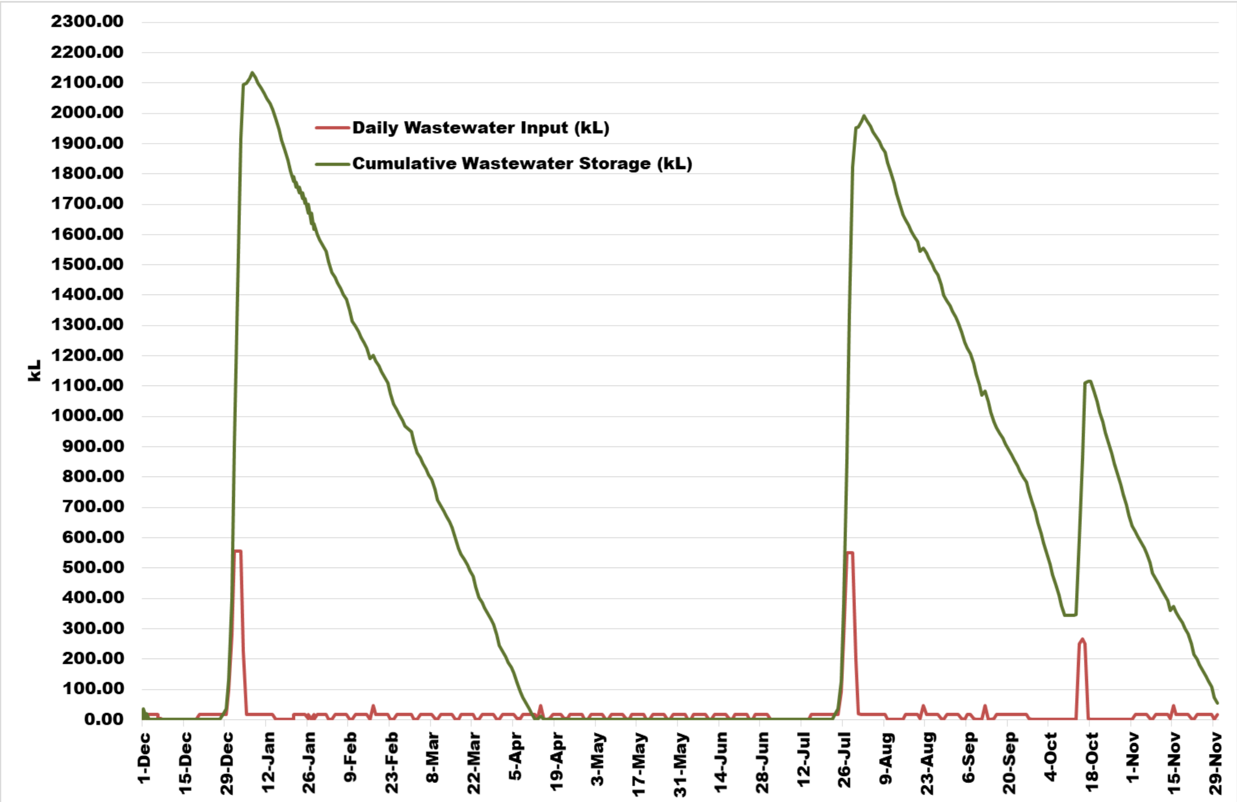
The storage volumes required for Stage 1-3 expansions are shown in Table 16. Given the minimal increase in treatment and irrigation requirements and maximum storage volumes between Stage 1 and 3 (32kL/day v 35kL/day treatment and 1,984kL v 2,134kL), the infrastructure installation and operating cost 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 4 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 neat 2,200kL, 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.

As can be seen from Graph 4, 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 reserve storage capacity.

Table 16: 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	2,134



Graph 4: 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 17. The pictographic of the NBP master treatment system for Stage 3 is shown in Graph 5, and location in Figure 9.

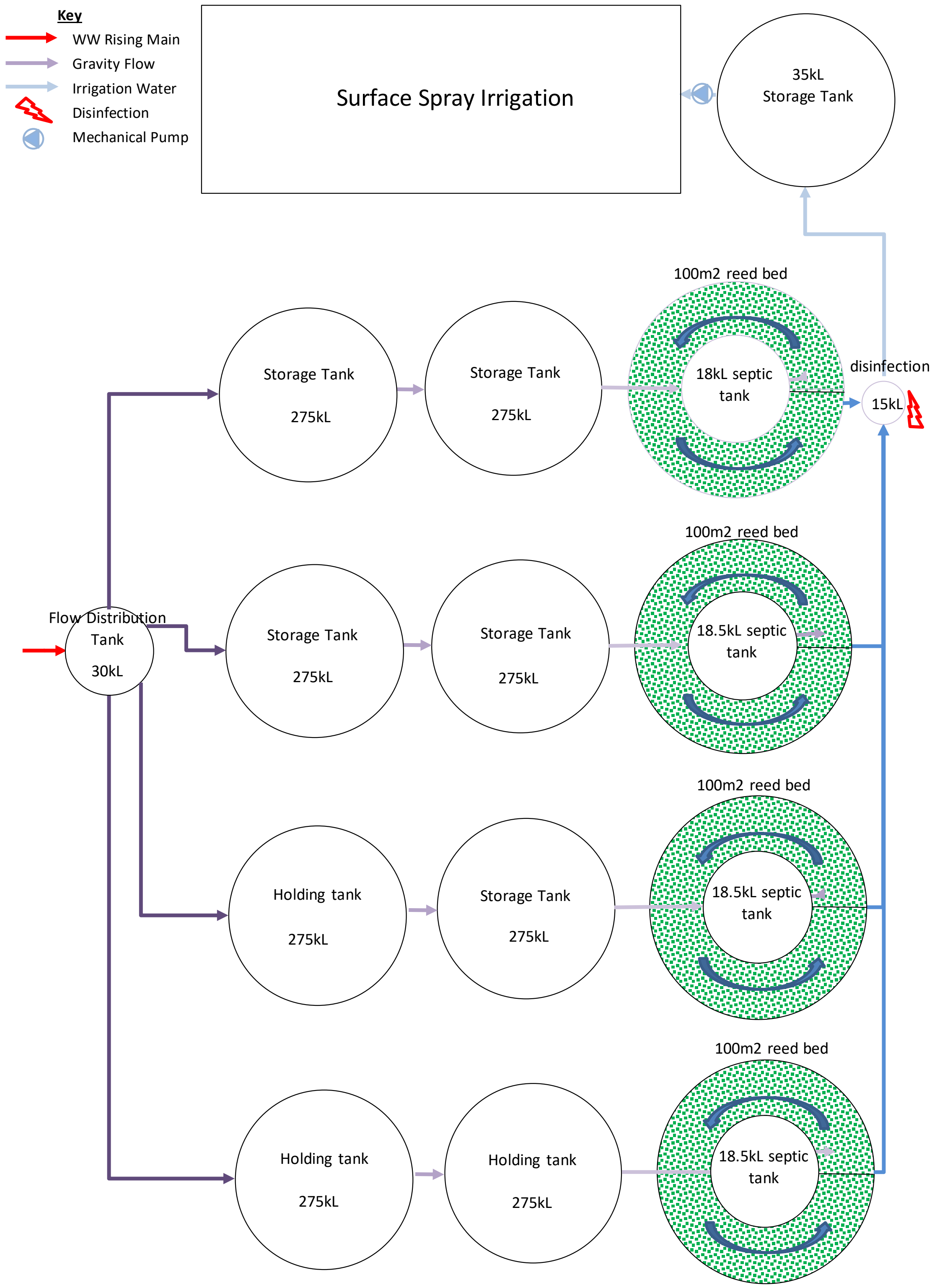
W&A recommend four reed bed treatment systems are run in parallel, which combined are capable of treating at least the required volume of wastewater to a secondary standard and provide the option of closing off one stream whilst maintaining 75% throughput, and completing maintenance, if required, between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

The treatment system has been sized such that maintenance is only required annually as a minimum, with pumping out of sludges.

Table 17: 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	74 (18.5 per stream)
Reed Bed Pod (1.5m deep)	m^2	400 ($100m^2$ 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 5: Schematic of NBP OSMS Treatment System for Stage 3

8.7.1 NBP Treated Effluent Quality

The expected secondary effluent quality following treatment will meet as shown in Table 18 and is compared to the classification for low strength effluent from NSW DEC (2004). This will enable sustainable and safe irrigation application.

Table 18: Expected Effluent Quality

Parameter	Units	Effluent Value	Target Low Strength
BOD	mg/L	20	<40
TSS	mg/L	30	-
TDS	Mg/L	<650	<650
Faecal coliforms	cfu/100ml	<100	<1,000
Residual Chlorine	mg/L	0.2-2	
Oil & Grease	mg/L	<1,500	<1,500
Total N concentration	mg/L	<45	<50
Total P concentration	mg/L	<10	<10

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.

The Byron Shire Council OSMS Design Model was used for sizing the irrigation area. This is a daily timestep model and non-default parameters were inputted to allow for compost toilet usage coupled with reed bed treatment.

The input data and results of modelling are presented in Table 19, and modelling calculation sheets are presented in Appendix D.

Table 19: 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

Data Parameter	Units	Value	Comments
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.

9.2 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 20. The existing repaired IDSFB beds would be able to sustainably manage 4.8kL/day application without risk of oversaturation and surface surcharging.

Table 20: 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.

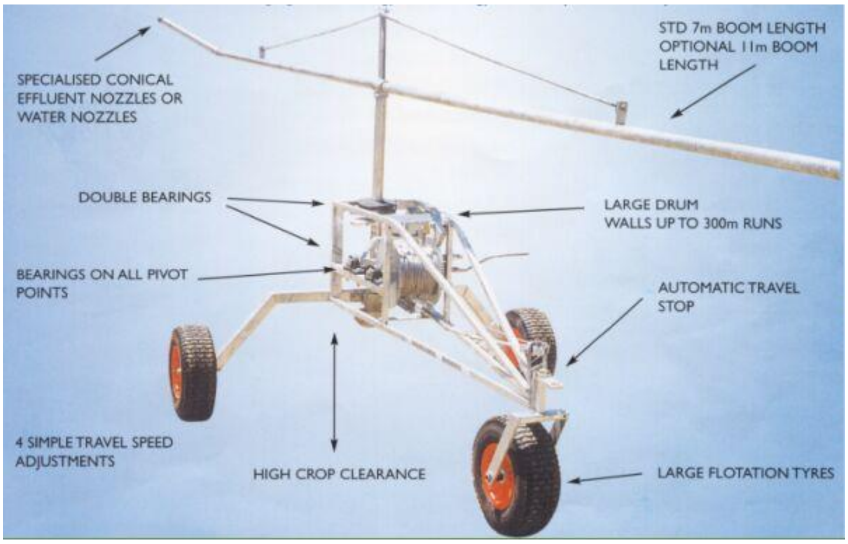
Data Parameter	Units	Value	Comments
Maximum Applicable Hydraulic Load	kL/day	4.8	

9.3 Surface Spray Irrigation Method

An irrigation management plan 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 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;
- Once the wet weather storage capacity is exceeded, emergency effluent irrigation and/or application into the existing 24 IDSFB 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 15);
- Vetiver produces a thick dense groundcover between 1-1.5m high (Photograph 16);
- 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 15: Vetiver grass and root system.

Photograph 16: Vetiver cultivation in Australia

10 Buffers

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 21. The adopted buffers will provide sufficient protection to public health and the environment.

Table 21: 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.

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 22 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 22: 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

11 Monitoring and Review

Regular monitoring and review is an important aspect of any effluent application scheme. Table 23 below presents the recommended minimum monitoring regime to provide assurance of continued operation.

Table 23: 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 sludges that pass through the treatment system.	Annual inspection of chamber to assess sludge levels and pump-out as biosolids as required.	Scheduled contractor.
	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	Scheduled contractor.

Item	Description	Timing	Responsibility
		months. No tractors or heavy mowers.	
	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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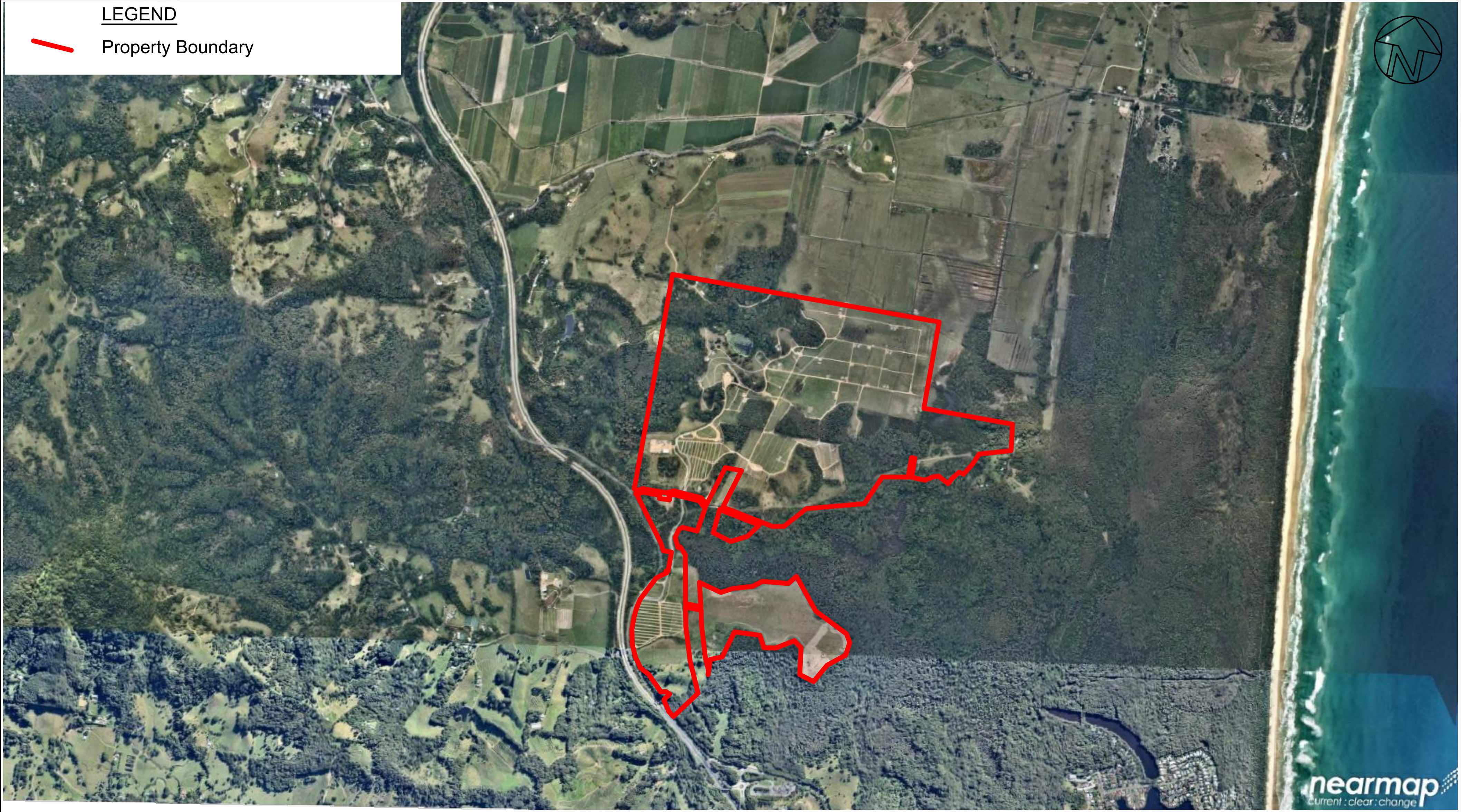
FIGURES



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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

Drawn:	Reviewed:	Approved:	Date:	Scale: 1:10,000 Approx @ A3	
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All units in m unless otherwise specified				Drawing No: Figure 2	Revision No: 2

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Horizontal Scale (metres) 1:6,000

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

Project: **WWMP FOR NORTH BYRON PARKLANDS**

Title: **NBP EXISTING WASTEWATER OVERVIEW**

Source: **SITE LAYOUT OCTOBER 2016 AND ARCHITECTS**

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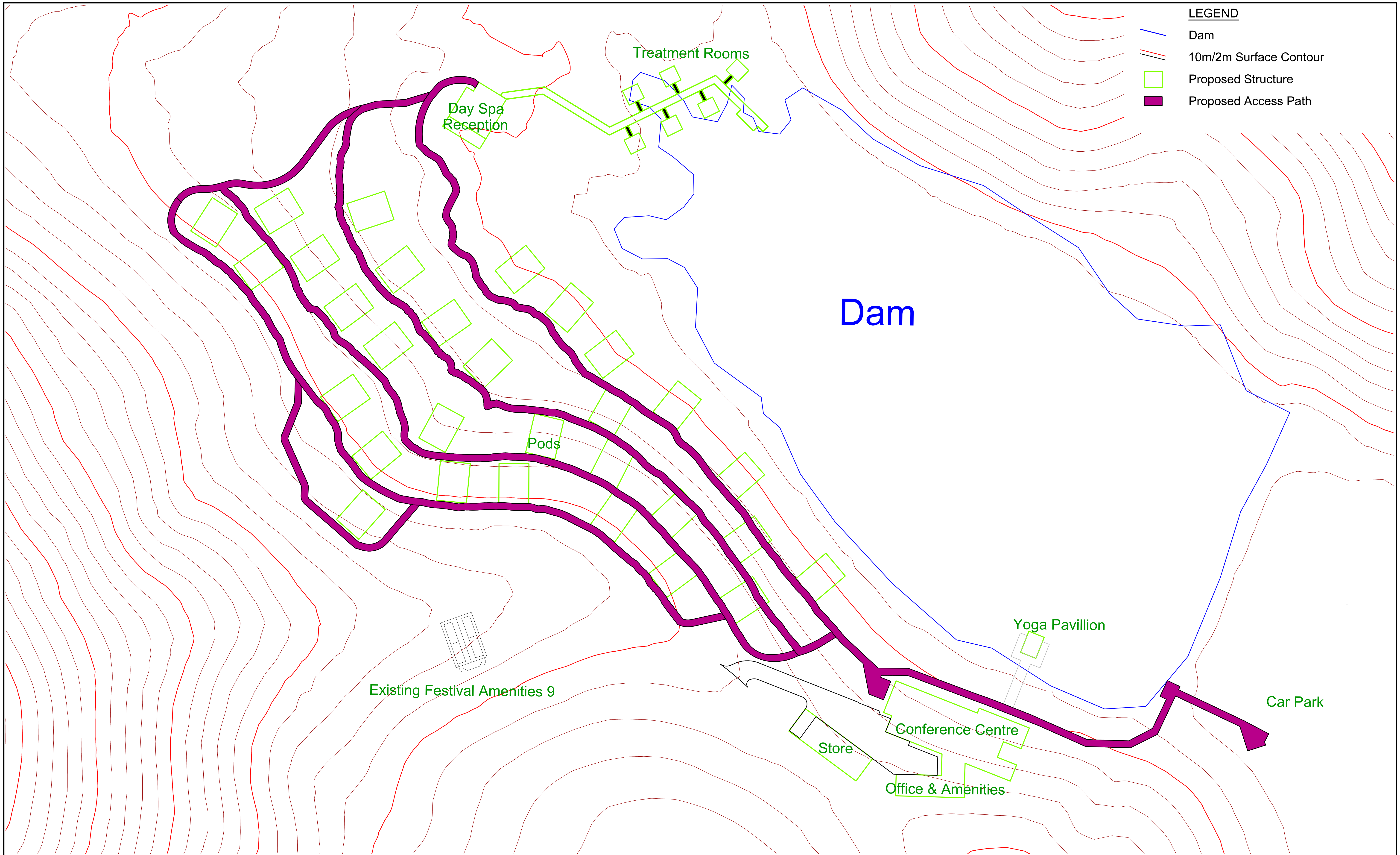

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Note: AERIAL PHOTOGRAPHS ARE INDICATIVE ONLY.

Client: BYRON VENUE MANAGEMENT P/L

Project: WWMP FOR NORTH BYRON PARKLANDS

Title: CONFERENCE CENTRE LAYOUT

Source: DOMINIC FINLAY JONES P/L DFJ148

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

Project: **WWMP FOR NORTH BYRON PARKLANDS**

Title: **FLOOD PLANNING EXTENTS & SOIL LANDSCAPES**

Source: **SITE LAYOUT OCTOBER 2016**

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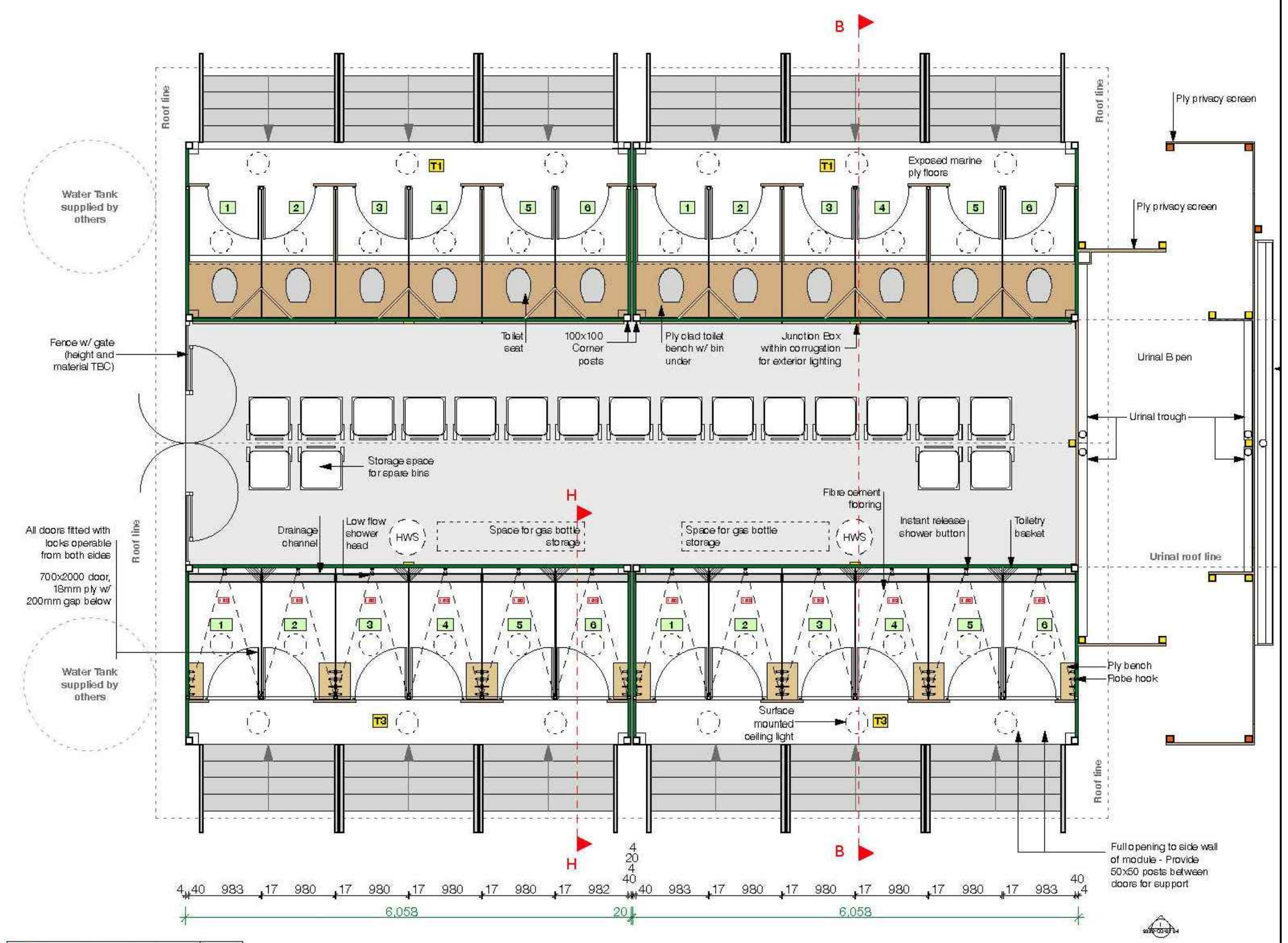
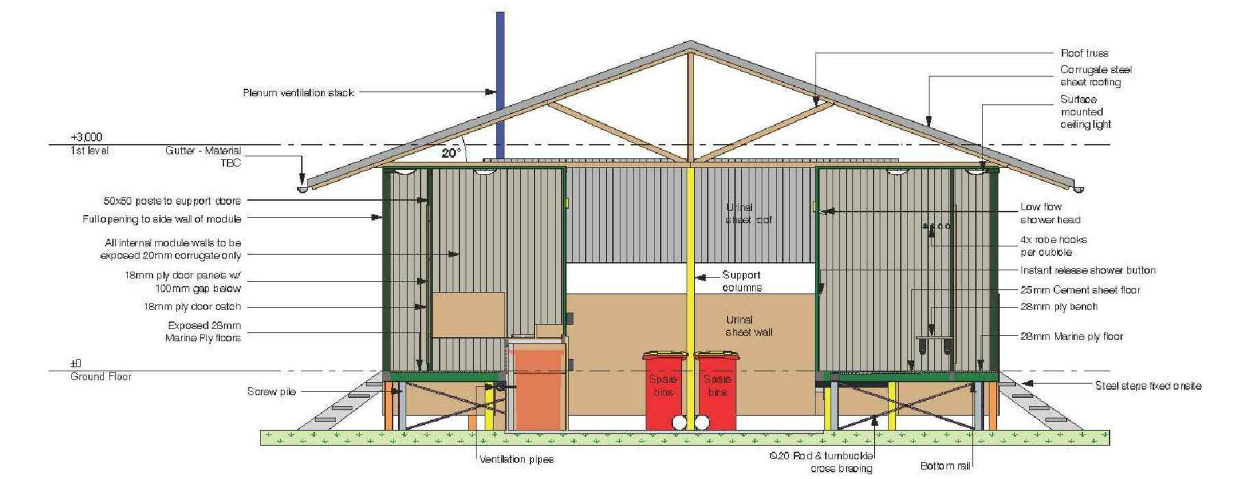


FLOOR PLAN: BUILDING B



SECTION: B-B BUILDING B

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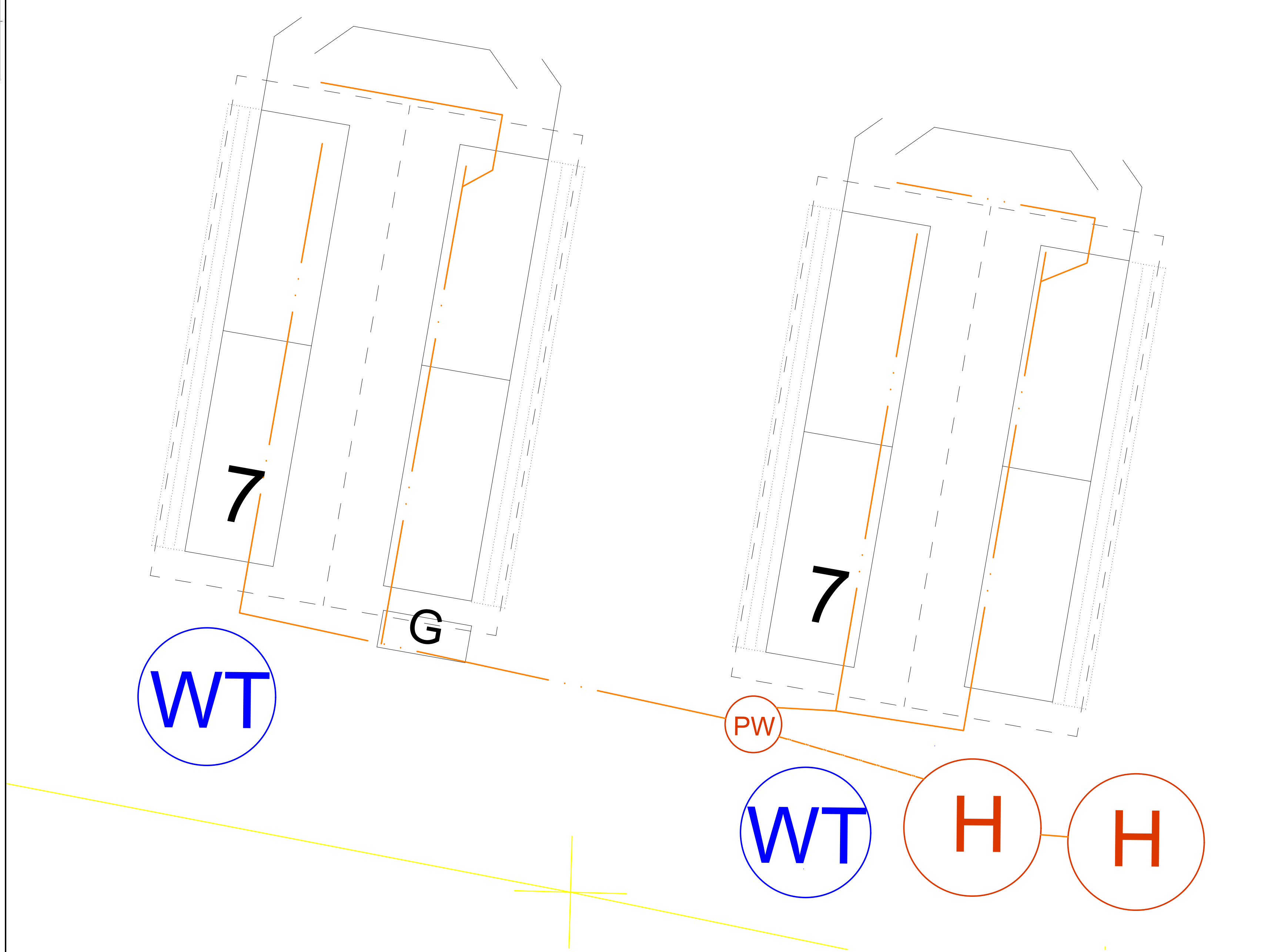
LEGEND

- Amenities Block
- Roof line
- WT Poly Water Tank
- H Poly Wastewater Holding Tank
- PW 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.

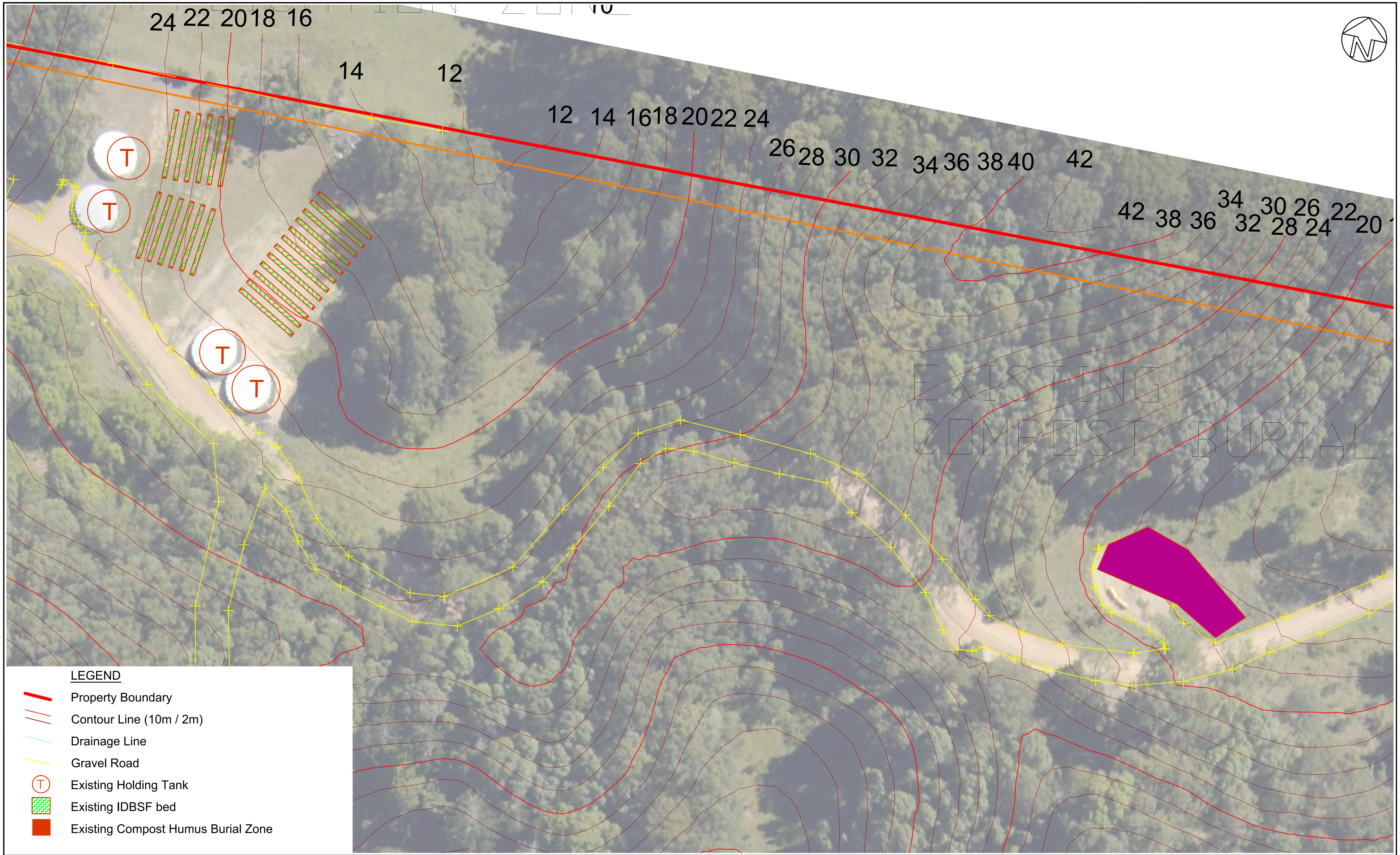
Client: BYRON VENUE MANAGEMENT P/L

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



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:	**EXISTING GREYWATER TREATMENT AND EMA AND HUMUS DUMP**
Source:	**NEARMAP 24/4/2017**

Drawn:	Reviewed:	Approved:	Date:	Scale: 1:1,000 Approx @ A3	
HM	SD	SD	05/10/17	Job No: 1912	Sheet: 1 of 1
All units in m unless otherwise specified				Drawing No: Figure 7	Revision No: 1

0 50 100 150 200

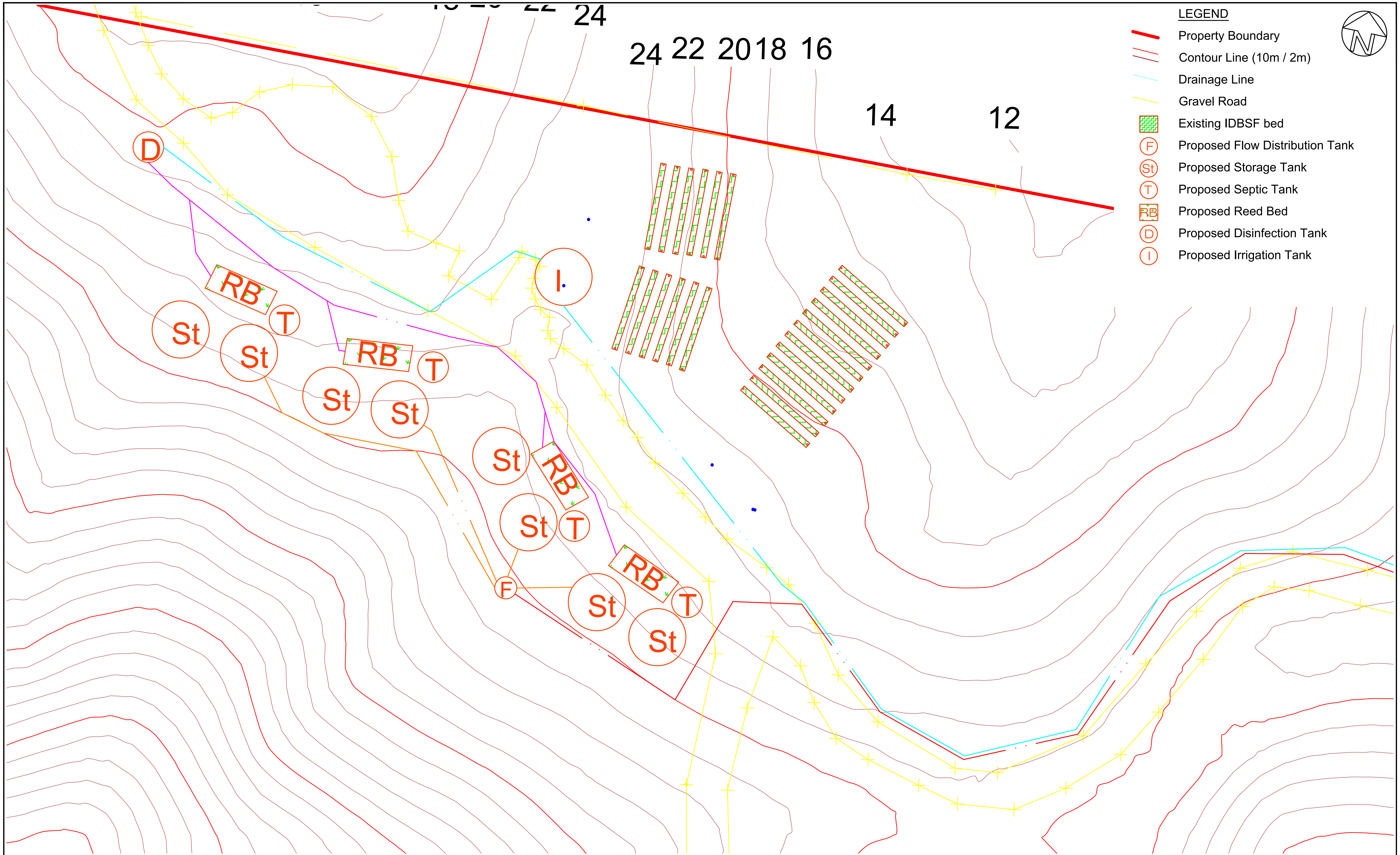
Horizontal Scale (metres) 1:2000

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



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: NEARMAP 24/4/2017

Drawn:	Reviewed:	Approved:	Date:	Scale: 1:600 Approx @ A3	
HM	SD	SD	05/10/17	Job No: 1912	Sheet: 1 of 1
All units in m unless otherwise specified				Drawing No: Figure 9	Revision No: 1

Appendix A

Gilbert & Sutherland Report - Borehole Logs and Soil Chemistry

Borehole: BH1

Project: GJ0926

Client: Splendour Pty Ltd

Latitude 28.29.103

Longitude 153.30.807

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, 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	Depth (m):	1
Client:	Splendour Pty Ltd	Logged by:	RJ
Latitude	28.28.992	Drilled by:	Gilbert & Sutherland
Longitude	153.30.905	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 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

GILBERT+SUTHERLAND
agriculture - water - environment

Project:	GJ0926	Depth (m):	1
Client:	Splendour Pty Ltd	Logged by:	RJ
Latitude	28.29.183	Drilled by:	Gilbert & Sutherland
Longitude	153.31.421	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, 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

GILBERT+SUTHERLAND
agriculture - water - environment

Project:	GJ0926	Depth (m):	1
Client:	Splendour Pty Ltd	Logged by:	RJ
Latitude	28.29.031	Drilled by:	Gilbert & Sutherland
Longitude	153.31.135	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)
			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
Client:	Splendour Pty Ltd
Latitude	28.29.208
Longitude	153.30.863
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)
			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

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)
			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

GILBERT+SUTHERLAND
agriculture - water - environment

Project:	GJ0926
Client:	Splendour Pty Ltd
Latitude	28.28.636
Longitude	153.31.145
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)
			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

Project: GJ0926

Client: Splendour Pty Ltd

Latitude 28.28.645

Longitude 158.31.442

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)
			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							.5
			LIGHT CLAY, 10YR 2/2 , Massive		10YR 2/2		
			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
Client: Splendour Pty Ltd
Latitude 28.28.077
Longitude 153.30.996
RL(m): _____

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

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 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

GILBERT+SUTHERLAND
agriculture - water - environment

Project:	GJ0926	Depth (m):	1
Client:	Splendour Pty Ltd	Logged by:	RJ
Latitude	28.28.056	Drilled by:	Gilbert & Sutherland
Longitude	153.30.967	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 3/4 , 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

GILBERT+SUTHERLAND
agriculture - water - environment

Project:	GJ0926	Depth (m):	0.9
Client:	Splendour Pty Ltd	Logged by:	RJ
Latitude	28.28.0	Drilled by:	Gilbert & Sutherland
Longitude	153.30.928	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 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

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

GILBERT+SUTHERLAND
agriculture - water - environment

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:

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:

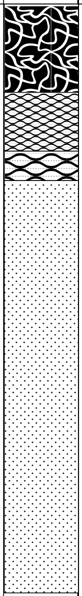
Soil Description

Depth NSL(m)	Depth (RL) m	Graphic log	Soil Description (as per McDonald et.al1990)	Aust. Soil Class.	Colour	Emerson Class	Depth NSL(m)
			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	Depth (m):	1
Client:	Splendour Pty Ltd	Logged by:	RJ
Latitude	28.26.41	Drilled by:	Gilbert & Sutherland
Longitude	153.30.19	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, 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:	

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 , 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:	

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:

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 2/1 , 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

GILBERT+SUTHERLAND
agriculture - water - environment

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

Depth (m): 1.1
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)
			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

, End of bore
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

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		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						

Appendix C
Storage Calculations

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)	Trucked WW Offsite (kL)	Stored Wastewater (kL)	Stored Wastewater from Previous Day (kL)	Cumulative Wastewater Storage (kL)	Actual DaiLy Irrigation Output (kL)	Monthly Avg (kL/day)	Monthly Total (kL/month)
1-Dec	1	0.02	21	641	35		-35	0	0	0	7	229
2-Dec	2	3.80			35		-31	0	0	4		
3-Dec	3	16.94			35		-18	0	0	17		
4-Dec	4	16.94			35		-18	0	0	17		
5-Dec	5	16.94			35		-18	0	0	17		
6-Dec	6	16.94			35		-18	0	0	17		
7-Dec	7	3.80			35		-31	0	0	4		
8-Dec	8	0.02			35		-35	0	0	0		
9-Dec	9	0.98			35		-34	0	0	1		
10-Dec	10	0.98			35		-34	0	0	1		
11-Dec	11	0.98			35		-34	0	0	1		
12-Dec	12	0.98			35		-34	0	0	1		
13-Dec	13	0.98			35		-34	0	0	1		
14-Dec	14	0.98			35		-34	0	0	1		
15-Dec	15	0.98			35		-34	0	0	1		
16-Dec	16	0.98			35		-34	0	0	1		
17-Dec	17	0.98			35		-34	0	0	1		
18-Dec	18	0.98			35		-34	0	0	1		
19-Dec	19	0.98			35		-34	0	0	1		
20-Dec	20	17.89			35		-17	0	0	18		
21-Dec	21	17.89			35		-17	0	0	18		
22-Dec	22	17.89			35		-17	0	0	18		
23-Dec	23	17.89			35		-17	0	0	18		
24-Dec	24	17.89			35		-17	0	0	18		
25-Dec	25	17.89			35		-17	0	0	18		
26-Dec	26	17.89			35		-17	0	0	18		
27-Dec	27	17.89			35		-17	0	0	18		
28-Dec	28	17.89			0		18	0	18	0		
29-Dec	29	17.89			0		18	18	36	0		
30-Dec	30	96.92			0		97	36	133	0		
31-Dec	31	279.28			0	15	264	133	397	0		
1-Jan	32	556.52	77	2,168	0	50	507	397	904	0	26	735
2-Jan	33	556.52			0	50	507	904	1,410	0		
3-Jan	34	556.52			0	50	507	1,410	1,917	0		
4-Jan	35	226.11			0	50	176	1,917	2,093	0		
5-Jan	36	17.55			0	12	5	2,093	2,098	0		
6-Jan	37	17.89			0		18	2,098	2,116	0		
7-Jan	38	17.89			0		18	2,116	2,134	0		
8-Jan	39	17.89			35		-17	2,134	2,117	35		
9-Jan	40	17.89			35		-17	2,117	2,100	35		
10-Jan	41	17.89			35		-17	2,100	2,083	35		
11-Jan	42	17.89			35		-17	2,083	2,066	35		
12-Jan	43	17.89			35		-17	2,066	2,049	35		
13-Jan	44	17.89			35		-17	2,049	2,031	35		
14-Jan	45	17.89			35		-17	2,031	2,014	35		
15-Jan	46	0.98			35		-34	2,014	1,980	35		
16-Jan	47	0.98			35		-34	1,980	1,946	35		
17-Jan	48	0.98			35		-34	1,946	1,912	35		
18-Jan	49	0.98			35		-34	1,912	1,878	35		
19-Jan	50	0.98			35		-34	1,878	1,844	35		
20-Jan	51	0.02			35		-35	1,844	1,809	35		
21-Jan	52	0.02			35		-35	1,809	1,774	35		
22-Jan	53	16.94			35		-18	1,774	1,756	35		
23-Jan	54	16.94			35		-18	1,756	1,738	35		
24-Jan	55	16.94			35		-18	1,738	1,720	35		
25-Jan	56	16.94			35		-18	1,720	1,702	35		
26-Jan	57	3.80			35		-31	1,702	1,671	35		
27-Jan	58	0.02			35		-35	1,671	1,636	35		
28-Jan	59	16.94			35		-18	1,636	1,618	35		
29-Jan	60	16.94	14	453	35		-18	1,618	1,600	35	35	1,085
30-Jan	61	16.94			35		-18	1,600	1,582	35		
31-Jan	62	16.94			35		-18	1,582	1,564	35		
1-Feb	63	16.94			35		-18	1,564	1,546	35		
2-Feb	64	0.02			35		-35	1,546	1,511	35		
3-Feb	65	0.02			35		-35	1,511	1,476	35		
4-Feb	66	16.94			35		-18	1,476	1,458	35		
5-Feb	67	16.94			35		-18	1,458	1,439	35		
6-Feb	68	16.94			35		-18	1,439	1,421	35		
7-Feb	69	16.94			35		-18	1,421	1,403	35		
8-Feb	70	16.94			35		-18	1,403	1,385	35		
9-Feb	71	0.02			35		-35	1,385	1,350	35		
10-Feb	72	0.02			35		-35	1,350	1,315	35		
11-Feb	73	16.94			35		-18	1,315	1,297	35		
12-Feb	74	16.94			35		-18	1,297	1,279	35		
13-Feb	75	16.94			35		-18	1,279	1,261	35		
14-Feb	76	16.94			35		-18	1,261	1,243	35		
15-Feb	77	16.94			35		-18	1,243	1,225	35		
16-Feb	78	0.02			35		-35	1,225	1,190	35		
17-Feb	79	46.63			35		12	1,190	1,202	35		
18-Feb	80	16.94			35		-18	1,202	1,184	35		
19-Feb	81	16.94			35		-18	1,184	1,166	35		
20-Feb	82	16.94			35		-18	1,166	1,147	35		
21-Feb	83	16.94			35		-18	1,147	1,129	35		
22-Feb	84	16.94			35		-18	1,129	1,111	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)	Trucked WW Offsite (kL)	Stored Wastewater (kL)	Stored Wastewater from Previous Day (kL)	Cumulative Wastewater Storage (kL)	Actual DaiLy Irrigation Output (kL)	Monthly Avg (kL/day)	Monthly Total (kL/month)
23-Feb	85	**0.02**			35		-35	1,111	1,076	35		
24-Feb	86	**0.02**			35		-35	1,076	1,041	35		
25-Feb	87	**16.94**			35		-18	1,041	1,023	35		
26-Feb	88	**16.94**			35		-18	1,023	1,005	35		
27-Feb	89	**16.94**			35		-18	1,005	987	35		
28-Feb	90	**16.94**			35		-18	987	969	35		
1-Mar	91	**16.94**	11	343	35		-18	969	951	35	35	1,050
2-Mar	92	**0.02**			35		-35	951	916	35		
3-Mar	93	**0.02**			35		-35	916	881	35		
4-Mar	94	**16.94**			35		-18	881	863	35		
5-Mar	95	**16.94**			35		-18	863	845	35		
6-Mar	96	**16.94**			35		-18	845	827	35		
7-Mar	97	**16.94**			35		-18	827	809	35		
8-Mar	98	**16.94**			35		-18	809	791	35		
9-Mar	99	**3.80**			35		-31	791	760	35		
10-Mar	100	**0.02**			35		-35	760	725	35		
11-Mar	101	**16.94**			35		-18	725	707	35		
12-Mar	102	**16.94**			35		-18	707	688	35		
13-Mar	103	**16.94**			35		-18	688	670	35		
14-Mar	104	**16.94**			35		-18	670	652	35		
15-Mar	105	**16.94**			35		-18	652	634	35		
16-Mar	106	**0.02**			35		-35	634	599	35		
17-Mar	107	**0.02**			35		-35	599	564	35		
18-Mar	108	**16.94**			35		-18	564	546	35		
19-Mar	109	**16.94**			35		-18	546	528	35		
20-Mar	110	**16.94**			35		-18	528	510	35		
21-Mar	111	**16.94**			35		-18	510	492	35		
22-Mar	112	**16.94**			35		-18	492	474	35		
23-Mar	113	**0.02**			35		-35	474	439	35		
24-Mar	114	**0.02**			35		-35	439	404	35		
25-Mar	115	**16.94**			35		-18	404	386	35		
26-Mar	116	**16.94**			35		-18	386	368	35		
27-Mar	117	**16.94**			35		-18	368	350	35		
28-Mar	118	**16.94**			35		-18	350	332	35		
29-Mar	119	**16.94**			35		-18	332	314	35		
30-Mar	120	**0.02**			35		-35	314	279	35		
31-Mar	121	**0.02**	13	404	35		-35	279	244	35	21	654
1-Apr	122	**16.94**			35		-18	244	226	35		
2-Apr	123	**16.94**			35		-18	226	208	35		
3-Apr	124	**16.94**			35		-18	208	190	35		
4-Apr	125	**16.94**			35		-18	190	171	35		
5-Apr	126	**16.94**			35		-18	171	153	35		
6-Apr	127	**3.80**			35		-31	153	122	35		
7-Apr	128	**3.80**			35		-31	122	91	35		
8-Apr	129	**16.94**			35		-18	91	73	35		
9-Apr	130	**16.94**			35		-18	73	55	35		
10-Apr	131	**16.94**			35		-18	55	37	35		
11-Apr	132	**16.94**			35		-18	37	19	35		
12-Apr	133	**16.94**			35		-18	19	1	35		
13-Apr	134	**0.02**			35		-35	1	0	0		
14-Apr	135	**46.63**			35		12	0	12	35		
15-Apr	136	**0.02**			35		-35	12	0	0		
16-Apr	137	**0.02**			35		-35	0	0	0		
17-Apr	138	**3.80**			35		-31	0	0	4		
18-Apr	139	**16.94**			35		-18	0	0	17		
19-Apr	140	**16.94**			35		-18	0	0	17		
20-Apr	141	**16.94**			35		-18	0	0	17		
21-Apr	142	**16.94**			35		-18	0	0	17		
22-Apr	143	**3.80**			35		-31	0	0	4		
23-Apr	144	**3.80**			35		-31	0	0	4		
24-Apr	145	**16.94**			35		-18	0	0	17		
25-Apr	146	**16.94**			35		-18	0	0	17		
26-Apr	147	**16.94**			35		-18	0	0	17		
27-Apr	148	**16.94**			35		-18	0	0	17		
28-Apr	149	**16.94**			35		-18	0	0	17		
29-Apr	150	**0.02**			35		-35	0	0	0		
30-Apr	151	**0.02**			35		-35	0	0	0		
1-May	152	**16.94**	13	377	35		-18	0	0	17	13	377
2-May	153	**16.94**			35		-18	0	0	17		
3-May	154	**16.94**			35		-18	0	0	17		
4-May	155	**16.94**			35		-18	0	0	17		
5-May	156	**16.94**			35		-18	0	0	17		
6-May	157	**0.02**			35		-35	0	0	0		
7-May	158	**0.02**			35		-35	0	0	0		
8-May	159	**16.94**			35		-18	0	0	17		
9-May	160	**16.94**			35		-18	0	0	17		
10-May	161	**16.94**			35		-18	0	0	17		
11-May	162	**16.94**			35		-18	0	0	17		
12-May	163	**16.94**			35		-18	0	0	17		
13-May	164	**3.80**			35		-31	0	0	4		
14-May	165	**0.02**			35		-35	0	0	0		
15-May	166	**16.94**			35		-18	0	0	17		
16-May	167	**16.94**			35		-18	0	0	17		
17-May	168	**16.94**			35		-18	0	0	17		
18-May	169	**16.94**			35		-18	0	0	17		
19-May	170	**16.94**			35		-18	0	0	17		
20-May	171	**0.02**			35		-35	0	0	0		
21-May	172	**0.02**			35		-35	0	0	0		
22-May	173	**16.94**			35		-18	0	0	17		
23-May	174	**16.94**			35		-18	0	0	17		
24-May	175	**16.94**			35		-18	0	0	17		

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)	Trucked WW Offsite (kL)	Stored Wastewater (kL)	Stored Wastewater from Previous Day (kL)	Cumulative Wastewater Storage (kL)	Actual DaiLy Irrigation Output (kL)	Monthly Avg (kL/day)	Monthly Total (kL/month)
25-May	176	**16.94**			35		-18	0	0	17		
26-May	177	**16.94**			35		-18	0	0	17		
27-May	178	**0.02**			35		-35	0	0	0		
28-May	179	**0.02**			35		-35	0	0	0		
29-May	180	**16.94**			35		-18	0	0	17		
30-May	181	**16.94**			35		-18	0	0	17		
31-May	182	**16.94**	13	377	35		-18	0	0	17	13	393
1-Jun	183	**16.94**			35		-18	0	0	17		
2-Jun	184	**16.94**			35		-18	0	0	17		
3-Jun	185	**0.02**			35		-35	0	0	0		
4-Jun	186	**0.02**			35		-35	0	0	0		
5-Jun	187	**16.94**			35		-18	0	0	17		
6-Jun	188	**16.94**			35		-18	0	0	17		
7-Jun	189	**16.94**			35		-18	0	0	17		
8-Jun	190	**16.94**			35		-18	0	0	17		
9-Jun	191	**16.94**			35		-18	0	0	17		
10-Jun	192	**0.02**			35		-35	0	0	0		
11-Jun	193	**0.02**			35		-35	0	0	0		
12-Jun	194	**16.94**			35		-18	0	0	17		
13-Jun	195	**16.94**			35		-18	0	0	17		
14-Jun	196	**16.94**			35		-18	0	0	17		
15-Jun	197	**16.94**			35		-18	0	0	17		
16-Jun	198	**16.94**			35		-18	0	0	17		
17-Jun	199	**3.80**			35		-31	0	0	4		
18-Jun	200	**0.02**			35		-35	0	0	0		
19-Jun	201	**16.94**			35		-18	0	0	17		
20-Jun	202	**16.94**			35		-18	0	0	17		
21-Jun	203	**16.94**			35		-18	0	0	17		
22-Jun	204	**16.94**			35		-18	0	0	17		
23-Jun	205	**16.94**			35		-18	0	0	17		
24-Jun	206	**0.02**			35		-35	0	0	0		
25-Jun	207	**0.02**			35		-35	0	0	0		
26-Jun	208	**16.94**			35		-18	0	0	17		
27-Jun	209	**16.94**			35		-18	0	0	17		
28-Jun	210	**16.94**			35		-18	0	0	17		
29-Jun	211	**16.94**			35		-18	0	0	17		
30-Jun	212	**16.94**			35		-18	0	0	17		
1-Jul	213	**0.00**	78	2,444	35		-35	0	0	0	5	154
2-Jul	214	**0.00**			35		-35	0	0	0		
3-Jul	215	**0.00**			35		-35	0	0	0		
4-Jul	216	**0.98**			35		-34	0	0	1		
5-Jul	217	**0.98**			35		-34	0	0	1		
6-Jul	218	**0.98**			35		-34	0	0	1		
7-Jul	219	**0.98**			35		-34	0	0	1		
8-Jul	220	**0.98**			35		-34	0	0	1		
9-Jul	221	**0.98**			35		-34	0	0	1		
10-Jul	222	**0.98**			35		-34	0	0	1		
11-Jul	223	**0.98**			35		-34	0	0	1		
12-Jul	224	**0.98**			35		-34	0	0	1		
13-Jul	225	**0.98**			35		-34	0	0	1		
14-Jul	226	**0.98**			35		-34	0	0	1		
15-Jul	227	**17.89**			35		-17	0	0	18		
16-Jul	228	**17.89**			35		-17	0	0	18		
17-Jul	229	**17.89**			35		-17	0	0	18		
18-Jul	230	**17.89**			35		-17	0	0	18		
19-Jul	231	**17.89**			35		-17	0	0	18		
20-Jul	232	**17.89**			35		-17	0	0	18		
21-Jul	233	**17.89**			35		-17	0	0	18		
22-Jul	234	**17.89**			35		-17	0	0	18		
23-Jul	235	**17.89**			0		18	0	18	0		
24-Jul	236	**17.89**			0		18	18	36	0		
25-Jul	237	**91.04**			0		91	36	127	0		
26-Jul	238	**272.56**			0	21	252	127	378	0		
27-Jul	239	**551.00**			0	70	481	378	860	0		
28-Jul	240	**551.00**			0	70	481	860	1,341	0		
29-Jul	241	**551.00**			0	70	481	1,341	1,822	0		
30-Jul	242	**198.87**			0	70	129	1,822	1,952	0		
31-Jul	243	**21.14**			0	17	4	1,952	1,955	0		
1-Aug	244	**17.89**	14	406	0		18	1,955	1,973	0	33	980
2-Aug	245	**17.89**			0		18	1,973	1,991	0		
3-Aug	246	**17.89**			35		-17	1,991	1,974	35		
4-Aug	247	**17.89**			35		-17	1,974	1,957	35		
5-Aug	248	**17.89**			35		-17	1,957	1,940	35		
6-Aug	249	**17.89**			35		-17	1,940	1,923	35		
7-Aug	250	**17.89**			35		-17	1,923	1,906	35		
8-Aug	251	**17.89**			35		-17	1,906	1,888	35		
9-Aug	252	**17.89**			35		-17	1,888	1,871	35		
10-Aug	253	**0.98**			35		-34	1,871	1,837	35		
11-Aug	254	**0.98**			35		-34	1,837	1,803	35		
12-Aug	255	**0.98**			35		-34	1,803	1,769	35		
13-Aug	256	**0.98**			35		-34	1,769	1,735	35		
14-Aug	257	**0.98**			35		-34	1,735	1,701	35		
15-Aug	258	**0.02**			35		-35	1,701	1,666	35		
16-Aug	259	**16.94**			35		-18	1,666	1,648	35		
17-Aug	260	**16.94**			35		-18	1,648	1,630	35		
18-Aug	261	**16.94**			35		-18	1,630	1,612	35		
19-Aug	262	**16.94**			35		-18	1,612	1,594	35		
20-Aug	263	**16.94**			35		-18	1,594	1,576	35		
21-Aug	264	**3.80**			35		-31	1,576	1,545	35		
22-Aug	265	**46.63**			35		12	1,545	1,556	35		
23-Aug	266	**16.94**			35		-18	1,556	1,538	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)	Trucked WW Offsite (kL)	Stored Wastewater (kL)	Stored Wastewater from Previous Day (kL)	Cumulative Wastewater Storage (kL)	Actual DaiLy Irrigation Output (kL)	Monthly Avg (kL/day)	Monthly Total (kL/month)
24-Aug	267	**16.94**			35		-18	1,538	1,520	35		
25-Aug	268	**16.94**			35		-18	1,520	1,502	35		
26-Aug	269	**16.94**			35		-18	1,502	1,484	35		
27-Aug	270	**16.94**			35		-18	1,484	1,466	35		
28-Aug	271	**3.80**			35		-31	1,466	1,435	35		
29-Aug	272	**0.02**			35		-35	1,435	1,400	35		
30-Aug	273	**16.94**			35		-18	1,400	1,382	35		
31-Aug	274	**16.94**	11	337	35		-18	1,382	1,364	35	35	1,085
1-Sep	275	**16.94**			35		-18	1,364	1,346	35		
2-Sep	276	**16.94**			35		-18	1,346	1,328	35		
3-Sep	277	**16.94**			35		-18	1,328	1,310	35		
4-Sep	278	**3.80**			35		-31	1,310	1,278	35		
5-Sep	279	**0.02**			35		-35	1,278	1,243	35		
6-Sep	280	**16.94**			35		-18	1,243	1,225	35		
7-Sep	281	**16.94**			35		-18	1,225	1,207	35		
8-Sep	282	**3.80**			35		-31	1,207	1,176	35		
9-Sep	283	**0.02**			35		-35	1,176	1,141	35		
10-Sep	284	**0.02**			35		-35	1,141	1,106	35		
11-Sep	285	**0.02**			35		-35	1,106	1,071	35		
12-Sep	286	**46.63**			35		12	1,071	1,083	35		
13-Sep	287	**0.02**			35		-35	1,083	1,048	35		
14-Sep	288	**0.02**			35		-35	1,048	1,013	35		
15-Sep	289	**3.80**			35		-31	1,013	982	35		
16-Sep	290	**16.94**			35		-18	982	964	35		
17-Sep	291	**16.94**			35		-18	964	945	35		
18-Sep	292	**16.94**			35		-18	945	927	35		
19-Sep	293	**16.94**			35		-18	927	909	35		
20-Sep	294	**16.94**			35		-18	909	891	35		
21-Sep	295	**16.94**			35		-18	891	873	35		
22-Sep	296	**16.94**			35		-18	873	855	35		
23-Sep	297	**16.94**			35		-18	855	837	35		
24-Sep	298	**16.94**			35		-18	837	819	35		
25-Sep	299	**16.94**			35		-18	819	801	35		
26-Sep	300	**16.94**			35		-18	801	783	35		
27-Sep	301	**3.80**			35		-31	783	752	35		
28-Sep	302	**0.96**			35		-34	752	718	35		
29-Sep	303	**0.96**			35		-34	718	684	35		
30-Sep	304	**0.96**			35		-34	684	650	35		
1-Oct	305	**0.96**	26	794	35		-34	650	616	35	25	735
2-Oct	306	**0.96**			35		-34	616	581	35		
3-Oct	307	**0.96**			35		-34	581	547	35		
4-Oct	308	**0.96**			35		-34	547	513	35		
5-Oct	309	**0.96**			35		-34	513	479	35		
6-Oct	310	**0.96**			35		-34	479	445	35		
7-Oct	311	**0.96**			35		-34	445	411	35		
8-Oct	312	**0.96**			35		-34	411	377	35		
9-Oct	313	**0.96**			35		-34	377	343	35		
10-Oct	314	**0.96**			0		1	343	344	0		
11-Oct	315	**0.96**			0		1	344	345	0		
12-Oct	316	**0.00**			0		0	345	345	0		
13-Oct	317	**2.34**			0		2	345	347	0		
14-Oct	318	**249.38**			0		249	347	597	0		
15-Oct	319	**265.63**			0		266	597	862	0		
16-Oct	320	**249.38**			0		249	862	1,112	0		
17-Oct	321	**4.06**			0		4	1,112	1,116	0		
18-Oct	322	**0.96**			0		1	1,116	1,117	0		
19-Oct	323	**0.96**			35		-34	1,117	1,083	35		
20-Oct	324	**0.96**			35		-34	1,083	1,049	35		
21-Oct	325	**0.96**			35		-34	1,049	1,015	35		
22-Oct	326	**0.96**			35		-34	1,015	981	35		
23-Oct	327	**0.96**			35		-34	981	947	35		
24-Oct	328	**0.96**			35		-34	947	913	35		
25-Oct	329	**0.96**			35		-34	913	879	35		
26-Oct	330	**0.96**			35		-34	879	845	35		
27-Oct	331	**0.96**			35		-34	845	810	35		
28-Oct	332	**0.96**			35		-34	810	776	35		
29-Oct	333	**0.96**			35		-34	776	742	35		
30-Oct	334	**0.96**			35		-34	742	708	35		
31-Oct	335	**0.96**	14	448	35		-34	708	674	35	35	1,085
1-Nov	336	**0.02**			35		-35	674	639	35		
2-Nov	337	**16.94**			35		-18	639	621	35		
3-Nov	338	**16.94**			35		-18	621	603	35		
4-Nov	339	**16.94**			35		-18	603	585	35		
5-Nov	340	**16.94**			35		-18	585	567	35		
6-Nov	341	**16.94**			35		-18	567	549	35		
7-Nov	342	**3.80**			35		-31	549	518	35		
8-Nov	343	**0.02**			35		-35	518	483	35		
9-Nov	344	**16.94**			35		-18	483	465	35		
10-Nov	345	**16.94**			35		-18	465	447	35		
11-Nov	346	**16.94**			35		-18	447	429	35		
12-Nov	347	**16.94**			35		-18	429	411	35		
13-Nov	348	**16.94**			35		-18	411	393	35		
14-Nov	349	**3.80**			35		-31	393	361	35		
15-Nov	350	**46.63**			35		12	361	373	35		
16-Nov	351	**16.94**			35		-18	373	355	35		
17-Nov	352	**16.94**			35		-18	355	337	35		
18-Nov	353	**16.94**			35		-18	337	319	35		
19-Nov	354	**16.94**			35		-18	319	301	35		
20-Nov	355	**16.94**			35		-18	301	283	35		
21-Nov	356	**3.80**			35		-31	283	251	35		
22-Nov	357	**0.02**			35		-35	251	216	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)	Trucked WW Offsite (kL)	Stored Wastewater (kL)	Stored Wastewater from Previous Day (kL)	Cumulative Wastewater Storage (kL)	Actual DaiLy Irrigation Output (kL)	Monthly Avg (kL/day)	Monthly Total (kL/month)
23-Nov	358	**16.94**			35		-18	216	198	35		
24-Nov	359	**16.94**			35		-18	198	180	35		
25-Nov	360	**16.94**			35		-18	180	162	35		
26-Nov	361	**16.94**			35		-18	162	144	35		
27-Nov	362	**16.94**			35		-18	144	126	35		
28-Nov	363	**16.94**			35		-18	126	108	35		
29-Nov	364	**0.02**			35		-35	108	73	35		
30-Nov	365	**16.94**			35		-18	73	55	35		
1-Dec	366	**16.94**	21	1,194	35		-18	55	37	35	10	297
2-Dec	367	**16.94**			35		-18	37	19	35		
3-Dec	368	**16.94**			35		-18	19	1	35		
4-Dec	369	**16.94**			35		-18	1	0	17		
5-Dec	370	**16.94**			35		-18	0	0	17		
6-Dec	371	**3.80**			35		-31	0	0	4		
7-Dec	372	**0.02**			35		-35	0	0	0		
8-Dec	373	**0.02**			35		-35	0	0	0		
9-Dec	374	**0.98**			35		-34	0	0	1		
10-Dec	375	**0.98**			35		-34	0	0	1		
11-Dec	376	**0.98**			35		-34	0	0	1		
12-Dec	377	**0.98**			35		-34	0	0	1		
13-Dec	378	**0.98**			35		-34	0	0	1		
14-Dec	379	**0.98**			35		-34	0	0	1		
15-Dec	380	**0.98**			35		-34	0	0	1		
16-Dec	381	**0.98**			35		-34	0	0	1		
17-Dec	382	**0.98**			35		-34	0	0	1		
18-Dec	383	**0.98**			35		-34	0	0	1		
19-Dec	384	**0.98**			35		-34	0	0	1		
20-Dec	385	**17.89**			35		-17	0	0	18		
21-Dec	386	**17.89**			35		-17	0	0	18		
22-Dec	387	**17.89**			35		-17	0	0	18		
23-Dec	388	**17.89**			35		-17	0	0	18		
24-Dec	389	**17.89**			35		-17	0	0	18		
25-Dec	390	**17.89**			35		-17	0	0	18		
26-Dec	391	**17.89**			35		-17	0	0	18		
27-Dec	392	**17.89**			35		-17	0	0	18		
28-Dec	393	**17.89**			0		18	0	18	0		
29-Dec	394	**17.89**			0		18	18	36	0		
30-Dec	395	**96.92**			0		97	36	133	0		
31-Dec	396	**279.28**			0	15	264	133	397	0		
1-Jan	397	**556.52**	78	1,628	0	50	507	397	904	0	26	735
2-Jan	398	**556.52**			0	50	507	904	1,410	0		
3-Jan	399	**556.52**			0	50	507	1,410	1,917	0		
4-Jan	400	**226.11**			0	50	176	1,917	2,093	0		
5-Jan	401	**17.55**			0	12	5	2,093	2,098	0		
6-Jan	402	**17.89**			0		18	2,098	2,116	0		
7-Jan	403	**17.89**			0		18	2,116	2,134	0		
8-Jan	404	**17.89**			35		-17	2,134	2,117	35		
9-Jan	405	**17.89**			35		-17	2,117	2,100	35		
10-Jan	406	**17.89**			35		-17	2,100	2,083	35		
11-Jan	407	**17.89**			35		-17	2,083	2,066	35		
12-Jan	408	**17.89**			35		-17	2,066	2,049	35		
13-Jan	409	**17.89**			35		-17	2,049	2,031	35		
14-Jan	410	**17.89**			35		-17	2,031	2,014	35		
15-Jan	411	**0.98**			35		-34	2,014	1,980	35		
16-Jan	412	**0.98**			35		-34	1,980	1,946	35		
17-Jan	413	**0.98**			35		-34	1,946	1,912	35		
18-Jan	414	**0.98**			35		-34	1,912	1,878	35		
19-Jan	415	**0.98**			35		-34	1,878	1,844	35		
20-Jan	416	**0.02**			35		-35	1,844	1,809	35		
21-Jan	417	**16.94**			35		-18	1,809	1,791	35		
22-Jan	418	**16.94**			35		-18	1,791	1,773	35		
23-Jan	419	**16.94**			35		-18	1,773	1,755	35		
24-Jan	420	**16.94**			35		-18	1,755	1,737	35		
25-Jan	421	**16.94**			35		-18	1,737	1,719	35		
26-Jan	422	**16.94**			35		-18	1,719	1,701	35		
27-Jan	423	**3.80**			35		-31	1,701	1,670	35		
28-Jan	424	**0.02**			35		-35	1,670	1,635	35		
Annual Total (kL)		9,187	305	9,743	11,690	544		average	644.8	8,630		
Average daily (kL)		25.2	0.7	23.0	32.0					23.6		

Max Storage	2,134	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	22
Conference Total	189

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	543.941125

		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)	25.2		
Annual Total Gen (kL)	9,173		
	Month Gen Total (kL)	gation Total (kL)	y Irrigation Avg (kL)
Dec	641	229	7
Jan	2,168	735	26
Feb	453	1,085	35
Mar	343	1,050	35
Apr	404	654	21
May	377	377	13
Jun	377	393	13
Jul	2,444	154	5
Aug	406	980	33
Sep	337	1,085	35
Oct	794	735	25
Nov	448	1,085	35
Dec	297	297	10
Jan	1,628	735	24
		Avg Daily Irrig (L	25.2
		Annual Total Irrig	9,173.5
		Max Irrig (L)	35

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