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INDEPENDENT ENVIRONMENTAL INVESTIGATIONS INCLUDING:

- Selected Soil & Water Analyses
- Site Monitoring
- Acid Sulfate Soil Management
- Effluent & Wastewater Disposal
- Groundwater & Dewatering
- Contaminated Land
- Dust Monitoring
- Environmental Management Plans

Preliminary Site Feasibility & Capacity Assessment for Wastewater Management for Upgrade of the Toilet Facility in Bruce Chick Conservation Park.

Location:

'Bruce Chick Park'
Tweed Valley Way
Stotts Creek

Prepared for:

Tweed Shire Council

Report No:

HMC2014.113

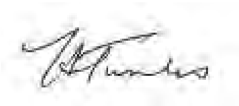
November 2014

RE: 'Bruce Chick Park' Tweed Valley Way Stotts Creek

HMC Environmental Consulting Pty Ltd is pleased to present our preliminary site feasibility and capacity assessment for the On-site Sewage Management for the upgrade of the toilet facility at the abovementioned site.

We trust this report meets with your requirements. If you require further information please contact HMC Environmental Consulting directly on the numbers provided.

Yours sincerely



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Because a report is based on conditions which existed at the time of the subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time, natural processes and the activities of man. Changes to the subsurface, site or adjacent site conditions may occur subsequent to the investigation described herein, through natural processes or through the intentional or accidental addition of imported material, and these conditions may change with space and time.

The findings of this report are based on the objectives and scope of work outlined within. HMC performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environment assessment profession. No warranties or guarantees, expressed or implied, are made. Subject to the scope of work, HMC's assessment is limited strictly to identifying typical environmental conditions associated with the subject property, and does not include evaluation of any other issues. This report does not comment on any regulatory obligations based on the findings, for which a legal opinion should be sought. This report relates only to the objectives and scope of the work stated, and does not relate to any other works undertaken for the Client. All conclusions regarding the property area are the professional opinions of the HMC personnel involved with the project, subject to the qualifications made above.

While normal assessments of data reliability have been made by HMC, HMC assume no responsibility or liability for errors in any data obtained from regulatory agencies, or information from sources outside HMC's control, or developments resulting from situations outside the scope of this project.

EXECUTIVE SUMMARY

Proposal	Upgrade of existing toilet facility to service day and overnight visitors. Existing waterless composting toilet is failing and is required to be pumped out approximately every 2 months (pers. comm. Solo Waste, 28.11.2014).
Property	Bruce Chick Conservation Park Northbound Tweed Valley Way, Stotts Creek
Local Government Area	Tweed Shire Council
Appropriate Regulatory Authority	Tweed Shire Council <2500EP or 750kL/day of sewage generated, therefore not a scheduled activity under the Protection of Environment Operations Act.
Area of lot	4.4 ha
Water Supply	Reticulated mains supply for potable purposes.
Assumed Patronage	PEAK LOAD: 50 overnight visitors PLUS 50 day visitors during Public and School Holidays (115 days/year). OFF-PEAK LOAD: 25 overnight visitors PLUS 25 day visitors (250 days/year) Based on current maximum vehicle parking capacity (assume 30 x vehicle). Based on ultimate daily north bound vehicles (Veitch, Lister Consulting, 2007)
Design Wastewater Flow Flushing WCs	PEAK: 4000L/day OFF-PEAK: 2000L/day
Equivalent Persons (EP)	<27 EP @ 150L/EP (ablutions & sanitary)
Wastewater Classification	Low Strength Influent (2004) Requires separate treatment of liquid waste from on-board recreational vehicle chemical toilets. (DEC, 2004)
Approvals Required under Legislation	Approval required under Section 68(5) of the Local Government Act 1993 to install, construct or alter a waste treatment device As the proposed development generates less than 250EP or 750kL/day, it is not a Scheduled Activity under the Protection of Environment Operations Act. An Environmental Protection Licence is not required.
Site Limitations	Flood liability. Shallow groundwater. Acid sulfate soil. Proximity to watercourse. High volume, seasonal rainfall. Low soil permeability
Maximum Design Loading Rate	5mm/day (assuming Wisconsin Mound system) 2mm/day (assuming elevated irrigation field, minimum 250mm imported topsoil required.
Available Land Application Area (LAA) on site	1300m2
Recommended Minimum Effluent Quality Criteria	The commercial on-site effluent treatment system is to provide at least an effluent of a quality to achieve compliance with the following criteria: • 20 mg/L BOD_5 • 30mg/L SS

<table>
<tr><td></td><td colspan="3">• 30 cfu/100mL
• TN 30mg/L
• TP 10mg/L</td></tr>
<tr><td>Required Site Mitigation</td><td colspan="3">Filling of effluent land application area (LAA) to 2.7m (1 in 20 year flood level).
Assume existing ground level of approximately 1.0m AHD.

Wet weather storage of effluent is recommended for an on-site sewage treatment system for the site. A wet weather storage system is to be provided with automatic controls based on soil-moisture sensors to provide water content assessment of soil. Wet weather storage tanks to be used to provide contingency effluent storage as an alternative to land application in wet conditions.</td></tr>
<tr><td rowspan="4">Preliminary LAA Sizing</td><td colspan="3">Recommended minimum required size of Land Application Area (LAA)</td></tr>
<tr><td>PEAK LOAD</td><td>Irrigation 1850m2
(Hydraulic Limiting)</td><td>Amended Sand Mound 950m2 built up application area.
Base area to allow for 3:1 batters</td></tr>
<tr><td>OFF PEAK LOAD</td><td>Irrigation 1032m2
(Nitrogen Limiting)</td><td>Amended Sand Mound 380m2 built up application area.
Base area to allow for 3:1 batters.</td></tr>
<tr><td colspan="3">No physical, chemical or permeability tests were undertaken on the soils within the available land application area. To provide a realistic assessment of soil properties, multiple tests are required. It is considered that the conservative loading rates based on site information presented in this report are adequate for design inputs in this case for a preliminary site capacity assessment.</td></tr>
<tr><td>CONCLUSION</td><td colspan="3">The report has presented as a preliminary site and soil evaluation to explore the options to upgrade the toilet facility at Bruce Chick Conservation Park. Assumptions on usage of the toilet facility have been made in lieu of specific data, and are to be considered as preliminary only.

The option of providing a reticulate sewerage system to connect to the municipal Sewage Treatment Plant at Tumbulgum has already been prepared and reported through the Tweed Shire Council Recreation Services Planning Report.

The appropriate toilet options have been identified and a brief overview of each option has been provided in regard to:
• potential environmental impacts,
• indicative capital works requirements,
• appropriateness for each category of Park user, and
• any on-going management requirements.

Based on the information presented in this report, the following conclusions are made:
• The existing waterless composting toilet is failing and the management requirements to improve and maintain the composting process at acceptable levels are significant and prohibitive for the continued Council management of the public use of the toilet facility at the site.
• The on-site treatment and land application of effluent is not preferred due to the cost and practicalities of the volume of fill required to build up the land application area, the flood proofing of the effluent treatment and storage tanks, and the management requirements for flood events.
• The off-site land application option is considered prohibitive in terms of the infrastructure</td></tr>
</table>

	and procurement of an alternative flood free site. • The pump-out option enables RV waste to be accepted, but incurs significant infrastructure costs and on-going costs from private liquid waste contractor. Based on the information presented in this report, it is considered that the on-site treatment and disposal of effluent to the land at Bruce Chick Park will create an unacceptable risk of environmental impact due to the sensitive location and site constraints primarily in terms of high water table and flood hazard.

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References/legislation utilised in the preparation of report

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1 INTRODUCTION

In accordance with a Tweed Shire Council resolution dated 17 July 2014, HMC Environmental Consulting Pty Ltd has been commissioned to prepare an on-site sewage management (OSSM) assessment to explore options to upgrade the toilet facility at Bruce Chick Conservation Park, located at Tweed Valley Way, Stotts Island.

The existing toilet facility comprises two pedestals, one male and one female, connected to a double chamber waterless composting toilet. The toilets are not functioning satisfactorily in to the composting process, with uncontrolled dumping of chemical toilet waste and foreign material.

Camping in parks and reserves is not permitted in the Tweed Shire, other than at the Bruce Chick Conservation Park Stotts Island tourist resting spot on Tweed Valley Way. The Bruce Chick Park rest area provides toilet facilities, picnic tables and car parking for recreation vehicles, caravans and passenger vehicles. Non Reticulated tank water services the toilets and wash hand basins. Reticulated sewerage is not available.

There are no public campervan dump points in the Tweed Shire. Campervan drivers are required to enter caravan parks in the Tweed Shire that contain dump point facilities, most parks only allow paying guests to utilise these facilities.

The report provides an investigation of the options for on-site sewage treatment and effluent disposal based on a preliminary site and soil assessment. The findings of this report are in accordance with AS/NZS 1547: 2012 – *On-site domestic wastewater management*, July 2012*, The Environment & Health Protection Guidelines – On-site Sewage Management for Single Households*", 1998, NSW Health, relevant contemporary research and industry recognised best practice.

2 PROPOSAL

Proposal	Upgrading of Toilet Facilities Preliminary Site Feasibility & Capacity Assessment for Wastewater Management
Property	**'Bruce Chick Park'** **Tweed Valley Way** **Stotts Creek**
Council Area/Approvals:	Tweed Shire Council
Existing Infrastructure	1 x amenity block, 2 x waterless composting toilet pedestals Elevated on timber poles with floor level at approximately 1.8m above ground.
Design Daily Hydraulic Load	Based on 120L/p/day wastewater flow allowance (AS1547:2012) for 5 person occutoielt pancy.
Water Saving Devices	Standard
Water Supply	Non-Reticulated roof catchment supply

3 LAND CAPABILITY – SITE & SOIL ASSESSMENT

3.1 Site Information

Should conditions vary from those described during any stage of installation HMC is to be notified to ensure the recommendations of this report remain valid or alternative recommendations be made.

The following information relates to the general site but more specifically to the available effluent land application area (LAA).

Inspected by	Helen Tunks
Date & Time of Inspection	21 October 2014
Environmentally Sensitive Areas & Adjacent Land Uses:	Bruce Chick Park is located on the northern side of Tweed Valley Way and is bounded by Leddys Creek to the east, an arm of theTweed River to the north, and a cane field drainage system to the west. The adjacent land use is predominantly sugar cane cultivation and rural residences. The sewered village of Tumbulgum is located approximately 3km upstream. The outfall from the Kingscliff municipal sewage treatment plant is discharged into the Tweed River at Chinderah, approximately 4km downstream. Bruce Chick Park serves as the pedestrian access point for the Stotts Creek Nature Reserve located on Stotts Island within the Tweed River, immediately north of the Park.
Site Conditions	Weather – warm, dry. Below average rain fall for previous 12 months.
Soil Properties (Morand, 1996)	Expected peaty loams and clay loam overlying marine clays, described as humic gleys or swamp soils with high clay content. Expected potential acid sulfate soil materials that are saline ,waterlogged, have low wet bearing strengths, high erodibility and high aluminium toxicity potential. Generally very low suitability for septic absorption. No physical, chemical or permeability tests were undertaken on the soils within the available land application area. To provide a realistic assessment of soil properties, multiple tests are required.
Site Constraints	Flood liability >1.7m peak level depth for 1 in 5 year flood. Permanently high watertable, waterlogged areas conducive to groundwater pollution. Potential acid sulfate soil. Proximity to watercourse. High volume, seasonal rainfall. Low soil permeability Shading, root encroachment from mature trees.
SITE FEATURES	
Size of property	Bruce Chick Park rest area, as bounded by the vehicle access to the west and Leddy's Creek to the east is approximately 1.2 hectares.
Available LAA	1300m2
Slope of available LAA	<5%, generally level, linear planar
Exposure & Aspect of available LAA	Available LAA generally faces south with shading and root encroachment
Boulders /Rock Outcrops	None observed in vicinity of LAA.
Run-on/Seepage	Minimal

Run-off	Minimal
Flooding Potential (Source: TSC Engineer Mr. D Rose)	Significant depths >1m. Indundation events occur more than once a year. Assuming ground level of approximately 1.0m AHD, the peak levels expected are: 1 in 5 year flood = 2.2m AHD 1 in 20 year flood = 2.7m AHD 1 in 20 year flood = 3.7m AHD
Site Drainage	Poorly drained, high watertable and subject to waterlogging.
Ground Surface Condition/Vegetation	100% coverage of native & exotic grasses
Erosion/mass movement	None observed in vicinity
Distance to watercourse	Approximately 10m to southern drain, 25m to Tweed River
Depth to Water Table Depth to artificial horizon	Expected <0.6m
Local Elevation of available LAA	Approximately 1.0m AHD
Landscape element	Marine plain and estuarine infill
Estimated Phosphorus sorption	Generally high >10000 kg P sorption/ha (Based on soil texture and assessment, Morand, 1996)
Climate	Warm-temperate and high volume, seasonal rainfall typical of region.
Permeability	Low, high base saturation
External Site Impacts eg neighbours, stormwater	Expected tidal and flood inundation.
Wet Weather Storage	Required
Available LAA	>1300m2

3.2 Setback Distances

The setback distances adopted for the site assessment were those presented in Table R1 of AS/NZS1547: 2012, as detailed in Table 1 below, and also from the Environment & Health Protection Guidelines – On-site Sewage Management for Single Households (DLG et al, 1998), as detailed in Table 2 below.

There is a permanent field drain at a distance of approximately 10m, with the Tweed River located 20m from the available land application area. .

This setback distance does not comply with the AS1547:2012 guideline range below or the specified separation distance of 100m as recommended by the Environmental Health Guidelines (DLG et al, 1998). There is no water bore on the property or any registered within 250m (online mapping, Natural Resource Atlas, www.nratlas.nsw.gov.au).

An evaluation of the site constraints was carried out to determine how they interact to provide either a pathway or barrier to wastewater movement, in accordance with Table R1 and R2 of AS1547:2012 (see Table 1 below). It is considered that the low permeability of the soil, high water table and significant flood hazard present an overriding lower constraint regarding protection of surface water quality.

It is considered that a setback distance of 10m to the field drain, and 20m to Tweed River is not appropriate on this site, balancing the site constraint factors.

Table 1 Guidelines for Horizontal and Vertical Setback Distances (from AS1547:2012, Table R1, TableR2)

Table R1 Guidelines for Horizontal and Vertical Setback Distances (to be used in conjunction with Table R2)		
Site Feature	**Setback Distance range (m)[1]**	**Site constraint items of specific concern (from table R2)[1]**
	Horizontal Setback Distance (m)	
Property Boundary	1.5-50[2]	A, D, J
Buildings/houses	2.0->6[3]	A, D, J
Surface Water[4]	15-100	A, B, D, E, F, G, J
Bore, Well[5]	15-50	A, C, H, J
Recreational areas (Children's play areas, swimming pools and so on)[7]	3-15[8,9]	A, E, J
In-Ground water tank	4-15[10]	A, E, J
Retaining wall and Embankments, escarpments, cuttings[11]	3.0m or 45° angle from toe of wall (whichever is greatest)	D, G, H
	Vertical Setback Distance (m)	
Groundwater [5,6,12]	0.6->1.5	A, C, F, H, I, J
Hardtoielt pan or bedrock	0.5-≥1.5	A, C, J

Notes:

1. The overall setback distance should be commensurate with the level of risk to public health and the environment. For example, the maximum setback distance should be adopted where site/system features are on the high end of the constrain scale. The setback distance should be based on an evaluation of the constraint items and corresponding sensitive features in Table R2 and how these interact to provide a pathway or barrier for wastewater movement.
2. Subject to local regulatory rules and design by a suitably qualified and experienced person, the separation of a drip line system from an upslope boundary, for slopes greater than 5%, may be reduced to 0.5m.
3. Setback distances of less than 3m from houses are appropriate only where a drip irrigation land application system is being used with low design irrigation rates, where shallow subsurface systems are being used with equivalent low areal loading rates, where the risk of reducing the bearing capacity of the foundation or damaging the structure is low,

or where tan effective barrier (designed by a suitably qualified and experienced person) can be installed. This may require consent from the regulatory authority.

4. Setback distance from surface water is defined as the areal edge of the land application system to the edge of the water. Where land application areas are planned in a water supply catchment, advice on adequate buffer distances should be sought from the relevant water authority and hydrogeologist. Surface water, in this case, refers to any fresh water or geothermal water in a river, lake, stream, or wetland that may be permanently or intermittently flowing. Surface water also includes water in the coastal marine area and water in man-made drains, channels, and dams unless these are to specifically divert surface water away from the land application area. Surface water excludes any water in a pipe or tank.
5. Highly permeable stony soils and gravel aquifers potentially allow microorganisms to be readily transported up to hundreds of metres down the gradient of an on-site system (see R3, Table 1 in Toielt pang et al. 2005). Maximum setback distances are recommended where site constraints are identified at the high scale for items A, C and H. For reading and guidance on setback distances in highly permeable soils and coarse-grained aquifers see R2. As microbial removal is not linear with distance, data extrapolation of experiments should not be relied upon unless the data has been verified in the field. Advice on adequate buffer distances should be sought from the relevant water authority and a hydrogeologist.
6. Setback distances from water supply bores should be reviewed on a case-by-case basis. Distances can depend on may factors including soil type, rainfall, depth and casing of bore, direction of groundwater flow, type of microorganisms, existing quality of receiving waters, and resource value of waters.
7. Where effluent is applied to the surface by covered drip or spray irrigation, the maximum value is recommended.
8. In the case of subsurface application of primary treated effluent by LPED irrigation, the upper value is recommended.
9. In the case of surface spray, the setback distances are based on a spray plume with a diameter not exceeding 2m or a plume height not exceeding 0.5m above finished surface level. The potential for aerosols being carried by the wind also needs to be taken into account.
10. It is recommended that land application of primary treated effluent be down gradient of in-ground water tanks.
11. When determining minimum distances from retaining walls, embankments, or cut slopes, the type of land application system, soil types, and soil layering should also be taken into account to avoid wastewater collecting in the subsoil drains or seepage through cuts and embankments. Where these situations occur setback clearances may need to be increased. In areas where slope stability is of concern, advice from a suitably qualified and experienced person may be required.
12. Groundwater setback distance (depth) assumes unsaturated flow and is defined as the vertical distance from the base of the land application systems to the highest seasonal water table level. To minimise potential for adverse impacts on groundwater quality, minimum setback distances should ensure unsaturated, aerobic conditions in the soil. These minimum depths will vary depending on the scale of the site constraints identified in Table R2. Where groundwater setback is insufficient, the ground level can be raised by importing suitable topsoil and improving effluent treatment. The regulatory authority should make the final decision in this instance. (See also the guidance on soil depth and groundwater clearance in Tables K1 and K2.

Table R2
Site Constraint Scale for Development of Setback Distances
(used as a guide in determining appropriate setback distances from ranges given in Table R1)

Item	Site/system feature	Constraint Scale [1] Lower ⟷ Higher Examples of constraint factors[2]		Sensitive features
		Lower	**Higher**	
A	Microbial quality of effluent [3]	Effluent quality consistently producing $\leq 10^6$ cfu/100mL *E.coli* (for example, primary treated effluent)	Effluent quality consistently producing $\geq 10^6$ cfu/100mL *E.coli* (for example, primary treated effluent)	Groundwater and surface pollution hazard, public health hazard
B	Surface water [4]	Category 1 to 3 soils [5] no surfce water down gradient within > 100m, low rainfall area	Category 4 to 6 soils, permanent surface water <50m down gradient, high rainfall area, high	Surface water pollution hazard for low permeable soils, low lying or poorly draining areas

			resource/environmental value[6]	
C	Groundwater	Category 5 & 6 soils, low resource/environmental value	Category 1 and 2 soils, gravel aquifers, high resource/environmental value	Groundwater pollution hazard
D	Slope	0-6% (surface effluent application)	>10% (surface effluent application), >30% subsurface effluent application	Off-site export of effluent erosion
E	Position of land application area in landscape [6]	Downgradient of surface water, property boundary, recreational area	Upgradient of surface water, property boundary, recreational area	Surface water pollution hazard, off-site export of effluent
F	Drainage	Category 1 and 2 soils, gently sloping area	Category 6 soils, sites with visible seepage, moisture tolerant vegetation, low lying area	Groundwater pollution hazard
G	Flood potential	Above 1 in 20 year flood contour	Below 1 in 20 year flood contour	Off-site export of effluent, system failure, mechanical faults
H	Geology and Soils	Category 3 and 4 soils, low porous regolith, deep, uniform soils	Category 1 and 6 soils, fractured rock, gravel aquifers, high porous regolith	Groundwater pollution hazard for porous regolith and permeable soils
I	Landform	Hill crests, convex side slopes and plains	Drainage plains and incise channels	Groundwater pollution hazard, resurfacing hazard
J	Application method	Drip irrigation or subsurface application of effluent	Surface/above ground application of effluent	Off-site export of effluent, surface water pollution

NOTES:

1. Scale shows the level of constraint to sitting on an on-site system due to the constraints identified by SSE evaluator or regulatory authority. See Figures R1 and R2 for examples of on-site system design boundaries and possible site constraints
2. Examples of typical siting constraint factors that may be identified either by SSE evaluator or regulatory authority. Site constraints are not limited to this table. Other site constraints may be identified and taken into consideration when determining setback distances.
3. The level of microbial removal for any on-site treatment system needs to be determined and it should be assumed that unless disinfection is reliably used then the microbial concentrations will be similar to primary treatment. Low risk microbial quality value is based on the values given in ARC (2004), ANZECC and ARMCANZ (2000), and EPA Victoria (Guidelines for environmental management: Use of reclaimed water 2003)
4. Surface water, in this case, refers to any fresh water or geothermal water in a river, lake, stream, or wetland that may be permanently or intermittently flowing. Surface water also includes water in the coastal marine area and water in man-made drains, channels, and dams unless these are to specifically divert surface water away from the land application area. Surface water excludes any water in a pipe or tank.
5. The soil categories 1 to 6 are described in Table 5.1 Surface water or groundwater that has high resource value may include potable (human or animal) water supplies, bores, wells, and water used for recreational purposes. Surface water or groundwater of high environmental value include undisturbed or slightly disturbed aquatic ecosystems as described in ANZECC and ARMCANZ (2000).
6. The regulatory authority may reduce or increase setback distance at their discretion based on the distances of the land application up or downgradient of sensitive receptors.

4 EFFLUENT QUALITY CRITERIA

4.1 Raw Influent Quality

The effluent treatment process assumes that there are no inhibitory or toxic substances within the wastewater that will impair the biological performance of the system. This could include harsh chemicals, excessive quantities of cleaning detergents or fats, oils and greases, or inorganic wastes or hydrocarbons. Waste from on-board chemical toilets in recreational vehicles is not suitable for disposal into an on-site sewage management system.

To achieve the recommended treatment targets from an upgrade of the toilet facilitiy, the raw influent entering the on-site sewage treatment system should fall between the limits of the desired raw influent quality set out below:

Table 2 Characteristics of Typical Untreated Domestic Wastewater

Parameter	Concentration
Flow – non-reticulated water supply	100-140L/p/day
Flow – reticulated water supply	150-300L/pday
Biological Oxygen Demand 5 Day (BOD_5)	200-300mg/L
Total Suspended Solids (SS)	200-300mg/L
Total Nitrogen (TN)	20-100mg/L
Total Phosphorus (TN)	10-25mg/L
Faecal Coliforms	10^3-10^{10}cfu/100mL

Source: Table 9, The Environment & Health Protection Guidelines – On-site Sewage Management for Single Households, 1998

4.2 Treated Effluent Quality

The method of land application chosen to suit the dwelling size and site will determine the treated effluent quality target criteria. Due to the high watertable and significant flood hazard of the site, the effluent is required to have a very high microbiological quality that is suitable for above ground land application.

"Secondary" effluent quality criteria is the minimum required by NSW Health for land application via covered surface drip and shallow sub-surface irrigation <300mm depth, as described in Tables 3 and 4 below.

Table 3 Expected Effluent Quality after Treatment in an Aerated Wastewater Treatment System

Expected Effluent Quality –AWTS	
Biological Oxygen Demand 5 Day (BOD5)	<20mg/L
Total Suspend Solids (TSS)	<30mg/L
Faecal coliforms after disinfection	<30cfu/100mL
Total Nitrogen	25-50mg/L Advanced Secondary
Total Phosphorus	10-15mg/L

Source: Table 14, The Environment & Health Protection Guidelines – On-site Sewage Management for Single Households, 1998.

Table 4 Effluent Quality and Final Application

Source: NSW Health Advisory Note 4 – May 2008 "Sewage Management Facility Accreditation Criteria Based on the Final Application of Treated Effluent and Risk of Disease Transmission".

Land Application System	Waste Material and Waste Management Facility	Treatment Standard Performance Requirement
Sub-soil (> 300 mm depth) • trenches • beds • mounds • off-site transfer • deep drippers	Sewage or Greywater Management • septic tank • collection well • greywater tank • CED pre-treatment tank • biolytic filter • greywater diversion (no treatment) • sewage ejection unit (no treatment)	Primary treatment to separate solids from liquids. No performance standard.
Irrigation • sub-surface (300 mm to 100 mm) • surface and spray irrigation (< 100 mm to above GL)	Sewage or Greywater Management • aerated wastewater treatment system • domestic greywater treatment system • aerobic sand filter • biological filter (which incorporate an active disinfection process)	A secondary treated disinfected effluent to the following accreditation standard is required: • BOD < 20 • TSS < 30 • T. coli < 30
Indoor • toilet flushing • washing machine	Greywater Management only (Sewage may be considered in the future) • domestic greywater treatment system	A secondary treated disinfected effluent to the following standard is required: • BOD < 10 • TSS < 10 • T. coli < 10

5 ESTIMATED TOILET USAGE STATISTICS

Usage data of the park and toilet facilities is limited other than the reported steady increase in the length of stay of overnight campers in both vehicle and tents (TSC Rec. Services, 2014).

In the absence of site specific data, alternative sources of information was used as references. Personal communication with Solo Waste has recorded the current pump-out frequency of the existing waterless compost chamber as generally once every 2 months. This pump out operation requires the addition of water to the dry waste to make a slurry material suitable pumping. This is not considered a useful source of information to develop usage statistics or wastewater flow volumes for an upgraded flushing toilet usage.

Roads and Traffic Authority counts from 29 January 2009 of the usage of the Sleepy Hollow Rest Area (southbound) on the Pacific Highway were previous obtained by HMC from Abigroup. This RTA count recorded 331 day visitors to the toilets, arriving from 143 vehicles, a ratio of 2.3 persons per vehicle, during the hours of 7am to 5am (see Figure 1 below).

The Tweed Road Development Study 2007 (Veitch Lister Consulting, July 2007), presents ultimate daily vehicle movements along Tweed Valley Way northbound, and Pacific Highway northbound, at the point of the Chinderah junction (see Figure 2 below). Using these as an indication of a ratio of 30%,the RTA visitor counts were extrapolated to come up with a figure of approximately 100 visitors/day expected to visit Bruce Chick Park in a similar period, based on this information alone.

There is existing available parking for a maximum of approximately 30 vehicles. This data was used to produce the following usage estimate::

Peak Daily Usage: 50 overnight visitors + 100 day visitors (School + Public Holidays) =
Off Peak Daily (50%): 25 overnight visitors + 50 day visitors

SLEEPY HOLLOW REST AREA SOUTHBOUND usage statistics

	Date: 29 January 2009	Time Start:	7:00 AM	Time Finish:	11:00 AM	Number of people using-		
	Vehicles	Cars w/trailer	Vehicles	Toilets		Rubbish	Playground	Picnic
Time	(Under 6 m)	or Caravan	(over 6 m)	Male	Female	Facilities	Equipment	Areas
7-8 AM	9	0	0	7	5	3	0	3
8-9 AM	6	4	1	12	8	2	0	4
9-10 am	12	0	3	13	9	5	0	2
10-11 am	16	2	2	15	12	3	0	1
TOTAL	**43**	**6**	**6**	**47**	**34**	**13**	**0**	**10**

	Date: 29 January 2009	Time Start:	11:00 AM	Time Finish:	3:00 PM	Number of people using-		
	Vehicles	Cars w/trailer	Vehicles	Toilets		Rubbish	Playground	Picnic
Time	(Under 6 m)	or Caravan	(over 6 m)	Male	Female	Facilities	Equipment	Areas
11-12 PM	11	7	2	16	14	6	1	6
12-1 PM	12	7	4	21	17	7	1	7
1-2 PM	21	7	4	27	23	11	2	16
2-3 PM	16	5	3	21	19	9	1	16
TOTAL	**60**	**26**	**13**	**85**	**73**	**33**	**5**	**45**

	Date: 29 January 2009	Time Start:	~~11:00 AM~~ 3PM	Time Finish:	~~3:00 PM~~ 5PM	Number of people using-		
	Vehicles	Cars w/trailer	Vehicles	Toilets		Rubbish	Playground	Picnic
Time	(Under 6 m)	or Caravan	(over 6 m)	Male	Female	Facilities	Equipment	Areas
3-4 PM	13	5	3	21	14	4	2	8
4-5 PM	16	3	1	19	17	4	2	5
12:00 AM	11	3	1	12	9	3	0	3
TOTAL	**40**	**11**	**5**	**52**	**40**	**11**	**4**	**16**

Figure 1 Usage Statistics, Sleepy Hollow Rest Area Southbound (RTA)

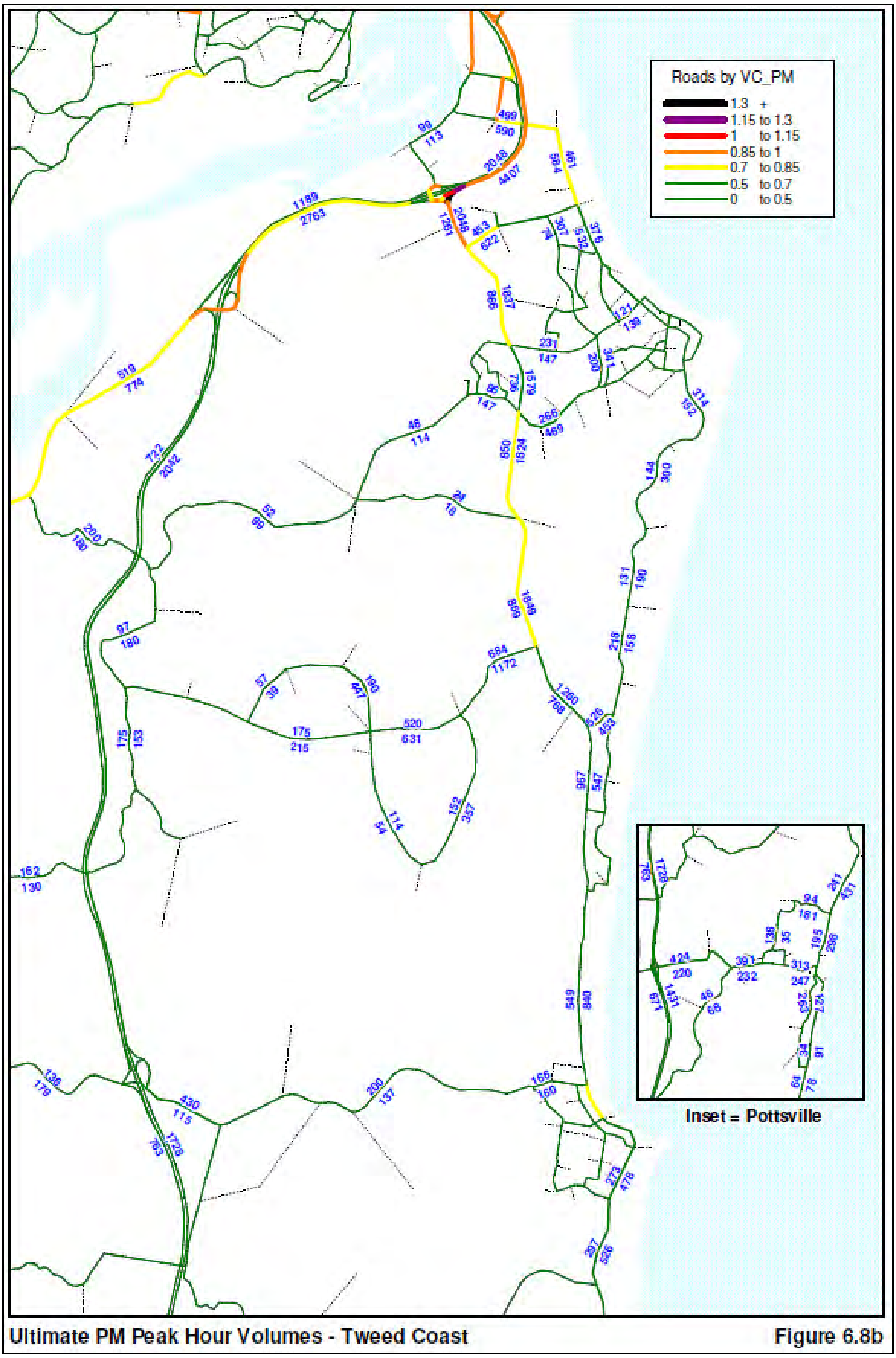


Figure 2 Extract from Tweed Road Development Strategy (VLC, 2007)

6 HYDRAULIC LOADING

According to the 2010 study carried out by the Urban Water Security Research Alliance in South East Queensland (Beal, C. et al, 2010), an average total water consumption of 370.7 litres per household per day (L/hh/d) was recorded during the period of analysis. This represented a per capita average of 145.3 L/p/d (Figure 16).

The average daily per capita water end use breakdown for all SEQ regions analysed was recorded as demonstrated in Figure 1 below:

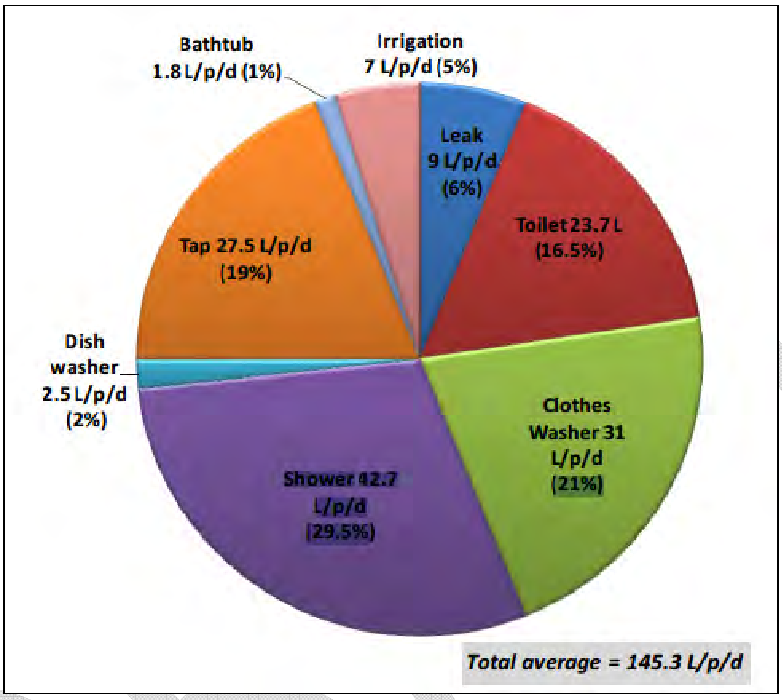


Figure 3 Average Daily Water Use per capita end use breakdown (Beal C. et al, 2010)

In order to estimate the volume of wastewater generated by flushing toilets and handwashing only, the difference in a wastewater flow allowance for a tea room with restroom facilities and without restroom facilities was used, as detailed in Table H4, AS/NZS1547:2012. Using that table, the wastewater flow allowance attributed to flushing toilets and hand washing is 5-10L/diner/day

As demonstrated in Figure 2, a flushing toilet in a domestic household averages 23.7L/person/day of water use, with the use of interior taps contributing 27.5L/p/day throughout the house. It is assumed from the above figures that the wastewater flow allowance generated by the installation of flushing toilets in the upgraded toilet facility will be in the range of 5- 24L/day, depending on the length of stay in the rest area.

Assuming the taps on the wash hand basins would be spring-loaded and the basin sized and designed to discourage use for other ablutions or cleaning purposes, it is considered appropriate to assume a conservative wastewater flow allowance of:

- 15L/p/day for day visitors
- 50L/p/day for overnight visitors (assume 24 hour maximum)

Peak Daily Usage: 50 overnight visitors @ 50L/p/day + 100 day visitors @ 15L/p/day = 4000L/day (115 days/year)
Off Peak Daily (50%): 25 overnight visitors @ 50L/p/day + 50 day visitors @ 15L/p/day = 2000L/day (250 days/year)

7 NUTRIENT LOADING

In consideration of nutrients such as nitrogen and phosphorus, a mass balance was used to estimate the application rate and long term management of the on-site sewage management system based on advanced secondary effluent quality generally readily achievable by small commercial sewage treatment plants, and the wastewater volume assumptions discussed in the previous section.

7.1 Total Nitrogen (TN)

In determination of the required land application area sizing in regard to TN the following data was used.

Table 5 Summary of TN Production in Treated Effluent – based on Source & Discharge Effluent Concentration

Design Treated Effluent Discharge Volume (L/day)	**Target TN Concentration In Discharged Effluent (mg/L)**	**TN Produced Per Year in Treated Effluent kgTN/year**
Expected peak flow: 4000 (School+Public Holidays)	30 mg/L (.00003kg)/L	4000L x 30mg/L =0.12 kg. x 115 days = 13.8kg TN/year
Expected off-peak flow: 2000	30 mg/L (.00003kg)/L	2000L x 30mg/L =0.06 kg. x 200 days = 12.0kg TN/year
TOTAL		25.8 kg TN/year

7.1 Total Phosphorus (TP)

In determination of LAA sizing in regards to TP the following data was used.

Table 6 Summary of TP Production in Treated Effluent – based on Source & Discharge Effluent Concentration

Design Treated Effluent Discharge Volume (L/day)	**Target TP Concentration In Discharged Effluent (mg/L)**	**TP Produced Per Year in Treated Effluent (kgTP/year)**
Expected peak flow: 4000 (School+Public Holidays)	10 mg/L (.00001kg)/L	4000L x 10mg/L =0.04 kg. x 115 days = 4.6 kg TP/year
Expected off-peak flow: 200	10 mg/L (.000010kg)/L	2000L x 10mg/L =0.02 kg. x 200 days = 4.0 kg TP/year
TOTAL		8.6 kg TP/year

8 LAND APPLICATION AREA SIZING AND DESIGN

8.1 Design Model Inputs – Recommended Minimum

No physical, chemical or permeability tests were undertaken on the soils within the available land application area. To provide a realistic assessment of soil properties, multiple tests are required. It is considered that the conservative design inputs are adequate for a preliminary site capacity assessment, based on the site information presented in this report. See Appendix 4 for modelling calculations.

Model Used Draft Richmond Tweed On-Site Regional Strategy (Alderson, 1999). Daily Time Step	
Climate Data	Tyalgum (1971 - 1984)
Wastewater Design Flow Allowance	15L/p/day for day visitors 50L/p/day for overnight visitors.
Wastewater Design Flow	PEAK 4000L/day (50 x o/n + 50 x day) OFF PEAK 2000L/day (25 x o/n + 25 x day)
Total Nitrogen (TN) concentration in treated effluent	30mg/L
Total Phosphorous (TP) concentration in treated effluent	10 mg/L (NOT A LIMITING FACTOR IN LAA SIZING)
Vegetation Removal (TN)	Kikuyu up to 520kg/ha/year (NSW Agriculture 1997) Conservative rate of (250 kg/ha/year) Vetiver Grass 100kg /ha/year (Vieritz et al, 2003)
Vegetation Removal (TP)	20 kg/ha/year (Myers et al 1994)
Phosphorus Adsorption	Minimum 10000 kg/ha/ based on field texture and work carried out by Morand, 1996
DIR (maximum)	10mm/day Amended Sand Mound System 3mm/day shallow sub-surface drip irrigation

8.2 Design Model Sizing – Hydraulic and Nutrient Balance – Secondary Treatment

Analyte (Secondary Quality Effluent)	**Minimum Size of On-site Land Application Area Required Flushing Toilets**			
	Peak Daily (School+Public Holidays) 4000L/day		**Off-peak Daily 2000L/day**	
	Irrigation	**Amended Sand Mound**	**Irrigation**	**Amended Sand Mound**
Hydraulic Load	1850m2	950m2	750m2	380m2
Nitrogen (TN)	1032m2	1032m2	1032m2	1032m2
Phosphorus (TP)	717m2	717m2	717m2	717m2
Design Irrigation Rate (mm/day)	2.2	6	2.1	6
Long Term Acceptance Rate (mm/day)	6	10	6	10

* Elevated disposal bed area only. 1:3 mound face slope on batters is required to calculate actual base of mound footprint and is dependent on bed elevation height

9 SEWAGE MANAGEMENT OPTIONS - DISCUSSION

9.1 Existing Waterless Composting Toilet

The existing waterless composting toilet (WCT) does minimise the volume of wastewater generated by the use of the toilet facilities but is not processing the human waste adequately. No recreational vehicle sullage or chemical toilet waste can be adequately treated by the WCT.

The composting chamber is currently pumped out approximately every 2 months via a Solo Waste 10,000L tanker, demonstrating that the composting process is not working satisfactorily. The liquid waste contractor has advised that the current pumping has to occur by placing the suction pipe directly into the interior toilet pan. The liquid waste contractor has also advised that the material within the compost chamber is dry, and foreign objects are found in the chamber and frequently block the pump. The liquid waste contractor has to apply water to the compost chamber material to enable the pumping to occur. There does not appear to be any associated on-site collection or disposal system for the liquid leachate expected to be generated as a result of the composting process.

NSW Health (Accreditation Guidelines for Waterless Composting Toilets) state that the design assumptions for human waste composition are:

- Faeces 6% nitrogen, Carbon:Nitrogen ratio = 7
- Urine 16% nitrogen, Carbon:Nitrogen ratio = 1.

The relatively high urine load in a public road service facility contributes a significant nitrogen concentration in the effluent entering the composting chamber. To achieve the desired carbon:nitrogen ratio of 14 in the raw waste material, as recommended by NSW Health (WCT Accreditation Guidelines), the additional of sufficient carbonaceous bulking material is required regularly. The effluent is not able to be satisfactorily composted via the waterless composting process without a management commitment to ensure the frequent and regular addition of sufficient bulking materials such as sawdust.

According to the NSW Health, the WCT should be capable of producing a composted end product which is innocuous, free from offensive odours, of a soil like or humus consistency and which complies with the following microbiological criteria:
a) Thermotolerant coliforms < 200 cfu per gram
b) Salmonella nil per gram

A healthy composting process should produce a well-composted soil-like, humus material suitable for burial on the site. The current practice of pumping out the chamber contents does not comply with NSW Health Guidelines for correct operation of the waterless composting toilet.

In 2012/2013 there was a changeover of Pacific Highway facilities at Sleepy Hollow rest stops from composting toilets to flushing systems, and flushing toilets were installed during construction of the Pacific Highway rest stop at Yelgun. This is typical of the Pacific Highway public facilities elsewhere in Australia and serves to demonstrate that is widely acknowledged composting is not sustainable for such public usage.

In addition, the relatively large opening by way of toilet pan design enables the dumping of foreign material into the composting toilet chamber. Recreational vehicle liquid wastes, in the form of sullage or on-board chemical toilet waste, can also readily be discharged into the compost chamber via the relatively wide access provided by the existing toilet pans.

It is also of concern that the compost chamber contents are reported by the liquid waste contractor to be continually dry given the expected high urine content. Should the chamber remain on-site and in use for storage or treatment of effluent, it is strongly recommended that the chamber is to undergo a structural integrity test.

9.2 On-site Sewage Treatment Plant

The alternative option for on-site effluent treatment is a small sewage treatment plant (STP) on the site, based on a primary settling and anaerobic digestion stage, and an advanced secondary aerobic microbial digestion and disinfection stage, to deliver adequate effluent quality criteria for land application within the sensitive environment and site constraints of Bruce Chick Park. No recreational vehicle chemical toilet waste can be adequately treated by the on-site STP. The discharge of raw sullage from recreational vehicle may impact on effluent quality in volumes excessive to the design capacity.

The use of a STP would require the installation of new flushing toilet pans and cisterns, water supply and drainage pipe work. The STP could accept untreated sullage/grey water but not chemical waste from on-board recreational vehicle toilets.

Based on the assumed usage figures, a domestic advanced secondary Aerated Wastewater Treatment System (AWTS) would be suggested to provide adequate effluent treatment of up to 2000L/day. Flow monitoring would be necessary to determine the need for an additional AWTS unit, as usage is expected to significantly increase during school and public holidays.

9.3 On-site Land Application

This option assumes treatment in an on-site sewage treatment plant, as discussed in Section 9.2 above.
No recreational vehicle chemical toilet waste can be adequately treated by the on-site STP. The discharge of raw sullage from recreational vehicle may impact on effluent quality in volumes excessive to the design capacity.

The site constraints of flood hazard, tidal impact and shallow water table of <0.6m, frequent water logging of soil and proximity to the Tweed River present severe limitations to the safe operation of an on-site effluent land application system.

The Environmental & Health Protection Guidelines – On-site Sewage Management for Single Households (NSW DLG et al, 1998) state that due to the risk of transporting wastewater off-site, system failure and electrocution hazard, the following is recommended:

- Land application systems to be site above 1 in 20 year flood contour, and
- Vents, openings and electrical components to be above 1 in 100 year contour.

The toilet facility at Bruce Chick Park is not for residential use and is used by the travelling public only. In lieu of providing the protection of elevation of the system components as above, management measure would need to be put in place during flooding of the land application area to ensure the toilet facility is closed. It is also considered necessary that the effluent treatment and storage tanks itself be encased within an engineered and suitable anchored flood proof structure to prevent structural damage to the system.

Due to the high water table and high risk of water-logging, it is considered that any land application system would require on-site wet weather effluent storage system and associated automatic soil moisture sensors. This would enable a capped daily effluent discharge to be applied to the land, and for effluent distribution to be able to cease if there is excess soil moisture. A groundwater quality monitoring system via the installation of monitoring wells, surface water and soil monitoring would also be recommended to monitor the performance of the on-site land application system.

A preliminary assessment of the soil profile and groundwater depth indicates that the effluent land application system would require to be built up a minimum of 0.5m above the surrounding ground level to achieve the minimum vertical buffer of at least 0.6m above the water table, as recommended by AS/NZS 1547:2012, to avoid the health and environmental risks presented by frequent inundation and waterlogged soil conditions.

To achieve elevation above the 1 in 20 year flood contour of 2.7m AHD) the effluent land application system would have to be built up to a height of 1.7m above the surrounding ground level. in the form of a 1300m2 (40m x 32.5m) irrigation bed..

9.4 Off-site Land Application

This option assumes treatment in an on-site sewage treatment plant, as discussed in Section 9.2 above.
No recreational vehicle chemical toilet waste can be adequately treated by the on-site STP. The discharge of raw sullage from recreational vehicle may impact on effluent quality in volumes excessive to the design capacity.

The application of treated wastewater to an off-site destination is an alternative to be considered as a overcoming the site constraints of on-site solutions.

The off-site disposal would entail:

- the procuring of suitable, flood-free land of minimum 4000 m2 is recommended for the purpose of effluent land application, including 100% reserve land application area,
- installation of a collection well, pumping system and pipe network to facilitate the transport of the effluent to the land application area, with the flood-protection engineering of the equipment recommended within the previous section.

9.5 Off-site Pump Out

According to the "Designing and Installing On-site Wastewater Systems" (SCA, 2012), pump out systems are not sustainable but may be considered in exceptional circumstances where effluent land application on a heavily constrained site is not practical.

Where pump-out systems are approved, the collection well must:

- be large enough for the wastewater flow volume. A larger tank size will decrease the frequency of the pump-out. A minimum of 10,000L pump well is recommended for Bruce Chick Park based on the usage assumptions presented in this report, and
- appropriately designed and/or anchored with collection well and lid have an appropriate weight to ensure no tank buoyancy problems. As discussed in the previous section, the tank itself is to be encased within an engineered and suitable anchored flood proof structure to prevent flood water ingress and structural damage to the system during inundation, and
- equipped with an indicator for wastewater level and an alarm for excess wastewater levels, and
- equipped with a readily accessible pump-out stand with a Kamlock (or similar) cover, and
- equipped with a small spillage well with a valve for the pump-out pipe pumped out regularly by a the liquid waste pump-out contractor.

All RV chemical toilet waste and sullage could be accepted at the toilet facility if this option was implemented.

10 SUMMARY OF OPTIONS FOR SEWAGE MANAGEMENT

Management Option	Capital Works Required	Ongoing Management Works Required	Risk to Environ-ment	Risk to Public Health	User Restrictions
1. Retain Composting Toilet	Retrofit maintenance access to chambers to enable inspection/servicing. Provide leachate collection and disposal system. Undergo structural integrity test on chamber.	Daily inspection/addition of bulking material. Raking of compost heap as required. Prevention of dumping of chemical toilet waste and foreign objects. Microbiological testing of compost material prior to removal and burial on-site.	Low	Medium	No recreation vehicle (RV) sullage or chemical toilet waste accepted.
2. On-site Sewage Treatment and On-site Land Application	Decommission/remove existing compost toilet infrastructure. Install new flushing toilet pedestals and cisterns, plumbing and drainage. Install small commercial sewage treatment plant within flood-proof structure. Construct built up effluent land application system via imported fill to minimum 0.5m above ground level. Minimum 1850m2 recomended.	Minimum quarterly servicing of plant by qualified service agent. Minimum quarterly servicing of irrigation field and equipment. Adequate electrical supply. Prevention of dumping of chemical toilet waste and foreign objects. Effluent quality monitoring. Soil monitoring – microbiological and chemical relevant to effluent disposal. Groundwater and surface water testing as applicable to site	Mediu m	Medium	No recreation vehicle (RV) chemical toilet waste can be accepted. Raw sullage will increase loadings and may impact on effluent quality.
3.On-site Sewage Treatment and Off-site Land Application	Decommission/remove existing compost toilet infrastructure. Install new flushing toilet pedestals and cisterns, plumbing and drainage. Install small commercial sewage treatment plant within flood-proof structure. Purchase/lease of suitable flood-free land minimum 4000 m2 and access/easements as required. Installation of collection well within flood-proof structure, associated pump and pipe network.	Minimum quarterly servicing of plant by qualified service agent. Minimum quarterly servicing of irrigation field and equipment. Adequate electrical supply. Prevention of dumping of chemical toilet waste and foreign objects. Quarterly servicing of irrigation field and equipment. Effluent quality monitoring. Soil monitoring – microbiological and chemical relevant to effluent disposal. Groundwater and surface water testing as applicable to site.	Mediu m	Low	No recreation vehicle (RV) chemical toilet waste can be accepted. Raw sullage will increase loadings and may impact on effluent quality.
4. Pump-out	Installation of minimum 10,000L collection well within flood proof structure. Decommission/remove existing compost toilet infrastructure. Install new flushing toilet pedestals and cisterns, plumbing and drainage.	Regular pump-out by liquid waste contractor. Current pump-out costs are Approximately $370/ pumpout using10kL tanker. Frequency determined by usage, expected range of 2000L- 4000L/day.	Low	Low	All RV waste can be accepted.

11 CONCLUSION

The report has presented as a preliminary site and soil evaluation to explore the options to upgrade the toilet facility at Bruce Chick Conservation Park. Assumptions on usage of the toilet facility have been made in lieu of specific data, and are to be considered as preliminary only.

The option of providing a reticulate sewerage system to connect to the municipal Sewage Treatment Plant at Tumbulgum has already been prepared and reported through the Tweed Shire Council Recreation Services Planning Report.

The appropriate toilet options have been identified and a brief overview of each option has been provided in regard to:

- potential environmental impacts,
- indicative capital works requirements,
- appropriateness for each category of Park user, and
- any on-going management requirements.

Based on the information presented in this report, the following conclusions are made:

- The existing waterless composting toilet is failing and the management requirements to improve and maintain the composting process at acceptable levels are significant and prohibitive for the continued Council management of the public use of the toilet facility at the site.
- The on-site treatment and land application of effluent is not preferred due to the cost and practicalities of the volume of fill required to build up the land application area, the flood proofing of the effluent treatment and storage tanks, and the management requirements for flood events.
- The off-site land application option is considered prohibitive in terms of the infrastructure and procurement of an alternative flood free site.
- The pump-out option enables RV waste to be accepted, but incurs significant infrastructure costs and on-going costs from private liquid waste contractor.

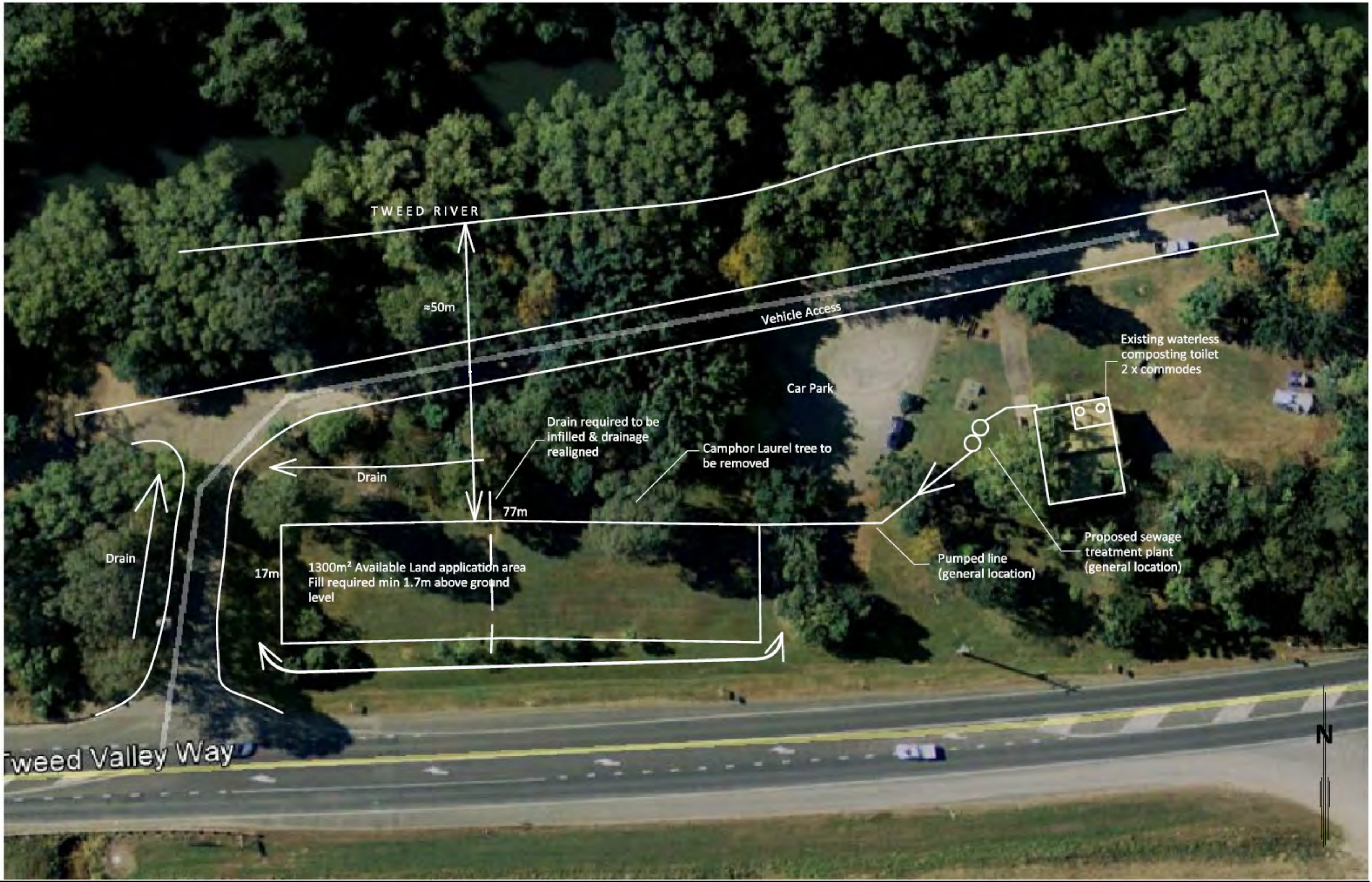
Based on the information presented in this report, it is considered that the on-site treatment and disposal of effluent to the land at Bruce Chick Park will create an unacceptable risk of environmental impact due to the sensitive location and site constraints primarily in terms of high water table and flood hazard.

12 APPENDICES

APPENDIX 1 Site Location

APPENDIX 2 Site Boundary

APPENDIX 3 Available Effluent Land Application Area



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ONSITE SEWAGE MANAGEMENT DESIGN - AVAILABLE LAND APPLICATION AREAS (LAA)

Bruce Chick Park
Tweed Valley Way

Base Drawing Source: NSW Land & Property Information

Job No: 2014.113
Date: Nov 2014
Revision Date:

APPENDIX 4 Modelling

Peak Load: Sub-surface Drip Irrigation on Elevated Irrigation Field

Daily Effluent Disposal Model using Boughton Water Balance Model - Tyalgum
Greg Alderson & Associates Pty Ltd
Period of Rainfall & Evaporation Record: 01/01/1971 - 31/12/1984

Client:	Bruce Chick Park	SCHOOL+PUBLIC HOLIDAYS	
Site:	Sub-surface drip or Spray Irrigation		
Number of Persons	1	equivalent persons	
Daily Flow =	4000	l/day	
Nitrogen Volume per year	25.8	kg/year	25.80 kg N /p/year - See Table 7 & table 8
Denitrification reduce to	25.80	kg/year	0.00 % reduction rate
Plant Uptake rate (N) =	250	kg/ha/year - See Table 6	
Phosphorus in Effluent (Ip) =	8.6	kg/year	8.6 kg P /person/year - see Table 11
P Uptake by plants (Hp) =	20	kg/ha/year - P which is taken up by vegetation, Table 9	
P sorption (Ps) =	10000	kg/ha/m depth - soil sorption capacity, Table 10	
Water Table Depth (Wtd) =	1	m - measured depth to the water table at the disposal site	
Buffer to W table (Bwt) =	0.5	m - adopted buffer to be set above water table	
Time for accumulation of P =	50.00	years	
Min. planted disposal area =	**1032**	m^2 (based on N loading)	
Min. planted disposal area =	**717**	m^2 (based on P loading)	
Hydraulic Area	1850	m^2 (ignored if less than Min. planted disposal area)	
Crop factor =	0.75	See Table 3 and Section- B2.8	
% Effective Rainfall =	75%	See Table 2	
Drainage below root zone/ Percolation =	6	mm/day - LTAR	
% of storage depth at which percolation occurs =	50%	See Section–B2.3	
Depth of topsoil/ Depth of trench =	0.45	m	
Available water/ Void space ratio =	0.175	Available water from Table 1 (m/m)	
Soil Moisture Holding Capacity/ Trench storage =	78.75	mm	
Permissible days overflow =	20	days/year	
Minimum effluent application =	2.16	$mm/day/m^2$	
Max cum stor =	13.28	mm	
Required permissible storage =	0.00	m^3	
Max cum stor =	24.58	m^3	

Peak Load : Amended Sand Mound

Daily Effluent Disposal Model using Boughton Water Balance Model - Tyalgum				
Greg Alderson & Associates Pty Ltd				
Period of Rainfall & Evaporation Record: 01/01/1971 - 31/12/1984				
Client:	Bruce Chick Park	SCHOOL+PUBLIC HOLIDAYS		
Site:	Amended Sand Mound			
Number of Persons	1	equivalent persons		
Daily Flow =	4000	l/day		
Nitrogen Volume per year	25.8	kg/year	25.80	kg N /p/year - See Table 7 & table 8
Denitrification reduce to	25.80	kg/year	0.00	% reduction rate
Plant Uptake rate (N) =	250	kg/ha/year - See Table 6		
Phosphorus in Effluent (Ip) =	8.6	kg/year	8.6	kg P /person/year - see Table 11
P Uptake by plants (Hp) =	20	kg/ha/year - P which is taken up by vegetation, Table 9		
P sorption (Ps) =	10000	kg/ha/m depth - soil sorption capacity, Table 10		
Water Table Depth (Wtd) =	1	m - measured depth to the water table at the disposal site		
Buffer to W table (Bwt) =	0.5	m - adopted buffer to be set above water table		
Time for accumulation of P =	50.00	years		
Min. planted disposal area =	**1032**	m^2 (based on N loading)		
Min. planted disposal area =	**717**	m^2 (based on P loading)		
Hydraulic Area	750	m^2 (ignored if less than Min. planted disposal area)		
Crop factor =	0.75	See Table 3 and Section- B2.8		
% Effective Rainfall =	75%	See Table 2		
Drainage below root zone/ Percolation =	10	mm/day - LTAR		
% of storage depth at which percolation occurs =	50%	See Section–B2.3		
Depth of topsoil/ Depth of trench =	0.45	m		
Available water/ Void space ratio =	0.3	Available water from Table 1 (m/m)		
Soil Moisture Holding Capacity/ Trench storage =	135	mm		
Permissible days overflow =	20	days/year		
Minimum effluent application =	5.33	$mm/day/m^2$		
Max cum stor =	29.32	mm		
Required permissible storage =	0.00	m^3		
Max cum stor =	21.99	m^3		

Off Peak Load: Sub-surface Drip Irrigation on Elevated Irrigation Field

Daily Effluent Disposal Model using Boughton Water Balance Model - Tyalgum
Greg Alderson & Associates Pty Ltd
Period of Rainfall & Evaporation Record: 01/01/1971 - 31/12/1984

Client:	Bruce Chick Park	OFF PEAK		
Site:	Sub-surface drip			
Number of Persons	1	equivalent persons		
Daily Flow =	2000	l/day		
Nitrogen Volume per year	25.8	kg/year	25.80	kg N /p/year - See Table 7 & table 8
Denitrification reduce to	25.80	kg/year	0.00	% reduction rate
Plant Uptake rate (N) =	250	kg/ha/year - See Table 6		
Phosphorus in Effluent (Ip) =	8.6	kg/year	8.6	kg P /person/year - see Table 11
P Uptake by plants (Hp) =	20	kg/ha/year - P which is taken up by vegetation, Table 9		
P sorption (Ps) =	10000	kg/ha/m depth - soil sorption capacity, Table 10		
Water Table Depth (Wtd) =	1	m - measured depth to the water table at the disposal site		
Buffer to W table (Bwt) =	0.5	m - adopted buffer to be set above water table		
Time for accumulation of P =	50.00	years		
Min. planted disposal area =	**1032**	m^2 (based on N loading)		
Min. planted disposal area =	**717**	m^2 (based on P loading)		
Hydraulic Area	950	m^2 (ignored if less than Min. planted disposal area)		
Crop factor =	0.75	See Table 3 and Section- B2.8		
% Effective Rainfall =	75%	See Table 2		
Drainage below root zone/ Percolation =	6	mm/day - LTAR		
% of storage depth at which percolation occurs =	50%	See Section–B2.3		
Depth of topsoil/ Depth of trench =	0.45	m		
Available water/ Void space ratio =	0.175	Available water from Table 1 (m/m)		
Soil Moisture Holding Capacity/ Trench storage =	78.75	mm		
Permissible days overflow =	20	days/year		
Minimum effluent application =	2.11	$mm/day/m^2$		
Max cum stor =	12.66	mm		
Required permissible storage =	0.00	m^3		
Max cum stor =	12.03	m^3		

Off Peak Load : Amended Sand Mound

Daily Effluent Disposal Model using Boughton Water Balance Model - Tyalgum			
Greg Alderson & Associates Pty Ltd			
Period of Rainfall & Evaporation Record: 01/01/1971 - 31/12/1984			
Client:	Bruce Chick Park	OFF PEAK	
Site:	Amended Sand Mound		
Number of Persons	1	equivalent persons	
Daily Flow =	2000	l/day	
Nitrogen Volume per year	25.8	kg/year	25.80 kg N /p/year - See Table 7 & table 8
Denitrification reduce to	25.80	kg/year	0.00 % reduction rate
Plant Uptake rate (N) =	250	kg/ha/year - See Table 6	
Phosphorus in Effluent (Ip) =	8.6	kg/year	8.6 kg P /person/year - see Table 11
P Uptake by plants (Hp) =	20	kg/ha/year - P which is taken up by vegetation, Table 9	
P sorption (Ps) =	10000	kg/ha/m depth - soil sorption capacity, Table 10	
Water Table Depth (Wtd) =	1	m - measured depth to the water table at the disposal site	
Buffer to W table (Bwt) =	0.5	m - adopted buffer to be set above water table	
Time for accumulation of P =	50.00	years	
Min. planted disposal area =	**1032**	m^2 (based on N loading)	
Min. planted disposal area =	**717**	m^2 (based on P loading)	
Hydraulic Area	380	m^2 (ignored if less than Min. planted disposal area)	
Crop factor =	0.75	See Table 3 and Section- B2.8	
% Effective Rainfall =	75%	See Table 2	
Drainage below root zone/ Percolation =	10	mm/day - LTAR	
% of storage depth at which percolation occurs =	50%	See Section–B2.3	
Depth of topsoil/ Depth of trench =	0.45	m	
Available water/ Void space ratio =	0.3	Available water from Table 1 (m/m)	
Soil Moisture Holding Capacity/ Trench storage =	135	mm	
Permissible days overflow =	20	days/year	
Minimum effluent application =	5.26	$mm/day/m^2$	
Max cum stor =	27.91	mm	
Required permissible storage =	0.00	m^3	
Max cum stor =	10.61	m^3	

APPENDIX 5 Site Photos

Photo 1 View west across available land application area (LAA) for on-site effluent distribution.

Photo 2 View East over available land application area (LAA).

Photo 3 Existing stormwater culvert approximately 10m north of available LAA. Discharges directly to Tweed River and is impacted by tidal movement.

Photo 4 Picnic area west of the toilet block.

Photo 5 Picnic area east of the toilet block

Photo 6 Grassed area amongst trees south of the toilet block, and adjacent to the road frontage.

Photo 7 Existing waterless composting toilet, showing aboveground masonry chambers and plastic covers and vents.

Photo 8 View from side of composting chamber showing clearance floor level clearance of 1.8m above ground level.

Photo 9 Compost chamber manholes.

Photo 10 View of toilet facilities and undercover area.

Photo 11

Photo 12
Photo 13