NOTICE OF MEETING

WATER, WASTE AND SEWER ADVISORY COMMITTEE MEETING

A Water, Waste and Sewer Advisory Committee Meeting of Byron Shire Council will be held as follows:

Venue	**Conference Room, Station Street, Mullumbimby**
Date	**Thursday, 31 January 2019**
Time	**11.30am**

Phil Holloway
Director Infrastructure Services

I2019/98
Distributed 24/01/19

CONFLICT OF INTERESTS

What is a "Conflict of Interests" - A conflict of interests can be of two types:

Pecuniary - an interest that a person has in a matter because of a reasonable likelihood or expectation of appreciable financial gain or loss to the person or another person with whom the person is associated.

Non-pecuniary – a private or personal interest that a Council official has that does not amount to a pecuniary interest as defined in the Local Government Act (eg. A friendship, membership of an association, society or trade union or involvement or interest in an activity and may include an interest of a financial nature).

Remoteness – a person does not have a pecuniary interest in a matter if the interest is so remote or insignificant that it could not reasonably be regarded as likely to influence any decision the person might make in relation to a matter or if the interest is of a kind specified in Section 448 of the Local Government Act.

Who has a Pecuniary Interest? - a person has a pecuniary interest in a matter if the pecuniary interest is the interest of the person, or another person with whom the person is associated (see below).

Relatives, Partners - a person is taken to have a pecuniary interest in a matter if:

- The person's spouse or de facto partner or a relative of the person has a pecuniary interest in the matter, or
- The person, or a nominee, partners or employer of the person, is a member of a company or other body that has a pecuniary interest in the matter.

N.B. "Relative", in relation to a person means any of the following:

(a) the parent, grandparent, brother, sister, uncle, aunt, nephew, niece, lineal descends or adopted child of the person or of the person's spouse;

(b) the spouse or de facto partners of the person or of a person referred to in paragraph (a)

No Interest in the Matter - however, a person is not taken to have a pecuniary interest in a matter:

- If the person is unaware of the relevant pecuniary interest of the spouse, de facto partner, relative or company or other body, or
- Just because the person is a member of, or is employed by, the Council.
- Just because the person is a member of, or a delegate of the Council to, a company or other body that has a pecuniary interest in the matter provided that the person has no beneficial interest in any shares of the company or body.

Disclosure and participation in meetings

- A Councillor or a member of a Council Committee who has a pecuniary interest in any matter with which the Council is concerned and who is present at a meeting of the Council or Committee at which the matter is being considered must disclose the nature of the interest to the meeting as soon as practicable.
- The Councillor or member must not be present at, or in sight of, the meeting of the Council or Committee:
  (a) at any time during which the matter is being considered or discussed by the Council or Committee, or
  (b) at any time during which the Council or Committee is voting on any question in relation to the matter.

No Knowledge - a person does not breach this Clause if the person did not know and could not reasonably be expected to have known that the matter under consideration at the meeting was a matter in which he or she had a pecuniary interest.

Participation in Meetings Despite Pecuniary Interest (S 452 Act)

A Councillor is not prevented from taking part in the consideration or discussion of, or from voting on, any of the matters/questions detailed in Section 452 of the Local Government Act.

Non-pecuniary Interests - Must be disclosed in meetings.

There are a broad range of options available for managing conflicts & the option chosen will depend on an assessment of the circumstances of the matter, the nature of the interest and the significance of the issue being dealt with. Non-pecuniary conflicts of interests must be dealt with in at least one of the following ways:

- It may be appropriate that no action be taken where the potential for conflict is minimal. However, Councillors should consider providing an explanation of why they consider a conflict does not exist.
- Limit involvement if practical (eg. Participate in discussion but not in decision making or vice-versa). Care needs to be taken when exercising this option.
- Remove the source of the conflict (eg. Relinquishing or divesting the personal interest that creates the conflict)
- Have no involvement by absenting yourself from and not taking part in any debate or voting on the issue as if the provisions in S451 of the Local Government Act apply (particularly if you have a significant non-pecuniary interest)

RECORDING OF VOTING ON PLANNING MATTERS

Clause 375A of the Local Government Act 1993 – Recording of voting on planning matters

(1) In this section, **planning decision** means a decision made in the exercise of a function of a council under the Environmental Planning and Assessment Act 1979:
  (a) including a decision relating to a development application, an environmental planning instrument, a development control plan or a development contribution plan under that Act, but
  (b) not including the making of an order under Division 2A of Part 6 of that Act.

(2) The general manager is required to keep a register containing, for each planning decision made at a meeting of the council or a council committee, the names of the councillors who supported the decision and the names of any councillors who opposed (or are taken to have opposed) the decision.

(3) For the purpose of maintaining the register, a division is required to be called whenever a motion for a planning decision is put at a meeting of the council or a council committee.

(4) Each decision recorded in the register is to be described in the register or identified in a manner that enables the description to be obtained from another publicly available document, and is to include the information required by the regulations.

(5) This section extends to a meeting that is closed to the public.

BUSINESS OF MEETING

1. APOLOGIES

2. DECLARATIONS OF INTEREST – PECUNIARY AND NON-PECUNIARY

3. ADOPTION OF MINUTES FROM PREVIOUS MEETINGS

3.1 Water, Waste and Sewer Advisory Committee Meeting held on 1 November 2018

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ADOPTION OF MINUTES FROM PREVIOUS MEETING

3.1 That the Minutes of Water, Waste and Sewer Committee Meeting held on 1 November 2018 be confirmed.

3.2 The minutes of the ordinary meeting held on 1 November 2018 were noted and the Committee Recommendations adopted by Council without changes at the Ordinary Meeting held on 22 November 2018

STAFF REPORTS - INFRASTRUCTURE SERVICES

Report No. 4.1 **Murtagh Wetlands Report Update**
Directorate: Infrastructure Services
Report Author: Bryan Green, Water Sewer Systems Environment Officer
File No: I2019/10
Theme: Infrastructure Services
Water Supplies

Summary:

At Council Ordinary meeting held on 21 June 2018 it has been resolved **(18-390)** that Council adopt the following Committee Recommendation(s):

1. *That Council review the state and performance of the West Byron STP Constructed Wetlands and 24 Ha Melaleuca Wetland and advise on future management.*

2. *That a report on scoping of water sensitive design and whole of catchment plan to integrate all works involving West Byron STP, Cape Byron Marine Park, Union Drain Trust and the community come to the next meeting WWSAC.*

3. *That the WWSAC receive a report on the current status of the old sand mining drain/path and its impact on the Belongil catchment.*

Recommendations

That Council note this report.

Attachments:

1 WWSAC Q1_State and performance of Byron Bay STP Constructed Wetlands and 24 Ha - Rev 01_D_24ha_20190116, E2019/4107 , page 8⇩
2 1-181009_2_BelongilWaterCycle-BSC, E2019/3137 , page 38⇩
3 1-181009_03_A_sandminetrack 13.11.18, E2019/3138 , page 56⇩

REPORT

At Council Ordinary meeting held on 21 June 2018 it has been resolved **(18-390)** that Council adopt the following Committee Recommendation(s):

Report No. 4.6 Murtagh Wetlands Report
File No: I2018/952

Committee Recommendation 4.6.1

1. *That Council review the state and performance of the West Byron STP Constructed Wetlands and 24 Ha Melaleuca Wetland and advise on future management.*

2. *That a report on scoping of water sensitive design and whole of catchment plan to integrate all works involving West Byron STP, Cape Byron Marine Park, Union Drain Trust and the community come to the next meeting WWSAC.*

3. *That the WWSAC receive a report on the current status of the old sand mining drain/path and its impact on the Belongil catchment.*

The points below are a response to the resolution:-

1. That council review the state and performance of the Byron Bay STP Constructed Wetlands and 24 Ha Melaleuca Wetland and advice on future management.

A performance and management review has been developed by AWC. The recommendations of this report are:-

a) Recommendations for the future management wetlands includes:
1. Conducting an annual water balance assessment.
2. Undertake a comprehensive vegetation assessment every five years and review the Weed Management Strategy (Bower 2005) as recommended in the Weed Management Strategy (Bower 2005)
3. Undertake six monthly rapid vegetation assessments in areas where active vegetation management works are being undertaken
4. Continue routine weed control works.
5. Include planting of bird resistant macrophyte species as part of routine vegetation maintenance
6. Routine assessments of the constructed wetland infrastructure including pipework, pits, valves, outlets, bunding and liners.
7. Continue the current practice of assessing the infrastructure as part of the planned maintenance program.

b) Recommendations for the future management of 24 hectares includes:
1. Surface soil sampling.
2. Groundwater level monitoring.
3. Water quality monitoring.
4. Conducting of an annual water balance assessment.
5. Completing a vegetation assessment.
6. Conducting a carbon sequestration assessment.

Refer attached report (E2019/4107): 1-181009_01_D_24ha_20190109.pdf

2. That a report on scoping of water urban sensitive design and whole of catchment plan to integrate all works involving Byron Bay STP, Cape Byron Marine Park, Belongil Union Drain Trust and the community come to the next WWSAC meeting.

A scoping brief has been developed by AWC. The recommendations of this report are:

a) To develop a Belongil Catchment Integrated Water Cycle Strategy, considering the following themes:

1. WSUD and demand management.
2. Recycled water.
3. Engagement and education including Indigenous cultural value of water.
4. Leveraging environmental repair from development
5. Restoration of natural floodplain processes.
6. Protecting and enhancing biodiversity and ecological restoration.

b) The Belongil Catchment Integrated Water Cycle Strategy should in consultation with the community and other stakeholders should confirm the extent of environmental offsets required to maintain (and ideally) improve water quality within the Belongil estuary.

This would be achieved via the following steps:

1. Creation of a pollution export model (e.g. MUSIC, Source) for the existing and ultimate developed catchment (say 2050) to quantify pollutant loads and concentrations generated within the catchment.
2. Creation of an ecosystem response model to determine the assimilative capacity of the estuary and the quantity of pollutant reduction required.
3. Create a pollution reduction strategy comprising retro-fit of existing catchments, adoption of best practice WSUD in new developments and identifying locations for strategic environmental repair to reinstate floodplain processes which can deliver water quality (and biodiversity) improvements.
4. The Belongil Catchment Integrated Water Cycle Strategy should investigate funding options and structures which could be adopted by Council with the strategy informing Council's DCP and LEP.

Refer attached report (E2019/3137): 1-181009_2_BelongilWaterCycle-BSC

3. That the WWSAC receive a report on the current status of the old sand mining drain/path and its impact on the Belongil catchment.

A technical memorandum has been developed by AWC . The recommendations of this memo are:

1. Thus the hydrology of the catchment is highly modified; the effect of the sand mining tack/drain on the hydrology in the overall catchment is indiscernible. Although further in depth hydrological studies are required to determine the possible role or impact the mining drain may have in the upper Belongil catchment, early visual indicators reveal the drain has a minimal affect. However, the conclusion made from the visual observations, indicate the railway track appears to have a greater influence on the catchment hydrology.
2. The impact of the drain must be studied and included in the Belongil Catchment Integrated Water Cycle Strategy.

Refer attached report (E2019/3138): 1-181009_03_A_sandminetrack 13.11.18

Leading environmental solutions...

AWC

Photo source: NearMaps (July 2018) (NTS)

Byron Bay Sewage Treatment Plant

Performance and Management Review of Constructed Wetlands and 24 Hectare Irrigation Area

Project control

Project name:	**Byron Bay Sewage Treatment Plant** Performance and Management Review of Constructed Wetlands and 24 Hectare Irrigation Area
Job number:	1-181009_01_D
Client:	Byron Shire Council
Contact:	Bryan Green

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Date:	Revision:	Prepared by:	Reviewed by:	Distributed to:
31/10/2018	A	Jesse Munro	Damian McCann	Bryan Green (BSC)
18/12/2018	B	Jesse Munro	Damian McCann	Bryan Green (BSC) Claudio Germany (BSC)
07/01/20189	C	Jesse Munro	Damian McCann	Bryan Green (BSC) Claudio Germany (BSC)
16/01/2019	D	Jesse Munro Damian McCann	Damian McCann	Bryan Green (BSC) Claudio Germany (BSC)

Executive Summary

A meeting of Byron Councillors have requested the Water and Sewer section of Council to *"...review the state and performance of the Byron Bay STP Constructed Wetlands and 24 Ha Melaleuca Wetland and advise on future management."* In turn AWC have been engaged to respond to this question and/or identify future management requirements.

Generally, both the constructed wetlands and 24 hectare irrigation area are performing well and are in good condition.

With regard to the constructed wetlands:

- The constructed wetlands are performing very well in terms of pollutant reduction
- There has not been any exceedance of the EPL at the outlet of the wetland complex to the Belongil catchment
- The macrophyte vegetation in the wetlands is mostly in line with industry standard however there are areas that are bare or have open water; these have been deliberately left for migratory bird habitat
- There are some areas with extensive weed growth

Recommendations for the wetlands include:

1. Install flow meter to isolate volumes being diverted to the constructed wetland system
2. Undertake a comprehensive vegetation assessment every five years and review the Weed Management Strategy (Bower, 2005) as recommended in the Weed Management Strategy (Bower 2005)
3. Undertake six monthly rapid vegetation assessments in areas where active vegetation management works are being undertaken
4. Continue routine weed control works
5. Include planting of bird resistant macrophyte species as part of routine vegetation maintenance
6. Continue the current practice of assessing the infrastructure as part of the planned maintenance program.

Comparison of current monitoring of the 24 hectare irrigation area with that stipulated in the operation management guidelines (Bonner, 2007) shows that monitoring effort needs to be increased. Three water quality loggers being installed in the irrigation area to enhance the current monitoring if the irrigation area in line with the s=suggestions in the management plan (Bonner 2007).

Recommended monitoring for the 24 hectares includes.

7. Surface soil sampling
8. Groundwater level monitoring
9. Water Quality Monitoring
10. Conducting of an Annual Water Balance
11. Completing a vegetation assessment.
12. Review and update Bonner (2007).

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1 Introduction and Background

1.1 Aims and Objectives

Byron Councillors have requested Council's Utilities, Infrastructure Services to:

> *"...review the state and performance of the Byron Bay STP Constructed Wetlands and 24 Ha Melaleuca Wetland and advise on future management."*

In turn AWC have been engaged to respond to this question and/or identify future management requirements.

The report summarises the existing management aims with comparison to the current management of the site and provides some recommendations for further detailed assessments and/or works.

The report is divided into two key sections, in line with the information request from Councillors, namely assessment of the Constructed Wetlands, and the 24 Hectare Wetland Irrigation Area, with each section detailing the 'state' and 'performance' of each asset.

2 Constructed Wetlands

Part of the BBSTP treatment are the constructed wetlands used as polishing ponds. These are a multi celled treatment system that improves discharge water quality after treatment in the STP; they also remove hydraulic loads through evapotranspiration and are important habitat. Figure 2-1 shows the extents of the constructed wetland system.

Water is drawn from the constructed wetlands for irrigation re-use on site (refer Section 2.3) with the remainder being discharged to the environment at the EPA approved location. Buffer storage during peak flows is a function of the constructed wetland complex. Cell H (refer Figure 2-1 – highlighted in blue) is not generally used for treatment, its purpose is to provide habitat for water birds and bird watching.

Figure 2-1 Constructed wetlands at Byron STP (bordered red), Cell H in blue (Source: NearMaps) (NTS)

An assessment of the state and performance of the constructed wetlands is the primary aim of this section of the report and is detailed in the sections below.

2.1 Assessment of the 'State' of the Constructed Wetlands

The state of the constructed wetlands is based on an assessment of the infrastructure and the vegetation, as detailed below.

2.1.1 Infrastructure

A preliminary review of wetland infrastructure was undertaken to inform this report. The compacted bunds used for containment appear structurally sound through the main thoroughfares and the pipework and delivery network is functional. There are no reports from staff of failing infrastructure or significant repairs being required beyond routine maintenance.

Routine inspection of the infrastructure is undertaken by BBSTP personnel, including pipework, valves, pits, bunds and lining.

2.1.2 Vegetation

No quantitative vegetation survey has been completed at the constructed wetlands for this assessment however the following findings are based on observations from a site walk over:

- There are areas of the constructed wetlands that do not have vegetation coverage; these have been deliberately left in this condition for diversity of habitat for migratory water birds
- There is *Typha spp* sporadically through the constructed wetland system. Although considered a weed in many situations, Typha does have benefits in wastewater treatment wetlands and is not considered a concern.
- There are large areas where the aquatic weed Parrots Feather (*Myriophyllum aquaticum*) is prevalent. There has been some attempt at control using foliar application herbicide however it is proving difficult due to the submerged root system re sprouting after initial die back. Alternative control methods are planned to be trialled including covering with tarp or black plastics and draining and mechanical removal using a small excavator or similar. It is likely that control of this species will be an ongoing challenge.
- Hairy Commelina (*Commelina benghalensis*) is also present within the cells and can suppress native macrophytes.
- Native macrophytes are prevalent throughout the system, though high bird numbers (Swamp Hens) is known to restrict the spread and abundance of certain species. This is particularly so of some macrophyte species that are preferred by waterbirds such as Jointed Twigrush (*Baumea articulata*) and *Eleocharis sp.*

2.1.2.1 Weeds

The constructed wetlands form Management Zone 2 in the West Byron Sewage Treatment Plant Weed Management Strategy (Bower 2005). Management Zone 2 is sectioned into three sub-zones labelled as the Constructed Effluent Polishing Cells (CEPC):

- CEPC 1-2: recently constructed/sedges
- CEPC 3-4: established/Melaleuca
- CEPC 5–6: recently constructed – Typha and sedges

The Weed Management Strategy (Bower 2005) is a comprehensive document however it is now 13 years old and many areas have established and stabilised and much of the document requires updating. It is recommended the Weed Management Strategy is revised, with emphasis on the constructed wetlands. The Weed Management Strategy (Bower 2005) suggests vegetation surveys

be undertaken every 6-12 months in areas that are undergoing active management and comprehensive vegetation surveys be undertaken over the whole STP site every five years.

2.1.3 Conclusion and Recommendations

Although vegetation in the constructed wetlands appears sufficient to achieve water quality objectives, maintaining plant cover is an ongoing requirement and there is the potential for a decline in plant health or for aggressive weed species to spread.

Bower (2005) recommends biannual or annual rapid vegetation assessments and this is agreed with. These rapid assessments should determine temporal distribution and abundance of weed and native species and identify any listed weeds within the constructed wetlands. This will inform weed management going forward. Additionally, a comprehensive vegetation assessment, as recommended in the Weed Management Strategy (Bower 2005), is overdue and would form part of a review and update of the strategy.

As part of the routine maintenance budget a replanting allocation should be made. Species selection should include macrophyte species less susceptible to bird predation including species such as Grey Rush (*Lepironia articulata*), Giant Sedge (*Cyperus exaltatus*) and Phragmites (*Phragmites australis*).

Weed control in general and in particular Parrots Feather and Hairy Commelina should continue on a routine basis with the other control options trialed.

An assessment of the constructed wetland infrastructure is recommended to be undertaken.

2.2 Assessment of the 'Performance' of the Constructed Wetlands

The aim of the constructed wetland system is to provide additional treatment to the STP discharge with additional benefits of habitat value and peak flow buffer storage. Water quality improvements and habitat value are assessed and discussed as indicators of the constructed wetland performance.

2.2.1 Water Quality

Water quality monitoring is required as part of the Environmental Protection License (EPL) for the Byron Sewage Treatment Works; EPL Number 3404 issued by the NSW EPA. An assessment of the data collected over the past year (10/05/2017 – 24/04/2018) has been completed to evaluate the 'performance' of the constructed wetlands.

The EPL has five nominated monitoring points, though only three are relevant to the performance of the constructed wetlands.

Table 2-1 provides a summary of the relevant sample locations. The data sets for monitoring points EPA1, EPA3 and EPA4 are provided in Appendix A.

Table 2-2 provides a summary of the recorded water quality values and a calculated reduction rate based on concentrations. For each of the parameters an average concentration value was calculated and a reduction rate (%) based on those average values determined. This is a relatively coarse assessment but illustrates general performance in terms of concentration reduction.

Not all analytes are tested at EPA4, reduction rates between EPA1 and EPA3 were then calculated.

This is problematic as the section of constructed wetland prior to the EPA3 draw point is forested wetland and is known to have a high bird population which impacts water quality parameters particularly fecal coliforms (FC).

Table 2-1 Sampling location summary and relevance to data review

EPA ID No.	Location	Relevance
EPA 1	Discharge point to the constructed wetland from the outlet of the STP	This is the representative of the constructed wetland influent water quality and will be compared with other data to determined reduction rates.
EPA 3	Discharge to re-use (24 ha irrigation area), mid-way through constructed wetland system.	Partly treated water.
EPA 4	Discharge from constructed wetland system to the environment.	This represents the final treatment water quality prior to discharge. These values will be compared with EPA 1 values to determine pollutant reduction.

Based on the concentration reduction of FC, TN and TP between the constructed wetland inlet (EPA1) and discharge to the environment (EPA4) the wetland is performing very well. FC values decrease overall through the system (76%), despite the substantial increase (239%) through the first stage of the wetland system suspected to be due to the bird population.

TN and TP concentration values decrease by 47% and 36% respectively between the inlet (EPA1) and outlet (EPA4) of the constructed wetland system. Nitrate (NH_3-N) concentration was reduced by 41% between EPA1 and EPA3.

Table 2-2 Average of recorded values and calculated concentration reduction

Parameter	Average of values			Reduction between EPA1 and EPA3	Reduction between EPA1 and EPA4
	EPA1	EPA3	EPA4		
BOD (mg/L)	1.57	2.1	--	-34%	N/A
Faecal coliforms (cfu/100mL)	213.6	725.0	51.42	-239%	76%
Grease & Oils (mg/L)	2.14	2.02	--	6%	N/A
NH_3-N (mg/L)	0.43	0.25	--	41%	N/A
TN (mg/L)	1.67	1.16	0.89	31%	47%
TP (mg/L)	0.11	0.1	0.07	9%	36%
SS (mg/L)	3.78	4.33	2.04	-14%	46%
pH (units)	7.16	7.22	--	-1%	N/A

Notes:
1. A negative % reduction value (e.g. -34%) is an increase in concentration
2. Not all parameters are required at all sites as part of EPL 3040; analysis additional to requirements is undertaken by BSC and included in the summary.

2.2.1.1 Concentration Exceedances

EPL 3404 provides concentration limits for the environmental discharge (EPA4) shown in Table 2-3.

The 100th%ile (maximum) value is 0.14 mg/L compared to a license concentration limit of 1.0mg/L. The calculated 90th%ile value of 0.13mg/L is also lower than the relevant concentration limit. Therefore there have not been any exceedances of the concentration limits set for EPA4 (environmental discharge) by EPL 3404. No comment on concentration exceedance at EPA1 is made as it is irrelevant to the performance of the constructed wetland.

Table 2-3 Concentration limit and calculated percentile values for discharge to the environment (EPA4)

Pollutant		
Phosphorus (TP)	EPL Concentration limits	Recorded values
90th%ile limit	0.3 mg/L	0.13 mg/L
100th%ile limit	1.0 mg/L	0.14 mg/L

2.2.1.2 Predicted pollutant reduction

Initial modelling undertaken by Australian Wetlands (2006a, 2006b) provided predicted discharge concentrations as shown in Table 2-4. The Reed model is considered conservative and rarely applicable in local conditions. The current average outlet concentrations are compared in the table. The selected pollutant concentrations recorded at the outlet are substantially below the concentrations expected using the Kadlec and Knight model.

Table 2-4 Predicted outlet concentrations (Australian Wetlands, 2006a/2006b) compared with current outlet concentrations

Model	TSS	TN	TP
Kadlec and Knight	6.16	1.75	0.29
Reed	0.82	0.03	0.28
Average recorded value# (EPA4)	2.04	0.89	0.07
# average values of the data set (10/05/2017 – 24/04/2018) shown, expanded data provided in Table 2-2, Table 2-3 and Table A0-3.			

2.2.2 Habitat

The habitat value at the site, particularly for water birds is high. There are routinely threatened species using the wetlands and mudflats for foraging and nesting with the forested cells providing roosting for other species. The community based group, Byron Bird Buddies, and other community members uses the site regularly for bird watching. Byron Bird Buddies have produced a guide (Birds of the Byron Wetlands – A Birdwatchers guide to the Wetlands http://www.byronbirdbuddies.com.au/wp-content/uploads/2017/03/BBB-Birdwatchers-Guide_onlinePDFfinal.pdf) listing 227 potential species known to use the wetlands.

2.2.3 Discharge Volume

Discharge volumes leaving the site are monitored at EPA-4. The values are determined using a V-notch weir and a water level logger with subsequent calculations collated on an hourly basis and distilled to provide a daily volume. The precision of this system has not been tested though is understood to be acceptable to meet the objectives.

Based on a year long data set to 28th November 2018, a summary of daily discharge to the environment (EPA4) is provided in Table 2-5. There are no specific volumetric discharge limits set by the EPL. There is a large range of daily discharge volumes; 12.29-0.32ML/day; the values at the

extents of the data set (minimum and maximum) are unlikely to be a true representation of flows and may be a result of unit malfunction, flood conditions or other factors affecting the water levels in the V-notch stilling pool (ie blockage of flows). The average/median values are 4.23ML/day and 3.92ML/day respectively. The range is dictated by high rainfall periods, high seasonal population variability in the Byron Bay township, evaporation and reuse/irrigation volumes drawn for the system.

Table 2-5 compares the data statistics from the 4 monitoring sites. There are substantial hydraulic losses through the wetland system due to evapotranspiration, and re-use both in the irrigation area and the urban irrigation sites. The losses are more apparent during low to medium flow periods; 76% of flow is lost at the minimum flow rate while a 44% and 24% hydraulic reduction is achieved at the 25th%ile and 50th%ile (median) data range respectively. Reductions stop completely in higher flows with a 12% and 21% increase at the 90th%ile and the maximum flow respectively.

Table 2-5 Summary statistics of daily discharge volumes at EPA2, EPA3, EPA5 and EPA4 (discharge to environment)

Statistic	Value (ML/day)				Reduction#	
	EPA2	EPA3	EPA5	EPA4	ML/day	%
max	10.13	3.23	1.31	12.29	-2.16	-21%
min	2.94	0.00	0.32	0.69	2.25	76%
average	5.18	0.52	0.70	4.23	0.94	18%
median	5.14	0.53	0.64	3.92	1.22	24%
25th%ile	4.63	0.15	0.62	2.60	2.04	44%
75th%ile	5.63	0.64	0.69	5.58	0.05	1%
90th%ile	6.27	1.08	1.01	7.05	-0.78	-12%
95th%ile	7.06	1.51	1.18	7.83	-0.77	-11%

EPA2 represents total raw sewage flow to the STP; EPA3 represents flow to effluent re-use (irrigation area); EPA5 represents the flow to the urban reuse; EPA4 represents flow to the environment (V-notch)
Data for EPA2, EPA3 and EPA5 provided by BSC
reduction between EPA2 (STP inlet) and EPA4 (final outlet) – includes re-use

The limitation with this comparison and analysis is the lack of specific flow data for the discharge to the wetland system; there is data for the total sewage influent to the STP, and flow values taken out of the system for re-use (irrigation and urban). The reduction values shown include the portions removed through re-use. In order to undertake accurate water balance calculations it is recommended there is a flow meter installed on the pipework after the UV disinfection system of the STP and prior to the discharge to the constructed wetland system. This would be aimed at isolating the flows discharged to the constructed wetland system.

2.2.4 Conclusion

Based on the treatment function and lack of discharge concentration exceedances the constructed wetland is performing very well. Although the bird population seems to be worsening some water quality parameters (Faecal coliforms) through the front end of the wetland system, the concentrations are decreased overall between the inlet and the outlet. Additionally, the habitat value for the birds is clearly high and so contributes to the site's biodiversity values.

TP values are routinely below the accepted modern technology standard of 0.3mg/L as stated in the EIS for the wetland complex. 0.3mg/L TP is also the 90th%ile discharge value in the EPL. The

recorded TN reduction rate of 47% approximates the generally accepted reduction rate of 50% expected in constructed wetlands for wastewater treatment; this value is expected to be higher without the significant bird (Ibis, swamp hens) population roosting in the wetland depositing nutrients.

There are substantial hydraulic losses from the constructed wetland system, particularly during the low-medium flow regimes. This based on interpolation of data to assume a flow to the constructed wetlands. It is recommended to install a flow meter on the inlet to the constructed wetland system to isolate flow values entering the constructed wetland system; this data will be used to undertake more accurate water balance equations.

2.3 Additional values

Although the constructed wetland system is designed with the primary aim of water treatment they have other values that are not necessarily assessed, monitored or quantified:

- Valuable community engagement and recreational space is provided at the wetlands
    - The primary function of wetland Cell H is for water bird habitat, both sedentary and transient/migrating species
    - The bird hide is a renowned spot for bird watchers in the local area and beyond
    - An interpretation centre at the wetlands is often used by community groups and education
- Carbon sequestration is an added process that is desirable in the current environmental climate; there has not been any site-specific study into the capacity of the carbon sequestration at the constructed wetland system
- The constructed wetland system acts as a buffering system allowing a relatively steady discharge rate to the environment
    - During peak loads flows can be throttled back and volumes retained in the cells
    - They can act as contingency operation emergency storage

3 24 Hectare Wetland Irrigation Area

Figure 3-1 shows the outline of the 24 hectare irrigation area. The area to the north of the central drain has existing irrigation infrastructure; the southern section is not currently irrigated. Both central and southern drains flow to the west meeting with the upper Union Drain network and eventually the Belongil Creek estuary system.

Figure 3-1 24 hectare irrigation re-use area (bordered yellow); central and southern drains shown red (Source: NearMaps) (NTS)

3.1 Existing Operation and Management Guidelines

The existing operational management is informed by two key documents:

The Byron Effluent Reuse Wetland Scientific Report. Bolton (2006).

Effluent Reuse & Wetland Regeneration (24ha site): Operational & Management Guidelines. Bonner (2007)

The Bolton (2006) report provides a few key management aims that need to be addressed in order to reduce environmental impact but specific maintenance actions or schedule. The Bonner (2007) report builds on the Bolton (2006) report and suggests ongoing monitoring and management in an

adaptive management framework. Management has been divided into the following sections:

- Melaleuca Plantation: Management and Maintenance
- ASS Management
- Irrigation: Water Demand
- Irrigation: Operation & Maintenance
- Monitoring [groundwater, soil, weather]
- Biodiversity Management
- Weed Management and Maintenance
- Feral Animal Management

The *Effluent Reuse & Wetland Regeneration [24ha site]: Operation and Management Guidelines* (Bonner 2007) document provides guidance; refer Table 3-1, Table 3-2, Table 3-3, and Table 3-4. Other guidance provided in that document but not presented here includes:

- Melaleuca Plantation. Described replanting, irrigation, wallaby predation and monitoring. Not relevant at this stage as the vegetation is well established.
- Biodiversity Management, Weed Management and Maintenance, and Feral Animal Management: Describes activities and ensures compliance with other supporting documentation, i.e. Biodiversity Management Plan, Weed Management Plan, and Feral Animal Management Plan.

3.1.1 Management Aims

Bolton (2006) suggested water table management (below surface level) in the irrigation area:

A) Do not allow the water table to drop below 600 mm.

Reason: *To prevent oxidation of the subsurface pyrite layer and the subsequent rapid release of high concentrations of acid products and metals.*

Management implications: *careful monitoring of water tables, and prioritization of effluent to the Melaleuca wetland if water tables fall to 600mm.*

Management notes: *The subsurface pyrite layer is generally situated 800 mm or lower in the peat profile, however it is more shallow in certain areas. Maintaining the water tables above 600 mm will provide a buffer against subsurface pyrite oxidation.*

B) Minimise surface ponding

Reason: *To reduce the rate of surface pyrite formation during periods of waterlogging*

Management implications: *Do not over irrigate, especially after rainfall events, careful monitoring of water tables. Develop a good knowledge of micro-topography of the site.*

Management note: *studies of pyrite dynamics have demonstrated that surface pyrite forms more rapidly in areas where water pools above the ground surface.*

C) Fluctuate the water table regularly

Reason: *To reduce the rate of surface pyrite formation during periods of waterlogging*

Management implications: *well-organised management schedules are required to allow the water table to fluctuate.*

Management note: *studies of pyrite dynamics have demonstrated that surface pyrite forms more rapidly when water tables remain stable compared with when water tables are allowed to fluctuate. The higher the frequency of fluctuation, the greater the pyrite inhibiting effect.*

D) Lower the water table if groundwater pH approaches a maximum value of 5.2

Reason: *to (i) halt the alkalinisation processes of pyrite formation and effluent dilution, and to main acid levels within the limits acceptable to acid frogs, and (ii) oxidize surface pyrite to prevent high concentrations from forming*

Management implications*. Careful monitoring of water tables and pH.*

Management notes. *It is important to consider that the peat soils of the Byron Effluent Reuse Wetland are naturally acidic, which has developed an acidophilic ecosystem. pH generally increases above 5.2 (the upper breeding limit of the threatened acid tolerant frogs on site) only after prolonged periods of waterlogging. A high pH is indicative that surface pyrite is accumulating to unacceptable levels.*

E) Raise the water table if groundwater pH approaches a minimum value of 3.

Reason: *To prevent groundwater pH from dropping below the range suitable for the acid tolerant frogs*

Management implications: *Careful monitoring of groundwater levels and pH.*

Management notes: *excessively low pH levels occur when water tables drop below the subsurface pyrite layer, although careful water table monitoring and management should mitigate this risk. Increasing the levels of the water table should increase the pH through the processes of effluent dilution and pyrite formation, and by preventing oxidation of the subsurface pyrite layer.*

F) Lower the water table if surface pyrite concentrations exceed 0.15%

Reason: *to prevent excessive surface pyrite formation and the subsequent rapid acid production when water tables are lowered.*

Management implications. *Surface pyrite monitoring programme.*

Management notes. *Surface pyrite forms in response to prolonged waterlogging. Concentrations exceeding 0.15% may form over a 3 month period. A management aim is to prevent excessive or rapid changes in groundwater chemistry in order to minimize stress to local fauna and flora.*

Groundwater level monitoring recommended (Bonner, 2007) includes:

- Weekly water table depth measured at five piezometer locations and the central weir

(within the ASS Management section)

3.1.2 ASS Management

The key management action at the site is fluctuation of groundwater level to reduce the formation of surface pyrite. Monitoring of groundwater levels includes water level data loggers at three locations in the wetland. The existing ASS management detailed in the O&M (Bonner 2007) is summarised and provided in Table 3-1. Many of the actions are not being completed and recorded on a routine basis.

Table 3-1 Existing ASS management and monitoring as per the O&M (Bonner, 2007, Table 4 ASS Management: Task Summary, p. 38-39)

Management Issue	Action Required	Comment
Groundwater: Monitoring		
- Water-table height	- Measure and record weekly at each of the five piezometer locations, plus boundary piezometers.	Frequency of monitoring was reduced due to lack of change observed. Three existing piezometers with water level logging data extracted monthly. Proposed new piezometers
- Physico-chemical	- Download data weekly, at each of the five piezometer locations, from the 90- FLMV data-logger to laptop computer.	Frequency of monitoring was reduced due to lack of change observed. Proposed to re-establish TPS water quality logging for conductivity, temperature and pH
- Soluble metals analysis	- Annual for Fe & Al (sample from the five piezometer sites)	Frequency of monitoring was reduced due to lack of change observed.
- Data management	- Maintain MS Excel database (or other as required): report as required	Will be instigated once data is collected.
Groundwater: Depth Variation		
- Depth	- Maintain water-table above 60cm - Raise water-table at earliest opportunity if it drops below 60cm	Manually/visually monitored by STP staff, not recorded but actioned.
- 3 monthly	- Lower water-table to 30 cm and maintain for one month, then - Raise water-table to surface and maintain for three months. - Avoid prolonged (> 3mths) surface waterlogging; lower water-table at earliest opportunity if this occurs. (This is the minimum water-table cycling required to allow controlled, regular oxidation of sulfides in the upper soil profile; and to decrease the build-up of re-formed sulfides).	Manually/visually monitored by STP staff, not recorded but actioned.
- pH < 3.5	- Apply effluent if possible	pH not monitored on a routine basis.
Drain Monitoring & Management (ASS export prevention)		
- Water monitoring	- Depth below surrounding soil surface (weekly). - Fe & Al (as for routine STP/ off-site drain monitoring) - DO, pH, EC, Eh, Temp (ongoing using 90-FLMV data-logger)	Three existing piezometers with water level logging data extracted monthly. Proposed new piezometers
- Infrastructure	- Reconstruct V-notch weirs on Central and Southern drains (or fill drains in) to impede	Drain clearing works have been

Management Issue	Action Required	Comment
	outflow and assist in maintaining higher water tables.	undertaken (Oct/Nov 2017) with drop board structure lowered. This is expected to lower the water level in the drain network and thus groundwater/surface water.
- Water Depth	- Maintain water level above 30cm depth (i.e. 30 cm below embankment) where possible. To assist in maintaining water-table height on-site.	Water levels are monitored visually by STP staff but not recorded
- pH < 4.0	- Minimise flow across weir. - Re-commence irrigation if paused (add effluent directly to drain if possible).	pH of groundwater or drain water not routinely monitored
Soil Sampling & Analysis		
- Annual	- Test for sulfide content a) 0 – 40 cm (0-5, 5-10, 10-15, 15-20, 20-30, 30-40 cm) b) 0 – 200cm (0-5, 5-10, 10-15, 15-20, then 10 cm intervals)	Soil sample collection and analysis is not done on a routine basis.

3.1.3 Irrigation – Distribution and Infrastructure

Irrigation distribution and infrastructure monitoring details in accordance with the O&M (Bonner, 2007) are provided in Table 3-2and Table 3-3 below. Completion of the tasks detailed occurs only intermittently due to staffing capacity. The actions should be reviewed and updated in consultation with Council staff to ensure they remain appropriate.

Table 3-2 Irrigation management and monitoring, as per the O&M (Bonner 2007, Table 12 Irrigation: Task Summary, p 51)

Management Issue	Acton Required	Comment
Irrigation: Water Demand		
- Even water distribution	- Check irrigation scheduling; clear infrastructure blockages; measure water-table depth.	-
- Seasonal flow variation	- Adjust daily flow according to seasonal demand (see Figure 7 or 8).	-
- Rainfall & flooding	- Reduce or cease irrigation.	-
- Flow volumes	- Record and maintain data-base.	-
- Crop water demand	- Annual review of water balance model predictions vs. actual field conditions.	-

Table 3-3 Irrigation network and monitoring, as per the O&M (Bonner 2007, Table 14 Irrigation network: routine maintenance and monitoring, p 55)

Management Issue	Acton Required	Comment
Irrigation network		
- Distribution chamber: - Distribution valve - Coarse screen - Fine screen	- Select distribution as required (cells I, J or H, or 24ha site) - Clean daily - Clean daily	-
- Pump	- Test for running: visual in-field check of pipes or at main pump control station adjacent the Interpretive Centre.	-
- Flow Data	- Flow to be recorded in daily log sheet.	-

Management Issue	Acton Required	Comment
	Cumulative flow to be noted, from the MagFlow, and forwarded to Dean Baulch.	
- Pressure release valve	- Visual inspection only (when running): check pressure on vacuum gauge, check vacuum pipes and other cables connected.	-
- Paddock valve(s)[SV]	- Select valve on/ off depending on irrigation requirements for individual paddocks.	-
- High risers	- Check flow (visual) for approximate 'balance' along the laterals.	-
- General	- Visual inspection of: - Pipe-work for damage e.g. root or plant debris intrusion. - Risers for balance, damage, blockage.	-

3.1.4 Groundwater

Three groundwater level loggers have been installed in the irrigation area with monthly data collection occurring. Additionally, water level is manually fluctuated between surface, 300mm and 600mm depth. Table 3-4 provided the requirements of the O&M (Bonner 2007) with regard groundwater management at the site with comments.

Table 3-4 Groundwater Monitoring and Management, as per the O&M (Bonner 2007, Table 17 Groundwater Management; Task Summary, p 64)

Management Issue	Acton Required	Comment
Groundwater and Drainwater		
- Water table height	- Measure and record weekly at each of the five piezometer locations, plus boundary piezometers.	Three piezometers with groundwater level logging are installed within the irrigation area. More are proposed.
- Physico-chemical	- Download data weekly, at each of the five piezometer locations, from the 90- FLMV data-logger to laptop computer.	Frequency of monitoring was reduced due to lack of change observed. It is proposed to install new piezometers within the irrigation area to collect groundwater level and quality data.
- Calibration	- Calibrate the sensor probes on the 90-FLMV weekly.	pH and conductivity sensors do not need weekly calibration, recommend fortnightly or monthly, along with data download when the TPS loggers are re-installed.
- Data management	- Maintain MS Excel database (or other as required): report as required*	Downloaded data shall be stored on a collated Excel file
- Phosphorous (P)	- Sample and analyse for total 'P' from Central V-notch weir: quarterly interval.	Not currently undertaken, though other EPA sampling done routinely in the vicinity.
- Phosphorous (P)	- Sample and analyse for total 'P' from fixed piezo sites: Sample if trend shows 'P' increase over time.	Proposed

3.2 Assessment of the 'State' of the 24 Hectare Irrigation Wetland

A visual assessment of the state of the wetlands suggests the irrigation area is in good physical condition. There are no signs of erosion or other soil degradation and vegetation cover is good with only minor weeds.

There has not been any soil analysis to determine the surface pyrite concentrations or other attributes as described in Table 3-1. It is recommended that routine soil sampling and analysis in accordance with the O&M (Bonner 2007) is instigated to ensure soil pH and acid drainage is within the ranges nominated within Bonner (2007).

Although vegetation coverage is generally very good, being close to 100% through most of the irrigation areas, there are some areas where the planted or design vegetation has not established. The north western section of the irrigation area (refer Figure 3-1) has only isolated *Melaleuca quinquenervia* trees though the coverage is 100% of other native grass/sedge species (e.g. *Gahnia spp, Baloskion tetraphyllum*).

There are weed species present in the irrigation wetlands however they are generally located in areas of disturbance such as access tracks and the drains. Whiskey Grass (*Andropogon virginicus*) occurs along some tracks but is a low priority for control, *Typha spp* is common within drains as well as Parrots Feather (*Myriophyllum aquaticum*). Intermittent drain clearing is keeping these species under control.

A vegetation assessment for distribution and abundance is not considered necessary however when assessing the potential for the irrigation area to effectively evapotranspiration some other assessment may be useful, including:

- Projected Foliage Cover (PFC)
- Density of surviving stands of *M. quinquenervia* (stems/m²)
- Diameter at Breast Height (DBH)
- Weed inventory including density and distribution assessment.

As discussed in Section 2.1.2 the Weed Management Strategy (Bower 2005) recommends a comprehensive vegetation survey is undertaken for the whole STP site every five years with more frequent vegetation surveys undertaken in areas of active management.

3.2.1 Drain Clearing

In October/November 2017 the central and southern drains (refer Figure 3-1) were cleared to improve drainage efficiency offsite. The drains had grown over with dense vegetation and silt which significantly impeded flows. Visual observations suggest the irrigation area is dryer since these works were completed and surface water in the western zone appears to have reduced.

Data from the three groundwater level loggers is inconclusive with regard to groundwater levels through the irrigation area following drain clearing. Two loggers were deployed in May 2018, i.e. after the drains were cleared. Additionally, these two loggers have not been surveyed to provide level data in order to calibrate the data to mAHD.

The third logger is located in the north western irrigation block. Data has been collected from this location by AWC since May 2015. An excerpt of the data is shown in Figure 3-2 for the period February 2017 to October 2018 which covers the time when the drains were cleared. The graph

does not show a visible difference in the water levels though the consistently high water between March 2017 to May 2018 suggests irrigation water was applied to maintain high water levels.

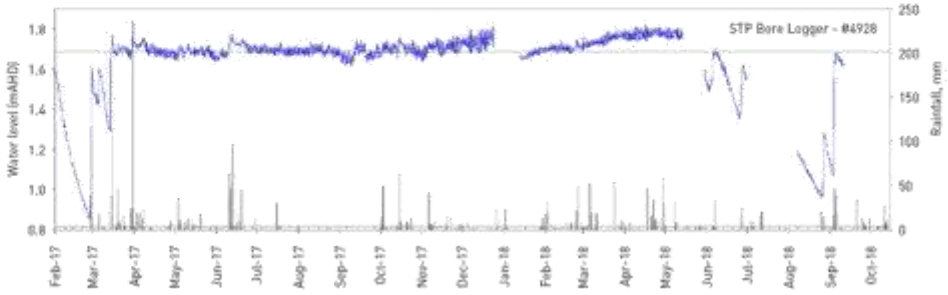

Figure 3-2 Groundwater levels from the irrigation area (Bore #4928). Drain clearing occurred in October/November 2017

3.3 Assessment of the 'Performance' of the 24 Hectare Irrigation Wetland

The primary aim of the 24 hectare irrigation wetland is to reduce the hydraulic load from the STP to the catchment through evapotranspiration. The monitoring of the system is to ensure no environmental impacts through acid water leaving the site.

The O&M (Bonner 2007) suggests an annual water balance review (refer Table 3-2) to determine model predictions vs actual field conditions; however, this assessment is not routinely completed. The model can be recreated using the method outlined by Bolton (2006) to simulate annual water balances retrospectively to ascertain re-use volumes. The data needed as inputs are:

- Daily rainfall
- Daily Irrigation
- Daily transpiration (formulated using a sub model)
- Daily runoff

Section 2.10 of the Bolton (2006) report describes the model construction. The estimated annual transpiration rates after year eight years (i.e. 2012 being eight years after final replanting effort in 2004) were between 34.7-43.9ML/hectare depending on wet/dry year (rainfall). This equates to 3.47-4.39m depth over the year and an average of 9.5-12mm/day.

Some of the model input values may be difficult to ascertain. For example, the exfiltration of the irrigated water to the groundwater and export off site is not quantified through monitoring and may confound runoff data. Quantification of site-specific evapotranspiration values is also expected to be difficult. Nonetheless, an annual water balance should be undertaken with all other assessments required to quantify input values undertaken.

4 Conclusions and Recommendations

Based on the review of information and discussions with operators the following summary of the conclusions and recommendations are made; more detail is found in the body of the report. The recommendations are divided into constructed wetlands and the 24 hectare irrigation area.

4.1 Constructed Wetlands

Conclusions and Recommendations pertaining to the constructed wetlands area include vegetation management and an infrastructure assessment, which are detailed below.

4.1.1 Conclusions

General conclusions regarding the constructed wetlands are provided below:

Vegetation:

- The macrophyte vegetation with the wetlands is mostly good however there are large areas that are bare or open water
- There are some areas that have weed growth evident

Performance:

- The constructed wetlands are performing very well in terms of pollutant reduction
- There has not been any exceedance of the EPL at the outlet of the wetland complex to the Belongil catchment
- The system is achieving substantial hydraulic losses through evapotranspiration and re-use, however accurate values for influent volumes are not available

1. It is recommended a flow meter is installed to isolate volumes being diverted to the constructed wetland system

4.1.2 Vegetation Management

Although vegetation within the constructed wetlands is generally seen as adequate in coverage and species diversity there are some weeds and some bare areas where bird damage is prevalent. The following is recommended:

2. Undertake a comprehensive vegetation assessment every five years and review the Weed Management Strategy (Bower 2005) as recommended in the Weed Management Strategy (Bower 2005)
3. Undertake six monthly rapid vegetation assessments in areas where active vegetation management works are being undertaken
4. Continue routine weed control works
5. Include planting of bird resistant macrophyte species as part of routine vegetation maintenance

4.1.3 Infrastructure Assessment

The following is recommended:

6. Routine assessments of the constructed wetland infrastructure including pipework, pits, valves, outlets, bunding and liners. Continue the current practice of assessing the infrastructure as part of the planned maintenance program.

4.2 24 Hectare irrigation Area

Recommendations pertaining to the 24 hectare irrigation re-use area include additional monitoring and vegetation assessment, which are detailed below, and investigate the value of irrigating a larger portion of the 24 hectare irrigation area.

4.2.1 Conclusions

Conclusions regarding the 24 hectare irrigation area are provided below:

- Much of the monitoring stipulated in the operational and management guidelines (Bonner, 2007) has been reduced since the small level of variation observed did not warrant weekly monitoring. Given the age of this document, a review and update is recommended
- Vegetation at the site is generally in good condition visually; 100% cover with only occasional weeds

4.2.2 Monitoring

To enable the assessment of performance and state of the 24 hectare irrigation area, monitoring and data collection are required. These recommendations are formed partly from tasks outlined in the Operation and Management Guidelines (Bonner 2007).

7. **Surface soil sampling**. Collect soil samples annually from five locations with laboratory analysis of pyrite concentrations. This is aimed at detection of surface pyrite formation through water logging/irrigation delivery.

8. **Groundwater level monitoring**. There are currently three groundwater level loggers deployed through the irrigation area taking groundwater level data on an hourly timestep. Data can be calibrated to mAHD for comparison with surrounding landscape features.

9. **Water Quality Monitoring**. Plans are in place to deploy at least three and potentially five, water quality loggers (TPS-FLW units) in strategic locations throughout the irrigation area. The Operation and Management Guidelines (Bonner 2007) suggests five locations. Other existing data logging units owned by Byron Shire Council are being assessed for functionality and will be deployed if suitable.

   The loggers will collect data on pH, conductivity and temperature. Results will inform further management tasks regarding ASS management through groundwater level fluctuation.

   Six new piezometers have been installed within the irrigation area, three on each side of the central drain. These can be used to monitor groundwater levels and groundwater quality with in-situ data logging equipment and to extract samples for analysis if required

10. **Annual Water Balance**. Assess model predictions vs. actual field conditions and attempt

to quantify evapotranspiration volume to determine if hydraulic removal has been as expected. Include in this modelling the total irrigation area (24ha) and potential losses which can be achieved.

4.2.3 Vegetation Assessment

While a preliminary assessment of the state of vegetation in the irrigation area suggests it is in generally good condition with low density and distribution of weeds, there has not been any detailed assessment as per Bonner (2007).

11. **A vegetation assessment is recommended.** Some assessments to quantify the state of the vegetation in the irrigation area are:
    - Projected Foliage Cover (PFC)
    - Density of surviving stands of *M. quinquenervia* (stems/m²)
    - Diameter at Breast Height (DBH)
    - Weed inventory including density and distribution assessment

5 References

Australian Wetlands (2006a) West Byron STP Wetlands Water Quality Review; November 2005 – May 2006. A report to Byron Shire Council (Ref: BB052-R5 dated 19.05.06)

Australian Wetlands (2006b) West Byron STP Wetlands Water Quality Review; February/March 2006. A report to Byron Shire Council (Ref: BB052-R2b dated 24.03.06)

Bolton, K.G.E (2006). The Byron Effluent Reuse Wetland Scientific Report. Consultancy report prepared for Byron Shire Council by Southern Cross University and Ecotechnology Australia Pty Ltd.

Bonner, D.A. (2007) Effluent Reuse & Wetland Regeneration (24ha site): Operational & Management Guidelines. A Byron Shire Council & Southern Cross University Collaborative Research Project.

Bower, S. (2005) West Byron Sewerage Treatment Plant – Weed Management Strategy. A report prepared for Byron Shire Council. Bower Bush Works Ecological Assessment & Restoration Services.

Appendix A

Water quality data

Table A0-1 EPA1 data set (10/05/2017 – 24/04/2018)

Byron Bay - EPA Annual Return Results - BB EPA P1									
Limits	BOD5	FC	GO	NH3-N	pH	SS	TN	TP	AL
90th %ile Max	10	200	5	2		15	10	0.5	
100th %ile Min					6.5				
100th %ile Max	20	600	10	5	8.5	30	15	1	
Units	mg/L	cfu/100mL	mg/L	mg/L	pH units	mg/L	mg/L	mg/L	mg/L
10/05/2017	1.5	<1	2	<0.02	6.9	3.4	0.9	0.09	0.116
24/05/2017	1.3	1	<2	<0.02	7.0	3.2	0.99	0.10	0.130
7/06/2017	2.0	<1	<2	<0.02	7.0	4.8	1.34	0.12	0.154
21/06/2017	1.1	<1	<2	<0.02	6.7	6.4	5.49	0.31	0.200
5/07/2017	2.2	<1	<2	0.02	6.9	4.1	1.45	0.13	0.154
19/07/2017	1.2	9	4.2	<0.02	7.0	6.1	4.46	0.13	0.362
2/08/2017	<1	<1	<2	<0.02	7.1	3.0	1.36	0.09	0.125
16/08/2017	1.2	188	<2	<0.02	7.2	3.6	0.86	0.10	0.160
30/08/2017	1.8	<1	<2	<0.02	7.4	2.8	0.87	0.07	0.120
13/09/2017	<1	<1	<2	<0.02	7.2	1.6	0.66	0.05	0.121
27/09/2017	1.6	15	<2	0.02	7.4	1.8	0.83	0.08	0.127
11/10/2017	1.0	3	<2	0.02	7.4	2.0	0.74	0.06	0.095
25/10/2017	<1	<1	<2	0.02	7.1	3.0	0.68	0.04	0.125
8/11/2017	1.4	12	<2	0.48	7.1	2.4	1.43	0.10	0.091
22/11/2017	1.5	<1	<2	0.02	7.2	4.2	0.87	0.07	0.135
6/12/2017	1.8	1	<2	0.02	7.4	4.3	0.91	0.12	0.138
20/12/2017	2.7	112	<2	0.05	7.4	5.6	0.98	0.10	0.120
3/01/2018	2.4	**5200**	3.7	**10.32**	7.4	6.5	11.60	0.23	0.175
9/01/2018	2.1	2	<2	0.15	7.3	3.4	1.01	0.07	0.095
17/01/2018	1.6	12	<2	0.02	7.3	5.8	1.22	0.12	0.121
31/01/2018	2.4	1	<2	0.03	7.4	5.5	1.04	0.14	0.115
14/02/2018	1.8	<1	<2	0.02	7.3	5.4	1.01	0.15	0.165
28/02/2018	<1	1	<2	0.02	7.1	2.4	0.99	0.10	0.137
14/03/2018	1.2	4	<2	0.03	6.9	3.2	0.68	0.06	0.209
28/03/2018	1.5	2	<2	0.02	7.0	3.0	0.87	0.08	0.150
11/04/2018	1.0	168	<2	<0.02	7.1	2.8	1.03	0.11	0.180
24/04/2018	2.0	26	<2	<0.02	7.0	1.8	0.97	0.10	0.129
Maximum Value (100th%ile)	2.7	5200	4.2	10.32	7.4	6.5	11.60	0.31	0.362
90th%ile	2.4	1190.4	--	3.432	7.4	6.18	4.666	0.166	0.201862

Table A0-2 EPA3 data set (10/05/2017 – 24/04/2018)

Byron Bay - EPA Annual Return Results - BB EPA P3								
	BOD5	**FC**	**GO**	**NH3-N**	**pH**	**SS**	**TN**	**TP**
Units	mg/L	cfu/100mL	mg/L	mg/L	pH units	mg/L	mg/L	mg/L
10/05/2017	4.2	530	<2	0.57	7.0	5.3	1.7	0.12
24/05/2017	4.4	730	<2	0.53	7.0	6.4	1.59	0.14
7/06/2017	<1	730	<2	0.87	7.1	1.0	1.46	0.09
21/06/2017	1.0	380	<2	0.71	6.9	<1	1.80	0.07
5/07/2017	2.0	790	<2	0.92	7.1	4.4	1.67	0.08
19/07/2017	<1	320	<2	0.40	7.2	3.0	1.12	0.06
2/08/2017	<1	740	2.0	0.64	7.2	2.3	1.29	0.06
16/08/2017	1.5	1190	<2	0.54	7.2	3.2	1.62	0.16
30/08/2017	1.2	450	<2	0.35	7.3	1.0	1.14	0.09
13/09/2017	<1	890	2.0	0.25	7.3	4.0	1.11	0.15
27/09/2017	3.2	1900	<2	<0.02	7.4	6.7	0.97	0.14
11/10/2017	2.8	530	<2	0.03	7.4	9.3	1.00	0.14
25/10/2017	2.6	520	<2	<0.02	7.6	15.0	1.07	0.12
8/11/2017	2.0	610	<2	<0.02	7.1	2.2	1.00	0.14
22/11/2017	2.1	490	<2	<0.02	7.2	3.8	0.81	0.09
6/12/2017	2.4	470	<2	<0.02	7.4	6.7	0.97	0.12
20/12/2017	3.3	630	<2	<0.02	7.4	4.2	1.05	0.13
3/01/2018	2.7	570	<2	<0.02	7.3	3.3	1.07	0.10
17/01/2018	1.6	160	<2	0.04	7.3	1.6	1.03	0.06
31/01/2018	2.2	560	2.0	0.02	7.4	2.7	1.01	0.08
14/02/2018	1.6	320	<2	0.02	7.2	2.6	0.94	0.07
28/02/2018	1.8	320	2.4	0.06	7.2	1.2	0.82	0.07
14/03/2018	2.1	930	<2	0.12	7.1	17.0	0.91	0.08
28/03/2018	2.8	2640	<2	0.12	7.0	2.8	1.08	0.10
11/04/2018	1.4	620	<2	0.10	7.1	<1	0.88	0.06
24/04/2018	1.6	830	<2	0.10	7.3	<1	0.95	0.05

Table A0-3 EPA4 data set (10/05/2017 – 24/04/2018)

BB EPA P4				
Limits	**TP***	**FC#**	**SS#**	**TN#**
90th %ile Max	0.3	N/A		
100th %ile Min				
100th %ile Max	1.0			
Units	**mg/L**	**cfu/100mL**	**mg/L**	**mg/L**
10/05/2017	0.04	14	2.0	0.81
24/05/2017	0.04	9	2.80	0.79
7/06/2017	0.03	27	<1	0.73
21/06/2017	0.03	22	<1	0.68
5/07/2017	0.02	19	<1	0.60
19/07/2017	0.04	71	<1	0.74
2/08/2017	0.03	19	<1	0.79
16/08/2017	0.05	26	2.0	0.96
30/08/2017	0.04	4	<1	0.85
13/09/2017	0.06	81	1.50	0.97
27/09/2017	0.11	120	1.20	0.88
11/10/2017	0.10	160	1.0	0.88
25/10/2017	0.05	56	1.0	0.71
8/11/2017	0.07	130	1.70	0.88
22/11/2017	0.05	51	1.40	0.76
6/12/2017	0.07	51	<1	0.85
20/12/2017	0.07	62	2.20	1.09
3/01/2018	0.13	113	2.0	1.04
17/01/2018	0.13	49	11.30	1.68
31/01/2018	0.13	76	3.50	1.35
14/02/2018	0.14	72	3.80	1.25
28/02/2018	0.11	26	1.20	0.84
14/03/2018	0.07	26	1.80	0.73
28/03/2018	0.08	18	1.60	0.85
11/04/2018	0.06	18	3.0	0.82
24/04/2018	0.04	17	<1	0.58
No of Samples	26	26	26	26
Minimum	0.02	4	0.50	0.58
Mean	0.07	51	1.88	0.89
Median	0.06	38.0	1.45	0.85
90th %ile	0.13	117	3.25	1.17
Maximum	0.14	160	11.30	1.68
* Only TP required for compliance with EPL 3040 # FC, SS and TN analysis undertaken as additional				

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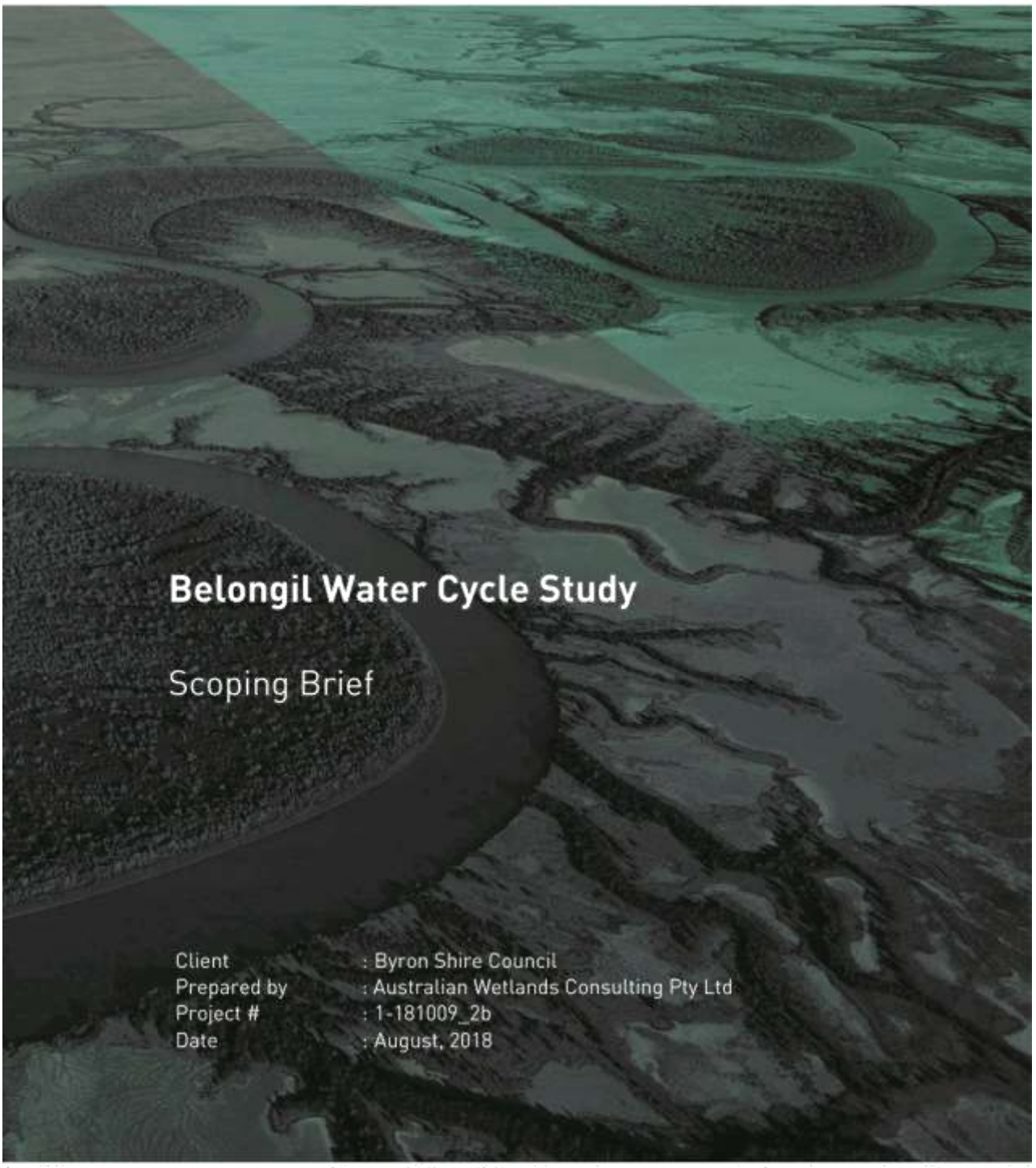

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Belongil Water Cycle Study

Scoping Brief

Project control

Project name: **Belongil Catchment**
Water Cycle Strategy

Job number: 1-181009-2b
Client: Byron Shire Council
Contact:

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Executive Summary

Over the past 20 years the Belongil catchment has been the subject of a large number of reports and investigations. These reports and investigations include investigations into flooding, ground and surface water behavior and quality, the impact of the STP on catchment water quality and hydrology, and Belongil estuary opening, and restoration strategies. Presently (Nov 2018), two investigations are being undertaken within the Belongil catchment: 1) the Belongil Estuary Opening Strategy; and 2) the Byron Shire Water Sensitive Urban Design (WSUD) strategy.

This document has been prepared following a request from Byron Shire Council to provide a scoping report that outlines the process and key elements of a Water Cycle Strategy for the Belongil catchment. Whilst the Belongil Estuary has been extensively studied there is no overarching document that summarises the current knowledge base and guides the management and vision for the Belongil catchment.

This report provides a summary of the key literature and gaps in knowledge to guide in the preparation of an integrated water cycle and catchment management plan, including the identification of key stakeholders . The Belongil catchment integrated Water Cycle strategy should reflect the knowledge within the existing reports, identify gaps and undertake any required supplementary studies to inform sustainable and practical management of the Belongil catchment water cycle. The final plan must be developed in consultation with the community that reflects the values and vision for the catchment.

The Belongil Catchment Water Strategy should consider the following themes:

- WSUD and demand management
- Recycled water
- Engagement and education including indigenous cultural value of water
- Leveraging environmental repair from development
- Restoration of natural floodplain processes
- Protecting and enhancing biodiversity and ecological restoration

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1 Introduction and Background

The Belongil Creek catchment comprises a mixture of landuses including rural, urban, industrial, commercial and tourism and discharges to an intermittently closed and open coastal lakes and lagoons (ICOLL). Approximately 80 % of the 30km² catchment is cleared of native vegetation and almost the entire catchment is partly or highly modified by drainage works constructed to de-water wetlands and improve productivity for farming and other activities. Water quality is variable throughout the catchment and is generally of reasonable quality but poor at times (Manly Hydraulics 1997, WBM Oceanics, 2000; Parker and Pont 2001; Holloway 2004; AWC, 2008) with incidences of elevated nutrients, pathogens, heavy metals and other contaminants. Acid sulfate soils are present and generated by the drying and oxidising of pyrite layers within rural landscapes.

Catchment hydrology is substantially altered with drainage works reducing inundation in some areas but an increase in impervious surfaces creating issues with flooding within others. Council has managed periodic artificial opening of the Belongil Creek mouth to alleviate flooding and manage water quality in the estuary for around 50 years. Despite these pressures the catchment retains a variety of high-value ecological features including coastal wetlands, littoral rainforest, endangered flora and fauna and nature reserves and attracts millions of visitors each year.

There are numerous of stakeholders and entities that manage and influence the Belongil Creek catchment under a range of legislation, management plans and informal arrangements, however there is no one overarching strategy for catchment and water cycle management establishing a cohesive set of objectives and vision. As a result of numerous studies which have investigated aspects of the catchment and provide a snapshot of ecosystem and catchment health, the system is well understood, however integration of this understanding and identification of potential knowledge gaps is required.

This report scopes requirements for the preparation of a Catchment and Integrated Water Cycle Plan in response to the request made by Council (July 2018):

> *That a report on scoping of water sensitive design and whole of catchment plan to integrate all works involving West Byron STP, Cape Byron Marine Park, Union Drain Trust and the community come to the next meeting WWSAC.*

In response this report:

- Provides a literature review and gaps analysis
- Identifies relevant stakeholders and referral agencies
- Outlines suggested themes to be included within a Water Cycle and Catchment Management Plan
- Provides a tender brief for the preparation of a Catchment and Integrated Water Cycle Plan

2 Existing studies

2.1 Overview

Since 2001 at least 10 significant studies have been (or are being) completed within the Belongil Catchment along with numerous monitoring reports associated with the health and status of the drainage network and management of the entrance openings. In addition there are management plans for key land use areas, notably Byron Town Centre Masterplan, West Byron Sewage Treatment Plant (STP), Cumbebin Swamp Nature Reserve, Cape Byron Marine Park and the Elements Resort.

2.2 Water quality

A variety of landuses place pressure on water quality within the Belongil catchment with agriculture, industrial and urban runoff discharging nutrients, sediment, heavy metals, hydrocarbons and pathogens. Routine monitoring of water quality has been undertaken for a number of reasons throughout the catchment, but principally by Council in support of its operations, notably West Byron STP and to inform the management of Belongil Creek mouth.

Water quality varies throughout the catchment depending upon the dominant land use in a locality with the principal pollutant sources being Byron town centre, the Arts and Industrial Estate and agricultural drains and there is a correlation between rainfall patterns and water quality (Manly Hydraulics, 1997).

Nitrogen in the form of nitrates is a significant contributor to eutrophication in coastal waterways (Davis and Koop, 2006) and this is no different for the Belongil Creek Estuary. Nitrates originate from a range of sources including sewer, stormwater fertilisers and animal manure and are a key contributor to algal blooms and anoxia within waterways (Harris, 2001). Significant concentrations of nitrates have been identified within Butler Street Drain, Bayshore Drive Drain and the Union Drain (Manly Hydraulics, 1997; WBM Oceanics, 2000; Parker and Pont 2001) with stormwater runoff reaching waterways largely unmitigated within these subcatchments.

Heavy metals, hydrocarbons and a number of other contaminants are commonly associated with intensive land uses such as manufacturing processing and freight within industrial estates (EAL, 2010). Heavy metals and other toxicants have been confirmed to be released from the Byron Arts and Industrial Estate and are present at elevated levels within surface and groundwater downstream (EAL, 2010). Sampling for these parameters has mainly been limited to discreet sampling events in support of development assessment and so only provide a snapshot of the extent and severity of the problem.

There is significant correlation between water quality and land use with water quality monitoring providing insight to where pollutants are originating. Routine sampling completed by Council since 1995 throughout the catchment confirmed that concentrations of several nutrients exceed ecosystem health guidelines and vary throughout the catchment (AWC, 2009, 2010, 2011). Data were compiled from eleven monitoring locations within the Belongil catchment, with parameters assessed including general physiochemistry, nitrates, ammonia, total phosphorus, suspended

solids, faecal coliforms. and salinity. Analysis confirmed elevated concentrations of nitrates, ammonia, phosphorous and that the most significant water quality problems found within the Union Drain, Butler Street Drain at Butler Street and Industrial Estate Drain at Bayshore Drive.

The Byron Shire Council Urban Stormwater Management Plan prepared by PPK (2000) and updated by Council in 2010 proposed numerous actions for management of stormwater within Byron town centre including:

- identifying locations for constructed wetlands (complete)
- installing litter baskets and GPTs
- identifying sewer overflow points (complete)
- identifying potential locations for swales and bioretention systems on road sides.

Since 2010 a number of actions have been completed, are underway or have been revised by subsequent reports, notably the Byron Town Centre Masterplan (McGregor Coxall, 2016). Currently the Belongil Estuary Management Plan is in preparation as is the Byron Shire Water Sensitive Urban Design (WSUD) Strategy. Key studies relevant to the Belongil Estuary Catchment are list in Table 2.1.

2.3 Hydrology

Prior to European settlement, the Belongil Catchment was a complex of freshwater and coastal wetlands, littoral rainforest, swamp sclerophyll forests and wallum heath which evolved in response to the unique combination of sub-tropical climate, geology and coastal geomorphology. For large parts of the year the floodplain was inundated and largely impassable due to high rainfall associated with tropical storms (AWC WMB, 2016).

European settlement instigated progressive land clearing and drainage works to improve access to and movement through the floodplain and to enable agriculture (IERM, 2005). Similar to many parts of the NSW North Coast (and Australia), a Drainage Union was formed via a collective of land holders to coordinate and cooperate on drainage works and maintenance. This drainage network in association with land clearing, urban development and sand mining substantially and permanently altered the hydrology of the Belongil catchment.

There are now several kilometres of drains within the Belongil Catchment in varying states of repair, with responsibility for management sitting with numerous individuals and entities including the Drainage Union, Council and National Parks and Wildlife Service. The Belongil Swamp Drainage Union operates under the Water Management Act 2000 and is permitted to undertake drain maintenance works without development consent provided those works are on land used for agriculture and the action is consistent with the Drainage Management Plan (Byron Shire LEP, 2014). Council is a member of the Drainage Union, and as a public entity Council is permitted to undertake drain maintenance without development consent (Part 5 Environmental Planning and Assessment Act;1979 and the Water Act, 1912), however for areas outside the Drainage Union jurisdiction there will generally be a requirement to complete an environmental impact assessment if the works are within sensitive habitat.

2.3.1 Entrance openings

Artificial opening of the Belongil Creek mouth has been occurring for at least 30 years and as a formalised activity since 2001 under an interim licence issued by the Department of Land and Water Conservation now Department of Lands. The trigger for an artificial opening is when creek water levels reach 1.0m AHD at Ewingsdale Bridge, with the purpose being to limit nuisance

flooding within the town while also avoiding adverse environmental conditions including anoxia and mobilisation of acidity associated with mono-sulfidic black ooze (MBO's) sitting on the creek bed and the oxidation of pyrite layers within floodplain sediments (IERM, 2005).

A summary of the key studies undertaken within the Belongil catchment is provided below.

Table 2-1 Summary key studies within the Belongil Catchment since 2001.

	Document	Author
1	Belongil Estuary Study and Management Plan (November 2001)	Peter Parker Environmental Consultants and Dave Pont
2	Belongil Creek Floodplain Risk Management Plan (March 2015)	BMT WBM
3	Belongil Creek Floodplain Risk Management Study and Plan Summary (March 2015)	BMT WBM
4	Byron Bay Drainage Maintenance Plan (July 2014)	Byron Shire Council
5	Byron Bay Drainage Strategy draft report (April 2010)	SMEC
6	Restoration Strategy Belongil – Cumbebin Wetland Complex Final Report (March 2005)	Australian Wetlands and Wetland Care Australia
7	Byron Bay Integrated Water Management Reserve: Groundwater Impact Verification	AWC
8	Plan of Management – Cumbebin Swamp Nature Reserve (February 2012)	NPWS
9	Byron Shire Council Urban Stormwater Management Plan (1st Review 2010)	BSC / PPK
10	Byron Town Centre Masterplan (2016)	McGregor Coxall
11	Byron STP Alternative Flow Path Study (2016)	AWC & BMT WBM
12	Belongil Entrance Opening Strategy	Alluvium (in preparation)
13	Byron Shire WSUD Strategy	BMT WBM (in preparation)

Since the inception of the entrance opening strategy there have been no major fish kills in the Belongil, however with changes in catchment land-use and the imminent expiry of the current opening license, the opening strategy will be updated if necessary. Monitoring has confirmed that

the entrance opens more regularly since the closure of Tallow Creek STP and upgrade of the West Byron STP.

A revised Belongil Estuary Entrance Opening Strategy is currently in preparation

2.3.2 Urban runoff

Urban stormwater reaches the Belongil estuary from two key sub-catchments: Butler Street Drain which receives runoff from Byron Town Centre and the Byron Arts and Industrial Estate combined with Sunrise Estate. There are also smaller urban areas at Ewingsdale and Belongil Beach. The majority of these urban areas were constructed prior to the requirement to the development of water sensitive urban design (WSUD) as a practice with the focus being on efficient conveyance rather than protecting water quality or hydrology. Newer developments within these catchments are adopting WSUD (e.g. Habitat, Bunnings, Rails carpark redevelopment) however the majority of these catchments remain untreated.

2.4 Ecology

The Belongil Estuary and broader catchment possesses significant environmental values via a rich biodiversity of flora and fauna much of which is protected under State and Federal legislation as well as migratory species protected by international treaties. Much of the remaining native vegetation has conservation significance and are protected under the Biodiversity Conservation Act (2016) (NSW) and/or the Environmental Protection and Biodiversity Conservation Act, 1999 (CTH).

Catchment hydrology and processes such as nutrient cycling, seasonal and tidal inundation and groundwater variability are key determinants of ecological character with regard to the composition and distribution of vegetation and the species these habitats support. Landuse activities notably agriculture and urban living impact on biodiversity directly through physical clearing, drainage works, spread of weeds, pollutants and predators and indirectly via changes in hydrological regimes under which many ecosystems and species are dependent.

There are three nature reserves within the catchment: Tyagarah Nature Reserve, Cumbebin Swamp, Hayters Hill as well significant native vegetation on private land, much of which is mapped as coastal wetlands and/or is zoned environmental lands (E2 or E3) within Council's LEP.

3 Integrated Water Cycle Strategy

Despite the numerous existing studies outlined in the preceding section there is no overarching strategy with a whole of catchment perspective of the management required to maintain and enhance the health of the Belongil Creek catchment.

With regard to the desire for a scoping of *water sensitive urban design (WSUD) and a whole of catchment plan to integrate all works involving West Byron STP, Cape Byron Marine Park, Union Drain Trust and the community,* a plan is required which:

- combines existing knowledge gained in existing reports,
- identifies knowledge gaps,
- completes supplementary studies in response to these knowledge gaps,
- confirms issues and practices detrimental to catchment and ecosystem health,
- in consultation with the community and other stakeholders, develops a vision for the Belongil Catchment which reflects the values and aspirations for a sustainable, cohesive and prosperous community,
- Develops a pathway with actions and timeframes for achieving this vision.

In response a project brief should be developed which seeks responses from suitably qualified practitioners with proposal to develop an Integrated Water Cycle and Catchment Management Plan for the Belongil Creek Catchment.

This plan should go beyond simply a technical investigation of the causes of poor catchment health to consider what the Belongil Catchment can become with regard to an ecologically rich landscape supporting a highly sustainable, productive and vibrant community.

The plan will be multi-faceted and consider the themes of:

- WSUD including demand management
- Recycled water
- Engagement and education including indigenous and local cultural value of water
- Leveraging environmental repair from development
- Restoration of natural floodplain processes
- Protecting and enhancing biodiversity and ecological restoration

3.1 WSUD

A WSUD Strategy for the Byron Shire is currently being prepared (2018) and will outline the approaches vision for sustainable stormwater management across the entire LGA. These principles need to be applied to the specific issues within the Belongil Catchment and a water sensitive strategy be developed via the following steps:

- Create a pollutant export model for the entire catchment, including future growth scenarios guided by land zoning to quantify pollutant loads and hotspots,
- Confirm the assimilative capacity of the Belongil Estuary and compare to anticipated

pollutant loads,

- Create a stormwater improvement strategy whereby the catchment is retro-fitted with stormwater improvement measures sufficient to bring pollutant export in line with the assimilative capacity of the estuary. Retrofitting may take on a number of forms including: street based treatment measures such as rain gardens, bio-swales, wetlands and gross pollutant traps (GPTs) as well as stormwater harvest and reuse at a local and precinct level.
- Prioritise retrofitting in response to greatest pollutant sources, cost and feasibility. Seek to partner with private landholders wherever practical to share the burden of stormwater management.
- Map and communicate the results

3.2 Recycled Water

West Byron Sewage Treatment Plant (WBSTP) contributes substantial flows to the Belongil Estuary and influences the frequency and duration of mouth openings (AWC, 2015, BMT WBM/AWC 2017) and with future population growth this is likely to increase. At the same time, strategic use of recycled water has a major role to play in reducing demand on potable water supplies and management of catchment health (e.g. management of acid sulfate soils).

The Water Cycle Strategy for the Belongil Catchment should assess those locations volumes and means via which recycled water can be used throughout the catchment without compromising competing objectives including entrance management and maintenance of productive agricultural land.

A recycled water component of the strategy would potentially include the following:

- Calculation of future recycled water volumes,
- Determine the role recycled water should play in maintaining water quality in the Belongil Estuary (via dilution),
- Identify key land uses where recycled water could be beneficial,
- Engage with stakeholders as required (conservation groups, landholders, State agencies)
- Prioritise and cost these actions.

3.3 Engagement and education

The support of community and key landholders is essential to the success of the strategy and development of a Vision for catchment health with widespread support. Engagement and education will be fundamental to this process and requires the development of a strategy for engagement and inclusion. To the extent that is appropriate, the strategy should build upon the foundations laid during preparation of the Byron Town Centre Masterplan. The strategy should include documentation of

This strategy should be developed as part of preparing the WMP in consultation with Council staff and include:

- An engagement and education plan,
- A summary and timetable of actions,
- Preparation of materials for use by Council in printed and social media.

3.4 Protecting and enhancing biodiversity

The Byron Biodiversity Conservation Strategy 2004, describes in detail biodiversity values throughout the entire LGA and within the Belongil catchment. This strategy provides an inventory of vegetation and fauna as well as threats and management issues which need addressing. An update of the strategy is close to completion and the actions and strategies from which should be incorporated into land management actions within the Belongil Catchment. Specifically; an assessment of biodiversity values within the catchment should be detailed in the Belongil Water Cycle Strategy including:

- mapping of native and non-native vegetation – or incorporation of mapping completed via other studies
- collation of new records for endangered plants and animals
- identification activities and landuses which present a threat to biodiversity – particularly wetlands and waterways
- confirmation of actual and potential biodiversity corridors on public and private land and appropriate buffers from wetlands and waterways.

3.5 Reinstating floodplain processes

The transition from forested catchment to agricultural and ultimately urban land uses has substantially altered the water cycle including the connectivity of Belongil Creek and it's tributaries to the floodplain. This has interrupted many of the processes fundamental to catchment health and the biodiversity present particularly coastal wetlands and other groundwater dependent ecosystems, cycling of nutrients and generation of carbon.

Reinstating floodplain processes will be fundamental to restoring the health of the Belongil Estuary and catchment and the Belongil Water Cycle Strategy should investigate opportunities for modifying drains and tributaries to slow water, re-engage wetlands and manage acid sulfate soils.

3.6 Leveraging environmental repair from development

Development will continue throughout the catchment in the form of greenfield and urban renewal consistent with State and local planning strategies and the normal course of economic activity within a prosperous tourist town. Having a clear vision of the social and natural environments that the community wishes to have in the Belongil Catchment is essential for being able to assess future proposals and the extent to which they are consistent with community aspirations and best practice in ecologically sustainable design (ESD). This includes a clear understanding of the hydrological and water quality limits of the estuary and the measures required to adhere to these limits.

The Belongil estuary has little or no ability to assimilate additional pollutants meaning that in addition to managing existing urban areas, future urban development and farming must achieve ensure that pollutant loads do not increase. This can often be difficult to achieve within the same property where the development is occurring but when considering the catchment as a whole there are significant opportunities for landscape scale responses where the impact of development activities can be offset.

The Belongil Water Cycle Strategy should in consultation with the community and other stakeholders should confirm the extent of environmental offsets required to maintain (and ideally) improve water quality within the Belongil estuary. This would be achieved via the following steps:

- Creation of a pollution export model (e.g. MUSIC, Source) for the existing and ultimate developed catchment (say 2050) to quantify pollutant loads and concentrations generated within the catchment
- Creation of an ecosystem response model to determine the assimilative capacity of the estuary and the quantity of pollutant reduction required
- Create a pollution reduction strategy comprising retro-fit of existing catchments, adoption of best practice WSUD in new developments and identifying locations for strategic environmental repair to reinstate floodplain processes which can deliver water quality (and biodiversity) improvements.

The scale of effort required to halt and reverse the decline of the estuary is difficult to estimate however assuming that the areas required will be at least as large as the area typically required to be dedicated to WSUD (3% to 7%) of catchment, and that the majority of the 3000 ha catchment is subject to agricultural or urban landuses, 100ha to 200ha of rehabilitation could be required.

The scale of these works is beyond the resources of Council meaning that alternative funding strategies are required. Options could include creation of biodiversity stewardship sites on private property, seeking contributions from developments to strategic environmental repair in locations confirmed as the highest priority for the catchment, an environmental levy and grant funding.

The Belongil Water Cycle Strategy should investigate funding options and structures which could be adopted by Council with the strategy informing Council's DCP and LEP.

4 Scope of Works

In the preparation of an integrated water cycle strategy for the Belongil Creek catchment, the following scope of works is suggested.

1. **Literature review and gap analysis**
   - Collate and review existing studies
   - Prepare a literature review and gap analysis

2. **Catchment investigations and ground truthing**
   - On the basis of the literature review complete catchment investigations to confirm the location and extent of management issues
   - Identification of catchment values

3. **Stakeholder and community consultation**
   - Prepare a community and stakeholder engagement and communication plan for review and approval by Council
   - Implement the approved engagement plan over the life of the project

4. **Pollution export and ecosystem response model**
   - Prepare a methodology for the required modelling for review and comment to Council prior to commencement
   - Based on existing and future land-use scenarios quantify pollution loads on a sub-catchment basis
   - The model developed should consider both ground, surface and flows from the West Byron STP
   - Develop an ecosystem response model to confirm the assimilative capacity of the estuary
   - Establish water quality objectives (loads and concentrations) for the estuary and tributaries
   - Consideration of the salinity interaction with groundwater should be included in the process of establishing water quality objectives with the intent of protecting groundwater from salinity contamination

5. **Preparation of a Draft Belongil Water Cycle Strategy including mapping of values, issues and management actions across the catchment**
   - Prepare a draft report which collates existing and new information
   - Present the methods and results for catchment investigations and modelling
   - Prepare GIS mapping of environmental values, existing and future land use pressures, pollutant hotspots on a sub-catchment basis, and opportunities for enhancement of floodplains to achieve water quality improvements
   - Create a costed and prioritised Action Plan. Incorporate incomplete actions from previous studies
   - Prepare a business case/cost-benefit analysis for the actions proposed
   - Provide recommendations for amendments to Council's planning scheme to facilitate implementation of the IWCMP

6. **Presentation to Council and the Community and other stakeholders, compilation of feedback**
    - Plan in consultation with Council presentations and information for the community and other stakeholders
    - Compile responses to the Draft Belongil Water Cycle Strategy and summarise the results for Council

7. **Preparation of a Final Belongil Water Cycle Strategy**
   Following receipt of comments, prepare the Final Belongil Water Cycle Strategy and associated mapping

4.1 Deliverables

Based on the scope of works above, the following deliverables would be obtained.

1. Literature review and gaps analysis
2. Stakeholder and community engagement strategy
3. Pollutant export and ecosystem response models
4. Draft Belongil Water Cycle Strategy
5. Final Belongil Water Cycle Strategy

5 References

AWC (2008). *Belongil Estuary Entrance Management Reports Stage 1.* Report prepared for Byron Shire Council, Byron Bay, NSW.

AWC and Wetland Care (2005). Restoration Strategy Belongil – Cumbebin Wetland Complex Final Report.

AWC (2010). Byron Bay Integrated Water Management Reserve: Groundwater Impact Verification

BMT WBM. (2015). Belongil Creek Floodplain Risk Management Plan.

BMT WBM (2015). Belongil Creek Floodplain Risk Management Study and Plan Summary (2015)

Byron Shire Council (2010). Byron Shire Council Urban Stormwater Management Plan.

Byron Shire Council (2014). Byron Bay Drainage Maintenance Plan.

Davis, R., and Koop, K. (2006). Eutrophication in Australian rivers, reservoirs and estuaries – a southern hemisphere perspective on the science and its implications. Hydrobiologia **559**:23-76

EAL (2010) *Preliminary Contaminated Land Assessment - As part of a state significant site study at West Byron Bay Urban Release Area, Byron Bay, NSW* - (A preliminary assessment of potential soil contamination as required for State Environmental Planning Policy 55). EAL Consulting Service in conjunction with the Environmental Analysis Laboratory, Southern Cross University. For: Byron Bay West Landowners Association (BBWLA), Report No.: EAL2432-CLA, 14 December 2010

Harris, G. P. (2001). Biogeochemistry of nitrogen and phosphorus in Australian catchments. Rivers and estuaries: effects of land use and flow regulation and comparison with global patterns. Marine and Freshwater Research **52**(1) 139 - 149.

Integrated Ecosystem Research and Management (IERM),(2005) *Belongil Creek draft EOS – Review of Environmental Factors.* Byron Shire Council.

Manly Hydraulics Laboratory (1997), *Belongil Creek Water Quality Monitoring.* Report prepared for the Department of Land and Water Conservation, Manly NSW.

McGregor Coxall (2016). Byron Bay Town Centre Masterplan.

NPWS (2012) Plan of Management – Cumbebin Swamp Nature Reserve

Parker, P. and D, Pont, (2001). Belongil Estuary Study and Management Plan.

WBM Oceanics (2000). *Tallow and Belongil Creeks. Ecological Studies.* Report to Byron Shire Council.

SMEC. (2009) Belongil Creek Flood Study- Final Report

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Technical Memorandum

Sandmining drain/track status and impact on Belongil catchment

To:	Bryan Green (Byron Shire Council)
From:	Damian McCann, Jesse Munro (AWC)
Date:	13 November 2018
Pg/Attach.:	5
Job ref:	1-181009_03_A_sandminetrack

Sandmining track/drain

AWC have been engaged to undertake an assessment of the disused sandmining track/drain system that runs north from the West Byron Sewage Treatment Plant (WBSTP). The aim of the assessment is to provide a report on the current status of the track/drain and its impact on the Belongil Creek catchment.

Water | Ecology | Management

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The investigation was in response to the following request:

That the WWSAC receive a report on the current status of the old sand mining drain/path and its impact on the Belongil catchment.

The assessment included:

- Site inspection;
  - Vegetation
  - Hydraulics
  - Train track
- Review of historic photographs

Findings have been compiled within the following memorandum. No further action is recommended at this stage.

Australian Wetlands Consulting Pty Ltd
ABN: 81 140 533 919

Site Inspection

Site inspections were undertaken on 26th July and 10th August 2018 by Jesse Munro and Damian McCann. Weather prior had been dry and cool. There had not been any rain for >12 days prior, and below average monthly totals in the previous three months.

During the first inspection the train tracks were used to access the site from the south in a northerly direction. The second inspection came into the northern end of the track/drain via Grays Lane in Tyagarah.

Vegetation

Generally, the vegetation immediately surrounding the train tracks in the south indicates a wetter environment. There are swathes of macrophyte beds in some locations, and swales along side the tracks with dense macrophyte growth. To the north of the rail line dunal ridge systems are evident with coastal heath/forest growing. In low lying areas forested wetlands dominated by Broad Leafed Paperbark were noted.

In the north, the track and drain are overgrown with short swamp forest type vegetation, including *Melaleuca quinquenervia* and *Leptospermum laevigatum* in the canopy and *Gahnia sp.*, *Baloskion pallens* in the understory.

Photo 1 - Example drain in the north

Photo 2 – Tannin coloured drain water in the north

A water sample was analysed for pH and conductivity; it showed pH of 4.24 and conductivity of 282µS/cm. The relatively low pH value is consistent with the wallum heath type of vegetation evident in the vicinity. The water shows a tannin stained colour, as seen in Photo 2 (above), a result of peat and tea tree pigments from the surrounding areas.

The conductivity shows the area is freshwater and is not tidally influenced. This is also reflected in the vegetation.

Hydrology

The train tracks appear to be causing a substantial impediment to water movement from the north to the south and entering the Belongil catchment. The tracks have been built on a compacted mound, of which the construction below the cobble basalt covering is unknown. It would be expected the soil below ground surface, below the tracks, is also compacted and stabilised which would limit lateral movement of groundwater.

Several constructed gaps (bridges) in the rail bund were evident (refer Photo 3), allowing surface flows to move south. Also evident were pipe culverts through the bund. The hydraulic control point of the culverts and gaps were generally above the natural ground surface causing some standing water in the area.

Photo 3 – Looking north, along the train line. Note bridge for water movement, and open area adjacent with tall forest vegetation

Although the sandmining drain in the north shows standing water, the hydraulic capacity would be diminished as there is dense vegetation on the edges and occasionally in the channel, as well as fallen vegetation and siltation. These are expected to reduce conveyance potential.

The track is mostly overgrown, though less dense than in the drainage channel. There appears to have been some imported fill material for track construction, rock, gravel and cobble in places. There are areas where past works may have occurred and caused disturbance to soil that is still evident; vegetation growth is low, with bare areas.

The southern section of the drain that runs in a south easterly direction from the rail line to the western boundary of the WBSTP was inspected. The edges are heavily vegetated with Broad Leaved

Paperbark and macrophytes. The drain is approximately five metres wide and had standing water during the inspection (refer photo below). A track or remnants was not visible through this area due to the dense vegetation.

Although there was no flow on the inspection day, it is assumed the flow is in a southerly direction. The drain stops at the boundary of the WBSTP with water dissipating through the site with no formalised channel. (Example images four and five).

Photo 4

Photo 5

Train Tracks

The north coast rail line from Casino to Murwillumbah was opened in the late 1800's, thus any modification of landscape scale hydrology resulting from the rail line has been in play for >100 years.

Current status of track/drain

The drain is generally functional though the conveyance is limited due to blockage by vegetation and siltation. Based on visual indicators, the vegetation, water quality and habitat are of good quality in the drainage line. It would be expected that a variety of fauna use the drainage line, in particular some of the wallum frog species some of which are threatened.

The sandmining track is considered unpassable by vehicles with dense vegetation growth. Other than *Leptospermum laevigatum* (Coast Teatree), there were very few weeds evident. Coast Teatree is not naturally found north of Nambucca Heads, it was often used for dune stabilisation and after sand mining. Some areas adjacent the track/drain show a greatly reduced vegetation density and diversity, potentially a result of sand mining operations that left the soil devoid of nutrients, organic matter and/or compacted.

Impact on Belongil Creek catchment

The impact of the sandmining track/drain on the Belongil Creek catchment is indiscernible. The drain may have lowered the water table and expedited water flow from the site, however the railway track may have caused a dam effect restricting surface and groundwater flows to the south.

Conclusion

The catchment of Belongil Creek is highly modified; a substantial portion of the catchment has been cleared for agricultural or urban use. Drains were cut into large areas of the catchment in order to lower the water table for agricultural use. Additionally, a large volume of water is imported into the catchment for potable use which is passed through the West Byron STP and discharges to the catchment in the upper reached of the union drain. Thus the hydrology of the catchment is highly modified, the effect of the sand mining tack/drain on the hydrology in the overall catchment is indiscernible. The rail track likely has a greater influence on the catchment hydrology.

The drain/track flows through the Tyagarah Nature Reserve which is protected from development and disturbance. Sand mining operations in the Byron Shire ceased in the 1970s. The ecology upstream of the train track is likely to have adapted, or is in the process of adapting to, the altered hydrology. Although a detailed assessment of the whole area was not done, there does not appear to be any substantial impacts in terms of vegetation growth.

Report No. 4.2 **Mullumbimby Inflow and Infiltration Update**
Directorate: Infrastructure Services
Report Author: Jason Stanley, Systems Planning Officer
File No: I2019/11
Theme: Infrastructure Services
Water Supplies

Summary:

Flow meters and rain gauges have been installed within Mullumbimby's gravity sewerage network late November 2018.

Highest recorded rain event to date was 56mm on 4 and 5 December 2018.

Mullumbimby drop-in information session was held 11 December.

RECOMMENDATION:

That the Committee note the report

Report

Progress is continuing on the Mullumbimby Inflow/Infiltration project.:-

- Environmental Data Services (EDS) have setup non-contact sensors within gravity sewerage manholes on 27th November 2018 to perform detailed flow monitoring for a three month period. EDS have also installed rain gauge as part of this three month trial to verify rainfall intensity. Results from this trial to be provided a next committee meeting.

- Draw down tests of sewage pump station within Mullumbimby been completed, a report on each of the pump stations is currently being developed. This information will be used to further calibrate Council's SCADA network.

- Weather stations are to be implemented across BSC's network with three weather stations planned to be setup across the Mullumbimby catchment.

- Data monitoring indicates that CCTV investigation is required for the sewerage and stormwater networks in central Mullumbimby. Contractors have been consulted and a RFQ is currently being developed to perform these investigation works as well as rehabilitation works if required.

- Information session was held on 11th December 2018 at the Council chambers with community members and Councillors in attendance. Council staff provided an overview of the project and discussion regarding concerns with the community.

Financial Implications

The direct connectivity between stormwater and the sewer system will allow for funding of this work from the sewer fund. Initially this will be from the currently allocated budget.

Statutory and Policy Compliance Implications

Compliance with EPA licence 13266.

Report No. 4.3 **Items Requested by Duncan Dey**
Directorate: Infrastructure Services
Report Author: Jason Stanley, Systems Planning Officer
File No: I2019/12
Theme: Infrastructure Services
Water Supplies

Summary:

This item has been requested by Committee member Duncan Dey for discussion by the Committee.

RECOMMENDATION:

That Council note the report.

REPORT

Duncan Dey suggested the below recommendations:

That Council:

1. *acknowledge that management of centralised urban sewage requires on-going assessment of the capacities of its 3 main elements:*

    a) *the sewer collection system;*
    b) *the sewage treatment plant; and*
    c) *receiving environments.*

2. *acknowledge that receiving environments potentially include:*

    a) *waterways,*
    b) *wetlands,*
    c) *irrigation areas; and*
    d) *recycled water schemes which are generally downstream of the EPA licence point for the STP.*

3. *receive reports on the capacities of environments that receive effluent from the Byron Bay STP, noting that such capacities may be complex algorithms rather than raw numbers (eg. wet weather flows versus dry weather).*

Background

Council recognised "fate of effluent" as an issue in the Belongil catchment in its last term 2012-16 and received a report costing $350k on the matter. Since then, Council's planning department continues to connect new loads to the Byron Bay sewer system despite fears that receiving capacities may already have been exceeded and in the face of opposition from landholders over whose properties the effluent flows. Council must at least receive regular updates of any previous assessment, including information on new loads approved and / or connected.

Legal/Statutory/Policy Considerations

Not Applicable

Financial issues

Not Applicable

Consultation and Engagement

Not Applicable

Report No. 4.4 **Update on alternate flow path for treated effluent from WestByronSTP**
Directorate: Infrastructure Services
Report Author: Jason Stanley, Systems Planning Officer
File No: I2019/14
Theme: Infrastructure Services
Water Supplies

Summary:

Item requested by Mark Tidswell:

Would like to have time to discuss the following:

Update on alternate flow path for treated effluent from West Byron STP using industrial estate drain network to take flows that currently discharged to EPA 4.

The update should give timelines on investigations and action by BSC.

RECOMMENDATION:

1. **That Council consider further options for the *Additional Flow Path* due to the fact that the one currently under the scope it can not be used during moderate to heavy rainfall periods.**

2. **That the options could include (but not limited to) the creation of biodiversity stewardship sites on private property, seeking contributions from developments to strategic environmental repair in locations confirmed as the highest priority for the catchment, an environmental levy and grant funding.**

REPORT

Current Status:

5 Planit Consulting has been engaged to develop the project of the Additional Flow Path for the Byron STP. The current status is as it follows:

3.2 DETAILED SURVEY (LANDSURV)	
3.2.1 Boundary Establishment	• Completed
3.2.2 Detailing Drain And Underground Services	• Completed but needs additional potholing in areas. Quote for these works coming from Dean Tosh.
3.3 PLANNING, APPROVALS, AND LICENSING (PLANIT CONSULTING)	
3.3.1 Review Of Environmental Factors (Ref)	• The REF has commenced including site walk and route confirmation. SEPP "Coastal Wetlands" now confirmed that the works are outside this area and no need for an EIS over this section.
3.3.2 Additional Discharge Point Approval	• Work has started on this as part of the REF and will progress within the next few weeks
3.3.3 Additional Ref Subconsultant Reports	• After the site walk and review of the zoning areas with the confirmed alignment there will be the need for additional sub-consultant reports to feed into the overall REF including: o Flora and Fauna assessment (Planit will provide a quote for this) o Acid Sulphate Soils Assessment (Getting a quote from HMC Environmental Consultants who did the bayshore drive roundabout ASS assessment) o Traffic Management Plan for the works crossing Bayshore Drive (Planit will provide a quote for this)
3.3.4 Lodgement/Licencing Fees	• Not completed, once we're closer to the licensing stage this will be known
3.4 Detailed Civil Design (Planit Consulting)	• Concept pipe long section completed from STP discharge location to Northern end of industrial drain. We are awaiting the potholing to confirm the exact alignment crossing Bayshore Drive and levels so we miss the existing services in the road corridor. We currently have three options and will pick the path of least resistance once we get the potholing information. • The shared path and industrial drain regrading has been design and drawings drafted. These include plan view, cross sections and bridge long section. • I've been in contact with some prefab bridge suppliers with a company called Landmark Products (spec sheet attached) looking like an easy option.
3.5 Drainage Network Modelling Allowance (Bmtwbm)	• BMT are now modifying their existing flow model and setting up the scenarios based on the updated drain cross section model we're providing them. They will set up the model and get levels critical areas in the drain where we need to put

	level sensors to relay back to the pump station. They are running an existing scenario based off the new detailed survey, a 3ML/day scenario and a 7ML/day scenario with 1, 5 and 10 ARI rain events to determine the sensitivity of the level when rainfall runoff occurs within the Industrial Estate.
3.6 Detailed Landscape And Wsud (Planit Consulting)	• This has commenced with planting types selected to provide a screen along the depot fence. We're just waiting to see where the indicative flow level is in the drain from the flood model to confirm the planting and WSUD planting in the industrial drain. • Will have a concept landscaping plan to send through for review in the next couple of weeks.
3.7 PUMP STATION AND CONTROL SYSTEM WORKS (PLANIT CONSULTING)	
3.7.1 Sps 3028 Assessment	• Assessment completed. Bryan, Rick and Andrew went out to site and have come up with a solution to modify the existing pump station to deal with the additional drain scenario.
3.7.2 New Sewer Pump Station Design (If Required)	• Andrew and Ricky are doing up a scope and estimate to complete the design modifications to SPS 3028.
3.7.3 Investigation Of Control Systems	• Investigation into the control system is almost completed, indication show level sensors along the drain at critical points which will be known once the flow modelling is complete.
3.7.4 Implementation And Design Of Control System	• This will follow from the control system investigation.

Background

Since the transfer of South Byron STP flows to the Byron STP (1999) local landholders adjoining the western boundary of the BBIWMR have raised concerns over the impact these flows have had on the local shallow groundwater levels. In response to these concerns, BSC have been investigating an alternative release pathway to the one is currently in use.

Key issues

1. The south eastern end of the Central Drain not being owned by West Byron (Villa World) and not BSC.
2. Getting the flow modelling completed to determine appropriate levels under different flows.
3. Getting potholing done to confirm the exact route of the discharge line under Bayshore Drive.
4. Confirming any additional constraints from the REF.

Options

Options could include creation of biodiversity stewardship sites on private property, seeking contributions from developments to strategic environmental repair in locations confirmed as the highest priority for the catchment, an environmental levy and grant funding.

Next steps

1. Complete drainage network modelling (3 weeks)
2. Complete REF and REF sub reports (6 weeks)

3. Finalise pump station design (4 weeks)
4. Develop control system (12 weeks)
5. Finalise landscaping design (6 weeks)
6. Finalise discharge line design (6 weeks)
7. Update licensing/discharge licence with DPI/EPA (14 weeks)
8. Finalise Project ready for construction (14-16 weeks)

Report No. 4.5 **The remediation & rehabilitation of the Myocum Quarry Landfill**
Directorate: Infrastructure Services
Report Author: Lloyd Isaacson, Team Leader Resource Recovery and Quarry
File No: I2019/17
Theme: Infrastructure Services
Waste and Recycling Services

Summary:

This report identifies the plan to rehabilitate the Myocum quarry site, which will form a key component of the future strategic direction for the transition of the Myocum Quarry into a resource recovery facility. This report is in response to the below email request from committee member Madeleine Green:

I'm not sure what the process is, but I was wanting to put an item on the next Water, Waste & Sewerage agenda for discussion: what plans are there for the remediation & rehabilitation of the Myocum Quarry Landfill? It might be too late for the next meeting, but whenever it is convenient.
As we can see from the Google shot below -& from Coolamon Scenic Drive - it is a blight on our landscape.

Thanks

RECOMMENDATION:

That the report is noted.

REPORT

Background

In 2016 the progression of the DA for the Myocum Quarry Landfill ceased due to a number of critical factors resulting in financial, environmental and social risks associated with the project and a shift in the strategic objectives and direction for the Shire's waste management. This move was based on Council's resolution (***Res 16-145***) stemming from the recommendation report "Review of Council's Waste Disposal Strategy 2009" by the WWSAC (following a presentation to the February 2016 Srategic Planning Workshop), which identified the re-focus of Council's strategic direction and capital investment to enhancement of resource recovery infrastructure and progression of a regional Alternative Waste Treatment facility rather than investment in landfill infrastructure.

This strategic focus has subsequently been enhanced following the unanimously supported NOM by Cr Richardson in June 2018 (***Res 18-419***) advocating a Zero Waste to Landfill aspirational target and embedment of circular economy principals into Council's Waste Management and Resource Recovery Strategy. This draft strategy will be presented to Council in March 2019.

The abovementioned WWSAC report identified the short term strategic planning direction to commence investigations for the final closure and rehabilitation of Myocum Landfill Southern Expansion Area and options for expansion and enhancement of the Byron Resource Recovery Centre, including the utilisation of Myocum Quarry site for resource recovery infrastructure development and operations.

This strategic planning has been progressed, with the development and implementation of the BRRC Masterplan which was presented to the WWSAC in February 2018 and the committee recommendation subsequently endorsed by Council (***Res 18-053***). As per the resolved strategic approach, the BRRC Masterplan also identified the Myocum Quarry as a site for expansion of resource recovery and alternative waste treatment operations.

Council Staff plan to commence the planning approval process to expand resource recovery operations into the Quarry in early 2019 with the objective of transition the quarry into a facility for composting and construction and demolition waste processing operations. As part of the planning process, Staff also plan to investigate the concept to extract further road construction material from the Quarry. Whilst this is unlikely to be a viable option due to requirements for geotech investigations, a s96 process, and increasingly complex compliance legislative requirements for extraction, conducting a high level cost/benefit analysis will alleviate any concerns regarding potential loss of quarry material from the immediate transition in operations, or alternatively, indicate that it is in fact a viable option prior to transition in operations for the site.

Planning consultant advice sought late in 2018 indicated that expansion of resource recovery operations into the quarry will require development approval as a resource recovery facility. In addition, that advice suggested it would be prudent to concurrently formalise the BRRC as a transfer station rather than a landfill facility – in line with the abovementioned strategic direction and on-going operation of the site.

A critical component associated with the legislative planning process for transition from quarry to resource recovery facility will be the requirement to appropriately rehabilitate the Quarry to meet all legislative planning and environmental requirements.

STRATEGIC CONSIDERATIONS

Community Strategic Plan and Operational Plan

The below table indicates alignment with relevant CSP and OP objectives and activities.

Objective: 1	We have infrastructure, transport and services which meet our expectations
Strategy 1.4	Provide a regular and acceptable waste and recycling service
Action 1.4 a)	Implement Integrated Waste Management and Resource Recovery Strategy
Activity 1.4 a)	Finalise strategy and implement 2018/19 action plan activities
Action 1.4 d)	Ensure facilities and services meet statutory requirements
Activity 1.4 d)	Maintain compliance with NSW Environmental Protection Licences for the Byron Resource Recovery Centre and Myocum Landfill

Legal/Statutory/Policy Considerations

As identified above, NSW Planning and Environmental legislative requirements will be critical factors for the transition process.

Financial issues

There is current allocation in the Waste budget and allocation will be included in 2019/20 Operational and Capital Works plan and associated budget.

Consultation and Engagement

A critical component of this process (and Council's greater Waste Management and Resource Recovery Strategy) will be on-going consultation and engagement with the community, with particular reference to the local Myocum residents. Council has invested a significant amount of resource in improving the environmental performance of the BRRC, and also rebuilding trust and relationship with the Myocum residents. Retaining (and continually improving) this relationship is a key objective for the on-going management of the site.

Report No. 4.6 **Make the Switch Program - Six Month Report**
Directorate: Infrastructure Services
Report Author: Lucy Wilson, Resource Recovery Projects and Education Officer
File No: I2019/59
Theme: Infrastructure Services
Waste and Recycling Services

Summary:

To provide the Water Waste and Sewer Committee with the December 2018 a six month progress report for council's single-use plastic reduction initiative – Plastic Free Byron Make the Switch program.

RECOMMENDATION:

That the Committee note the December 2018 - Six Month progress report for the Plastic Free Byron Make the Switch program and communicate successes to key stakeholders.

REPORT

In December 2017 a unanimously supported NOM put forward by Cr Ndiaye resulted in Council resolving (**Res 17-405**) to implement the following initiatives to achieve the objective of reduction in single use of plastic bags and packaging:

a) Engage with Boomerang Alliance to implement the Communities Taking Control program of education and assistance for businesses and the community to reduce single use plastic bags and packaging;
b) Develop and implement a targeted program that creates and promotes more public water stations across the Shire to reduce the need for single use water bottles; and
c) Lobby State and federal politicians via distribution of the attached letter to NSW Premier Gladys Berejiklian, NSW Environment Minister Gabrielle Upton, NSW MLC for Ballina, Tamara Smith, NSW Member for the Northern Rivers, Benjamin Franklin and the Federal Member for Richmond, Justine Elliot.

Boomerang Alliance were engaged to implement the Plastic Free Byron "Make the Switch" program as a community project to reduce Byron Shire's plastic footprint. The Program is a collaboration between Byron Shire Council (sponsor), the Boomerang Alliance and local Community group, Plastic Free Byron. It is based on the Boomerang Alliance's successful Communities Taking Control Plastic Free Noosa Program which focuses on achieving wide scale change away from plastic pollution.

Make the Switch works directly with food businesses, markets and events in the Shire to help them switch to more sustainable (reusable or compostable) packaging options. The Program targets the top six single-use plastic items found in the litter stream including bags, straws, coffee cups water bottles, cutlery, takeaway containers.

The Program has been very successful and received positive feedback form the community. Boomerang Alliance have provided the attached progress report for the first six months of the program, with some of the key performance indicators included below:

- **40 members engaged** – these are food retailers, events or markets that have signed up to the program and taken action to eliminate at least one or more of the six single-use plastic items
- **13 Plastic Free Champions** – members who have eliminated all six target single-use plastic items
- **Amount of single use plastics reduced by the program** (by audits of participant packaging procurement):
    a. The report identifies that preliminary limited data from four of the Plastic Free Champion Cafes gives a combined reduction of 8334 single-use plastic items. This figure is a significant under representation of what actually has been reduced, due to challenges with obtaining data from business and suppliers in the initial stages of the project. Improving the method for data collection has been highlighted as a critical focus for the next 6 months of the program to enable accurate assessment of results against targets..
    b. An alternate metric to assess the reduction in the use of single use plastics resulting from the program can be derived from data collected in the Noosa program, which was implemented 6 months prior to Byron's program commencing. Data from this

program indicates that each plastic item eliminated from a café reduces approximately 5000 single-use plastic items per month. Applying this figure to the known number of items reduced from the Make the Switch Plastic Free Byron program equates to an approximate combined figure of 60,000 single-use plastic items eliminated per month.

With regard to section (b) of the resolution, Staff have progressed the development of the "Re-fill Here" program. The Refill Here program aims to create a staged-based model to provide a viable alternative to single-use plastic water bottles for business and community. The three stages of this component of the project to are:

1. Create a system of 'refill here' points (local businesses and water stations) where consumers can refill water bottles. Points will be identified through signage/stickers and can be located on an interactive map or app.

2. Council bulk buy 'Byron' branded water bottles which will be made available to participating businesses at a subsidised rate to on sell for a profit as an incentive to reduce or eliminate single-use water bottles.

3. Increase the number of street water stations in high visitation areas.

The implementation of the program will further be enhanced by the recent notification of a successful grant for an additional $15,000 Federal Government funding from the Stronger Communities program to which will assist in the installation of 5 new water refill stations throughout the Shire to be installed in May.

Next steps

- Continued drive to sign up food retailers, potentially undertaking a specific business event to promote the program, benefits and solutions to businesses
- Work with current program members to facilitate achievement of Champion status.
- Progress the implementation the Refill Here water bottle reduction program.
- Increase media communication output including release of video and communication of program success to key stakeholders.
- Continue to improve the process for data collection and monitoring of volume of plastic reduced.
- Plan for the continuation and expansion of the program in line with the planned strategic focus to improve commercial and industrial waste management practices and resource recovery within the Shire.

STRATEGIC CONSIDERATIONS

Community Strategic Plan and Operational Plan

The below table indicates alignment with relevant CSP and OP objectives and activities.

Objective: 1	We have infrastructure, transport and services which meet our expectations
Strategy 1.4	Provide a regular and acceptable waste and recycling service
Action 1.4 a)	Implement Integrated Waste Management and Resource Recovery Strategy
Activity 1.4 a)	Finalise strategy and implement 2018/19 action plan activities

Financial Considerations

This program has budget allocation in the 2018/19 Waste budget funded via the NSW EPA Better Waste and Recycling Fund Grant and additional Federal Government Stronger Communities Program grant.

Consultation and Engagement

Since the Program launched in May, the following communication and engagement activities have taken place:

- **Developed key relationships with stakeholders** (North East Waste, Santos Organics, Clean Coast Collective, Bay FM, The Echo, Chambers of Commerce, Business associations and local packaging suppliers)

- **Program materials developed**
  - Plastic Free Byron Make the Switch website page
  - Flyers and brochures
  - Member guidelines
  - Signage for events
  - Plastic Free Champion signs

- **Business engagement:**
  - Face to face engagement with over 60 local food businesses in Brunswick Heads, Mullumbimby, Bangalow and Byron Bay to discuss the program. All were overwhelmingly supportive of the Program and looking to sign up in 2019.
  - Direct engagement with all 40 businesses that have signed up to the Program. This involves a half to 1 hour personalised induction for each member, plus follow up action report for businesses who require extra assistance, advice or help sourcing products.
  - Speaking engagement at Chamber of Commerce meetings.
  - Database of businesses set up and maintained to keep track of all interactions with each business.

- **Promotion:**
  - Waste Free for the Sea launch event.
  - Regular radio segments - 3 Bay FM interviews and 7 different ads on weekly rotation since July 2018).
  - Print promotion – 12 x Echo advertisements, 4 x print articles in the Echo, Byron Shire News, Byron Life and Byron Bazaar.
  - Weekly social media promotion.
  - Two newsletters - Make the Switch Individual Newsletter and Member Business Newsletter.
  - A Make the Switch promotional video developed by local Mullumbimby Film maker, Caitlin Weatherstone (https://www.youtube.com/watch?v=wYEpELloTDo&feature=youtu.be). Following the WWSAC meeting the video will be promoted more promoted via Plastic Free Byron and Council's Facebook pages, Instagram accounts and website, and shared will all key stakeholders.

Report No. 4.7 **Illegal Dumping and Litter Education and Enforcement Plan**
Directorate: Infrastructure Services
Report Author: Lloyd Isaacson, Team Leader Resource Recovery and Quarry
File No: I2019/66
Theme: Infrastructure Services
Waste and Recycling Services

Summary:
The attached Illegal Dumping and Litter Education and Enforcement Plan (IDLEEP) provides an overarching strategic framework for reducing illegal dumping and litter in the Shire.

RECOMMENDATION:

That Council endorse the implementation of the Illegal Dumping and Litter Education and Enforcement Plan 2019.

Attachments:

1 Illegal Dumping and Litter Education and Enforcement Plan (IDLEEP)_FINAL for WWSAC, E2019/4698 , page 81⇩

REPORT

Illegal dumping and littering are issues that cause significant environmental, financial and social impacts for the Byron Shire.

The main impacts of littering and illegal dumping include:

- becoming a community norm if not dealt with effectively
- negative impacts on visual amenity
- damaging community pride and tourism reputation
- being costly to clean up
- risks associated with hazardous substances such as asbestos and chemical waste
- the spread of weeds and exotic species into public reserves, bushland and parks
- polluting land, waterways and beaches
- harming or killing marine and other wildlife
- becoming a fire hazard or harbouring vermin and pests.

In the 2016-17 financial year, Byron Shire Council recorded 715 illegal dumping incidents and costs associated with clean-up were in excess of $100,000. These figures, based on data from a 12 month NSW Environment Protection Authority funded Baseline Data research project, have highlighted the need for targeted action.

Council also faces significant challenges with litter, particularly cigarette butts and other micro litter along the Byron Bay Foreshore and beaches. 2016-17 local litter data showed that cigarette butts make up 51% of littered items in Apex Park, Byron Bay. These challenges are intensified by the increasingly high tourist population.

The attached Illegal Dumping and Litter Education and Enforcement Plan (IDLEEP) provides an overarching strategic framework for reducing illegal dumping and litter in the Shire. It outlines a multi-faceted approach to tackling these problems and coordinates action on education, enforcement and infrastructure.

The IDLEEP aims to address illegal dumping and littering through targeted reduction and prevention programs in collaboration with key stakeholders including, relevant Council departments, North East Waste, land managers, community groups, local businesses and the NSW Environment Protection Authority (NSW EPA).

The IDLEEP outlines six and five key approaches to reducing illegal dumping and littering respectively, with detailed action plans for each approach. These approaches are consistent with those identified in the NSW EPA's Draft Litter and Illegal Dumping Strategies 2017-20, as listed in Table 1 below.

Illegal dumping approaches	*Littering approaches*
Approach 1: Building an evidence base	Approach 1: Rewarding responsible behavior
Approach 2: Stakeholder engagement and capacity building	Approach 2: Education and awareness
Approach 3: Education and awareness	Approach 3: Infrastructure and clean-up
Approach 4: Prevention, infrastructure, and clean-up	Approach 4: Regulation and enforcement
Approach 5: Regulation and enforcement	Approach 5: Evaluation and monitoring
Approach 6: Evaluation and monitoring	

These approaches will be supported via detailed specific action plans to address the priority issues for illegal dumping and littering. Some the key actions are outlined below:

Illegal dumping

- Develop a kerbside dumping program in collaboration with local real estate agents and strata managers that is focused on the issue of end of tenancy associated kerbside
- Investigate the expansion and refinement of the current Bulk Waste Drop-off System including the following:
    - Investigate the implementation of additional free waste drop-off services (e.g. free bulk and/or green waste drop-off days at the BRRC)
    - Investigate the option of providing courtesy trailers for the community to transport unwanted items to the BRRC
    - Investigate potential for multiple drop-off entitlement
- Program for addressing the issue of commercial waste bins stored on public land, with particular reference to the Lawson Street Carparks.

Littering

- Take 3 For the Sea Program
    - Staff have been liaising with Take 3 who are an Australian not-for-profit organisation that are committed to reducing plastic pollution and promoting the transition to a circular economy through education and participation. They promote a simple call to action message:

      "Take 3 pieces of rubbish with you when you leave the beach, waterway or anywhere special, and you've made a difference."

    - Take 3 utilise local celebrities/identities (of which there are no shortage in the Byron Shire) to promote and engage their simple yet effective message to a targeted audience.
    - This program directly aligns with the objectives of the IDLEEP by educating and incentivise Byron Shire's tourist visitors to care for its natural environment through innovative communications to a clearly defined and significant target audience.
    - In partnership with Council, Take 3 and Surfa Rosa Communications will engage local, regional state and national tourism organisations and selected travel distributors and tourism industry media targeting international visitors. Where

possible incentives will be built into travel packages sold by participating travel partners.

- As part of an associated action program to review the educational and compliance signage throughout the Shire, the potential to utilise Take 3 educational messaging (shown below) on key public place bin assets to assist in achieve the IDLEEP goals and objectives.

- "Butt Free Byron" Program
  - Butt Free Byron is currently being implemented via an alliance of local groups dedicated to protecting our environment from cigarette butt pollution. The program is funded via a $100,000 EPA grant application successfully received in 2018.
- Plastic Free Byron Make the Switch Program
  - Make the Switch is a community program to reduce Byron's plastic footprint. The objective of the program is to work directly with food businesses and the community to help them switch to more sustainable packaging options. The program aims for a reduction - leading to elimination - of the top six single-use plastic items found in the litter stream: water bottles, straws, coffee cups, takeaway containers, foodware and plastic bags.

Implementation of the IDLEEP will be included in Council's Annual Operations Plan and will be funded via the domestic waste budget, general fund and external funding such as grants or partnerships.

STRATEGIC CONSIDERATIONS

Community Strategic Plan and Operational Plan

The below table indicates alignment with relevant CSP and OP objectives and activities.

Objective: 1	We have infrastructure, transport and services which meet our expectations
Strategy 1.4	Provide a regular and acceptable waste and recycling service
Action 1.4 a)	Implement Integrated Waste Management and Resource Recovery Strategy
Activity 1.4 a)	Finalise strategy and implement 2018/19 action plan activities

Legal/Statutory/Policy Considerations

The following table lists the key relevant State and Council legislation, policies and strategies that provide a framework for the development of the IDLEEP.

State Legislation, Strategy and Policy	*Council Legislation, Strategy and Policy*
The Protection of the Environment Operations Act 1997 (and associated Waste 2014 Regulation)	Local Government Act 1993
NSW Illegal Dumping Strategy 2017-21	Enforcement Policy 2016
Draft NSW Litter Strategy 2017-20	11/2010 Smoke Free Outdoors Policy

Financial Considerations

Implementation of the associated action plans in the IDLEEP will be included in Council's Annual Operations Plans and will be funded via the relevant domestic waste budget, general fund and/or external funding such as grants or partnerships.

Consultation and Engagement

Consultation and engagement with the large number of key internal and external stakeholders identified in the IDLEEP is a critical component required for the successful implementation of the plan. There will be comprehensive consultation and engagement via a range of avenues and initiatives for the multitude of programs listed in the IDLEEP Action Plans.

Illegal Dumping and Litter Education and Enforcement Plan

2019

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1. EXECUTIVE SUMMARY

Illegal dumping and littering are issues that cause significant environmental, financial and social impacts for governments and communities.

The main impacts of littering and illegal dumping include:

- becoming a community norm if not dealt with effectively
- negative impacts on visual amenity
- damaging community pride and tourism reputation
- being costly to clean up
- risks associated with hazardous substances such as asbestos and chemical waste
- the spread of weeds and exotic species into public reserves, bushland and parks
- polluting land, waterways and beaches
- harming or killing marine and other wildlife
- becoming a fire hazard or harbouring vermin and pests.

In the 2016-17 financial year, Byron Shire Council recorded 715 illegal dumping incidents and costs associated with clean-up were in excess of $100,000. These figures, based on data from a 12 month NSW Environment Protection Authority funded Baseline Data research project, have highlighted the need for targeted action.

Based on analysis of what material is being illegally dumped the following priority issues have been identified:

1. Dumping of household waste on public land (e.g. the kerbside).
2. Dumping green waste on public land, parks and reserves.
3. Dumping household, commercial and illegal campers' waste in public litter bins.
4. Commercial waste skips and bins illegally stored on public land.

Council also faces significant challenges with litter, particularly cigarette butts and other micro litter along the Byron Bay Foreshore and beaches. 2016-17 Local Litter Check (LLC) data showed that cigarette butts make up 81% of littered items throughout the Byron Shire. This is despite regular litter clean-ups by Council staff and dedicated community groups. Council spent in excess of $180,000 on litter clean-up and removal in the 2017/18 FY. These challenges are intensified by the increasingly high tourist population.

Based on analysis of what material is being littered the following priority items have been identified:

1. Smoking related items including cigarette butts, cigarette packets, and lighters
2. Take away related items including takeaway containers, straws, coffee cups, plastic bags, napkins and bottles
3. Beverage related items including cans, glass and plastic containers.
4. 'Other' related items including unidentifiable hard and soft plastics, cloth, gum, metal/foil, foam, wood, food and hazardous material.

This Illegal Dumping and Litter Education and Enforcement Plan (IDLEEP) provides an overarching strategic framework for reducing illegal dumping and litter in the Shire. It outlines a multi-faceted approach to tackling these problems and coordinates action on education, enforcement and infrastructure.

The IDLEEP aims to address illegal dumping and littering through targeted reduction and prevention programs in collaboration with key stakeholders including, relevant Council departments, North East Waste, land managers, community groups, local businesses and the NSW Environment Protection Authority (NSW EPA).

It distinguishes between litter (supermarket bag size or smaller) and illegal dumping (larger items). Illegal dumping covers bulky waste such as general household rubbish, large household items like fridges and mattresses, garden material, building materials, clinical and hazardous waste, abandoned cars and tyres. Although littering and illegal dumping have some similarities, there are different reasons behind each type of behaviour, which occur at different places and frequencies. As such the Plan is divided into separate illegal dumping and litter components.

The IDLEEP outlines six and five key approaches to reducing illegal dumping and littering respectively, with detailed action plans for each approach. These approaches are consistent with those identified in the NSW EPA's Draft Litter Strategy 2017-20 and Illegal Dumping Strategy 2017-20, as listed in the table below (Table 1).

Table 1: Approaches to reducing illegal dumping and littering

Illegal dumping approaches	*Littering approaches*
Approach 1: Building an evidence base	Approach 1: Education and awareness
Approach 2: Stakeholder engagement and capacity building	Approach 2: Infrastructure and clean-up
Approach 3: Education and awareness	Approach 3: Regulation and enforcement
Approach 4: Prevention, infrastructure, and clean-up	Approach 4: Evaluation and monitoring
Approach 5: Regulation and enforcement	Approach 5: Rewarding responsible behavior
Approach 6: Evaluation and monitoring	

These approaches will be supported by detailed action plans to address each of the priority issues for illegal dumping and littering identified above.

Implementation of the IDLEEP will be included in Council's Annual Operations Plan and will be funded via the domestic waste budget, general fund and external funding such as grants or partnerships.

The IDLEEP will be reviewed annually to determine effectiveness in achieving stated objectives

2. LEGISLATIVE AND STRATEGIC CONTEXT

The following table lists the key relevant State and Council legislation, policies and strategies that provide a framework for the development of the IDLEEP (Table 2)

Table 2: Relevant State and Council legislation, polices and strategies

State Legislation, Strategy and Policy	*Council Legislation, Strategy and Policy*
The Protection of the Environment Operations Act 1997 (and associated Waste 2014 Regulation)	Local Government Act 1993
NSW Illegal Dumping Strategy 2017-21	Enforcement Policy 2016
Draft NSW Litter Strategy 2017-20	11/2010 Smoke Free Outdoors Policy

3. ILLEGAL DUMPING

Scope Objectives and Targets

Vision Target and Objectives

Combatting illegal dumping is a priority for Byron Shire Council. Council is committed to protecting the local environment and community by reducing illegal dumping and its social, environmental, health and financial impacts. Council's goal is to reduce all types of illegal dumping incidents in the Byron Shire by at least 30% by the end of 2021 (based on baseline 2016-17 figures), which is line with the NSW EPA's illegal dumping strategy targets.

Council's objective is to create anti-illegal dumping behaviour for the future through an integrated approach of evidence gathering, education and awareness, prevention, enforcement, infrastructure and evaluation.

What does the Illegal Dumping Plan cover?

The illegal dumping component of the IDLEEP provides the framework for prioritising action to tackle the Shire's priority illegal dumping issues and to achieve the stated objective.

Appendix 1 Illegal Dumping Action Tables summarises present and future projects to tackle the Shire's priority illegal dumping issues, using an integrated approach consistent with the NSW EPA's Illegal Dumping Strategy 2017-20.

Key Stakeholders

Internal stakeholders	External Stakeholder
Community Enforcement Branch	North East Waste
Open Spaces Team	Residents
Bush Regeneration Team	Local media
Utilities Branch	Real estate agents
Works Branch	Local businesses
Customer Service Team	Land care
Communications Team	Dune Care
Executive Team	SOLO Waste
Councillors	Richmond Waste

	Landscaping businesses Chambers of Commerce Master planning committees

Understanding illegal dumping

What is illegal dumping?

Illegal dumping is the unlawful deposit of waste larger than litter onto land. Illegally dumped items include large domestic household items, construction and demolition waste, green waste, and hazardous materials. It ranges from dumping small bags of rubbish or unwanted items in townships and suburbs to larger scale dumping of materials like construction waste. This waste can include dangerous materials like asbestos.

While illegal dumping is in some ways like littering, there are different reasons for the two behaviours, which occur at different places and on different scales.

Why do people illegally dump waste?

It is important to understand why businesses and people illegally dump in the Byron Shire so that appropriate prevention mechanisms can be developed. While there is no typical dumper, most people understand that dumping is illegal.

Social research conducted by the NSW EPA shows that, depending on the type and quantity of waste, illegal dumpers are motivated by:

- convenience
- the opportunity to make money
- an unwillingness to pay
- an uncaring attitude
- a lack of understanding on what impacts illegal dumping have on the community

This research also showed that:

- people mostly dump household waste on the kerbside
- illegal dumping is a growing problem
- it is not confined to one demographic.

In September 2018, Byron Shire Council ran a month long community survey to understand resident's opinion of illegal dumping in the region.

26 out of 46 responses admitted to some type of illegal dumping. 16 admitted to putting items on the kerbside with a 'free sign' , 6 admitted to putting items on the kerb without a free sign and 4 had dumped lawn clipping or palm fronds over their back fence. Over 67% of survey participates where over 46 years of age (see figure 1) and 73% of all survey participates were rate payers (see figure 2).

Illegal Dumping and Litter Education and Enforcement Plan 2019

Figure 1: Age demographic of initial illegal dumping survey.

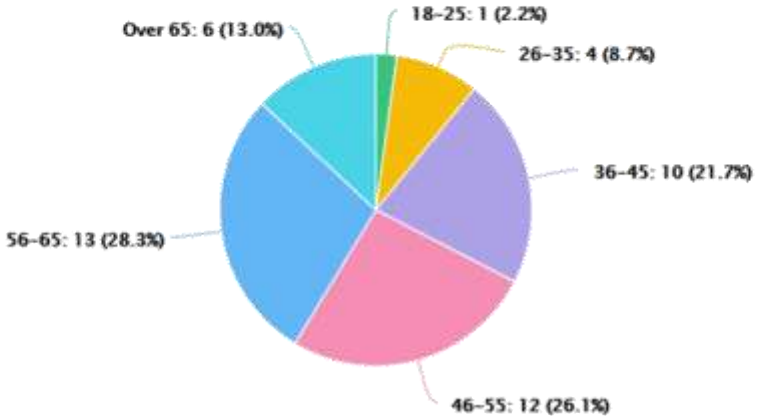

Figure 2: Number of ratepayers in initial illegal dumping survey

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Why is reducing illegal dumping important?

Illegal dumping has a number of impacts as listed below in **Table 3.**

Table 3: Impacts of illegal dumping

Environmental	Human	Visual	Resource	Economic
Dumped waste can contaminate and degrade land, plant and animal habitats and pollute waterways. It can also pose a fire risk The most significant environmental impact from illegal dumping in the Byron Shire is the impact of disposal of exotic plants and noxious weeds into nature reserves and bushland.	Dumped waste can affect our health, especially if it contains chemicals or asbestos.	Illegal dumping makes public places unsightly, which lowers community pride and attracts more dumping.	Easily recycled resources, like whitegoods, tyres and green waste, are generally lost when dumped.	Dumping waste can lower land values and undermines legitimate recycling facilities. Clean-up is expensive. **$109,920** was spent on illegal dumping associated costs in the 2016/17 FY.

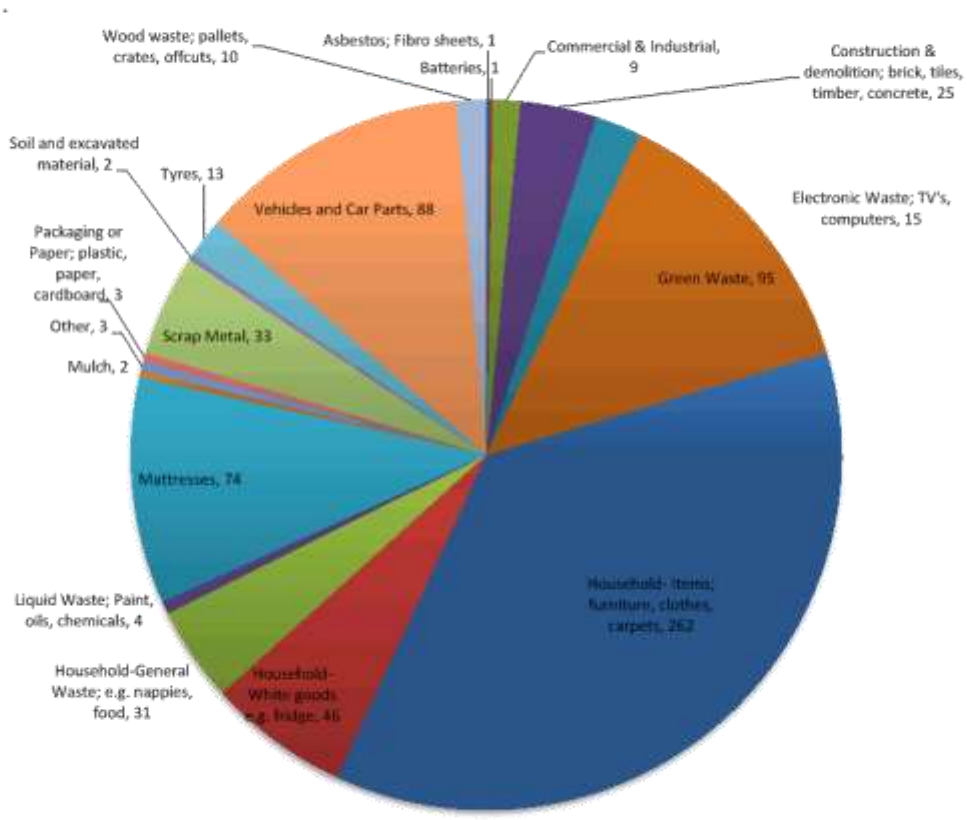
What waste is illegally dumped in the Byron Shire?

In June 2016, Byron shire Council received NSW EPA Clean Up and Prevention funding to implement a 12 month illegal dumping data improvement and in-field reporting project. The 2016-17 data generated from this program was specifically collected as baseline data and provides a comprehensive set of data for utilisation as baseline data for the IDLEEP. This data set has also been used as the baseline data for a subsequent NSW EPA Illegal Dumping clean-up and prevention grant Council received in June 2018.

As part of this project Council adopted the Reporting Illegal Dumping Online (RID Online) system to gather data and adapted the Council Customer Request Management System (CRM) to mimic the data required by RID Online.

Prior to this project, Council was significantly under-calculating and under estimating the true cost of illegal dumping on operations and resources. The collection of better data through this project has provided accurate information about the types of waste dumped (see figure 3), illegal dumping hotspots, the costs associated with clean-up and the volumes of waste illegally dumped.

Figure 3: Incidents by waste types illegally dumped August 2016-July 2017



Where does illegal dumping happen in the Byron Shire?

The number one illegal dumping hotspot in the Byron Shire is the township of Byron Bay (107) followed by Suffolk Park (100), Ocean Shores (72) and Byron Sunrise area (50) (see table 4).

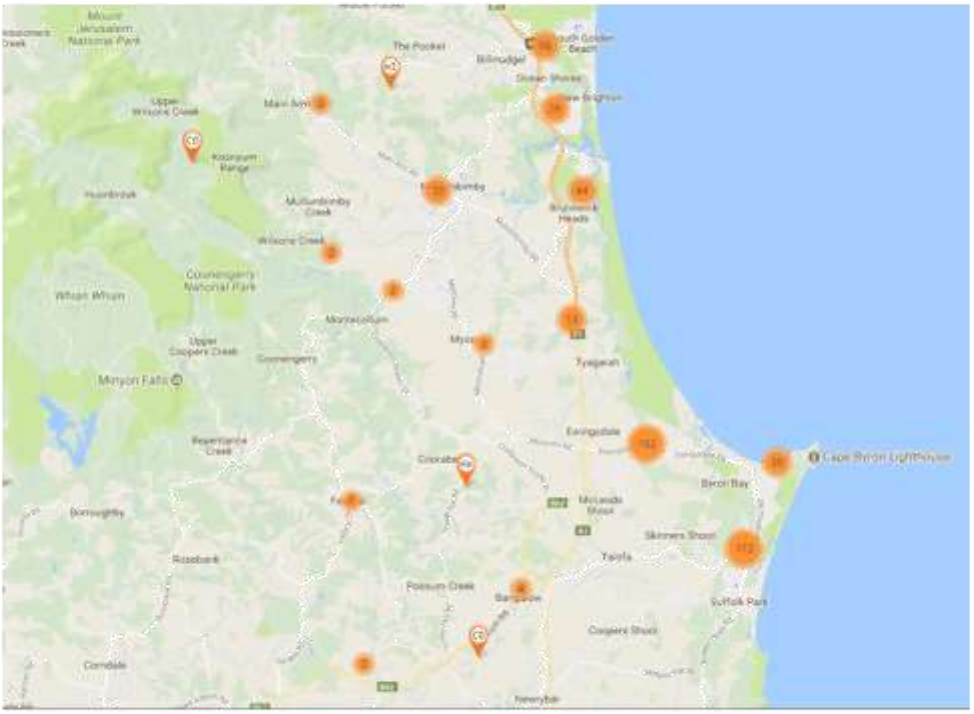
Within the township of Byron, hotspots have been identified in the residential areas and the industrial area. In residential areas the most common dumping is household items and green waste, while in the industrial area the addition of abandoned vehicles and furniture is prominent.

Table 4: Breakdown of dumping incidents by location in the Byron Shire between August 2016 - July 2017

Byron Central	Suffolk Park	Ocean Shores	Byron Sunrise	Mullumbimby	Byron Industrial	South Golden Beach	Brunswick Heads
102	100	72	50	39	37	19	17

Illegal Dumping and Litter Education and Enforcement Plan 2019

Figure 4: Locations of dumping recorded in RIDonline in the Byron Shire



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Volume of illegal dumping

Byron Shire Council recorded 717 illegal dumping incidents from August 2016-July 2017. Past underestimated records indicated 64 incidents in 2015 and 42 in 2014. This equated to an estimated to 287.8 tonnes of illegally dumped waste. Past underestimated records indicated 24.5 tonnes in 2015 and 37 tonnes in 2014.

Measuring illegal dumping in the Byron Shire

Council will continue to use the RID Online database for gathering accurate illegal dumping data. This will assist Council to:

- understand the nature, extent and causes of illegal dumping
- roll out successful projects, policies and identify new ways to reduce illegal dumping
- target Council's efforts
- monitor illegal dumping rates

Priority illegal dumping issues in the Byron Shire

Byron Shire Council has identified four priority illegal dumping issues through the analysis of RIDonline data for the period July 2016-December 2018 and historic data obtained from Council's pervious Illegal Dumping Action Plan. These are:

1. Dumping of household waste on public land (e.g. the kerbside).
2. Dumping green waste on public land, parks and reserves.
3. Dumping household, commercial and illegal campers' waste in public litter bins.
4. Commercial waste skips and bins illegally stored on public land.

This list is not exhaustive and subsequent issues that arise as evidence and data are gathered will be added to the IDLEEP.

Illegal Dumping Approaches

A combination of the six approaches outlined below will form the overarching plan to reducing illegal dumping in the shire. These approaches will be supported by detailed action plan (see Appendix 1) to address each of the priority issues identified above. These approaches are consistent with those identified in the NSW EPA's Illegal Dumping Strategies 2017-22.

Approach 1: Building an evidence base

Gathering information about illegal dumping can be challenging. Dumping is often done in remote areas, and dumpers try to keep it out of sight, undetected and anonymous, but accurate, comprehensive data will help direct and prioritise preventative action. It enables the problem to be quantified and provides an understanding of where the problems are and what material is dumped. An initial community survey allowed Council to get an insight into the communities understanding of illegal dumping. A follow up survey at the end of the campaign will see if this understanding has changed.

Approach 2: Stakeholder engagement and capacity building

All of Council's illegal dumping programs will be based on strong stakeholder engagement and partnerships. Building these relationships will provide an opportunity to improve skills and enable vital information to be shared to identify illegal dumpers and hotspots, and develop effective reduction programs together.

Approach 3: Education and awareness

Educating the community is the first step towards changing behaviour. It raises awareness of the problem and its consequences and builds the social norm that illegal dumping is wrong.

Results from the initial illegal dumping survey showed that 60% of participants did not know how to report illegal dumping to Council, 30% were not aware that Council offers an Annual Free Drop Off Service, 15.6% did not know about our Community Recycling Centres and what items can be dropped of for free and 13% did not know the impacts of green waste dumping on the environment.

To reduce the number of incidents of illegal dumping in the long term, Council must develop programs that change the way people who currently illegally dump dispose of their waste. This strategy will focus on creating a new social norm that illegal dumping is wrong.

The following key findings from the NSW EPA's social research will help Council develop and implement strategies that target different behaviours, situations and barriers that lead to illegal dumping:

- Seeing others illegally dump makes people feel more comfortable doing it themselves,
- 35% of people surveyed had dumped waste illegally.

Approach 4: Prevention, infrastructure, and clean-up

Prevention and deterrence are central to reducing illegal dumping. The NSW EPA's social research has established five targeted methods relevant to the Byron Shire Council:

1. making dumping harder using infrastructure, like fencing and lighting
2. increasing the risk of getting caught
3. reducing financial gains
4. making it easy to dispose of waste lawfully
5. educating the community.

Timely clean-up of illegally dumped waste is important as it sends the message that waste does not belong there, and removes environmental and health risks. Keeping sites clean reduces the risk of more dumping.

Approach 5: Regulation and enforcement

NSW EPA research shows that less people will dump waste if they think they will get caught. An integrated approach using a range of tools is needed to reduce instances of opportunistic and premeditated illegal dumping. Regulation and enforcement helps to change behaviour, protects the environment and reduce health risks.

What are the illegal dumping laws?

In NSW, state and local government agencies can enforce illegal dumping laws under the Protection of the Environment Operations Act 1997 (POEO Act) and its subordinate Protection of the Environment (Waste) Regulation 2014.

Under the POEO Act, waste generators, transporters and owners of receiving premises are all responsible for ensuring that waste is disposed of appropriately. This enables Council to issue penalty notices or prosecute dumpers, however also allows Council to prosecute the generator of the waste for failing to exercise due diligence to ensure that their waste was disposed of legally.

Where breaches can be identified, Council or the NSW EPA has various enforcement options, including:

- **Prosecutions** – there are four main offences relating to illegal dumping of waste that can be prosecuted through the Land and Environment Court or Local Court
- **Penalty Notices** – On the spot fines generally for minor breaches. Penalty notice amounts include fines of up to $15,000 for corporations and $7,500 for individuals.
- **Clean Up Notices** – where either the dumper or the generator of the waste can be required to clean up waste and take it to a licensed waste disposal facility. A notice carries a financial penalty in the form of a mandatory administration fee.
- **Prevention Notices** – used to prevent ongoing pollution or waste dumping problems such as use of private land for waste storage or disposal. A notice carries a financial penalty in the form of a mandatory administration fee.
- **Compliance Cost Notices** – enables Council to recover costs of monitoring and follow up action when Clean Up or Prevention Notices are issued.

Local councils generally regulate small-scale dumping, while the NSW EPA regulates larger incidences. Council has powers to investigate illegal dumping however, the ability to take action is often limited unless the act of dumping is witnessed by a Council ranger, a member of the public, or there is evidence with the waste that identifies the origin of the waste.

Council has an existing Enforcement Policy (**E2016/14523)** which assists Council staff in responding promptly, consistently and effectively to reports of alleged unauthorised activity.

Approach 6: Evaluation and monitoring

Why is monitoring and evaluation important?

As Council continues to gather data and information on illegal dumping, a better understanding and review of what is working, what isn't working and why, will allow Council to develop programs accordingly. Council's target is to reduce illegal dumping incidents by 30% by 2021 so setting baseline evidence is key to tracking and evaluating progress towards this target.

What work has been done so far?

The 2016-17 Clean-up and Prevention Project (CU&P) has provided a baseline for Council to monitor effectiveness of the IDLEEP against stated target in the reduction of illegal

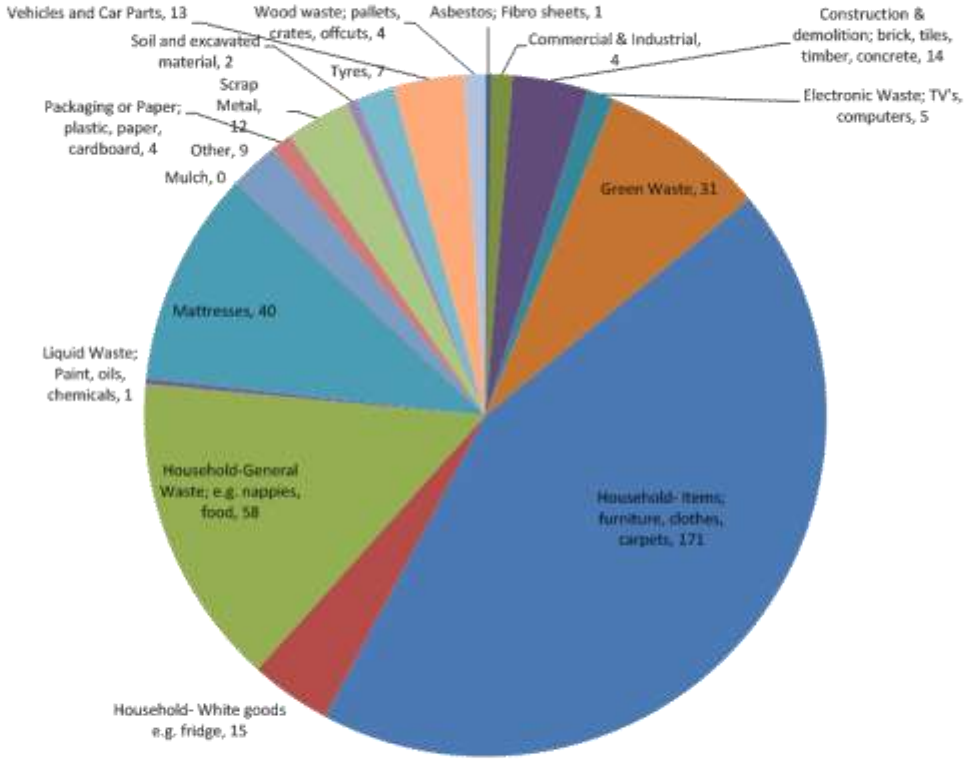
dumping incidents. The results of the CU&P project assisted in the justification of the employment of a full time Waste Education and Compliance Officer to deliver the IDLEEP.

Since employment, the majority of illegal dumping incidents are investigated, taped or stickered and a letter is delivered to surrounding properties. Since October 2017, 91 out of 345 (26%) reports of illegal dumping to Councils Customer Request Management System (CRM) were removed by the public after undergoing this process. Illegal Dumping incidents have continued to be recorded in RIDonline to account for waste type (see figure 5), volume and location. In 2017/18 a total of 391 incidents have been recorded equating to 1198.85t of waste.

Comparative to the baseline data, the number of incidents has significantly decreased from 715 to 391 incidents. Whilst this is a positive result and response to the initial stages of the project, the 17/18 data is likely to be underestimated in comparison the baseline data as the level of active surveillance for illegally dumped material was not as thorough.

Illegal Dumping and Litter Education and Enforcement Plan 2019

Figure 5: Incidents by waste type dumped in the Byron Shire July 2017/18



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Appendix 1: Illegal Dumping Action Plans

Issue	Approach	Action	BSC Responsibility	Partners	Timeframe
1. **Dumping household waste on public land** 2. **Dumping green waste on public land, parks and reserves.**	Building an evidence base	On-going consistent measurement data collection and reporting incidents of illegal dumping into the RID Online database.	Resource Recovery	Community Enforcement Parks Works Customer Service	On-going
		On-going weekly surveillance of identified illegal dumping hotspot areas.	Resource Recovery	Community Enforcement Parks Works Customer Service	On-going
		On-going quantification of the Annual Free Drop-Off Service.	Resource Recovery		On-going
	Stakeholder engagement and capacity building	Develop a kerbside dumping program in collaboration with local real estate agents and strata managers that is focused on the issue of end of tenancy associated kerbside dumping.	Resource Recovery	Real estate agents Strata Managers North East Waste	Current and ongoing
		Support community initiatives – develop partnerships and support to Landcare, Dunecare, Bush Regeneration and all groups whose work is impacted by illegal dumping of green waste.	Resource Recovery	Landcare Dunecare Bush Regeneration Landscaping businesses	Current and ongoing
	Education and awareness	Develop an IDLEEP communication plan	Resource Recovery	North East Waste Media Communications	Complete
		Develop and implement a Shire-wide kerbside and green waste illegal dumping education/compliance program and campaign that's	Resource Recovery	Media Communications North East Waste	Current and ongoing

		integrated with media coverage, random inspections, increased patrols and partnerships with stakeholders.			
		Develop kerbside Illegal dumping branding and educational materials including: Letters, flyers, stickers and tape, signage.	Resource Recovery	Media and Communications North East Waste	Complete
		Promote Council's waste services including: • Information about the range of waste and recycling services available, particularly those that are free. • Annual Free Drop off system • Re-use opportunities such as garage sales and online swap and sell forums. • Information about the green organics bin and home composting. • New MAF green waste composting facility at the BRRC	Resource Recovery	Media and Communications	On-going
		Promote Reporting Illegal Dumping (RID) Online – promote the use of RID Online and encourage the community to report Illegal Dumping via the Byron Shire Council Website or Resource Recovery Hotline.	Resource Recovery	Media and Communications Community North East Waste	On-going
		Publicise successes and promote illegal dumping penalties and enforcement activities in the media to raise awareness that Council is responding to this issue.	Resource Recovery	Media and Communications	On-going

		Investigate and implement innovative and contemporary illegal dumping education and awareness programs that assist with achieving litter reduction objectives and targets.	Resource Recovery	All relevant stakeholders	On-going
	Prevention, infrastructure and clean-up	Investigate the expansion and refinement of the current Bulk Waste Drop-off System including the following: • Investigate the implementation of additional free waste drop-off services (e.g. free bulk and/or green waste drop-off days at the BRRC). • Investigate the option of providing courtesy trailers for the community to transport unwanted items to the BRRC. • Investigate potential for multiple drop-off entitlement.	Resource Recovery	North East Waste Corporate Governance (insurance implications)	Current and on-going
		Fee Relief Policy – provide fee annual BRRC drop-off allocation for not-for-profit/charity groups and organisations conducting clean-up activities on Council land.	Resource Recovery	Not-for-profit/charity groups	On-going
		Identify and Install relevant infrastructure at hotspot locations to prevent access for dumping. E.g. lighting, gates, barriers, restricted access points, surveillance cameras, signage.	Resource Recovery	Community Enforcement North East Waste	On-going
		Provide a rapid response to illegal dumping to reduce the likelihood of opportunistic dumping in the same	Resource Recovery	Open Space Works Community	On-going

		Location by: • Streamlining illegal dumping clean-up operations using a mix of contractor and internal resources. • Collection of dumped material by Wast Compliance Officer during routine inspection/surveillance • Investigating the utilisation of existing Waste Track software to assist in route optimisation and clean-up collection logistics and monitoring.		Enforcement Community Clean-up contractor	
	Regulation and enforcement	On-going visual Council surveillance including: • Patrols to provide visibility • Use of cameras, signage, surveillance contractors in hotspot areas.	Community Enforcement	Resource Recovery	On-going
		For each kerbside illegal dumping incident, where possible, provide: • information about potential fines and why illegal dumping is wrong • correct waste disposal options via written or verbal communication with residents.	Resource Recovery	Community Enforcement	
		Use stickers, signage and enforcement tape to identify dumped loads and advertise clean-up costs to ratepayers.	Resource Recovery	Media and Communications	Current and ongoing
		Develop a procedure in-line with Council's Enforcement Policy for issuance of the following enforcement options to ensure consistency and to	Resource Recovery	Community Enforcement	On-going

		define repeat offenders/serious incidents. • Penalty Notices • Clean Up Notices • Prevention Notices • Compliance Cost Notices			
	Monitoring and evaluation	Monthly analysis of data captured using RID Online to monitor and evaluate: • hotspot data trends • utilisation of RIDonline reporting tool by the community • volume of dumped incidents against target.	Resource Recovery	Community Enforcement	On-going
		Provide quarterly progress reports to relevant staff and senior management to evaluate progress success against stated targets.	Resource Recovery	Community Enforcement	On-going
		On-going analysis of bulk waste drop-off program utilisation to measure effectiveness of program uptake.	Resource Recovery		On-going
		Community surveys to measure resident awareness and satisfaction against June 2018 baseline survey.	Resource Recovery	Media and Communications	Initial June 2018 Follow up May 2019

Issue	Approach	Action	BSC Responsibility	Partners	Timeframe
3. Dumping household, commercial	Building an evidence base	Conduct baseline audit program of known hotspot public place bins to determine: • Composition and extent of illegally	Resource Recovery	SOLO Waste	Jan-Mar 2018

and illegal campers' waste in public litter bins.		dumped waste • Sources • Community engagement opportunity			
	Stakeholder engagement and capacity building	Develop partnerships with relevant businesses and community groups including youth hostels and the chambers of commerce to support household and commercial dumping programs.	Resource Recovery	Businesses Chambers of Commerce	Ongoing
		Develop partnerships with relevant Tourism operators or campervan providers to support tourist related illegal dumping programs	Resource Recovery	Tourism operators	Ongoing
	Education and awareness	Develop a pilot compliance and education campaign for Mullumbimby that's integrated with media coverage, random inspections, increased patrols and partnerships with stakeholders. Review and expand Shire wide.	Resource Recovery	Community Enforcement North East Waste	Ongoing
		Develop a communications plan.	Resource Recovery	Media and Communications	Ongoing
		Develop educational materials including letters and flyers for tourist, residential and commercial target audiences.	Resource Recovery	Media and Communications Businesses Chambers of Commerce Tourist Operators	Ongoing
		Promote Council and Private Contractor's Commercial Waste service options including: • Information about the range of domestic and commercial waste and recycling services available	Resource Recovery	Media and Communications Businesses Chambers of Commerce Tourist Operators	Ongoing

		• Promote uptake and utilisation of additional weekly servicing of red landfill and yellow recycling bins over the Christmas/New Year period			
		Publicise successes and advertise the cost of servicing public place litter bins to the community.	Resource Recovery	Media and Communications	Ongoing
	Prevention, infrastructure and clean-up	Use controlled opening on public litter bins and enclosures where possible to restrict access for the dumping of bulk quantities of household or commercial waste.	Resource Recovery		Ongoing
		Implement a compulsory rural waste service.	Resource Recovery	Rates	June 2018
		Provide additional weekly domestic kerbside collection services during 2-week Christmas/New Year peak waste and recycling generation period	Resource Recovery	Solo Waste	Current and ongoing
		Ensure public place bins are regularly serviced and maintained.	Resource Recovery	SOLO Waste Open Space	Current and ongoing
	Regulation and enforcement	Install consistent signage and notices regarding illegal dumping of household and commercial waste in public bins across the Shire.	Resource Recovery	Legal Team	Current and ongoing
		On-going visual Council surveillance including: • Patrols to provide visibility. • Use of cameras, signage, surveillance contractors in hotspot areas	Resource Recovery Community Enforcement	Resource Recovery	Ongoing
		Develop a procedure in-line with Council's Enforcement Policy for issuance of the following enforcement	Resource Recovery Community	Resource Recovery	Ongoing

		options to ensure consistency and to define repeat offenders/serious incidents. • Penalty Notices • Clean Up Notices • Prevention Notices • Compliance Cost Notices	Enforcement		
	Monitoring and evaluation	On-going audit and monitoring against baseline audit numbers to assess effectiveness of program against target	Resource Recovery		July 2018
		Community surveys to measure resident awareness and satisfaction against June 2018 baseline survey.	Resource Recovery	Media and Communications	Initial June 2018 Follow up May 2019

Issue	Approach	Action	BSC Responsibility	Partners	Timeframe
4. **Commercial waste skips and bins illegally stored on public land.**	Building an evidence base	Conduct survey, Consult with local businesses to determine bin type and location in North and South Lawson Street Carpark	Resource Recovery	Byron Bay Businesses	Complete
		Create a contact list of businesses that back onto Lawson Street carpark.	Resource Recovery	Byron Bay Businesses	Complete
	Stakeholder engagement and capacity building	Consultation with key stakeholders/Partners (local businesses, Chambers of Commerce, Byron Bay Master planning Committee and Richmond Waste) to determine: • the nature of the problem	Resource Recovery	North East Waste Richmond Waste Byron Bay Chamber of Commerce Byron Bay businesses	Complete

		• the desired outcomes • solutions .		Byron Bay Town Centre Masterplanning Committee	
	Education and awareness	Develop a program Communications Plan	Resource Recovery	Communications Team	2019
		Develop a step by step guideline (in a pamphlet format) for businesses indicating: • Reasons why Council are acting on the issue • Objectives of the program • Requirements for businesses (see below)	Resource Recovery		April 2019
		Promote successes in the media.	Resource Recovery	Media and Communications	TBD 2019
	Prevention, infrastructure and clean-up	Implement the following requirements for business straining bins on Council land in Lawson St Carparks: 1. Business is required to develop a waste management plan 2. Implement on-site storage of bins (if available) 3. Implement precinct private land storage if available 4. Enter a lease agreement for commercial use of Council Land 5. If lease agreement is successful business must erect a screen or enclosure to shield bins. or an appropriate aesthetic shield/design for the bins	Resource Recovery	North East Waste North East Waste Richmond Waste Byron Bay Chamber of Commerce Byron Bay businesses Byron Bay Town Centre Masterplanning Committee	June 2019
	Regulation and	If the issue are not resolved in the required timeframe, consider taking	Resource Recovery	Community Enforcement	TBD

	enforcement	enforcement action to remove bins where they are not legally permitted.			
		Commercial bins and skips removed from identified locations.	Resource Recovery		June 2019
		Reclassify the small portion of land in the north Lawson Street carpark from community land to operational land to allow for lease agreement for commercial use of Council land to store bins.	Environment and Economic Planning Team Resource Recovery Legal Team	Community Business Byron Bay Town Centre Master planning Committee	2020
	Monitoring and evaluation	Ongoing monitoring of bin enclosures/screens to ensure that businesses are being compliant by keeping area clean and not overfilling their bins.	Resource Recovery	Community Enforcement	June onwards
		Ongoing monitoring of site to ensure Waste Management Plans are being complied with.	Resource Recovery	Community Enforcement	June onwards

4. LITTERING

Goals, Vision and Objectives

Combatting littering in the Byron Shire is a priority for Council. Council is committed to protecting the local environment and community by reducing the amount of litter and its social, environmental, health and financial impacts. Council's goal is to reduce the amount of litter in the Byron Shire in line with the on-going NSW State Government's littering targets. After this time, that target is by 40% reduction by 2020 (which will be based on 2016-17 baseline figures).

Council's objective is to create anti-littering behaviour in the Byron Shire through an integrated approach of education and awareness, infrastructure, enforcement and monitoring and evaluation.

What does the Littering Plan cover?

The littering component of the IDLEEP provides the framework for prioritising action to tackle the Shire's priority litter issues and to achieve the stated objective.

A number of key Litter Action Plans have been developed with current and planned projects to tackle the priority litter issues, using an integrated approach consistent with the NSW EPA.

Stakeholders

Internal stakeholders	External stakeholders
Community Enforcement Works Department Open Spaces Customer Service Team Communications Team Executive Team Councillors	Boomerang Alliance Plastic Free Byron Positive Change For Marine Life Cape Byron Marine Park National Parks and Wildlife Service Australian Life Guards – North Coast North East Waste Reflections Holiday Park Surfer Rosa Take3 for the Sea Seaside Scavenge Local media Local businesses Master planning committees

Understanding littering

What is littering?

Littering has been defined as the deposit of waste at a place that is an amount less than 200L in volume. Common types of litter include cigarette butts, drink bottles, fast food wrappers, material from a trailer that is poorly secured, grass clippings swept into the gutter and fishing tackle.

Littering includes throwing food wrappers or cigarette butts form a vehicle, leaving a food container under a park bench, stubbing a cigarette onto a footpath, tossing and apple core into a garden bed or allowing waste to blow from a moving vehicle.

Dangerous littering is litter which causes or is likely to cause harm to a person or the environment. Common types of dangerous litter include discarded syringes, lit cigarettes and intentionally broken glass.

Why do people litter?

It is important to understand why people litter so that appropriate prevention mechanisms can be developed. While there is no typical litterer, most people understand that littering is illegal.

Social research conducted by the NSW EPA shows that the main causes of littering include:

- Laziness
- A perception that litter is not an important environmental concern
- A feeling that someone else is paid to clean up anyway
- Cleanliness of the area

Why is reducing litter important?

Not only does litter pose a major threat to the local environment and wildlife, it also costs ratepayers a lot of money. There are significant clean-up costs, and it can have a negative impact on local businesses and the tourism industry. Litter impacts us all and can prevent us from enjoying our local community such as parks, beaches, rivers and the town centre.

Littering has a number of impacts as listed below in **Table 4.**

Table 4: Impacts of littering

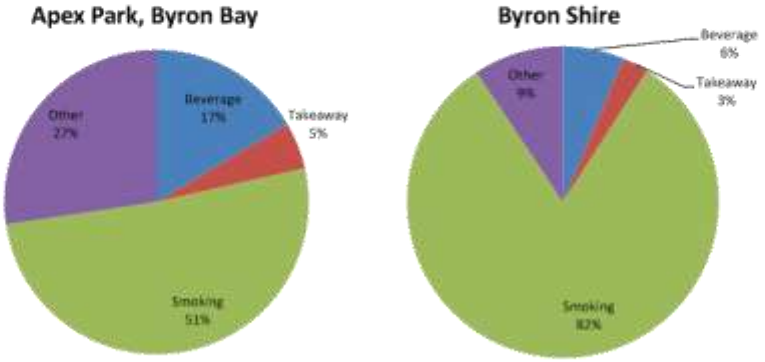
Environmental	Human	Visual	Resource	Economic
Litter damages natural environments and harms wildlife and marine life	Dangerous litter like broken glass and syringes can cause injury to persons. The presence of litter makes it more likely that more serious anti-social behaviour will occur, like graffiti and property damage	Litter makes public places unsightly, which lowers community pride and attracts more litter.	Easily recycled resources, like plastic drink bottles, are lost when littered	A 2016 survey of local councils, public and private land managers and community groups found that more than $180 million is spent each year on managing litter. **$186032.75** was spent on litter associated costs in the 2016/17 FY

What is commonly littered in the Byron Shire?

Byron Shire Council established baseline data by conducting weekly Local Litter Checks between April and July 2017 in 'hotspot' Apex Park and 'clean spot' Denning Park, Byron Bay. As a result, Council recorded 545 smoking related items in Apex Park compared to just 69 recorded in Denning Park. This equates to 51% of the over all litter (Other 27%, Beverage 17% and Takeaway 5%) in Apex Park and 61% of the over all litter (Other 18%, Beverage 16%, Takeaway 5%) in Denning Park.

Subsequently, Council further investigated smoking related litter hotspots in the Byron Shire by conducting weekly Local Litter Checks in Byron Bay town centre, Suffolk Park, Mullumbimby, Brunswick Heads, Coolamon Scenic Drive, Bangalow and Federal for a period of 4 weeks (see figure 6). In total, 2912 smoking related items where recorded, equating to 82% of the litter composition (Other 27%, Beverage 6%, Takeaway 3%).

Figure 6: Litter type in Apex Park and the Byron Shire 2017.

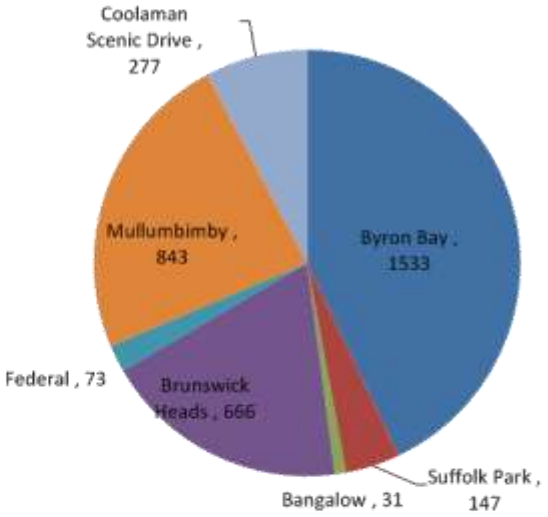


Local non-for-profit group Positive Change For Marine Life has run fortnightly beach cleans on Main Beach, Byron Bay since 2012, collecting over 400,000 items of litter. The data provided by this group is consistent with that presented above, with the main items largely consisting of cigarette butts and plastic takeaway items.

Where does littering occur in the Byron Shire?

The township with the highest number of littered items in the Byron Shire is the township of Byron Bay (1533) followed by Mullumbimby (843) and Brunswick Heads (666) (see figure 7). The increase in litter correlates to the significantly higher volume of visitors to Byron Bay as opposed to other parts of the Shire. The Byron Shire consists of approximately 32,000 residents; however there are an estimated 2 million + tourists that visit per annum.

Figure 7: Number of items collected during baseline local litter check in the Byron Shire September-October 2017



Volume of litter

Council has collected 4634 individual items throughout the Local Litter Checks equating to 39.9L of litter.

Based on the Local Litter Check data in Apex Park Byron Bay, the highest individual item littered was smoking related (545), however this equated to the lowest volume of litter (0.3L). This is due to the small size of smoking related items. The highest volume of litter was 'Beverage' (4.4L) followed by 'Other' (4L) followed by 'Takeaway' (1.8L) related items.

Who is littering in the Byron Shire?

The structure of the target audience emerged during the Local Litter Checks comprised a mix of locals, visitors, youth, adults, over 50s and seniors. BSC staff surveyed 55 individuals in Apex Park (Main Beach Byron). Figure 8 illustrates the demographic of the people survey (note that those surveyed were random and not observed to be littering) 13 where local and 42 were visitors, 33 were aged between 18-29, 16 aged between 30-65, 5 aged 65+ and 2 aged <18.

On days where Local Litter Checks commenced an estimated 4000 park goers were counted in Apex Park and 2500 in the adjacent Denning Park.

Figure 8: Age, locality and gender of litter survey participants

Furthermore, on days when Litter Checks were conducted, Council recorded half hour litter behavioural observations in Apex Park. Observations of litter incidents correlate to the largest age demographic observed, with most individuals observed littering being young adults from 15-29. Council also recorded observations of young families leaving non-smoking related litter behind.

Measuring litter in the Byron Shire

Council will continue to conduct EPA Local Litter Checks for gathering accurate littering data. This will assist Council to:

- Understand the nature, extent and causes of littering
- Understand the litter type, amount and volume.
- Roll out successful projects, policies and identify new ways to reduce littering
- Target Council's efforts
- Monitor littering rates

Priority littering issues in the Byron Shire

Byron Shire Council has identified four priority litter issues based on the baseline local litter check data. These are

1. Smoking related items including cigarette butts, cigarette packets, and lighters.
2. Take away related items including takeaway containers, straws, coffee cups, plastic bags, napkins and bottles.
3. Beverage related items including cans, glass and plastic containers.
4. 'Other' related items including unidentifiable hard and soft plastics, cloth, gum, metal/foil, foam, wood, food and hazardous material (syringes, condoms, band aids, dog poo).

Littering Approaches

The following approaches, developed by the NSW EPA, will be used to tackle the priority illegal dumping issues in the Byron Shire.

Approach 1: Education and awareness

Why is education important?

Community education is critical for changing behaviour. It raises awareness in the community about littering and builds the norm that littering is not the right thing to do. This can influence peoples' motivations and support them to choose not to litter. Good education approaches encourage people to dispose of their litter appropriately and responsibly. These can include feedback, rewards, privileges and other incentives, information and ways to participate and get involved. Raising awareness and education can also build community engagement and support for litter prevention actions.

What work has been done so far?
Byron Shire Council is currently implementing the following litter reduction campaigns.

Butt Free Byron Shire - Butt Free Byron Shire is an alliance of local groups dedicated to protecting our environment from cigarette butt pollution. Butt Free Byron Shire is working towards reducing cigarette butt pollution by 40% by April 2019.

Image 1: Representatives from the Butt Free Byron Shire Alliance, from left to right, Positive Change For Marine Life, National Parks and Wildlife Service, North East Waste, Byron Shire Council, Byron Bay Lifeguards and Cape Byron Marine Park

- **Don't be a Tosser! campaign -** The NSW EPA Don't be Tosser! Campaign evolves the conversation with the community about litter. The Campaign uses a range of excuses which are used as humour and irony of the types of excuses people use to justify their behaviour

Image 2: NSW EPA Don't Be a Tosser! campaign street banners in the Byron Shire.

- **Plastic Free Byron 'Make the Switch-'** is a community plan with an aspirational goal to reduce the use of identified single-use plastic packaging in Byron Shire (by 50%) by June 2019.

Image 3: Plastic Free Champions at The Farm Byron Bay

- **NSW Return and Earn – Container Deposit Scheme** - A container deposit scheme (CDS) is a simple way to reward responsible behaviour, reduce drink container litter and increase recycling by encouraging the person consuming the drink to hold onto the empty container for later redemption and by providing an incentive for other people to pick up littered containers to receive the refund.

Image 4: Nationals Parliamentary Secretary for Northern NSW Ben Franklin using the reverse vending machine at the Cavanbah Centre Byron Bay.

Approach 2: Infrastructure and clean up

Why is infrastructure important?

The NSW EPA's social research shows that people are less likely to litter if it is easy to disposer of their rubbish correctly. Each bin and its placement sends a signal about what should happen with rubbish at a site. It is important to provide clean, well-maintained bins that are site-specific, taking into account who uses a site and how.

Why is clean up important?

As well as bins, it is important to keep sites clean to reduce litter. This is vital to any litter prevention activity, as doing so sends the message that litter doesn't belong. Sites that are clean will stay cleaner. Littered sites imply that littering is simply the norm

What work has been done so far?

In 2016/17, Council upgraded its public place bin network which included the installation of new enclosures and bin stands and introduction of an extensive public place recycling network throughout the Shire. A review of service regimes and frequencies was also conducted, with the development of a peak/off-peak collection schedule. This was coupled with the development of a comprehensive public place bin asset management program, to ensure the network is cleaned and maintained to a high standard. Council spent $568,000 on servicing, cleaning and maintain the public place bin network in the 2017/18 FY.

Council has regularly scheduled litter clean ups in place. Six days a week manual litter collection is undergone in Byron Bay hotspots including Apex Park to Clarkes Beach, Railway Park, Lawson Street Carpark and Ewingsdale Road. Twice a week Mullumbimby CBD and recreation grounds is manually cleaned. Council also has a contractor Friday-Monday to do four hours each morning to clean the Byron CBD. In 2017/18 FY, Council spent $186,000 on litter collection and removal.

Council has regular mechanical street sweepers in Byron Bay CBD three days a week, Mullumbimby two days a week and Suffolk park one day a week. Other weekly locations include the Cavanbah centre and Ewingsdale road.

Local non-for profit group Positive Change For Marine Life does fortnightly beach cleans on Byron Bay main beach and Seven Mile Beach in Broken Head. Other groups such as Landcare, Dune care, Green Mean Awareness Team, Clean Coast Collective and other volunteer groups do regular cleans throughout the Shire.

Approach 3: Enforcement

Why is enforcement needed?

NSW EPA research shows that less people will litter less if they think they will get caught. Regulation and enforcement helps to change behaviour, protects the environment and reduce health risks.

What are the littering laws?

The Protection of the Environment Operations Act 1997 (POEO Act) is the primary piece of environmental legislation regulating littering in NSW. The range of littering offences

includes littering generally, aggravated littering, littering from a vehicle/ trailer, release of balloons and irresponsible depositing of advertising material.

Other relevant legislation includes The Local Government Act 1993 (breaking glass and other matter, acting contrary to notices erected by council), Graffiti Controls Act 2008 (Posting Bills and other markings) and the Companion Dog Act 1998 (Dogs defecating in public places).

Littering is subject to a tiered range of fines under the POEO Act 1997 including:

- $80 for littering small items, such as bottle tops and cigarette butts
- $250 for general littering
- $250 for an individual littering from a vehicle ($500 for corporations)
- $450 for littering in aggravated or dangerous circumstances, such as depositing a syringe or a lit cigarette ($900 for corporations).

Council has an existing Enforcement Policy **(E2016/14523)** which assists Council staff in responding promptly, consistently and effectively to reports of alleged unauthorised activity. This Policy will be referred to when enforcing the smoking ban on beaches and during scheduled litter blitzes as identified in the Litter Action Plans (Attachment 2).

Approach 4: Monitoring and Evaluation

Why is a strong evidence base needed?

As Council learns more about littering in the Shire through Local Litter Checks, it will enable Council to understand and review what is working, what isn't working and why, and to develop programs accordingly. Council's target is to reduce micro litter in the Byron Shire by 40% by 2020, so setting baseline evidence is key to tracking and evaluating progress towards this target

What work has been done so far?

The Local Litter Checks has provided Council with baseline data to monitor the effectiveness of the IDLEEP against the reduction of litter in the Byron Shire.

Approach 5: Rewarding responsible behaviour

Why is rewarding responsible behaviour important?

NSW EPA research shows that reinforcing and rewarding existing positive behaviour helps to incentivise and solidify responsible behaviour, protects the environment and reduce health risks.

What work has been done so far?

As part of the NSW Return and Earn Container Deposit Scheme two reverse vending machines have been installed in the Byron Shire; one at the Byron Bay Cavanbah Centre and one at the Mullumbimby Ex-Services Bowling Club.

Appendix 2: Litter Action Plans

Issue	Approach	Action	BSC Responsibility	Partners	Timeframe
1. Smoking Related Litter	Education and awareness and rewarding responsible behaviour	Develop and implement a Shire-wide litter reduction education campaign using a combination of ' Don't be a Tosser!' material and BSC ' Butt Free Byron Shire; branding to promote educational messages on the effect of micro litter such as cigarette butts on the Cape Byron Marine Park.	Resource Recovery	National Parks and Wildlife Service North Coast Branch Byron/ Ballina Lifeguards Cape Byron Marine Park Positive Change For Marine Life Reflections Holiday Park North East Waste NSW EPA	Current and ongoing
		Develop, implement and maintain communications plan	Resource Recovery	Media and Communications	May 2018
		Develop, implement and maintain 'Butt Free Byron Shire' branding and educational materials including pamphlets, bags, stickers and banners.	Resource Recovery	Ahoy Design Media and Communications	May 2018

		Develop, implement and maintain Don't be a Tosser!' branding and educational materials including street banners, infrastructure stickers, bus shelter adds, pamphlets and engagement banners.	Resource Recovery	Ahoy Design EPA Media and Communications	June 2018
		Develop, implement and maintain a specific tourism litter reduction campaign to tackle cigarette butt litter in popular hot-spot foreshore car parks, open space areas and on local beaches. BSC will engage youth hostels and tourism companies to promote educational messaging in multiple languages.	Resource Recovery	Media and Communications Surfer Rosa Take 3 For the Sea	July 2019
		Develop and implement a schoolies litter reduction plan to tackle schoolies related litter on local beaches and foreshores.	Resource Recovery	Ballina Byron Lifeguards Byron High School Positive Change for Marine life	November 2018 and on-going
		On-going investigation and implementation of innovative and contemporary smoking related litter education programs that will assist in achieving litter reduction objectives.	Resource Recovery	All relevant stakeholders	On-going
	Infrastructure and clean-up	Upgrade cigarette butt bin infrastructure Shire-wide.	Resource Recovery	Enviropole	Septembe r 2018

		Develop branding and ground adhesives for cigarette butt bin infrastructure advertising their cigarette recycling capabilities.	Resource Recovery	Enviropole	July-August 2018
		Service and maintain cigarette butt bin infrastructure Shire-wide.	Resource Recovery	Enviropole	On-going
		Support and promote Community Groups' clean-up events	Resource Recovery	Community Groups	On-going
		Investigate and implement innovative and contemporary infrastructure and clean-up programs that assist in achieving litter reduction objectives and targets.	Resource Recovery	All relevant stakeholders	On-going
	Regulation and Enforcement	Increase litter patrols throughout the busy summer period	Community Enforcement	Resource Recovery	On-going
		Adopt revised BSC "Smoke-free Outdoor Areas Policy' as a formal BSC regulation policy, and have enforcement become regulatory.	Resource Recovery	Council	Jan 2018
		Install and maintain appropriate signage to enable enforcement of policy in prohibited areas.	Resource Recovery	Open Spaces Infrastructure Services	On-going
		Develop schedule to enforce smoking ban.	Community Enforcement Resource Recovery	Resource Recovery	On-going
		Publicise successes and promote smoking litter penalties and enforcement activities in the media to raise awareness that Council is responding to this issue.	Resource Recovery	Media and Communications	On-going

	Monitoring and Evaluation	Conduct monthly Local Litter Checks with partner organisations to monitor litter trends against target reductions.	Resource Recovery	Positive Change For Marine Life North East Waste	On-going
		Conduct community surveys with partner organisations to measure community satisfaction of project delivery	Resource Recovery	Positive Change For Marine Life North East Waste	Feb 2019
		Progress reports to relevant staff, senior management, partners and the community to highlight project success and adjust the project to incorporate feedback where necessary.	Resource Recovery	Media and Communications	On-going
		Enviropole servicing and maintenance package allows for the collection and development of detailed reports that provide the average holding capacity full for each unit size, the collection average for each individual unit at time of service, comparative charts that indicate collection trends, which units require more frequent servicing, units that may be may damaged or unserviceable, contract performance Issues, WHS issues, complaints and feedback	Resource Recovery	Enviropole	On-going

Illegal Dumping and Litter Education and Enforcement Plan 2019

Issue	Approach	Action	BSC Responsibility	Partners	Timeframe
2-4. Takeaway, Beverage and Other Litter	Rewarding Responsible Behaviour and Education and Awareness	Implement and expand the Plastic Free Byron Make the Switch program.	Resource Recovery	Boomerang Alliance Plastic Free Byron Positive Change For Marine Life	Current and on-going pending review
		Develop, implement and maintain the "Refill Here" single use water bottle reduction program	Resource Recovery	Boomerang Alliance Plastic Free Byron	2019 and on-going pending review
		Develop and implement "Take 3 for the Sea" tourism focused program that educates and incentivise Byron Shire's visitors to care for its natural environment through innovative communications to a clearly defined and significant target audience.	Resource Recovery	Take 3 for the Sea Surfa Rosa	2019 and on-going pending review
		Continue to promote, facilitate and support of the NSW State Government's Return and Earn Container Deposit Scheme through Council and Partner networks.	Resource Recovery	Exchange for Change Plastic Free Byron Positive Change For Marine Life North East Waste	On-going
		Develop and implement a peak public event (e.g. New Year's Eve, Australia Day) litter reduction plan to tackle associated spikes in litter on local	Resource Recovery	NSW Police Community Enforcement Open Space	2019 and on-going

		beaches, parks and foreshores		Community Development Solo Community Groups	
		On-going investigation and implementation of innovative and contemporary litter education programs that will assist in achieving litter reduction objectives.	Resource Recovery	Industry Community	On-going
	Infrastructure and Clean-up	Refill Here Program – expand and maintain public drinking water fountain network (Installation of 5 new water fountains in 2019)	Resource Recovery	Utilities Open Space	2019 and on-going
		CDS – Maintain current RVM site at the Cavanbah Centre Carpark and Continue to lobby for a secondary Byron Bay Reverse Vending Machine location that is more conveniently located closer to hotspot litter zones.	Resource Recovery	NSW State Government (EPA) Tomra-Cleanaway	On-going
		Review and upgrade regulatory and educational signage network with a key focus on the Byron Bay foreshore	Resource Recovery	NSW Police Community Enforcement Open Space Community Development	2019
		Investigate the use of solar compacting bins for peak volume areas (e.g. Apex Park)	Resource Recovery	Industry Solo	2019
		Maintain implementation of public place bin network service, maintenance and cleaning program	Resource Recovery	Solo Open Space	On-going
		Maintain implementation of Council's litter clean-up program	Open Space	Resource Recovery	On-going

		Support and promote Community Groups' clean-up events	Resource Recovery	Community Groups	On-going
		Investigate and implement innovative and contemporary infrastructure and clean-up programs that assist in achieving litter reduction objectives and targets.	Resource Recovery Open Space	All Relevant Stakeholders	On-going
	Regulation and Enforcement	Increase litter compliance patrols throughout peak tourist visitation periods	Community Enforcement Resource Recovery	NSW Police Open Space Community Development	On-going
		In collaboration with NSW Police, develop an enforcement strategy for alcohol related litter prevention programs	Resource Recovery	NSW Police Community Enforcement Open Space Community Development	On-going
		Publicise successes and promote litter offence penalties and enforcement activities in the media to raise awareness that Council is responding to this issue.	Communications Resource Recovery	NSW Police Community Enforcement Open Space Community Development	On-going
		Investigate and implement innovative and contemporary enforcement programs that assist in achieving litter reduction objectives and targets.	Resource Recovery	All relevant stakeholders	On-going
	Monitoring and evaluation	Data from local litter checks analysed to monitor reduction in takeaway, beverage and other litter related items against stated goals and objectives.	Resource Recovery	Boomerang Alliance Plastic Free Byron Positive Change For Marine Life	On-going
		On-going periodic review of all Litter	Resource	All Relevant	On-going

		Reduction Programs against stated KPIs to monitor and evaluate success and effectiveness and determine on-going implementation.	Recovery	Stakeholders	