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SUSTAINABLE WATER
STORMWATER & RUNOFF
STREAMS & WATERWAYS
ENVIRONMENTAL

Cinnamon Dunsford
Senior Strategic Planner/ DA Co-ordinator
Shoalhaven City Council

C/O: Ralph Lucas, Lucas Property Group

Dear Cinnamon,

RECYCLED WASTEWATER STRATEGY FOR BADGEE LAGOON DEVELOPMENT

Background

Badgee Lagoon comprises of a 700 Lot golf course development at Sussex Inlet to be developed in 3 stages, over approximately 30 years. Water is to be supplied from Council's water infrastructure, and wastewater generated from the development is to be transferred to Sussex Inlet STP for treatment and then returned to the development for disposal. A DCP for the Development is proposed to ensure demand management strategies (up to 60% off criteria) are achieved thereby reducing the sewages flows and subsequent pressure on effluent disposal.

This memorandum provides an estimate of:

- Demand management strategy and water efficiency
- Design sewage flows
- Daily sewage flows
- Wastewater treatment capacity required
- Recycled Effluent Strategy
- Development stages; and
- A strategy for disposal of treated effluent

Due to planning constraints it is possible that the proposed Badgee Lagoon development will be the last major subdivision in Sussex Inlet.

Key Findings

Stage 1 (up to 150 dwelling over 6 years)

1 The development will incorporate a high level of water efficiency throughout the development and aim to achieve 106L/d/EP a 60% reduction off the Council's 180L/d/EP criteria. This is critical to minimise waste water generation and reduce pressure on the disposal of effluent on site.
2 Demand for recycled water at the golf course exceeds the supply from the development for this stage.
3 An upgrade of the STP is not required for this stage.

Stage 2 (from 150 dwellings to 450 dwellings) STP Upgrade Required

1 The development will incorporate a high level of water efficiency throughout the development.
2 Demand for recycled water at the golf course exceeds the supply from the development for this stage.
3 A 31% increase of the STP capacity is required for peak seasonal demands during this period. It is recommend that the plant upgrade should be designed to cater for the ultimate development.

Stage 3 (from 450 dwellings to 700 dwellings)

1 The development will incorporate a high level of water efficiency throughout the development.
2 Supply of recycled water is greater than the demand for water at the golf course during winter months.
3 A wetland is to be constructed at the development for treatment, reuse and discharge of excess recycled water to the environment during winter months or periods of excess supply.
4 Storage for recycled water during wet weather conditions will be provided at the development as part of the constructed wetland.

Should you have any further queries please do not hesitate to contact Ben Wolfgramm on 9499 4333.

Yours sincerely,

Ben Wolfgramm
Projects Development Manager
STORM_CONSULTING PTY LTD

RECYCLED WASTEWATER STRATEGY FOR BADGEE LAGOON DEVELOPMENT

DRAFT

Background

Badgee Lagoon comprises of a 700 Lot golf course development at Sussex Inlet to be developed in 3 Stages, over approximately 30 years. Water is to be supplied from Council's water infrastructure, and wastewater generated from the development is to be transferred to Sussex Inlet STP for treatment and then returned to the development for disposal.

This memorandum provides an estimate of:

- Demand Management Strategy
- Design sewage flows
- Daily sewage flows
- Wastewater treatment capacity required
- Recycled Effluent Strategy
- Development stages; and
- A strategy for disposal of treated effluent

Demand Management Strategy

The development will incorporate water efficient appliances, fixtures and best practice demand management practice including;

- Toilets - 6 WELS star rating
- Bathroom Taps - 6 WELS star rating
- Kitchen Taps - 6 WELS star rating
- Showerheads - 3 WELS star rating
- Washing Machine - 2.5 WELS star rating

The ultimate development has a population of 2800 persons based on an EP/ET ration of 4/1. This is considered to be high due to the target demographic for the development. Based on the high water efficiency of all appliances a daily demand of 106L/day/EP has been estimated.

Table 1: Water Consumption (L/Day)for Badgee Lagoon development

Fixtures	WELS Star rating selection	Resulting Water efficiency (L/min, except for toilets L/flush)	Calculated Water Consumption (L/day)
Toilets	6Star	2.5	28000
Bathroom Taps	6Star	4.5	13230
Kitchen Taps	6Star	4.5	25200
Showerheads	3star+	7.5	168000
Washing Machines (6kg)	2.5star	105.4	63239
Total Internal Water Use/day			297669.3
Total Population			2800

Total Daily Use	**106**

Design Sewage Flows

Based on high water efficiency for the development the daily average sewer flow for the Badgee Lagoon development is estimated to be **106 L/d/EP or 0.0049L/s/ET.**

As a comparison the *Sewerage Code of Australia* (WSAA, 2002)/ Shoalwater Supplement to WSAA September 2011 **recommends 180L/d/EP** or **0.0083L/s/ET** well above that proposed for the development.

Daily Sewage Flows Estimation

Daily sewage flows have been estimated using the *Sewerage Code of Australia* (WSAA, 2002) and Shoalwater Supplement September 2011**.** The results of the flow estimate calculations are shown in **Table 2**.

Table 2: Design Sewer Flow Estimation for Badgee Lagoon development Stage 3

Stage	**1**	**2**	**3**
ET's	150	450	700
EP's	600	1800	2800
ADWF	1.245	3.735	5.81
PDWF	3.79	9.59	14.00
SA	4.50	13.50	21.00
PWWF	8.29	23.09	35.00

Wastewater Treatment Plant Capacity

The following assumptions have been made:

1. The population peak occurs over 3 weeks at Christmas at a magnitude 1.5x the average population for the rest of the year.
2. It is proposed that the development will incorporate a smart sewer system thereby reducing wet weather peak flows. A reduction factor *could* be applied to PWWF as recommended by the *Planning Guidelines for Water Supply and Sewerage* (DERM, 2005).

The Average Daily Dry Weather Flow ADWF (L/s) has been used to determine the wastewater treatment plant capacity in ML/day. **Table 3** shows the expected daily loading rates from Badgee Lagoon for Stages 1-3 of the development. The results show that treatment plant requirements for the Badgee Lagoon development for Stage 1 are up to 0.16 ML/day and 0.75ML/d for the ultimate development depending on the estimation method adopted.

Table 3: Daily loading rates for Average Conditions

	WSAA/ SW	WSAA - Seasonal Peak	
Average daily sewer flow	180	180	*L/p/d*
Occupancy per dwelling	4	6	*persons*
ADWF_1st Stage (up to 150 Lots)	0.108	0.162	*ML/d*
ADWF_2nd Stage (up to 450 Lots)	0.324	0.486	*ML/d*
ADWF_Final Stage (up to 700 Lots)	0.504	0.756	*ML/d*

These results are considered to be high due to the base criteria not accounting for the high water efficiency strategy 106L/day/EP v 180L/day/EP and lower ET/EP ratio expected due to the target demographic for the development.

Wet Weather Storage

Based on the design relationship for wet weather storage as documented in the *Sussex Inlet Sewerage System Information* document (SCC, 2011) and associated drawings by Sinclair Knight & Partners (**Appendix A);** the volume required is based on storage of the ADWF for 14 days. Table 4 shows the nominal wet weather storage requirements for the development at the final stage.

Table 4: Wet Weather Storage requirements at the final stage of development

	WSAA	Unit
ADWF_Final Stage (up to 700 Lots)	**0.504**	***ML/d***
Wet Weather Storage available at ADWF	14	*days*
Wet Weather Storage volume required at final stage	7	*ML*

Existing Sussex Inlet STP Capacity

Based on the design data provided in the *Sussex Inlet Sewerage System Information* document (**Appendix A**), the Sussex Inlet STP has a capacity of 1.9ML/day. Discussions with Walter Moore confirmed this figure. Based on this information it appears the STP has been designed to treat the peak flow rate for average conditions (1.8ML/d) which occurs during the 3 weeks around Christmas which was the design criteria at the time.

Table 5 summarises the observed flow rates at Sussex Inlet STP.

Table 5: Inflows observed at Sussex Inlet sewage treatment plant in relation to weather patterns and population peaks (Walter Moore, pers. comm.).

Weather conditions	Most of the year	3 weeks around Christmas
Extended dry periods	1.0 ML/d	1.6 ML/d
Average conditions	1.2-1.4 ML/d	1.8-2.0 ML/d
Extremely wet periods	2.9 ML/d	3.5 ML/d

Based on the drawings by Sinclair Knight & Partners (**Appendix A**) existing wet weather storage at the Sussex Inlet STP equates to 27ML however Council has indicated based on aerial images storage capacity closer to 23ML.

Recycled Effluent Disposal Strategy

The sewage treatment plant at Sussex Inlet is capable of treating up to 1.9 ML/day of tertiary treated effluent that can be used to irrigate open space areas that have restricted access (Walter Moore, e-mail 16th March 2011). These areas include public sites irrigated at night (with appropriate buffer zones), with the treated effluent generated from Sussex Inlet STP currently used to irrigate 3 Ha of sports fields.

It is intended that wastewater generated from the development will be returned to the development for disposal as recycled effluent. The following section provides the strategy for disposal of treated effluent for all stages of the development. The strategy assumes there will be 3 stages of development, for which the treatment and disposal requirements will differ:

- Stage 1 – development up to 150 Lots
- Stage 2 – development up to 450 lots
- Stage 3 – development up to 700 lots (includes the Stage 1 and 2 totals, i.e. cumulative)

Golf Course Disposal (9 Holes, Area: 16.8Ha)

Maximum irrigation application rates were estimated by AgEnviro for the golf course based on an assessment of a daily water balance prepared using 34 years of local rainfall data. This assessment included calculations based on the existing golf course and an extended area by widening the fairways. A minimum 20 m buffer between effluent irrigation areas and sensitive environmental areas was used.

The amount of water that could be applied to Sussex Inlet Golf course (9 holes) is approximately:

- **128 ML/yr** for a median year; and
- **110 ML/yr** for a wet year.

Table 5 shows the maximum irrigation applications rates on a monthly basis for the golf course, for a dry, median, and wet year.

Table 6: Maximum application rates (ML/month) for a 9-hole turf golf course during wet, median and dry rainfall years

Demands (ML/month)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Wet (10 perc)	12.9	11.8	5.9	4.7	5.9	5.9	5.9	5.9	12.9	12.9	11.8	13.3	109.7
Median (50 perc)	14.1	12.9	7.1	7.1	7.1	7.1	7.1	7.1	14.1	15.3	14.1	15.3	128.2
Dry (90 perc)	15.3	14.1	7.1	7.1	8.2	7.1	7.9	8.2	15.3	16.5	15.3	16.5	138.4

Based on historical weather conditions at Sussex Inlet, irrigation demand is likely to be low from March through to August. During wet years there will be a reduction in irrigation demand, resulting in a minimum demand of 4.7ML in the month of April. Conversely, during median and dry years irrigation demand will be a minimum of 7.1 ML/month during the winter months.

Wastewater Wetlands (discharge to environment)

Constructed wetlands are an 'eco friendly' or passive alternative for treatment of secondary and tertiary wastewater. Applied to the Badgee Lagoon development they would provide polishing of secondary treated effluent prior to discharge to the environment. Some storage would be included in the wetland design for the containment of wet weather flows. The wetland is for contingency purposes only to take this winter/wet flow. The wetland will further treat the treated effluent - polishing to reduce nutrients and pathogens by small but measurable amounts. It will also provide for storage of the treated effluent. The intent is to use the stored effluent from the wetland for irrigation purposes once the wet weather has passed. The volume of the wetland has not been determined as yet. Additional storage may be required extant to the wetland, again the sizing is not yet determined. When the capacity of the wetland and storage is exceeded, discharge to the environment (Badgee Lagoon) would occur. This will be a very infrequent occurrence. A license for this discharge may be required.

Golf Course (Additional Holes)

Additional holes maybe integrated into the future development; however, the current strategy does not rely on this. Additional holes will be a 'bonus' to the development by creating more demands for treated effluent.

STAGE 1 (development up to 150 Lots) No STP Upgrade Required

At a rate of development of 25Lots/year, the initial stage of development will consist of 150 Lots and will take 6 years to develop. Daily sewage flows have been estimated for this stage and the results summarised in **Table 7** and **Figure 1.** The results show additional sewage flows under normal conditions an STP upgrade is not required. The results show additional sewage flows from the initial 150 lot development have a low impact on the STP and no upgrade of the STP is required.

Table 7: Estimated Sewage flows from Initial Development for Average Conditions (ML/d)

ADWF (ML/d)	Current Observed at Sussex STP	Stg1 (150ET) (WSAA)	Total Flow for Average Conditions (150ET)	STP Capacity (1.92 ML/d)	Excess Capacity (ML/d)
Most of the Year (Badgee)	1.2	0.05	1.25	1.92	0.66
3 week period (Badgee)	1.8	0.08	1.88	1.92	0.04

Most of the Year (WSAA)	1.2	0.10	1.30	1.92	0.61
3 week period (WSAA)	1.8	0.16	1.96	1.92	-0.04

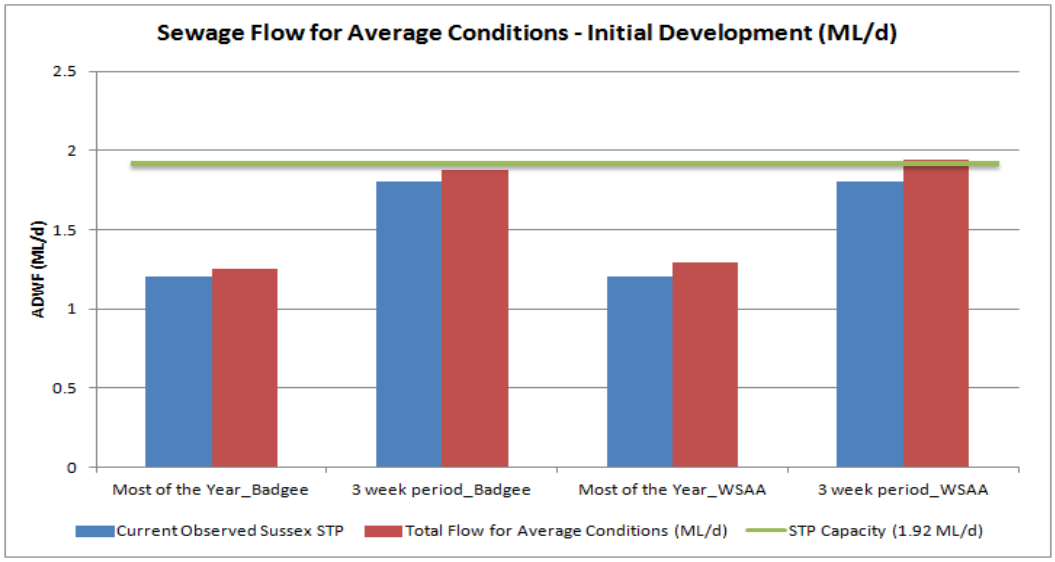

Figure 1: Estimated Sewage flows from Initial Development for Average Conditions (ML/d)

Treated effluent generated by the development during this stage will be returned to the subdivision and used to supply irrigation demands at the 9-hole golf course. As shown by **Figure 2,** the demands for recycled effluent at the golf course during average years and even wet years will exceed effluent generated by the proposed subdivision during this development period. Additional recycled effluent may be sought or an alternative supply may be relied upon to make up the deficit in water requirements.

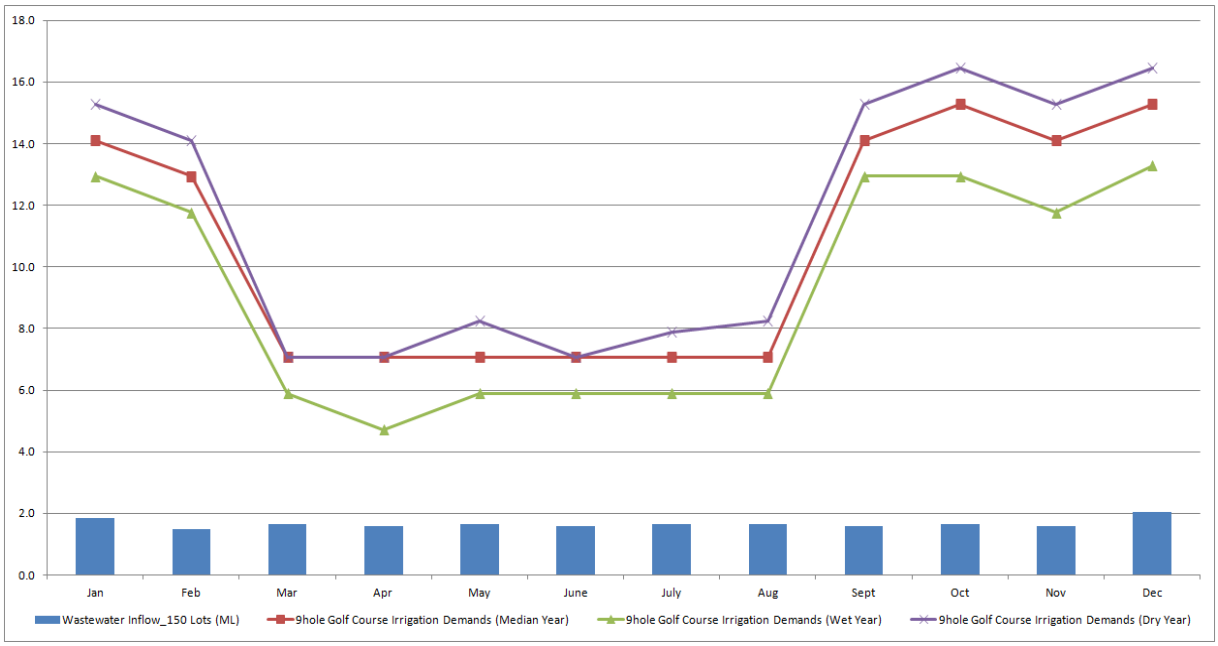

Figure 2: Effluent generation (during initial development phase versus irrigation requirements at 9-hole Golf Course (ML)

STAGE 2 (development up to 450 Lots) Upgrade Required

The second stage of development will consist of a further 300 Lots and will take 12 years to complete. Daily sewage flows have been estimated for this stage and the results summarised in **Table 8** and **Figure 3.**

The results show additional sewage flows from the second stage of development (up to 450 Lots) have an impact on the STP, and an upgrade of 31% the STP treatment capacity is required top deal with the peak seasonal demand. The STP upgrade should accommodate for final development sewage flows (refer to Stage 3).

Table 8: Estimated Sewage flows from the second stage of development for Average Conditions (ML/d)

ADWF (ML/d)	Current Observed at Sussex STP	Stage 2 (450ET)	Total Flow for Average Conditions (450ET)	STP Capacity (1.92 ML/d)	Excess Capacity (ML/d)
Most of the Year (Badgee)	1.2	0.16	1.36	1.92	0.56
3 week period (Badgee)	1.8	0.24	2.04	1.92	-0.12
Most of the Year (WSAA)	1.2	0.32	1.52	1.92	0.44
3 week period (WSAA)	1.8	0.48	2.28	1.92	-0.31

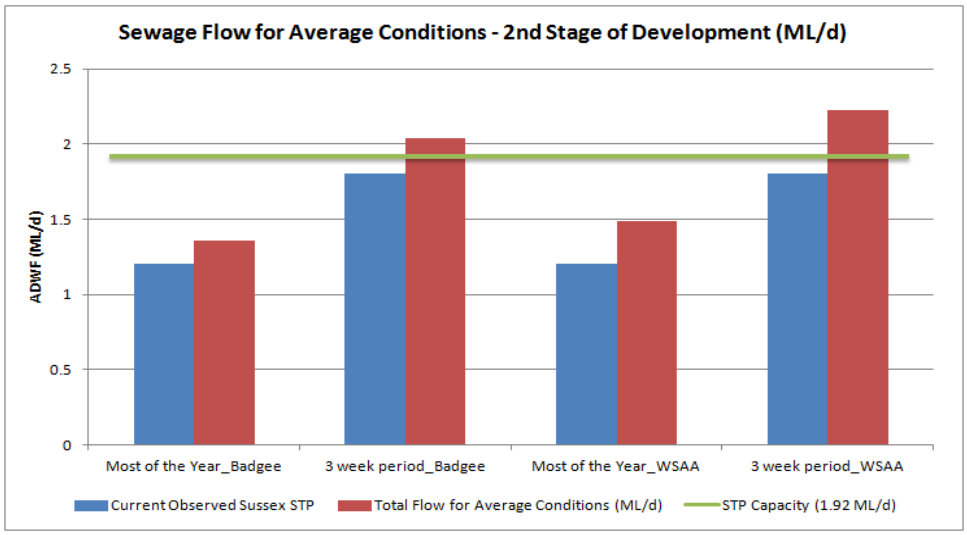

Figure 3: Estimated Sewage flows from the second stage of development for Average Conditions (ML/d)

Treated effluent generated by the development during this stage will be returned to the subdivision and used to supply irrigation demands at the 9-hole golf course. As shown by **Figure 4,** the demands for recycled effluent at the golf course during average years and even wet years will exceed effluent generated by the proposed subdivision during this development period. Additional recycled effluent may be sought or an alternative supply may be relied upon to make up the deficit in water requirements.

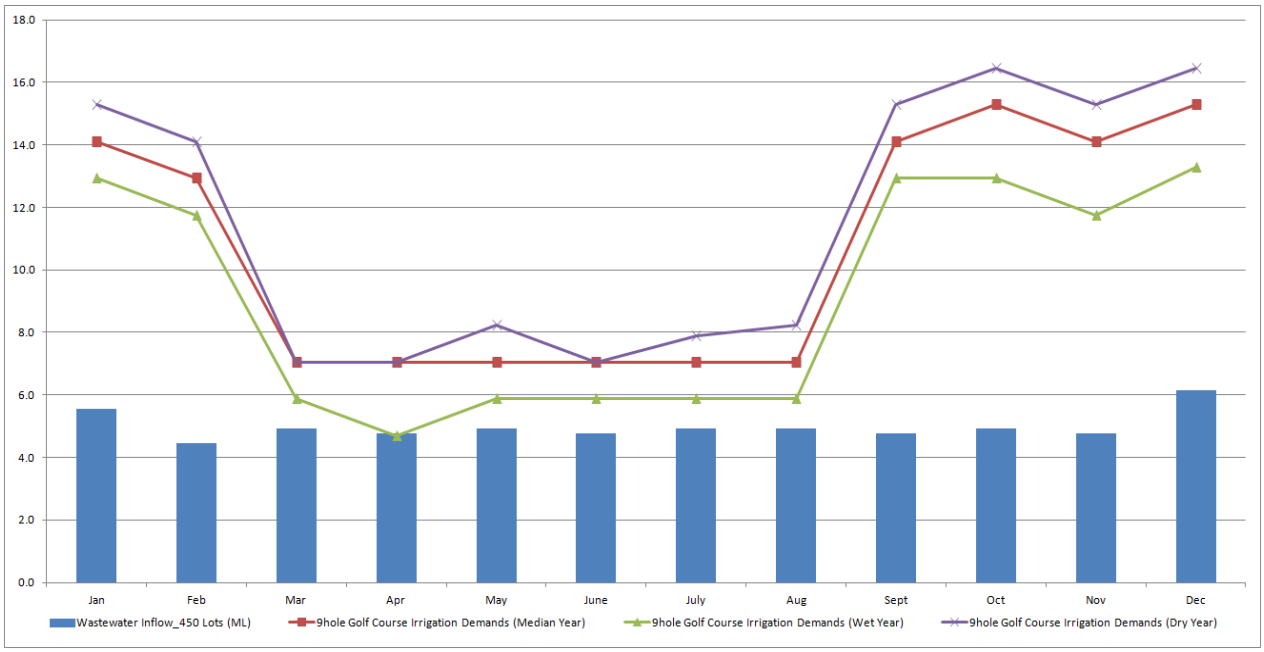

Figure 4: Effluent generation during the 2nd development phase versus irrigation requirements at 9-hole Golf Course (ML)

STAGE 3 (development up to 700 Lots) Constructed Wetland Required

The ultimate development will be comprise an additional 250 lots (700 lots total) and **Table 9** and **Figure 5** shows the additional sewage flows discharged from the development. The additional sewage flows discharged from the final 700 Lot development, are significant enough to require a 35% upgrade in STP treatment capacity (or 630 kL/d) depending on the estimation method.

Table 9: Estimated Sewage flows from final Development for Average Conditions (ML/d)

ADWF (ML/d)	Current Observed at Sussex STP	Final (700ET)	Total Flow for Average Conditions (700ET)	STP Capacity (1.92 ML/d)	Excess Capacity (ML/d)
Most of the Year (Badgee)	1.2	0.25	1.45	1.92	0.47
3 week period (Badgee)	1.8	0.37	2.17	1.92	-0.25
Most of the Year (WSAA)	1.2	0.50	1.70	1.92	0.22
3 week period (WSAA)	1.8	0.75	**2.55**	1.92	-0.63

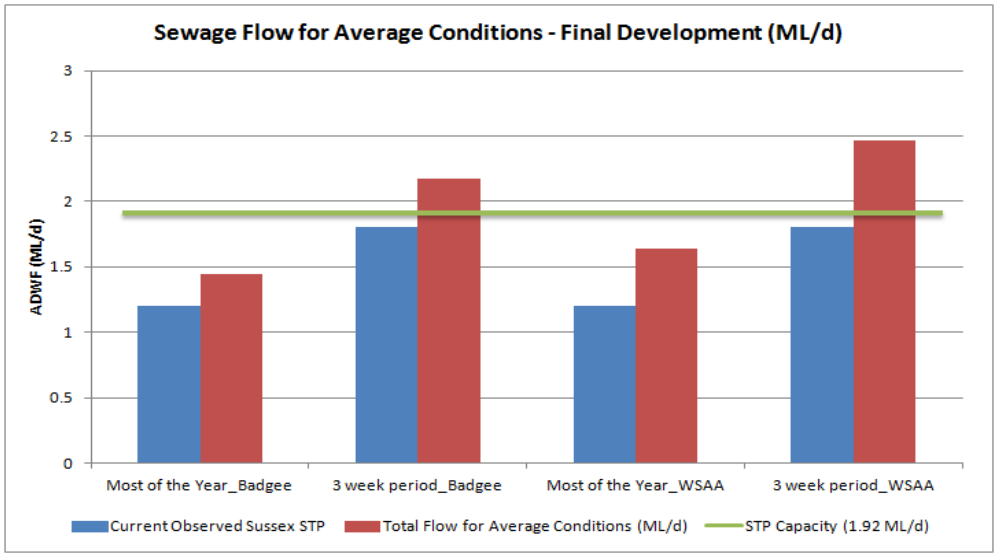

Figure 5: Estimated Sewage flows from Final Development for Average Conditions (ML/d)

Recycled Effluent Demands

Treated effluent generated by the development during this stage will be returned to the subdivision and used to supply irrigation demands at the 9-hole golf course, and excess discharged to wastewater wetlands prior to discharge to the downstream environment. As shown by **Figure 6,** the demands at the golf course during most years will be exceeded by effluent generated by the proposed subdivision during winter months. Additional recycled effluent may be sought or an alternative supply may be relied upon to make up the deficit in water requirements during summer months.

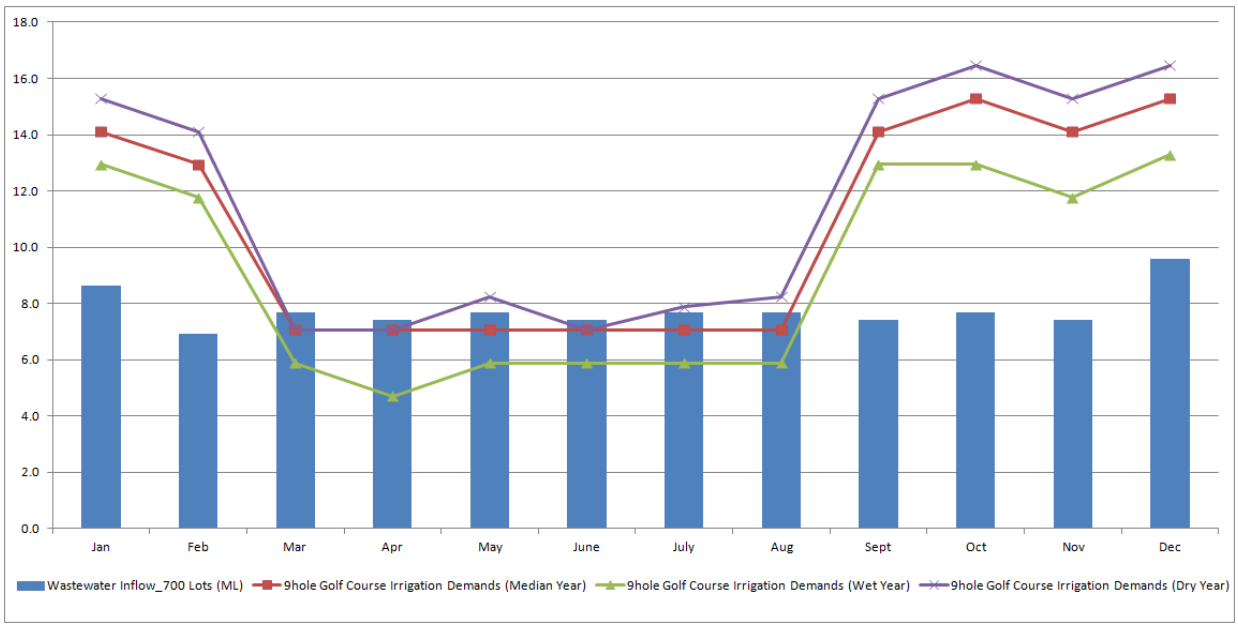

Figure 6: Effluent generation during the final development phase versus irrigation requirements at 9-hole Golf Course (ML)

Figure 7 shows a summary of the recycled effluent strategy for each stage of the development.

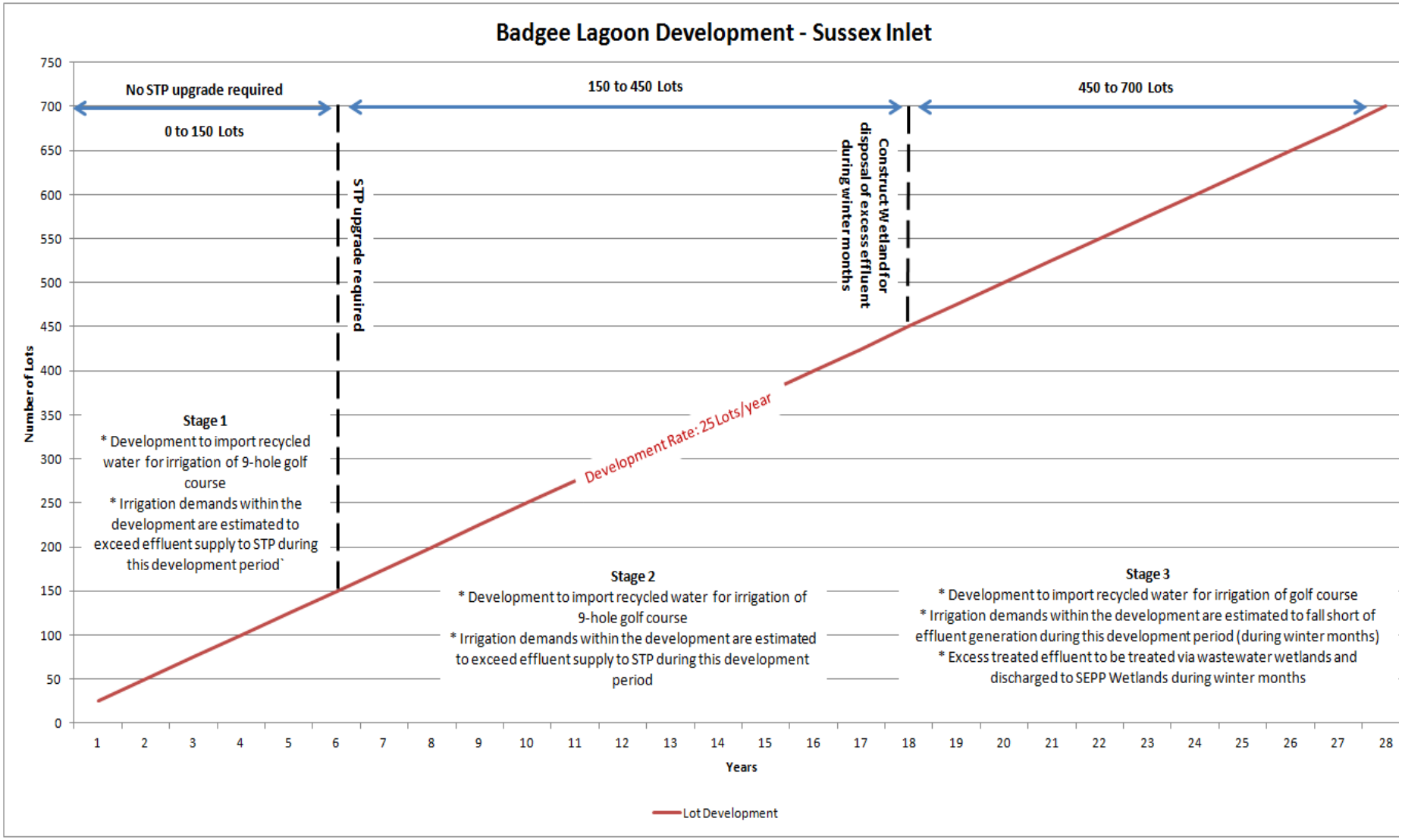

Figure 7: Summary showing recycled effluent strategy for each project stage.

Discussion

Based on water efficient development, Stage 1 (150Lots) of the development adds approximately 4-5% (80-90KL/day) of additional load at the STP during the peak summer period, for which the existing STP has sufficient capacity. It is proposed that Stage 1 commence in mid 2012 with approximately 25lots development/ annum.

Based on a water efficient development for the ultimate 700 lots an additional 20% (0.37ML/day) during the peak summer period will require treatment, taking the total STP capacity required up to 2.17 ML/day; necessitating an upgrade to existing STP infrastructure.

It is proposed that Council confirm planning for an upgrade of approximately 0.5-0.6ML/day (~30% increase) of Sussex Inlet STP commencing in 2015 for additional loads from the Badgee Lagoon Development. Future development within Sussex Inlet indicate infill housing of a similar scale to that of Badgee Lagoon (700ET's) which would suggest a combined upgrade of 1-12.ML/day for the STP will ultimately be required although the effluent management strategy outlined in this proposal does not included for development outside of this project.

Maximum demands for treated effluent at the golf course are 128ML/annum. During the last stage of development (450 to 700 lots), supply exceeds demands during wet winter months and this excess is to be discharged to wastewater treatment wetlands for storage, treatment, reuse prior to discharge to the downstream environment.

This report confirms that in both normal, peak and wet weather conditions, all of the effluent generated by the 700 lot development can be disposed of within the development.

During wet weather, storage will be required at the STP to balance the inflow from the development with plant capacity and some wet weather storage will be provided at the development, upstream of the wetland.

In summary the proposed development can dispose of the wastewater generated and with adequate wet weather storage there is no requirement to increase the effluent disposal rates to the sand dune at Sussex Inlet. In fact it may be possible to divert some of the recycled effluent for the 'dunes,' to the development for disposal under normal conditions.

Appendix A

Sussex Inlet Sewerage System Information by Shoalhaven City Council