WASTEWATER FLOWS AND ALLOCATION AT THE "WESTWYCK- STAGE 2" DEVELOPMENT 490, 492, 492A VICTORIA ST, WEST BRUNSWICK

for

Construction Queen Pty Ltd
496 Lygon Street
Brunswick East

by

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1. INTRODUCTION

At the request of Construction Queen Pty Ltd estimates were made of the amounts of rainfall that may be captured by the various components of the "Westwyck" development and of the extent that treated wastewater, suitable for irrigation of garden spaces, can be utilized or has to be discharged to sewer.

The estimates of rainwater harvesting are based on mean monthly rainfall and evaporation data for the Melbourne Regional Office meteorological observation station (#086071). It is assumed that in case of light, short rainfalls, much of the rain evaporates directly of the hard roof surfaces and in the estimates the loss is set at 5% of annual rainfall. The scenario of rainwater flows can be adjusted by changing the default values in the associated excel spreadsheet.

Wastewater flows have been allocated assuming:

- Minimal daily flow for households using the highest level of water-saving devices as per EPA Publication 891.2 (under review) is 115 L/person.day and calculated as (# of bedrooms + 1) x 115 L;
- On average, each apartment will accommodate 2.5 persons;
- Wastewater flow generated from toilet usage is 40% of total flow; wastewater flow generated from baths, showers, vanities, kitchen and laundry is 60%;
- Water use by vegetated garden areas is estimated by multiplying the Class A Pan Evaporation rate with a crop factor that varies from 70% during the five warmest months from November to March and then declines to 50% during July and August;
- When natural rainfall, based on mean monthly data, is inadequate to support full plant water requirement the deficit is supplied from treated wastewater;
- Any treated wastewater that remains unused will be discharged to sewer.
- The total area of irrigable garden space is 400 m^2.
- 500 m^2 of the site is permeable surface, granitic gravel on crushed rock sub base.

Should in future a proportion, say 15%, of treated wastewater be recycled for toilet flushes, the volume of treated wastewater for discharge to sewer will decline by that amount, the volume of town water used will also be reduced, but the total volume of black water will remain the same.

2. RAINWATER FLOWS FROM SPECIFIED AREAS

The roof areas in the Table below were supplied by Construction Queen.

Table 1 Hard roof surface areas

Hard Roof Surface Areas	**(m^2)**
Apartment Block East	428.8
Apartment Block West	293.1
School Building	589

Rainfall volumes harvested over the year are shown in Table 2.

Table 2 Monthly and annual rainfall runoff

Number of days in month		31	28	31	30	31	30	31	31	30	31	30	31	365
Direct evaporation loss from very light showers (5 percent) **insert value next column**	**0.05**	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Rain (P) in mm		48.2	47	50.9	58.3	56.8	49.8	47.9	50.3	58.7	67.4	59.3	59.1	653.7
Rainwater harvested in mm/m^2 impervious surface		45.8	44.7	48.4	55.4	54.0	47.3	45.5	47.8	55.8	64.0	56.3	56.1	621.0
Crop Coefficient (vegetation on Evapotranspiration area)		0.7	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.6	0.6	0.7	0.7	0.625
Evap (Eo) in mm		182.9	156.8	124.0	78.0	49.6	33.0	40.3	55.8	78.0	111.6	138.0	167.4	1215.4
Evtr (Et) from irrigated garden in mm		128.0	109.8	86.8	46.8	29.8	19.8	20.2	27.9	46.8	67.0	96.6	117.2	796.54
Total water runoff (m^3)														
Apartment Block East														
Hard Roof 428.8 m^2	**428.8**	19.63	19.15	20.73	23.75	23.14	20.29	19.51	20.49	23.91	27.46	24.16	24.07	266.29
Green Roof 0 m^2	**0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
											Sum East Block			266.29
Aoartment Block West														
Hard Roof 293.1 m^2	**293.1**	13.42	13.09	14.17	16.23	15.82	13.87	13.34	14.01	16.34	18.77	16.51	16.46	182.02
Green Roof 0 m^2	**0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
											Sum West Block			182.02
School Building														
Hard Roof 589 m^2	**589**	26.97	26.30	28.48	32.62	31.78	27.87	26.80	28.15	32.85	37.71	33.18	33.07	365.78
All hard roof surface areas combined														**814.09**

3. ALLOCATION OF WASTEWATER FLOWS

The allocations of wastewater flows below in Table 3 are based on a summary of the number of apartments, number of bedrooms and the likely number of residents in each apartment.

Table 3 Individual daily wastewater flows from all planned apartments for the highest level of water saving devices

Unit No.	No.	Likely No.	Maximum No.	WC's	Vanities	Showers	Baths	Kitchen	Dishwasher	Washing	Laundry		Design Flow (EPA 891.1)	Assumed flow Likely	Assumed flow Maximum
	Bedrooms	Occupants	occupants					Sink		Machine	Trough		L/day.bedroom	L/day.bedroom	L/day.bedroom
490/1	2	2.5	4	1	1	1	0	1	1	1	1		287.5	287.5	460
490/2	3	2.5	6	2	2	2	1	1	1	1	1		287.5	287.5	690
490/3	1	2.5	2	1	1	1	0	1	1	1	0		287.5	287.5	230
490/4	2	2.5	4	1	2	1	0	1	1	1	1		287.5	287.5	460
490/5	3	2.5	6	2	2	2	1	1	1	1	1		287.5	287.5	690
490/6	3	2.5	6	2	2	2	0	1	1	1	1		287.5	287.5	690
490/7	2	2.5	4	2	2	1	0	1	1	1	1		287.5	287.5	460
490/8	2	2.5	4	2	2	1	1	1	1	1	1		287.5	287.5	460
492/1	2	2.5	4	2	1	1	0	1	1	1	1		287.5	287.5	460
492/2	3	2.5	6	2	2	2	0	1	1	1	1		287.5	287.5	690
492/3	3	2.5	6	2	2	2	1	1	1	1	1		287.5	287.5	690
492/4	3	2.5	6	2	2	2	1	1	1	1	1		287.5	287.5	690
492/5	3	2.5	6	2	2	1	0	1	1	1	1		287.5	287.5	690
492a/1	3	2.5	6	2	2	2	1	1	1	1	1		287.5	287.5	690
492a/2	2	2.5	4	1	1	1	0	1	1	1	1		287.5	287.5	460
492a/3	2	2.5	4	1	1	1	0	1	1	1	1		287.5	287.5	460
492a/4	4	2.5	8	2	2	2	0	1	1	1	1		287.5	287.5	920
492a/5	3	2.5	6	2	2	1	0	1	1	1	0		287.5	287.5	690
Totals		**45.0**	**92**											**5175**	**10580**

Table 4 presents the scenario where the total available irrigated garden area is utilized for partial recycling of treated wastewater.

Table 4 Monthly rainfall, evapotranspiration, water deficits and irrigation – No indoor recycling of treated wastewater

Assumed flow Likely	Black water component	Grey water component (=1-B2)	Melbourne Regional Office (Met. Station 086071) - Median rainfall and median Pan evaporation (mm)														
L/day.bedroom	0.6	0.4			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
287.5	172.5	115															
287.5	172.5	115	Number of days in month		31	28	31	30	31	30	31	31	30	31	30	31	365
287.5	172.5	115															
287.5	172.5	115	Crop Coefficient (Grass on Evapotranspiration area)		0.7	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.6	0.6	0.7	0.7	0.625
287.5	172.5	115															
287.5	172.5	115	Evap (Eo) in mm		182.9	156.8	124.0	78.0	49.6	33.0	40.3	55.8	78.0	111.6	138.0	167.4	1215.4
287.5	172.5	115	Evtr (Et) from irrigated garden in mm		128.0	109.8	86.8	46.8	29.8	19.8	20.2	27.9	46.8	67.0	96.6	117.2	759.6
287.5	172.5	115															
			Rain (P) in mm		48.2	47	50.9	58.3	56.8	49.8	47.9	50.3	58.7	67.4	59.3	59.1	653.7
			Rainwater deficit in mm		79.8	62.8	35.9	-11.5	-27.0	-30.0	-27.8	-22.4	-11.9	-0.4	37.3	58.1	105.9
287.5	172.5	115						No irrigation in these months									
287.5	172.5	115	Potential irrigation volume L per m^2 /day		2.58	2.24	1.16								1.24	1.87	
287.5	172.5	115															
287.5	172.5	115	Area needed for full disposal m^2		62297	64646	138529								124866	85626	
287.5	172.5	115															
			Area available for irrigation m^2	400													
287.5	172.5	115	Monthly wastewater volume L		160425	144900	160425	155250	160425	155250	160425	160425	155250	160425	155250	160425	1888875
287.5	172.5	115															
287.5	172.5	115	Monthly irrigation demand L		31932	25104	14360								14920	23232	109548
287.5	172.5	115															
287.5	172.5	115	Monthly discharge to sewer L		128493	119796	146065	155250	160425	155250	160425	160425	155250	160425	140330	137193	1779327
5175	3105	2070															

Table 5 represents the scenario where 15% of the treated water is reused for toilet flushing.

Table 5 Monthly rainfall, evapotranspiration, water deficits and irrigation – Limited indoor recycling of treated wastewater

Assumed flow Likely		**Melbourne Regional Office (Met. Station 086071) - Median rainfall and median Pan evaporation (mm)**													
L/day.bedroom				**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
287.5		Number of days in month		31	28	31	30	31	30	31	31	30	31	30	31	365
287.5		Crop Coefficient (Grass on Evapotranspiration area)		0.7	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.6	0.6	0.7	0.7	0.625
287.5		Evap (Eo) in mm		182.9	156.8	124.0	78.0	49.6	33.0	40.3	55.8	78.0	111.6	138.0	167.4	1215.4
287.5		Evtr (Et) in mm		128.0	109.8	86.8	46.8	29.8	19.8	20.2	27.9	46.8	67.0	96.6	117.2	759.6
287.5		Rain (P) in mm		48.2	47	50.9	58.3	56.8	49.8	47.9	50.3	58.7	67.4	59.3	59.1	653.7
		Rainwater deficit in mm		**79.8**	**62.8**	**35.9**	**-11.5**	**-27.0**	**-30.0**	**-27.8**	**-22.4**	**-11.9**	**-0.4**	**37.3**	**58.1**	105.9
287.5							No irrigation in these months									
287.5		Potential irrigation volume L per m^2 /day		2.58	2.24	1.16								1.24	1.87	
287.5		Area needed for full disposal m^2		62297	64646	138529								124866	85626	
287.5		Percentage wastewater recycled for toilet flushes	**0.15**													
		Area available for irrigation m^2	**400**													
287.5		Monthly wastewater volume before subtracting toilet use L		160425	144900	160425	155250	160425	155250	160425	160425	155250	160425	155250	160425	1888875
287.5		Monthly wastewater volume after subtracting toilet flushes L		136361	123165	136361	131963	136361	131963	136361	136361	131963	136361	131963	136361	1605544
287.5		Monthly irrigation demand L		31932	25104	14360								14920	23232	109548
287.5																
287.5		Monthly discharge to sewer L		104429	98061	122001	131963	136361	131963	136361	136361	131963	136361	117043	113129	1495996
5175																

5. CONCLUSIONS

Table 2 shows that if all rainwater could be stored on site a total volume of more than 800 m^3 (800 kL) could be made available to the development. On the basis of the scenario above the daily wastewater generation is 5175 L after all apartments have been completed and occupied. On a yearly basis this amounts to 1,888,875 L or nearly 1900 m^3 (1900 kL). Thus, rainwater is potentially capable of supplying 43% of the water use in an average rainfall year.

Harvesting rainwater will be a beneficial element in promoting the highest level of environmental sustainability and should significantly reduce the need for town water. However, under normal rainfall patterns the rainfall is not evenly distributed over the year with more falling in winter than in summer. Furthermore, storage tanks occupy a considerable amount of space, which may be limiting within the Westwyck development.

Tables 4 and 5 indicate that the volume of treated wastewater is far in excess of the amount that can be sustainably used for irrigation of the garden. Therefore the Project may consider not treating all the grey water produced but only a small proportion per apartment block, and save the cost of treatment by discharging directly to sewer. It is assumed that no mains water is required for landscape use.

If treated wastewater were to be reused for toilet flushing the combined use of treated wastewater and rainwater would replace even more of the town water required.