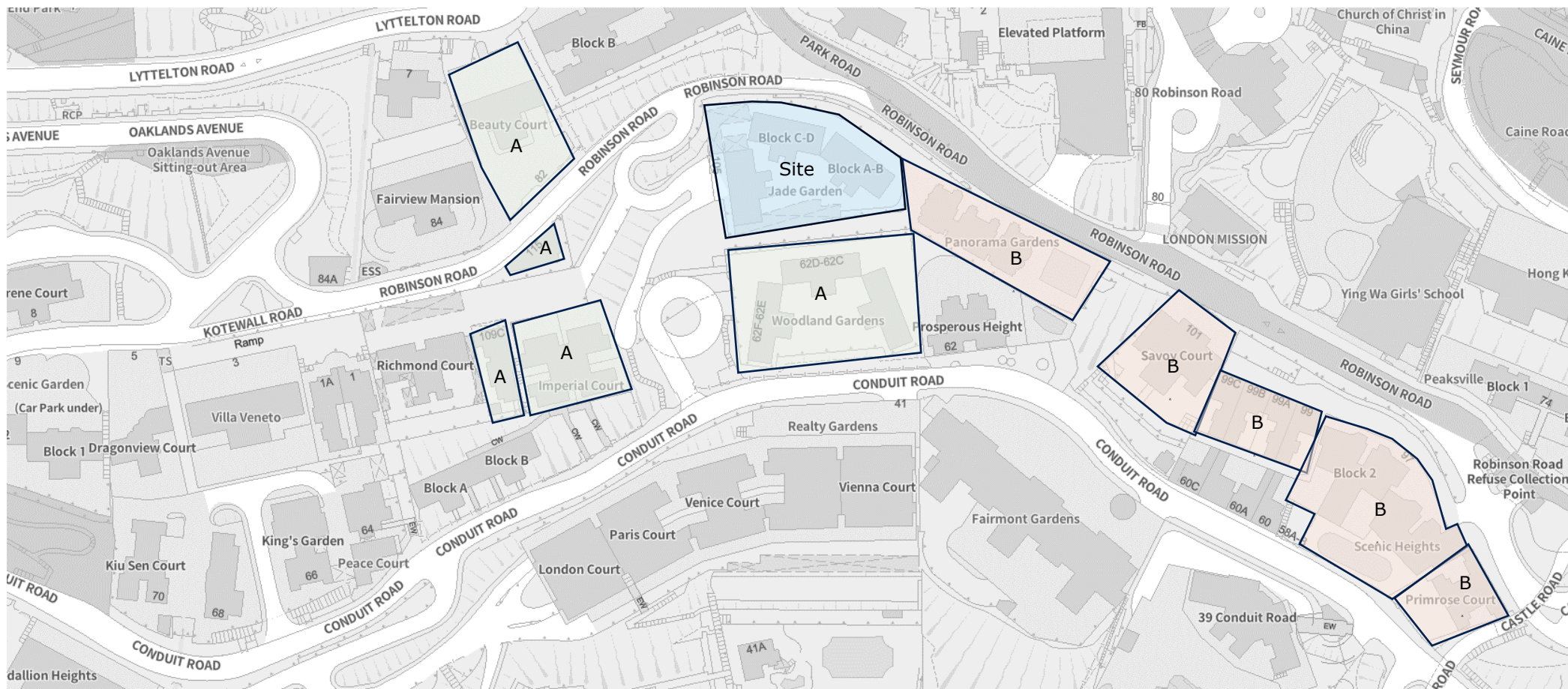


Attachment 2

Planning Application No. A/H11/107

Sewerage Review and Hydraulic Calculation

Catchment Area in the vicinity of the Site at 105 Robinson Road



Confidential

Table 1 Hydraulic Capacity of Existing Sewers on Robinson Road

Segment	Manhole Reference	Manhole Reference	Pipe Dia.	Pipe Length	Invert Level 1	Invert Level 2	g	k _s	s	v	V	Area	Q	Estimated Capacity
			mm	m	mPD	mPD	m/s ²	m		m ² /s	m/s	m ²	m ³ /s	L/s
Site	Terminal Manhole	FMH7005730	150	7.3	114.00	106.69	9.81	0.0006	1.000	0.000001	10.16	0.018	0.18	180
FWD7007291	FMH7005730	FMH7005537	150	31.9	106.69	105.65	9.81	0.0006	0.033	0.000001	1.82	0.018	0.03	32
FWD7007295	FMH7005537	FMH7005734	150	4.2	105.65	105.41	9.81	0.0006	0.057	0.000001	2.42	0.018	0.04	43
FWD7007293	FMH7005734	FMH7005733	150	25.3	105.41	104.34	9.81	0.0006	0.042	0.000001	2.08	0.018	0.04	37
FWD7007292	FMH7005733	FMH7005538	150	14.4	104.34	103.66	9.81	0.0006	0.047	0.000001	2.20	0.018	0.04	39
FWD7007079	FMH7005538	FMH7005539	150	2.4	103.66	103.58	9.81	0.0006	0.033	0.000001	1.84	0.018	0.03	33
FWD7007266	FMH7005539	FMH7005711	150	17.6	103.58	102.99	9.81	0.0006	0.033	0.000001	1.84	0.018	0.03	33
FWD7007264	FMH7005711	FMH7005712	150	10.9	102.99	102.63	9.81	0.0006	0.033	0.000001	1.84	0.018	0.03	33

Remarks:

- (1) g=gravitational acceleration; k_s=equivalent sand roughness; s=gradient; v=kinematic viscosity of water; V=mean velocity
- (2) The value of k_s = 3.0mm is used for the concrete sewer (based on Table 5: Recommended roughness values in Sewerage Manual)
- (3) The value of velocity (V) is referred to the Tables for the hydraulic design of pipes, sewers and channels (8th edition)
- (4) Equation used:
$$V = -\sqrt{(8gDs)} \log\left(\frac{k_s}{3.7D} + \frac{2.51v}{D\sqrt{(2gDs)}}\right)$$
- (5) Invert levels for Manholes FMH7005711 and FMH7005712 are unavailable on Drainage Record Plans. For assessment purpose, the missing invert levels have been estimated by interpolation.

Table 1 Estimated Sewage Flow for Proposed Development at 105 Robinson Road

Connected to Terminal Manhole

Residential

Total number of units	=	217	Units
Total number of residents	=	565	people
Unit Flow Factor (UFF)	=	0.27	m ³ /person/day -- (refer to Table T-1 of GESF - R2)
Design Average Dry Weather Flow (ADWF)	=	152.6	m ³ /day

Property Management, Residential Recreational Facilities

No. of Employees	=	16	people
Unit Flow Factor (UFF)	=	0.08	m ³ /day -- J12
Design Average Dry Weather Flow (ADWF)	=	1.3	m ³ /day

Maintenance Works, Environmental Hygiene Service

No. of Employees	=	4	people
Unit Flow Factor (UFF)	=	0.28	m ³ /day -- J11
Design Average Dry Weather Flow (ADWF)	=	1.1	m ³ /day

Car Park Management, Security

No. of Employees	=	5	people
Unit Flow Factor (UFF)	=	0.08	m ³ /day -- Commercial Employee
Design Average Dry Weather Flow (ADWF)	=	0.4	m ³ /day

Total Flow from Proposed Development

Total ADWF	=	155.4	m ³ /day
Contributing Population	=	575	people
Peaking Factor	=	8	
Peak Flow	=	14.4	L/s

Table 3a Estimated Sewage Flow from Upstream Catchment (Catchment A)

			Remarks
Discharged to Existing Manhole FMH7005730			
<u>Imperial Court Court, 62G Conduit Road</u>			
Total number of units	=	196 units	
Total number of residents	=	510 people	Average household size of 2.6
Unit Flow Factor (UFF)	=	0.27 m ³ /person/day	GESF Table T-1 -- Private R2
Total number of employees	=	6 people	
Unit Flow Factor (UFF)	=	0.28 m ³ /person/day	GESF J11
Total number of employees	=	24 people	
Unit Flow Factor (UFF)	=	0.08 m ³ /person/day	GESF J12
Design Average Dry Weather Flow (ADWF)	=	141.2 m ³ /day	
<u>Woodland Gardens, 62E-62F Conduit Road</u>			
Total number of units	=	54 units	
Total number of residents	=	141 people	Average household size of 2.6
Unit Flow Factor (UFF)	=	0.27 m ³ /person/day	GESF Table T-1 -- Private R2
Total number of employees	=	6 people	
Unit Flow Factor (UFF)	=	0.28 m ³ /person/day	GESF J11
Total number of employees	=	16 people	
Unit Flow Factor (UFF)	=	0.08 m ³ /person/day	GESF J12
Design Average Dry Weather Flow (ADWF)	=	41.0 m ³ /day	
<u>109C Robinson Road</u>			
Total number of units	=	4 units	
Total number of residents	=	11 people	Average household size of 2.6
Unit Flow Factor (UFF)	=	0.37 m ³ /person/day	GESF Table T-1 -- Private R3
Total number of employees	=	8 people	
Unit Flow Factor (UFF)	=	0.28 m ³ /person/day	GESF J11
Total number of employees	=	14 people	
Unit Flow Factor (UFF)	=	0.08 m ³ /person/day	GESF J12
Design Average Dry Weather Flow (ADWF)	=	7.4 m ³ /day	
<u>Beauty Court, 82 Robinson Road</u>			
Total number of units	=	76 units	
Total number of residents	=	198 people	Average household size of 2.6
Unit Flow Factor (UFF)	=	0.27 m ³ /person/day	GESF Table T-1 -- Private R2
Total number of employees	=	2 people	
Unit Flow Factor (UFF)	=	0.28 m ³ /person/day	GESF J11
Total number of employees	=	11 people	
Unit Flow Factor (UFF)	=	0.08 m ³ /person/day	GESF J12
Design Average Dry Weather Flow (ADWF)	=	54.8 m ³ /day	
<u>Swimming Pool Discharge from Backwashing</u>			
Approx. Water volume	=	100 m ³	
Turnover Rate	=	4 hr	
Surface Loading Rate of Filter	=	50 m ³ /m ² /hr	
Filter Areas required	=	0.5	
Backwash Duration	=	3 min/day	
Backwash flow rate	=	30 m ³ /m ² /hr	
Design flow for Backwashing	=	0.7 m ³ /day	
Peak flow for Backwashing for 3 mins	=	4.2 L/s	
<u>115 Robinson Road</u>			
Total number of units	=	5 units	
Total number of residents	=	13 people	Average household size of 2.6
Unit Flow Factor (UFF)	=	0.27 m ³ /person/day	GESF Table T-1 -- Private R2
Total number of employees	=	2 people	
Unit Flow Factor (UFF)	=	0.28 m ³ /person/day	GESF J11
Total number of employees	=	5 people	
Unit Flow Factor (UFF)	=	0.08 m ³ /person/day	GESF J12
Design Average Dry Weather Flow (ADWF)	=	4.5 m ³ /day	
Sub-total of ADWF from Residential Portion of Catchment A	=	253.1 m ³ /day	
Contributing Population	=	937 people	Total Average flow/0.27
Peaking factor	=	8	GESF Table T-5 for population <1,000 incl. stormwater allowance
Sub-total of Peak Flow from Catchment A	=	23.4 L/s	
Total Peak Flow (including backwash) from Catchment A	=	27.6 L/s	

Table 3b Estimated Sewage Flow from Downstream Catchment (Catchment B)

			Remarks
Discharged to Existing Manhole FMH7005539			
<u>Panorama Gardens, 103 Robinson Road</u>			
Total number of units	=	140 units	
Total number of residents	=	364 people	Average household size of 2.6
Unit Flow Factor (UFF)	=	0.27 m ³ /person/day	GESF Table T-1 -- Private R2
Total number of employees	=	4 people	
Unit Flow Factor (UFF)	=	0.28 m ³ /person/day	GESF J11
Total number of employees	=	10 people	
Unit Flow Factor (UFF)	=	0.08 m ³ /person/day	GESF J12
Design Average Dry Weather Flow (ADWF)	=	100.2 m ³ /day	
<u>Swimming Pool Discharge from Backwashing</u>			
Approx. Water volume (140 x 1.25m)	=	175 m ³	
Turnover Rate	=	4 hr	
Surface Loading Rate of Filter	=	50 m ³ /m ² /hr	
Filter Areas required	=	0.9 m ²	
Backwash Duration	=	3 min/day	
Backwash flow rate	=	30 m ³ /m ² /hr	
Design flow for Backwashing	=	1.3 m ³ /day	
Peak flow for Backwashing for 3 mins	=	7.3 L/s	
<u>Savoy Court</u>			
Total number of units	=	24 units	
Total number of residents	=	62 people	Average household size of 2.6
Unit Flow Factor (UFF)	=	0.27 m ³ /person/day	GESF Table T-1 -- Private R2
Total number of employees	=	4 people	
Unit Flow Factor (UFF)	=	0.08 m ³ /person/day	GESF J12
Design Average Dry Weather Flow (ADWF)	=	17.2 m ³ /day	
<u>99, 99A, 99B, 99C Robinson Road</u>			
Total number of units	=	24 units	
Total number of residents	=	62 people	Average household size of 2.6
Unit Flow Factor (UFF)	=	0.27 m ³ /person/day	GESF Table T-1 -- Private R2
Total number of employees	=	4 people	
Unit Flow Factor (UFF)	=	0.08 m ³ /person/day	GESF J12
Design Average Dry Weather Flow (ADWF)	=	17.2 m ³ /day	
<u>Scenic Heights</u>			
Total number of units	=	215 units	
Total number of residents	=	559 people	Average household size of 2.6
Unit Flow Factor (UFF)	=	0.27 m ³ /person/day	GESF Table T-1 -- Private R2
Total number of employees	=	10 people	
Unit Flow Factor (UFF)	=	0.28 m ³ /person/day	GESF J11
Total number of employees	=	10 people	
Unit Flow Factor (UFF)	=	0.08 m ³ /person/day	GESF J12
Design Average Dry Weather Flow (ADWF)	=	154.5 m ³ /day	
<u>Swimming Pool Discharge from Backwashing</u>			
Approx. Water volume (170 x 1.25m)	=	213 m ³	
Turnover Rate	=	4 hr	
Surface Loading Rate of Filter	=	50 m ³ /m ² /hr	
Filter Areas required	=	1.1 m ²	
Backwash Duration	=	3 min/day	
Backwash flow rate	=	30 m ³ /m ² /hr	
Design flow for Backwashing	=	1.6 m ³ /day	
Peak flow for Backwashing for 3 mins	=	8.9 L/s	
<u>Primrose Court</u>			
Total number of units	=	100 units	
Total number of residents	=	260 people	Average household size of 2.6
Unit Flow Factor (UFF)	=	0.27 m ³ /person/day	GESF Table T-1 -- Private R2
Total number of employees	=	8 people	
Unit Flow Factor (UFF)	=	0.28 m ³ /person/day	GESF J11
Total number of employees	=	8 people	
Unit Flow Factor (UFF)	=	0.08 m ³ /person/day	GESF J12
Design Average Dry Weather Flow (ADWF)	=	73.1 m ³ /day	
Sub-total of ADWF from Residential Portion of Catchment B	=	362.1 m ³ /day	
Contributing Population	=	1341 people	Total Average flow/0.27
Peaking factor	=	6	GESF Table T-5 for population 1,000-5,000 incl. stormwater
Sub-total of Peak Flow from Catchment B	=	25.1 L/s	
Total Peak Flow (including backwash) from Catchment B	=	41.3 L/s	

Table 4 Summary of Sewage flow from the Proposed Development and Catchment Areas

				Existing Condition, without Site					Future Condition, with Site					
Catchment		ADWF (m ³ /day)	Swimming Pool Peak Flow (L/s)	Catchment Area Included	Existing ADWF (m ³ /day)	Existing Contributing Population	Peaking Factor	Existing Peak Flow with Swimming Pool Backwash (L/s)	Catchment Area Included	Cumulative ADWF (m ³ /day)	Cumulative Contributing Population	Peaking Factor	Sub-total Peak Flow (L/s)	Cumulative Peak Flow with Swimming Pool Backwash (L/s)
Site	Residential	155.4	-	-	-	-	-	-	Site	155.4	575	8	14.4	14.4
Catchment A	Imperial Court	141.2	-	A	248.9	922	8	27.2	Site + A	404.3	1497	6	28.1	32.2
	Woodland Gardens	41.0	-											
	109C Robinson Road	7.4	-											
	Beauty Court	54.8	4.2											
	115 Robinson Road	4.5	-											
Catchment B	Panorama Gardens	100.2	7.3	A + B	584.7	2166	6	60.9	Site + A + B	740.1	2741	6	51.4	71.7
	Savoy Court	4.0	-											
	99, 99A, 99B, 99C	4.0	-											
	Scenic Heights	154.5	8.9											
	Primrose Court	73.1	-											

Remarks:

(1) The value of peaking factor = 8 is used for population <1,000 incl. stormwater allowance (refers to Table T-5 of GESF)

(2) The value of peaking factor = 6 is used for population 1,000-5,000 incl. stormwater allowance (refers to Table T-5 of GESF)

(3) The value of peaking factor = 5 is used for population 5,000-10,000 incl. stormwater allowance (refers to Table T-5 of GESF)

Table 5 Hydraulic Capacity of the Existing Sewers in Robinson Road with Estimated Sewage Flow

Segment	Pipe Dia. (mm)	Pipe Length (m)	Gradient	Estimated Capacity (L/s)	Catchment Area Included	Existing Peak Flow, without Site (L/s)	% Capacity Occupied (with Backwash)	Catchment Area Included	Cumulative Peak Flow with Max. Backwash Flow Rate (L/s)	% Capacity Occupied (with Backwash)
Site	150	7.3	1.000	180	-	-	-	Site	14.4	8.0%
FWD7007291	150	31.9	0.033	32	A	27.2	84.4%	Site + A	32.2	100.0%
FWD7007295	150	4.2	0.057	43	A	27.2	63.6%	Site + A	32.2	75.4%
FWD7007293	150	25.3	0.042	37	A	27.2	74.0%	Site + A	32.2	87.7%
FWD7007292	150	14.4	0.047	39	A	27.2	70.0%	Site + A	32.2	83.0%
FWD7007079	150	2.4	0.033	33	A	27.2	83.4%	Site + A	32.2	98.9%
FWD7007266	150	17.6	0.033	33	A + B	60.9	186.8%	Site + A + B	71.7	219.9%
FWD7007264	150	10.9	0.033	33	A + B	60.9	186.8%	Site + A + B	71.7	219.9%

Note: There is surcharge condition under peak discharge condition along segments FWD7007266 and FWD7007264 in the existing condition, even without proposed development.

E&M FLOOR PLAN

