ENQUIRIES: OLIVER WALSH
PROJECT NO: 30916-4-SYD-C

27 July 2018

AGED CARE FACILITY – CLOSEBOURNE HOUSE, MORPETH
SITE STORMWATER MANAGEMENT

Wood & Grieve Engineers have been engaged by Lend Lease to provide stormwater management design in support of the Development Application associated with the proposed construction of a new aged care facility in Morpeth, NSW.

This report discusses the proposed stormwater management for the development which has been prepared in accordance with Council's Development Control guidelines.

1.1 The Development Site

The development sites address is part of Lot 3 on DP270740 in the vicinity of Tank Street, Morpeth. The site area is 2.04 Ha however only a portion of this will be developed.

The site is currently developed as 'Closebourne House' and it is proposed to maintain certain significant heritage structures on the site. The site generally falls to the south east and north east, with a ridge running through the site in the east-west direction.

Figure 1 - Proposed Site Location

1.2 Flooding

Referencing the flood inundation mapping available on council's website has confirmed that the site is not subject to flood related controls.

Figure 2 - Existing 100 Year Flood Extent (Source: Maitland Council Mapping)

As the development site will not be flood impacted there are no flood protection measures proposed for the development.

1.3 Stormwater Conveyance

All roof areas will be drained through a gravity system. The drainage system will be designed in accordance with AS3500.3 to convey the minor design storm runoff from the roof to the in ground drainage system. Flows in excess of the design flows will surcharge the roof drainage system and discharge onto the surrounding ground where it will then be conveyed overland to the surrounding in ground drainage network.

The surface runoff will be drained through a combination of in ground gravity drainage system and infiltration through the landscaping to a subsoil drainage system which will convey the runoff to the in ground drainage system.

The in ground drainage will be designed to meet the following criteria:

- In the minor design storm event (10 year) there will be no surcharging of the in ground drainage system and;
- In the major design storm event (100 year) there will be no uncontrolled discharge from the site onto the residential properties surrounding the site.

1.4 Stormwater Detention

In line with Maitland Council's DCP:

"Detention of stormwater flows that mimics natural, pre-developed flows for all storm events up to and including the 100 year ARI even."

The figures below illustrate the DRAINS model and the runoff generated for the design storm events.

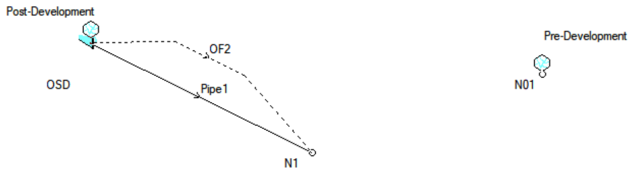

Figure 3 - Proposed DRAINS set-up

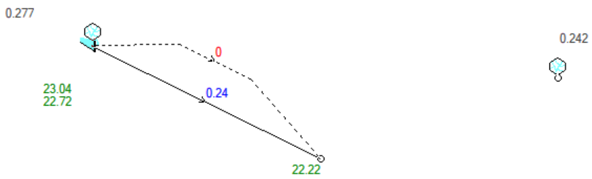

Figure 4 - Post Development vs Pre-development 2 Year ARI storm event

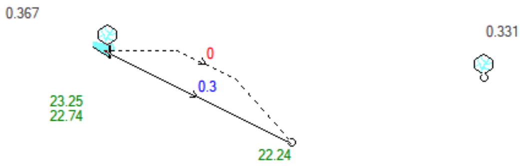

Figure 5 - Post Development vs Pre-development 5 Year ARI storm event

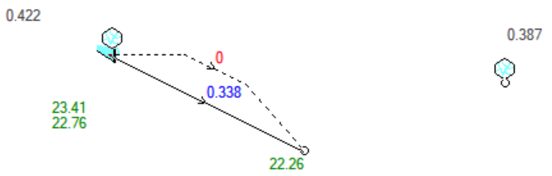

Figure 6 - Post Development vs Pre-development 10 Year ARI storm event

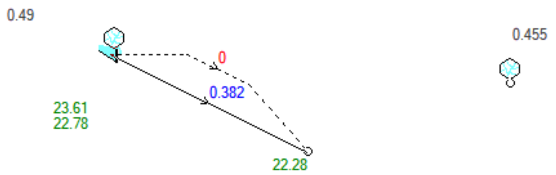

Figure 7 - Post Development vs Pre-development 20 Year ARI storm event

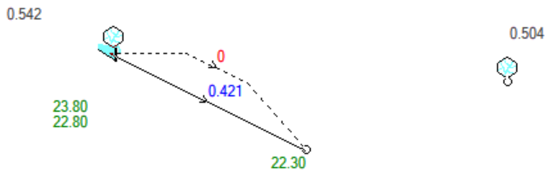

Figure 8 - Post Development vs Pre-development 50 Year ARI storm event

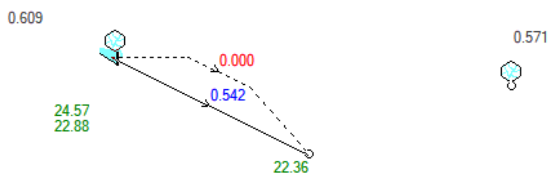

Figure 9 - Post Development vs Pre-development 100 Year ARI storm event

Table 1 summarises pre vs post development runoff calculations from the above figures to verify compliance with council controls.

Storm Event (ARI)	Pre Development (L/s)	Post Development (L/s)
2	242	240
5	331	300
10	387	338
20	455	382
50	504	421
100	571	542

Table 1: Pre-Development vs Post Development Runoff Summary

1.5 Legal Point of Discharge

The legal point of discharge for the development will be to a proposed headwall within the existing site. The headwall to be located along the southern side of the proposed development. The proposed headwall to include riprap to prevent erosion.

1.6 Stormwater Treatment

There are a wide range of potential stormwater pollutant sources which occur from urbanised catchments, many which can be managed through appropriate stormwater quality treatment. Typical urban pollutants may include:

- Atmospheric deposition
- Erosion (including that from subdivision and building activities)
- Litter and debris
- Traffic emissions and vehicle wear
- Animal droppings
- Pesticides and fertilisers
- Application, storage and wash-off of car oil, detergents and other household and commercial solvents and chemicals
- Solids accumulation and growth in stormwater systems
- Weathering of buildings

These pollutants in urban stormwater can be placed into various categories as follows. The pollutants underlined below are able to be readily modelled:

- Suspended Solids
- Litter
- Nutrients such as Nitrogen and Phosphorous
- Biological oxygen demand (BOD) and chemical oxygen demand (COD) materials
- Micro-organisms
- Toxic organics
- Trace metals
- Oils and surfactants

While only the key pollutants underlined above will be examined within the modelling, the Stormwater Quality Improvement Devices implemented are expected to assist in reducing a wide range of pollutants. For example, heavy metals are commonly associated with, and bound to fine sediments. Thus reducing the discharge of fine sediment during the construction and operational phases will also reduce the discharge of heavy metals to existing stormwater systems.

In order to achieve the pollutant reduction targets specified by Maitland Council, the following treatment train will be provided. The diagram below illustrates the proposed treatment train for this development.

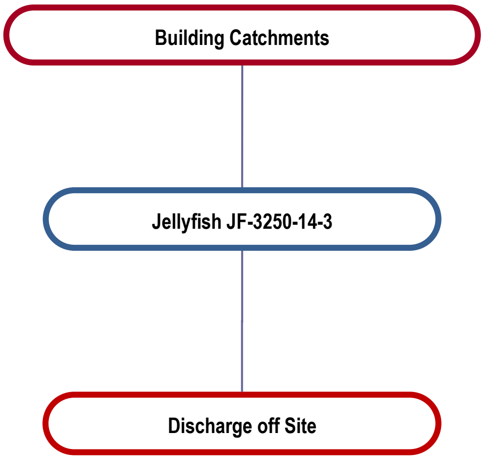

Figure 10 - Proposed Water Quality Treatment Train

In order to demonstrate that the proposed treatment train meets the required reduction targets, pollutant reduction modelling is proposed using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) Software program Version 6.3 by eWater CRC. Pollutant export rates are currently only available for Total Suspended Solids (TSS), Total Nitrogen (TN), Total Phosphorous (TP) and Gross Pollutants (GP). Therefore, only quantitative modelling for TSS, TN, TP & GP has been undertaken using MUSIC.

For Music Modelling (using MUSIC 6.3.0) the following parameters have been used:

Model Parameters	
Meteorological Data:	Sydney 1959
Evaporation Data:	Sydney 1959
Time Step:	6 minute

Table 2 - MUSIC modelling parameters

Node Description	Area (Ha)	Percentage Impervious (%) / Area Impervious (Ha)		Land Use Rainfall and Pollutant Parameters
Building Catchment	1.242	66	0.82	Urban Residential

Table 3 - Catchment modelling parameters

MUSIC Model

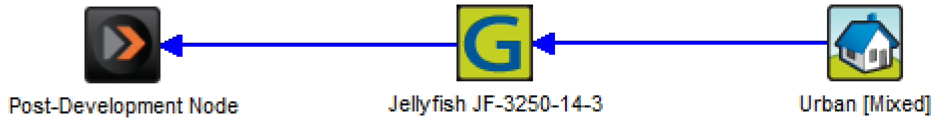

Figure 11 - MUSIC Model

MUSIC Runoff Generation Parameters

The following properties have been used in the MUSIC Modelling based on the Land Use Rainfall and Pollutant Parameters.

Parameter	Urban Residential
Rainfall Threshold (mm)	1
Soil Capacity (mm)	120
Initial Storage (%)	25
Field Capacity	80
Infiltration Capacity Coefficient a	200
Infiltration Capacity Coefficient b	1
Initial Depth (mm)	10
Daily Recharge Rate (%)	25
Daily Drainage Rate (%)	5
Daily Deep Seepage Rate (%)	0

Table 4 - Recommended MUSIC Runoff Generation Parameters

MUSIC Concentration Parameters

Land-use Type	Parameters	TSS Log10 mg/L		TP Log10 mg/L		TN Log10 mg/L	
		Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow
Urban Residential	Mean	1.1	2.2	-0.82	-0.45	0.32	0.42
	STD Dev	0.17	0.32	0.19	0.25	0.12	0.19

Table 5: MUSIC Concentration Parameters for Sydney Catchments

MUSIC Output

	Sources	Residual Load	% Reduction
Flow (ML/yr)	13	13	0
Total Suspended Solids (kg/yr)	2480	477	80.8
Total Phosphorus (kg/yr)	5	2.01	59.9
Total Nitrogen (kg/yr)	36.2	18.3	49.6
Gross Pollutants (kg/yr)	331	9.29	97.2

Figure 12 - MUSIC Results

Indicator	Total Site Reduction	Site Targets	Target Achieved
Gross Pollutants	97.2%	75%	Yes
Total Suspended Solids (TSS)	80.8%	80%	Yes
Total Phosphorus (TP)	59.9%	45%	Yes
Total Nitrogen (TN)	49.6%	45%	Yes

Table 6 - Treatment Train Efficiencies

From the results presented above it can be seen that the proposed stormwater quality treatment meets with the reduction targets set for the development by Maitland Council.

1.7 Sediment & Erosion Control

The control of erosion and sedimentation describes the measures incorporated during and following construction of a new development to prevent the pollution and degradation of the downstream watercourse.

A Soil and Water Management Plan has prepared as part of the development application documentation.

Common control measures adopted are:

- Sedimentation fences;
- Sedimentation basins;
- Stormwater drainage inlet protection;
- Overland flow diversion swales;
- Shaker Grids and wash downs for vehicles leaving the construction site;
- Dust control measures.

The maintenance of these control measures throughout their intended lifespan will ensure that the risk of erosion and sedimentation pollution of the downstream watercourse will be minimised.

We trust that this information is sufficient for your purposes, however should you have any queries in regards to this report please feel free to contact the undersigned.

Yours faithfully

Oliver Walsh
for **Wood & Grieve Engineers**

Project Design Calculations

Project Name:	Closebourne House, MORPETH
Project Number:	30916-4
Design Engineer:	OKW
Office:	Sydney
Date:	27/07/2018 10:15 AM
Design Section:	Stormwater Management

Stormwater Detention Design

Design Basis: OSD to be provided to attenuate the discharge flows from the site to those of the pre-developed site.

Rainfall Intensities

Home | IFD Table | IFD Chart | Coefficients | ARI | Print IFD table | Help IFD table

Intensity-Frequency-Duration Table

Location: 32.725S 151.625E Issued: 26/7/2018

Rainfall intensity in mm/h for various durations and Average Recurrence Interval

Duration	Average Recurrence Interval 1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
5Mins	77.2	99.9	130	147	171	202	226
6Mins	72.3	93.7	122	138	160	189	212
10Mins	59.1	76.5	99.3	113	131	154	173
20Mins	42.9	55.5	71.9	81.6	94.4	111	124
30Mins	34.8	45.0	58.3	66.1	76.4	90.2	101
1Hr	23.6	30.6	39.6	44.9	51.9	61.3	68.5
2Hrs	15.6	20.2	26.3	29.8	34.5	40.7	45.5
3Hrs	12.2	15.8	20.5	23.3	27.0	31.9	35.7
6Hrs	8.00	10.4	13.5	15.3	17.8	21.1	23.6
12Hrs	5.26	6.81	8.91	10.2	11.8	14.0	15.7
24Hrs	3.46	4.49	5.90	6.76	7.87	9.36	10.5
48Hrs	2.22	2.90	3.84	4.42	5.17	6.17	6.94
72Hrs	1.67	2.18	2.91	3.35	3.93	4.70	5.31

(Raw data: 30.64, 6.83, 2.19, 60.44, 13.8, 4.65, skew=0.05, F2=4.32, F50=15.97)

Copy Table

Catchment Assessment

Catchment Area 1.242 Ha

Pre-development Impermeable Area 25%

Post-development Impermeable Area 66%

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Discharge Assessment

From DRAINS:

Storm Event	Discharge Pre (m3/s)	Discharge Post (m3/s)
10	0.249	0.361
100	0.667	0.740

On Site Detention Assessment

From DRAINS

Providing a tank with the following dimensions will attenuate the flows back to pre-development flows:

Plan Area: 80 m²

Invert of Outlet 22.50mAHD

100yr Top Water Level 24.57 mAHD

OSD volume 92.2 m³

From DRAINS

Storm Event (Years)	Pre Development (L/s)	Post Development (L/s)
2	242	240
5	331	300
10	387	338
20	455	382
50	504	421
100	571	542

This indicates that the detention tank can successfully attenuate the discharge flows.

Project Design Calculations

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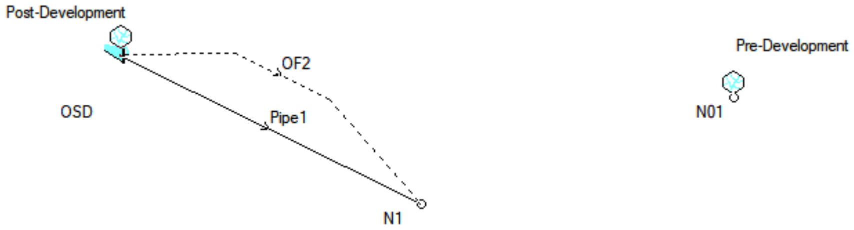
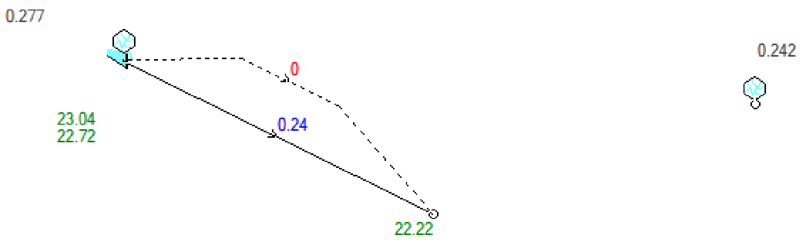
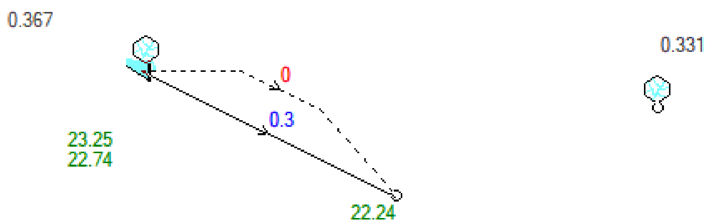
Drains Model Arrangement



Drains Model Results – 2 yr ARI Event



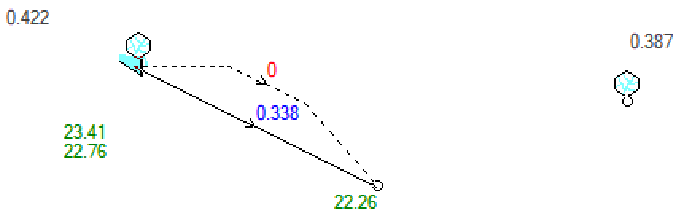
Drains Model Results – 5 yr ARI Event



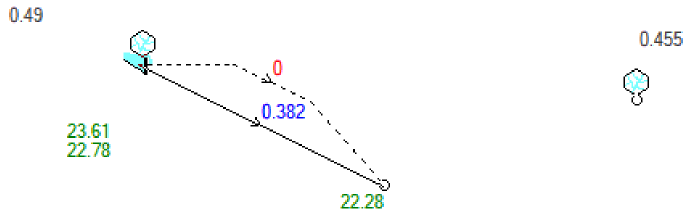
Project Design Calculations

Project Name:	Closebourne House, MORPETH
Project Number:	30916-4
Design Engineer:	OKW
Office:	Sydney
Date:	27/07/2018 10:15 AM
Design Section:	Stormwater Management

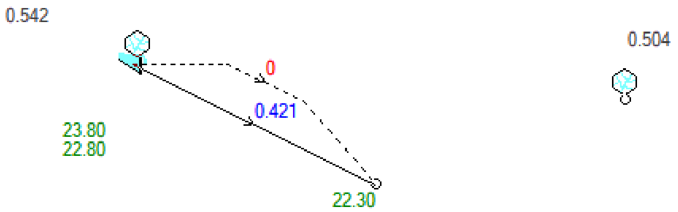
Drains Model Results – 10 yr ARI Event



Drains Model Results – 20 yr ARI Event



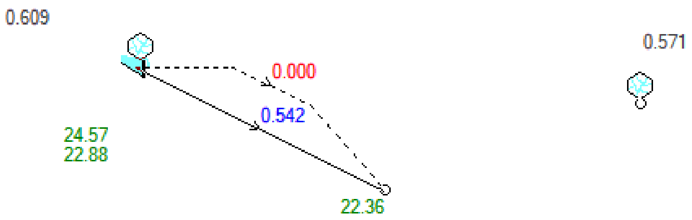
Drains Model Results – 50 yr ARI Event



Project Design Calculations

Project Name:	Closebourne House, MORPETH
Project Number:	30916-4
Design Engineer:	OKW
Office:	Sydney
Date:	27/07/2018 10:15 AM
Design Section:	Stormwater Management

Drains Model Results – 100yr ARI Event



Project Design Calculations

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Project Number:	30916-4
Design Engineer:	OKW
Office:	Sydney
Date:	27/07/2018 10:15 AM
Design Section:	Stormwater Management

DRAINS Data

PIT / NODE DETAILS Version 13

Name Type Family Size Ponding Pressure Surface Max Pond Base Blocking x y Bolt-down id Part Full
Inflow Pit is

Volume Change Elev (m) Depth (m) Inflow Factor lid Shock Loss Hydrograph

(cu.m) Coeff. Ku (cu.m/s)

N01 Node 23.1 0 533.333 -330.833 199 No

N1 Node 23.1 0 345.000 -395.000 1 No

DETENTION BASIN DETAILS

Name Elev Surf. Area Not Used Outlet Type K Dia(mm) Centre RL Pit Family Pit Typex y HED Crest RL
Crest Length(m)id

OSD 22.5 1 Orifice 445 22.80 162.000 -305.000 No 29978

22.8 1

22.9 80

24 80

24.01 1

Project Design Calculations

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Design Engineer:	OKW
Office:	Sydney
Date:	27/07/2018 10:15 AM
Design Section:	Stormwater Management

24.5 1

SUB-CATCHMENT DETAILS

Name	Pit or Gutter	Total Gutter	Paved Gutter	Grass Rainfall	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Lag Time		
	Node Length	Area Slope	Area FlowFactor	Area	Area Multiplier	Time	Time	Time	Length	Length	Length	Slope(%)		Slope	Slope	Rough	Rough	Rough	or Factor	
		(ha)	%	%	%	(min)	(min)	(min)	(m)	(m)	(m)	%	%	%					(m)	%
Pre-Development			N01	1.2420 1	25.0	75.0	0.0	7	7	7										0
Post-Development			OSD	1.2420 1	66.0	34.0	0.0	7	7	7										0

PIPE DETAILS

Name	From etc	To	Length	U/S IL	D/S IL	Slope	Type	Dia	I.D.	Rough	Pipe Is	No. Pipes		Chg From		At Chg	Chg	Rl	Chg	RL
			(m)	(m)	(m)	(%)		(mm)	(mm)						(m)	(m)	(m)	(m)	(m)	
Pipe1	OSD	N1	30	22.500	22.000	1.67	Concrete, under roads, 1% minimum slope						525	525	0.3	NewFixed		1	OSD	0

Project Name:	Closebourne House, MORPETH
Project Number:	30916-4
Design Engineer:	OKW
Office:	Sydney
Date:	27/07/2018 10:15 AM
Design Section:	Stormwater Management

DETAILS of SERVICES CROSSING PIPES

Pipe Chg Bottom Height of Service Chg Bottom Height of Service Chg Bottom Height of Service etc

(m) Elev (m) (m)(m) Elev (m) (m)(m) Elev (m) (m)etc

CHANNEL DETAILS

Name From To Type Length U/S IL D/S IL Slope Base Width L.B. Slope R.B. Slope Manning Depth Roofed

(m) (m) (m) (%) (m) (1:?) (1:?) n (m)

Project Name:	Closebourne House, MORPETH
Project Number:	30916-4
Design Engineer:	OKW
Office:	Sydney
Date:	27/07/2018 10:15 AM
Design Section:	Stormwater Management

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	
OF2	OSD	N1	0.8	24.500	1	1.6	Swale with 1:6 sideslopes	0.15	0.1	1	1	0	217	30

PIPE COVER DETAILS

Name	Type	Dia (mm)	Safe Cover (m)	Cover (m)	
Pipe1	Concrete, under roads, 1% minimum slope	525	0.6	-0.57	Unsafe

This model has no pipes with non-return valves

Project Design Calculations

Project Name:	Closebourne House, MORPETH
Project Number:	30916-4
Design Engineer:	OKW
Office:	Sydney
Date:	27/07/2018 10:15 AM
Design Section:	Stormwater Management

DRAINS Results – 10yr ARI Event

DRAINS results prepared from Version 2018.01

PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N1	22.26		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Pre-Development	0.387	0.113	0.274	7	7	7	AR&R 10 year, 25 minutes storm, average 73.0 mm/h, Zone 1
Post-Development	0.422	0.298	0.124	7	7	7	AR&R 10 year, 25 minutes storm, average 73.0 mm/h, Zone 1

Outflow Volumes for Total Catchment (1.13 impervious + 1.35 pervious = 2.48 total ha)

Project Design Calculations

Project Name:	Closebourne House, MORPETH
Project Number:	30916-4
Design Engineer:	OKW
Office:	Sydney
Date:	27/07/2018 10:15 AM
Design Section:	Stormwater Management

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 10 year, 5 minutes storm, average 147 mm/h, Zone 1	304.29	180.77 (59.4%)	81.94 (59.2%)	98.83 (59.6%)
AR&R 10 year, 10 minutes storm, average 113 mm/h, Zone 1	467.82	316.51 (67.7%)	156.35 (73.5%)	160.17 (62.8%)
AR&R 10 year, 15 minutes storm, average 94.0 mm/h, Zone 1	583.74	409.85 (70.2%)	209.09 (78.7%)	200.76 (63.1%)
AR&R 10 year, 20 minutes storm, average 82.0 mm/h, Zone 1	678.96	487.15 (71.8%)	252.42 (81.7%)	234.74 (63.4%)
AR&R 10 year, 25 minutes storm, average 73.0 mm/h, Zone 1	755.55	541.62 (71.7%)	287.26 (83.6%)	254.36 (61.8%)
AR&R 10 year, 30 minutes storm, average 66.0 mm/h, Zone 1	819.72	586.54 (71.6%)	316.46 (84.8%)	270.08 (60.5%)
AR&R 10 year, 45 minutes storm, average 53.0 mm/h, Zone 1	987.39	712.69 (72.2%)	392.75 (87.4%)	319.93 (59.5%)

Project Design Calculations

Project Name:	Closebourne House, MORPETH
Project Number:	30916-4
Design Engineer:	OKW
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Date:	27/07/2018 10:15 AM
Design Section:	Stormwater Management

AR&R 10 year, 1 hour storm, average 44.8 mm/h, Zone 1	1112.83	802.99 (72.2%)	449.83 (88.8%)	353.16 (58.2%)
AR&R 10 year, 1.5 hours storm, average 35.4 mm/h, Zone 1	1318.96	951.22 (72.1%)	543.62 (90.6%)	407.60 (56.7%)
AR&R 10 year, 2 hours storm, average 29.8 mm/h, Zone 1	1480.44	1067.15 (72.1%)	617.09 (91.6%)	450.06 (55.8%)
AR&R 10 year, 3 hours storm, average 23.4 mm/h, Zone 1	1743.71	1259.33 (72.2%)	736.88 (92.9%)	522.45 (55.0%)
AR&R 10 year, 4.5 hours storm, average 18.3 mm/h, Zone 1	2045.57	1455.01 (71.1%)	874.22 (93.9%)	580.78 (52.1%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Pipe1	0.338	3.12	22.762	22.262	AR&R 10 year, 25 minutes storm, average 73.0 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

Project Name:	Closebourne House, MORPETH
Project Number:	30916-4
Design Engineer:	OKW
Office:	Sydney
Date:	27/07/2018 10:15 AM
Design Section:	Stormwater Management

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF2	0	0	0	0	0	0	0	

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
OSD	23.41	43.8	0.338	0.338	0

CONTINUITY CHECK for AR&R 10 year, 25 minutes storm, average 73.0 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
N01	253.93	253.93	0	0
OSD	287.69	287.68	0.01	0
N1	287.68	287.68	0	0

Run Log for CI run at 14:59:52 on 26/7/2018

Flows were safe in all overflow routes.

Project Name:	Closebourne House, MORPETH
Project Number:	30916-4
Design Engineer:	OKW
Office:	Sydney
Date:	27/07/2018 10:15 AM
Design Section:	Stormwater Management

DRAINS Results – 100yr ARI Event

DRAINS results prepared from Version 2018.01

PIT / NODE DETAILS Version 8

Name	Max HGL		Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N1	22.36		0.000					

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q	Grassed Max Q (cu.m/s)	Paved Tc	Grassed Tc (cu.m/s)	Supp. Tc	Due to Storm (min)	(min)	(min)
Pre-Development			0.571	0.160	0.411	7.00	7.00	7.00	AR&R 100 year, 20 minutes storm, average 125 mm/h, Zone 1
Post-Development			0.609	0.423	0.186	7.00	7.00	7.00	AR&R 100 year, 20 minutes storm, average 125 mm/h, Zone 1

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Outflow Volumes for Total Catchment (1.13 impervious + 1.35 pervious = 2.48 total ha)

Storm Total Rainfall Total Runoff Impervious Runoff Pervious Runoff

cu.m cu.m (Runoff %)cu.m (Runoff %)cu.m (Runoff %)

AR&R 100 year, 5 minutes storm, average 226 mm/h, Zone 1 467.82 342.86 (73.3%) 156.35 (73.5%) 186.51 (73.2%)

AR&R 100 year, 10 minutes storm, average 172 mm/h, Zone 1 712.08 558.88 (78.5%) 267.49 (82.6%) 291.39 (75.1%)

AR&R 100 year, 15 minutes storm, average 143 mm/h, Zone 1 888.03 710.99 (80.1%) 347.54 (86.0%) 363.45 (75.1%)

AR&R 100 year, 20 minutes storm, average 125 mm/h, Zone 1 1035.00 837.24 (80.9%) 414.41 (88.0%) 422.83 (75.0%)

AR&R 100 year, 25 minutes storm, average 111 mm/h, Zone 1 1148.85 929.43 (80.9%) 466.22 (89.2%) 463.21 (74.0%)

AR&R 100 year, 30 minutes storm, average 101 mm/h, Zone 1 1254.42 1016.76 (81.1%) 514.25 (90.1%) 502.51 (73.5%)

AR&R 100 year, 45 minutes storm, average 81.0 mm/h, Zone 1 1509.01 1226.78 (81.3%) 630.09 (91.8%) 596.69 (72.6%)

AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1 1689.14 1371.88 (81.2%) 712.05 (92.6%) 659.83 (71.7%)

AR&R 100 year, 1.5 hours storm, average 54.0 mm/h, Zone 1 2012.04 1638.89 (81.5%) 858.97 (93.8%) 779.92 (71.1%)

AR&R 100 year, 2 hours storm, average 45.5 mm/h, Zone 1 2260.48 1842.03 (81.5%) 972.01 (94.5%) 870.02 (70.6%)

AR&R 100 year, 3 hours storm, average 35.8 mm/h, Zone 1 2667.82 2168.47 (81.3%) 1157.35 (95.3%) 1011.12 (69.5%)

AR&R 100 year, 4.5 hours storm, average 28.0 mm/h, Zone 1 3129.78 2520.77 (80.5%) 1367.54 (96.0%) 1153.23 (67.6%)

Project Design Calculations

Project Name:	Closebourne House, MORPETH
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Design Section:	Stormwater Management

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Pipe1	0.542	3.46	22.879	22.357	AR&R 100 year, 20 minutes storm, average 125 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF2	0	0	0.000	0	0	0	0	

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level

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OSD 24.57 92.2 0.542 0.542 0.000

CONTINUITY CHECK for AR&R 100 year, 20 minutes storm, average 125 mm/h, Zone 1

Node	Inflow	Outflow	Storage Change	Difference
	(cu.m)	(cu.m)	(cu.m)	%
N01	404.79	404.79	0.00	0.0
OSD	432.46	432.76	0.00	-0.1
N1	432.76	432.76	0.00	0.0

Run Log for CI run at 14:46:00 on 26/7/2018

The maximum water level in these storages exceeds the maximum elevation you specified: OSD.

DRAINS has extrapolated the Elevation vs Storage table to a higher Elevation. Please provide accurate values for higher elevations.

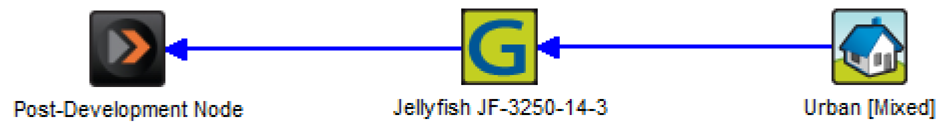
Flows were safe in all overflow routes.

IGNORE THESE WARNINGS AT YOUR OWN PERIL.\cf1

Project Design Calculations

Project Name:	Closebourne House, MORPETH
Project Number:	30916-4
Design Engineer:	OKW
Office:	Sydney
Date:	27/07/2018 10:15 AM
Design Section:	Stormwater Management

MUSIC Model Arrangement



Treatment Train Effectiveness

	Sources	Residual Load	% Reduction
Flow (ML/yr)	13	13	0
Total Suspended Solids (kg/yr)	2480	477	80.8
Total Phosphorus (kg/yr)	5	2.01	59.9
Total Nitrogen (kg/yr)	36.2	18.3	49.6
Gross Pollutants (kg/yr)	331	9.29	97.2

Project Design Calculations

Project Name:	Closebourne House, MORPETH
Project Number:	30916-4
Design Engineer:	OKW
Office:	Sydney
Date:	27/07/2018 10:15 AM
Design Section:	Stormwater Management

MUSIC Modelling Results

Source nodes
Location,Urban
ID,1
Node Type,UrbanSourceNode
Zoning Surface Type,Mixed
Total Area (ha),1.242
Area Impervious (ha),0.817588208955224
Area Pervious (ha),0.424411791044776
Field Capacity (mm),80
Pervious Area Infiltration Capacity coefficient - a,200
Pervious Area Infiltration Capacity exponent - b,1
Impervious Area Rainfall Threshold (mm/day),1
Pervious Area Soil Storage Capacity (mm),120
Pervious Area Soil Initial Storage (% of Capacity),25
Groundwater Initial Depth (mm),10
Groundwater Daily Recharge Rate (%),25
Groundwater Daily Baseflow Rate (%),5
Groundwater Daily Deep Seepage Rate (%),0
Stormflow Total Suspended Solids Mean (log mg/L),2.2
Stormflow Total Suspended Solids Standard Deviation (log mg/L),0.32
Stormflow Total Suspended Solids Estimation Method,Stochastic
Stormflow Total Suspended Solids Serial Correlation,0
Stormflow Total Phosphorus Mean (log mg/L),-0.45
Stormflow Total Phosphorus Standard Deviation (log mg/L),0.25
Stormflow Total Phosphorus Estimation Method,Stochastic
Stormflow Total Phosphorus Serial Correlation,0
Stormflow Total Nitrogen Mean (log mg/L),0.42
Stormflow Total Nitrogen Standard Deviation (log mg/L),0.19
Stormflow Total Nitrogen Estimation Method,Stochastic
Stormflow Total Nitrogen Serial Correlation,0
Baseflow Total Suspended Solids Mean (log mg/L),1.1
Baseflow Total Suspended Solids Standard Deviation (log mg/L),0.17
Baseflow Total Suspended Solids Estimation Method,Stochastic
Baseflow Total Suspended Solids Serial Correlation,0
Baseflow Total Phosphorus Mean (log mg/L),-0.82
Baseflow Total Phosphorus Standard Deviation (log mg/L),0.19
Baseflow Total Phosphorus Estimation Method,Stochastic
Baseflow Total Phosphorus Serial Correlation,0
Baseflow Total Nitrogen Mean (log mg/L),0.32
Baseflow Total Nitrogen Standard Deviation (log mg/L),0.12
Baseflow Total Nitrogen Estimation Method,Stochastic
Baseflow Total Nitrogen Serial Correlation,0
Flow based constituent generation - enabled,Off
Flow based constituent generation - flow file,
Flow based constituent generation - base flow column,
Flow based constituent generation - pervious flow column,
Flow based constituent generation - impervious flow column,
Flow based constituent generation - unit,
OUT - Mean Annual Flow (ML/yr),13.0
OUT - TSS Mean Annual Load (kg/yr),2.49E3
OUT - TP Mean Annual Load (kg/yr),5.25
OUT - TN Mean Annual Load (kg/yr),36.3
OUT - Gross Pollutant Mean Annual Load (kg/yr),331
Rain In (ML/yr),18.5008
ET Loss (ML/yr),5.50408
Deep Seepage Loss (ML/yr),0
Baseflow Out (ML/yr),1.02815

Imp. Stormflow Out (ML/yr),11.0529
Perv. Stormflow Out (ML/yr),0.915657
Total Stormflow Out (ML/yr),11.9685
Total Outflow (ML/yr),12.9967
Change in Soil Storage (ML/yr),-1.2E-5
TSS Baseflow Out (kg/yr),13.967
TSS Total Stormflow Out (kg/yr),2480.25
TSS Total Outflow (kg/yr),2494.22
TP Baseflow Out (kg/yr),0.170796
TP Total Stormflow Out (kg/yr),5.07962
TP Total Outflow (kg/yr),5.25041
TN Baseflow Out (kg/yr),2.2343
TN Total Stormflow Out (kg/yr),34.1101
TN Total Outflow (kg/yr),36.3444
GP Total Outflow (kg/yr),332.691

No Imported Data Source nodes

No USTM treatment nodes

Generic treatment nodes
Location,Jellyfish JF-3250-14-3
ID,3
Node Type,GenericNode
Lo-flow bypass rate (cum/sec),0
Hi-flow bypass rate (cum/sec),0.0775
Flow Transfer Function
Input (cum/sec),0
Output (cum/sec),0
Input (cum/sec),10
Output (cum/sec),10
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Gross Pollutant Transfer Function
Enabled,True
Input (kg/ML),0
Output (kg/ML),0
Input (kg/ML),100
Output (kg/ML),1
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),

Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Total Nitrogen Transfer Function
Enabled,True
Input (mg/L),0
Output (mg/L),0
Input (mg/L),7
Output (mg/L),3.2
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Total Phosphorus Transfer Function
Enabled,True
Input (mg/L),0
Output (mg/L),0
Input (mg/L),0.4
Output (mg/L),0.14
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Total Suspended Solids Transfer Function
Enabled,True
Input (mg/L),0
Output (mg/L),0
Input (mg/L),200

Output (mg/L),22
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
TSS Flow based Efficiency Enabled,Off
TSS Flow based Efficiency,
TP Flow based Efficiency Enabled,Off
TP Flow based Efficiency,
TN Flow based Efficiency Enabled,Off
TN Flow based Efficiency,
GP Flow based Efficiency Enabled,Off
GP Flow based Efficiency,
IN - Mean Annual Flow (ML/yr),13.0
IN - TSS Mean Annual Load (kg/yr),2.49E3
IN - TP Mean Annual Load (kg/yr),5.25
IN - TN Mean Annual Load (kg/yr),36.3
IN - Gross Pollutant Mean Annual Load (kg/yr),331
OUT - Mean Annual Flow (ML/yr),13.0
OUT - TSS Mean Annual Load (kg/yr),480
OUT - TP Mean Annual Load (kg/yr),2.13
OUT - TN Mean Annual Load (kg/yr),18.1
OUT - Gross Pollutant Mean Annual Load (kg/yr),9.29
Flow In (ML/yr),12.9956
ET Loss (ML/yr),0
Infiltration Loss (ML/yr),0
Low Flow Bypass Out (ML/yr),0
High Flow Bypass Out (ML/yr),1.03871
Orifice / Filter Out (ML/yr),0
Weir Out (ML/yr),0
Transfer Function Out (ML/yr),11.9574
Reuse Supplied (ML/yr),0
Reuse Requested (ML/yr),0
% Reuse Demand Met,0
% Load Reduction,-0.00364738
TSS Flow In (kg/yr),2493.99
TSS ET Loss (kg/yr),0
TSS Infiltration Loss (kg/yr),0
TSS Low Flow Bypass Out (kg/yr),0
TSS High Flow Bypass Out (kg/yr),231.387
TSS Orifice / Filter Out (kg/yr),0
TSS Weir Out (kg/yr),0
TSS Transfer Function Out (kg/yr),248.901
TSS Reuse Supplied (kg/yr),0
TSS Reuse Requested (kg/yr),0
TSS % Reuse Demand Met,0
TSS % Load Reduction,80.7422

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Design Section:	Stormwater Management

TP Flow In (kg/yr),5.25018
TP ET Loss (kg/yr),0
TP Infiltration Loss (kg/yr),0
TP Low Flow Bypass Out (kg/yr),0
TP High Flow Bypass Out (kg/yr),0.449969
TP Orifice / Filter Out (kg/yr),0
TP Weir Out (kg/yr),0
TP Transfer Function Out (kg/yr),1.68009
TP Reuse Supplied (kg/yr),0
TP Reuse Requested (kg/yr),0
TP % Reuse Demand Met,0
TP % Load Reduction,59.4289
TN Flow In (kg/yr),36.344
TN ET Loss (kg/yr),0
TN Infiltration Loss (kg/yr),0
TN Low Flow Bypass Out (kg/yr),0
TN High Flow Bypass Out (kg/yr),2.75294
TN Orifice / Filter Out (kg/yr),0
TN Weir Out (kg/yr),0
TN Transfer Function Out (kg/yr),15.356
TN Reuse Supplied (kg/yr),0
TN Reuse Requested (kg/yr),0
TN % Reuse Demand Met,0
TN % Load Reduction,50.1735
GP Flow In (kg/yr),331.057
GP ET Loss (kg/yr),0
GP Infiltration Loss (kg/yr),0
GP Low Flow Bypass Out (kg/yr),0
GP High Flow Bypass Out (kg/yr),6.10451
GP Orifice / Filter Out (kg/yr),0
GP Weir Out (kg/yr),0
GP Transfer Function Out (kg/yr),3.18263
GP Reuse Supplied (kg/yr),0
GP Reuse Requested (kg/yr),0
GP % Reuse Demand Met,0
GP % Load Reduction,98.1561

Other nodes
Location,Post-Development Node
ID,2
Node Type,PostDevelopmentNode
IN - Mean Annual Flow (ML/yr),13.0
IN - TSS Mean Annual Load (kg/yr),480
IN - TP Mean Annual Load (kg/yr),2.13
IN - TN Mean Annual Load (kg/yr),18.1
IN - Gross Pollutant Mean Annual Load (kg/yr),9.29
OUT - Mean Annual Flow (ML/yr),13.0
OUT - TSS Mean Annual Load (kg/yr),480
OUT - TP Mean Annual Load (kg/yr),2.13
OUT - TN Mean Annual Load (kg/yr),18.1
OUT - Gross Pollutant Mean Annual Load (kg/yr),9.29
% Load Reduction,56.1E-9
TSS % Load Reduction,80.7
TN % Load Reduction,50.2
TP % Load Reduction,59.4
GP % Load Reduction,97.2

Links
Location,Drainage Link,Drainage Link

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Source node ID,1,3
Target node ID,3,2
Muskingum-Cunge Routing,Not Routed,Not Routed
Muskingum K, ,
Muskingum theta, ,
IN - Mean Annual Flow (ML/yr),13.0,13.0
IN - TSS Mean Annual Load (kg/yr),2.49E3,480
IN - TP Mean Annual Load (kg/yr),5.25,2.13
IN - TN Mean Annual Load (kg/yr),36.3,18.1
IN - Gross Pollutant Mean Annual Load (kg/yr),331,9.29
OUT - Mean Annual Flow (ML/yr),13.0,13.0
OUT - TSS Mean Annual Load (kg/yr),2.49E3,480
OUT - TP Mean Annual Load (kg/yr),5.25,2.13
OUT - TN Mean Annual Load (kg/yr),36.3,18.1
OUT - Gross Pollutant Mean Annual Load (kg/yr),331,9.29

Catchment Details
Catchment Name,CI-CA-MUSIC Model Morpeth_18.07.23
Timestep,6 Minutes
Start Date,1/01/1959
End Date,31/12/1959 11:54:00 PM
Rainfall Station, 66062 SYDNEY
ET Station,Monthly User Defined
Mean Annual Rainfall (mm), 1490
Mean Annual ET (mm), 1260