STORMWATER MANAGEMENT STRATEGY REPORT

Site Address	Glen Ora Estate, Munro Avenue, Sunshine North
Job Number	13 19 20
Date:	19/05/2020
Client:	R D Silverstein
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Revision A

Contents

Executive Summary

Our client is currently involved in planning the provision of roads, stormwater drainage, water and sewerage services and electricity/telecommunications facilities to an existing industrial estate known as the Glen Ora Estate (the Estate) located to the north of Munro Avenue in North Sunshine in the City of Brimbank. The Estate was sub-divided in the 1920's without the provision of any civil infrastructure. Moodie and Associates has been engaged to investigate and report on stormwater drainage outfall strategies for the Estate, in response to a recent request from Brimbank City Council, the local government drainage authority for the North Sunshine area.

This report presents an analysis of the Q10 and Q100 hydrology and hydraulics of the Glen Ora Estate and its existing stormwater drainage outfalls.

Our conclusion is that the existing DN1200mm/DN1350mm Brimbank City Council main outfall drain running on a north-south alignment, from the eastern end of Munro Avenue to the Somers Street Melbourne water main drain, has adequate capacity to carry stormwater generated by a Q10 rainfall event over the Estate Southern Catchment only. At the Q100 level, surcharge flows, over and above the capacity of the existing Council main outfall drain, will be adequately accommodated within a combination of the existing Munro Avenue and Bunnett Street formations. The Northern Catchment will require the establishment of a separate outfall through adjacent land in an easterly direction, to be negotiated with the relevant adjoining land owners at some point in the future.

1 Site Context

1.1 GENERAL

The Estate comprises approximately 417 separately titled small industrial lots created by subdivision in the 1920's without any infrastructure provision. The site is bounded to the east by industrially and residentially zoned land fronting the Maribyrnong River Reserve, by the Albion to Jacana Railway reserve to the west, by Baldwin Avenue to the north and by Munro Avenue to the south. Figure 1 shows the extent of the Estate.

The Estate comprises a central segment of land developed on the western bank of the Maribyrnong River valley just south of the Western Ring Road. The Maribyrnong River is located to the east with the railway reserve skewed in a south-west direction to the west

Figure 1 Aerial View of existing site.

1.2 SITE CLASSIFICATION

The zoning of the Estate is industrial.

1.3 SITE TOPOGRAPHY

1.3.1 General

The Estate is 35.8 ha in total area, and comprises two catchments, a smaller Northern Catchment located generally to the north of Whitehill Avenue and a larger Southern Catchment comprising all the lots located between Whitehill and Munro Avenues together with approximately 40 lots located north of Whitehill Avenue.

1.3.2 Northern Catchment

The Northern catchment is 15.1 ha in area, with the lay of the land falling in a north-easterly direction from a common central height of 59m AHD adjacent to the Railway Reserve, to the Vermont Avenue east boundary at an elevation of 53.56m AHD, a fall of 5.4m. The full Northern Catchment falls into the Vermont Street road reserve.

1.3.3 Southern Catchment

The Southern Catchment is 20.7 ha in area with the lay of the land falling in a south-easterly direction from the common estate central height of 59m AHD, adjacent to the Railway Reserve, to the south-east corner at an elevation of 53m AHD, a fall of 6.0m. The full Southern Catchment falls into the Munro Avenue road reserve.

Figure 2 Site Topography

2 Existing Stormwater outfalls

2.1 NOTHERN CATCHMENT

The Northern Catchment outfall is a low point located 75m south of the corner of Baldwin and Vermont Avenues, and currently discharges east into the open grassed land of the adjacent property. This point of discharge is not piped and consists of an overland flow path created by the natural fall of the land. Refer to Figure 3.

Figure 3 General Northern Catchment Stormwater Outfall Layout

2.2 SOUTHERN CATCHMENT

The Southern Catchment has the option of discharging into two Legal Points of Discharge (LPoDs). These comprise a DN1200mm Council main drain originating at the eastern end of the Munro Avenue road reserve and running south along an internal boundary adjacent to the historical quarry lake, and a DN900mm Council main drain located at the intersection of Bunnett and Tube Streets. Both outlets are piped and have independent overland flow paths. Refer to Figure 4 and Appendices A and B.

2.3 EASTERN END OF MUNRO AVENUE

2.3.1 General

The location of this outlet (LPod) is at the eastern end of the Munro Avenue road reserve. The access to this point is via the southern verge of Munro Avenue. As the historical quarry lake is situated adjacent to the end of Munro Avenue, no eastern road extension following the fall of the land is possible.

2.3.2 Q10 Discharge

Located in the south-east corner of the Munro Avenue road reserve is the upstream end of a DN1200mm outfall stormwater drain serving the lowest point of the estate (52.35m AHD).

Figure 4 General Southern Catchment Stormwater Outfall Layout

The upstream end of the DN1200 outfall stormwater drain lacks an endwall or a junction pit, and will be upgraded a 1500mm x 1500mm sized junction pit connecting to a new main drain running along the Munro Avenue road reserve, thereby enabling the development of the Glen Ora Estate Southern Catchment.

2.3.3 Outlet Pipe Alignment Condition

The DN1200mm outfall stormwater drain is centrally located within a 3-metre drainage easement located on the north-south boundary of the Bunnett Street industrial lots, adjacent to the historical quarry lake. This easement passes through a private allotment fronting Bunnett Street and extends 270m south meeting the Lance Road main drain at 90 deg, the combined flows then outfalling through a larger DN1350mm size pipe extending 260m further south to Somers Street. Refer Figure 4 and Appendix A. The DN1200mm drain grades at 1:155 (0.65%) and yields a 3.15m3/sec capacity; due to the complete lack of development within the Glen Ora Estate, its condition is excellent, requiring only minor clearing out of debris to restore it to full capacity. Refer Figure 5.

Figure 5 DN1200mm Stormwater Outfall pipe existing condition

2.3.4 Overland Flows

The overland flow path consists of a direct path down Munro Avenue to an adjacent open quarry that is proposed to be transformed into a future recreational lake in the Riverview estate. The slope of the street falls @ a slope of 1:200 (0.5%). The maximum capacity of this overland flow path is 1.2m3/sec.

2.3.5 Munro Avenue Q10/Q100 year Outlet Capacity Summary

Rainfall event	Pipe Diameter	Pipe Grade	Qm3/sec
Q10	DN1200mm	1:155 (0.64%)	3.15
Q100	-		1.20

2.4 BUNNETT AND TUBE STREET INTERSECTION

2.4.1 General

A second LPoD is located on the north west corner of the Bunnett and Tube Street intersection, positioned in an industrial subdivision south of the Southern Catchment. Refer Figure 6.

Figure 6 Bunnett and Tube Street intersection looking north

2.4.1 Q10 Discharge

The outlet, a DN900mm pipe graded at 1:150 (0.5%), has a 1.48m3/sec capacity and is located on the north-west corner of the intersection. Across the Bunnett Street carriageway just south of the intersection, a DN1050mm pipe graded at 1:150 (0.5%) has a 2.21 m3/sec capacity. Access to this location is via the Bunnett Street road reserve.

The 18.25m wide cross section of Burnett Street comprises a 12.25m pavement; the left verge includes a gas main (at 2.1m offset) and a high voltage power line (at 2.55m offset) and the right verge contains a water main (at 1.5m offset), Telstra (at 1.25m offset) and the DN1050mm SW drain. Refer to Figure 7.

Figure 7 Bunnett Street Cross Section

2.4.2 Overland flow path

The overland flow path consists of a 12.5m wide bitumen pavement heading south down Bunnett Street. The street falls at a slope of 1:166. The overland flow capacity is 1.1m3/sec.

2.4.3 Bunnett and Tube Street Intersection Q10/Q100 year Outlet Capacity Summary

Rainfall event	Pipe Diameter	Pipe Grade	Qm3/sec
Q10	DN900mm	1:150 (0.66%)	1.48
Q100	-		1.10

2.4.4 Bunnett Street Q10/Q100 year Outlet Capacity summary

Rainfall event	Pipe Diameter	Pipe Grade	Qm3/sec
Q10	DN1050mm	1:150 (0.66%)	2.21
Q100	-		1.10

3 Hydrology

3.1 HYDROLOGY INFORMATION SOURCE

Site hydrology information is sourced from Bureau of Meteorology Rainfall IFD Data System Water Information web site http://www.bom.gov.au/water/designRainfalls.

3.2 LOCATION

Location: Munro Avenue, Sunshine, Victoria
Latitude: 37 Degrees 45 Minutes 29 Seconds
Longitude: 144 Degrees 50 Minutes 25 Seconds

Rainfall: For industrial and Commercial Areas 10% (Q10)
Floodway's Gap Flow or 1% (Q100) if no pipe is provided
Refer to Appendix C for IFD Design Rainfall Intensity Chart

3.3 AREA

Catchment	**Area (Ha)**
Northern Catchment	15.1
Southern Catchment	20.7
Total	35.8

3.4 IMPERVIOUS AREA % (Q10)

Allotments	**Impervious area**
Roof area	70%
Carpark area	20%
Landscape area	10%
Road Reserve	
Road pavement	80%
Grassed verge	20%

3.5 TIME OF CONCENTRATION

Catchment	**Time of Concentration (Tc)**
Catchment Northern	10 min
Catchment Southern	14.5 min

Calculated using the Bransby-Williams formula

3.6 COEFFICIENT OF RUNOFF (Q10)

Impervious carpark/road	C=0.85
Impervious roof	C=0.90
Pervious landscape	C=0.33

3.7 COEFFICIENT OF RUNOFF (Q100)

Impervious	C=1.0
Pervious	n/a

Refer City of Brimbank. Engineering Guidelines and Specifications for the Design and Construction of Roads and Drainage Works.

Figure 8 –Sub division Layout

3.8 HYDRAULICS

Computation of runoff shall be determined using the Rational Method:

Q = CIA/360

where: Q = Design discharge (m3/s)

C = Runoff coefficient

I = Rainfall intensity (mm/h)

A = Catchment area (ha)

3.9 CALCULATED CATCHMENT STORMWATER DISCHARGE

3.9.1 Northern Catchment

10 year Event

Pavement Type	Intensity 10 year	Area	Co Efficient	Qm3/sec
Factory Roof (70%)	**82**	6.09	0.90	1.25
Factory Carpark (20%)	**82**	1.74	0.85	0.34
Factory Landscape (10%)	**82**	0.87	0.33	0.07
Road Pavement (80%)	**82**	5.12	0.85	1.00
Road Verge (20%)	**82**	1.28	0.33	0.10
			Q10 Design Flow	2.76

100 year Event

Intensity 100 year	Area	Co Efficient	Qm3/sec
140	15.1	1	5.87
		Q100 Design Flow	5.87

3.9.2 Southern Catchment

10 year Event

Pavement Type	Intensity 10 year	Area	Co Efficient	Qm3/sec
Factory Roof (70%)	67	10.80	0.9	1.81
Factory Carpark (20%)	67	3.08	0.85	0.49
Factory Landscape 910%)	67	1.54	0.33	0.09
Road Pavement (80%)	67	4.22	0.85	0.67
Road Verge (20%)	67	1.05	0.33	0.06
			Q10 Design Flow	3.12

100 year Event

Intensity 100 year	Area	Co Efficient	Qm3/sec
115	20.7	1	6.61
		Q100 Design Flow	6.61

4 Drainage Analysis

4.1 NORTHERN CATCHMENT

4.1.1 Topography

The Northern catchment falls at 2% from its northern high point to its outlet. The catchment will ultimately be developed with small to medium size impervious factories and warehouses, with a probable building permit requirement of a 10% landscaped area.

4.1.2 Q10 stormwater event analysis

The catchment is at present undeveloped with no physical stormwater infrastructure and no nominated outlet or legal point of discharge. The adjacent site is undeveloped and owned by others. The time of concentration is calculated at 10min to the outlet and the Q10 flow total is 2.76m3/sec. The height of the Northern Catchment boundary is 3.6m above the existing surface level of the natural point of discharge.

4.1.3 Q100 stormwater event analysis

Overland flow routing can only be to the nominated catchment low point as both the northern and southern boundaries of the northern catchment are elevated relative to the catchment low point, being higher by 1.0m and 3.6m respectively. The Q100 discharge is 5.87m3/sec.

4.2 SOUTHERN CATCHMENT

4.2.1 Topography

The Southern Catchment falls at 1% from its northern end to the point of discharge, with a 0.5% fall along the Munro Avenue road reserve. The catchment will ultimately be developed with small to medium size impervious factory and warehouse developments, with a probable building permit requirement of a 10% landscaped area.

4.2.2 Q10 Analysis

The Southern Catchment is at present undeveloped but is served with a major nominated outlet and two minor secondary outlets. The catchment time of concentration is calculated at 14.5 min to the entry point to the major nominated outlet and the Q10 flow total is 3.12m3/sec. As the site falls naturally to the south east and the minimum height to any boundary of the southern stage is 4m (approx.), the nominated LPoD and the secondary outlets are the only viable outlets for Q10 flows.

There are three options for providing the Southern Catchment with drainage outfalls:
Option 1: Pipe routing to the end of Munro Avenue into DN1200mm stormwater pipe with a capacity of 3.15m3/sec.
Option 2: Pipe routing to the Bunnett Street / Tube Street intersection, into DN900mm stormwater pipe with a capacity of 1.48m3/sec.
Option 3: Pipe routing to the Bunnett Street/Tube Street intersection, into DN1050mm stormwater pipe with capacity of 1.61m3/sec.

4.2.3 Q100 analysis.

The Q100 discharge is 6.61m3/sec. Three overland flow paths are open for the Southern Catchment:
Flow path 1: Overland flow routing along Bunnett Street with 1.10m3/sec cross-sectional capacity.

Flow path 2: Overland flow routing to the eastern end of Munro Avenue, directing the flow into the quarry/Wetlands, with 1.20m3/sec cross-sectional capacity.
Flow path 3: Combination of the first two with a combined 2.7m3/sec cross-sectional capacity.

5 Conclusions

5.1 NORTHERN CATCHMENT

5.1.1 Topography

The topography of the Northern catchment could possibly be changed by future development, but this is very unlikely. Realistically, drainage infrastructure provision to the Northern catchment is contingent upon the provision of a stormwater drainage easement through the industrially zoned land to the east.

5.1.2 Q10 Discharge

The only viable and realistic option for the provision of Q10 piped drainage infrastructure to the Northern catchment is through the creation of a drainage easement as part of the future industrial development of the land located to the east.

5.1.3 Overland Flow

The overland flow routing will be into the adjacent land via a future drainage easement or development.

5.2 SOUTHERN CATCHMENT

5.2.1 Topography

The topography of the Southern catchment will be unchanged by future development. The difference in height from the top of the catchment to the bottom of the catchment is 4.25m approx. with the natural fall constant from the north-west to the south-east.

5.2.2 Q10 Discharge

Of the three main options open for the Southern catchment, we conclude as follows:
Option 1: Compared to the pipe capacity of 3.15m3/sec, the Q10 discharge from the Southern catchment being 3.12m3/sec is just below full pipe capacity (FBNUH capacity) and is therefore the preferred option.
Option 2: Capacity of 1.48m3/sec in the DN900mm pipe located at the Bunnett Street / Tube Street intersection is roughly half of the Southern catchment requirement and is therefore not a possible standalone option.
Option 3: Capacity of 1.61m3/sec in the DN1050mm pipe running along Lance Road from Bunnett Street outlet is roughly half of the catchment requirement and is therefore also not a possible standalone option.

5.2.3 Overland Flow

Of the two main options open for the Southern Catchment we conclude as follows:
Option 1: Compared to the cross-sectional capacity of 1.60m3/sec, the Q100 discharge out of the Southern Catchment being 6.61m3/sec is approx. 4 times that of the cross-sectional capacity.
Option 2: Compared to the cross-sectional capacity of 1.10m3/sec the Q100 discharge out of the southern catchment being 6.61m3/sec is approx. 4 times that of the cross-sectional capacity.

6 Recommendations

6.1 NORTHERN CATCHMENT

6.1.1 Topography

The requirement to adjust the natural surface above 3.5m to achieve the minimum recommended finished level is neither cost efficient nor structurally practicable in relation to the adjacent property, so the recommendation is that provision of infrastructure to this area will be contingent on the provision of an easement to carry Q10 flows to the Maribyrnong River through the industrially zoned land to the east.

6.1.2 Q10 Discharge

Established infrastructure with an outlet capacity of 3.15m3/sec is available to serve the Southern catchment on a standalone basis. Even if the Northern catchment topography was to be reshaped by excavation and filling at enormous cost and provided with a Q10 outfall heading south, there is no spare capacity available in the existing main outfall drains located south of Munro Avenue and in Bunnett Street/Lance Road. The recommendation therefore is for an outfall pipe or open channel to be aligned through the adjacent industrially zoned property to the Maribyrnong River following the natural water course. This must be done in conjunction with the respective landowners.

6.1.3 Overland Flow

The topography of the catchment does not allow for the reshaping of the existing surface allowing for the alignment of the Q100 overland flow. The recommendation is for the overland flow to discharge into a constructed open channel to be aligned through the adjacent property to the Maribyrnong River following the natural water course. This must be done in conjunction with the respective landowners.

6.2 SOUTHERN CATCHMENT

6.2.1 Topography

The natural fall of the land requires no adjustment, with the Munro Street grade achieving a minimum pavement grade of 0.5%.

6.2.2 Q10 Discharge

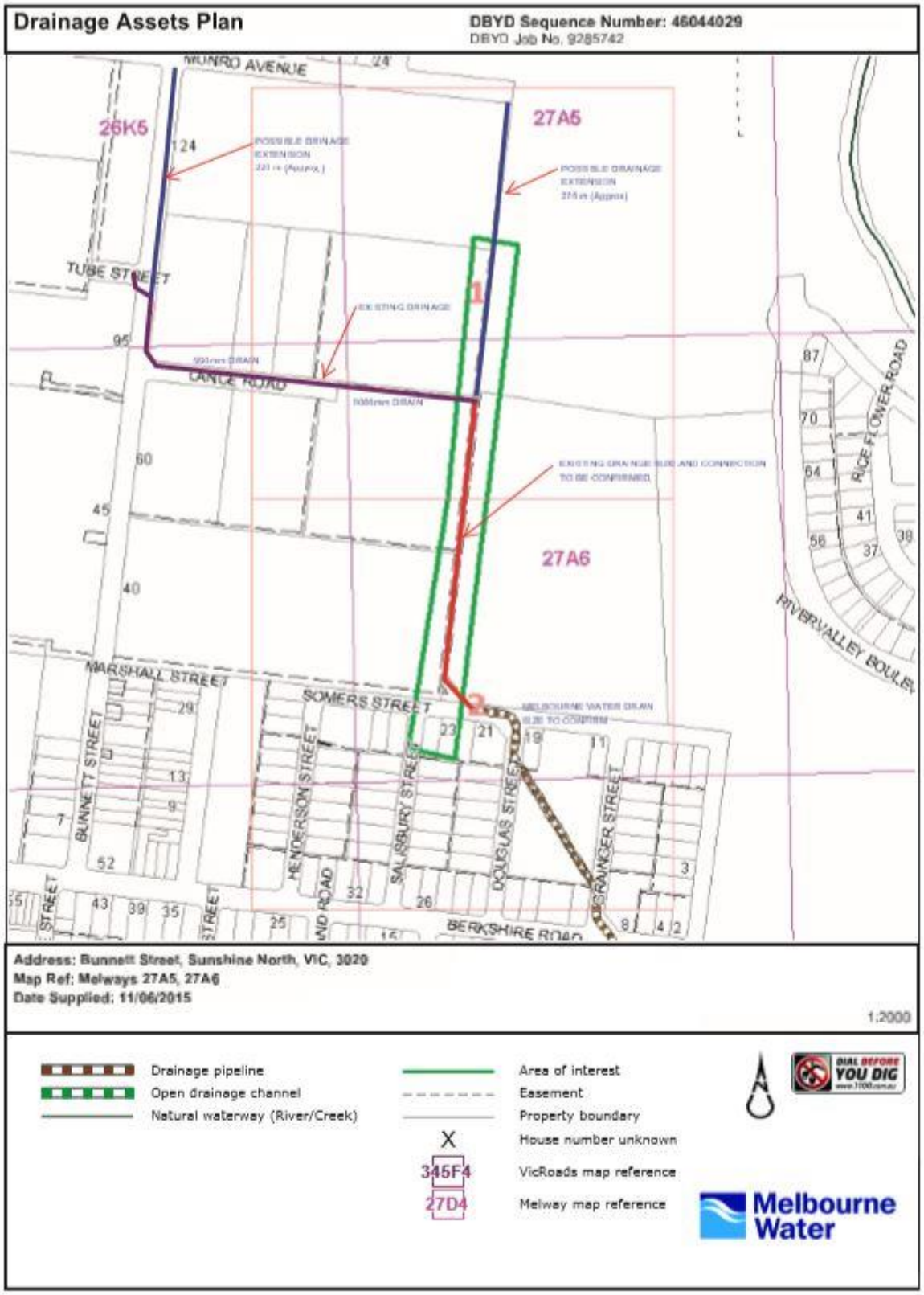
The requirement for a Q10 flow discharge of 3.12m3/sec is achieved with the existing DN1200mm outfall drain capacity of 3.15m3/sec. The recommendation is to have one outlet only at the end of the Munro Avenue road reserve. The construction of a large outfall drain along Bunnett Street will be seen as difficult and expensive, due the presence of existing services in the Bunnett Street verges. The principal recommendation is that the alternative Bunnett Street outlets should be considered as “back up” points of connection only.

6.2.3 Overland Flow

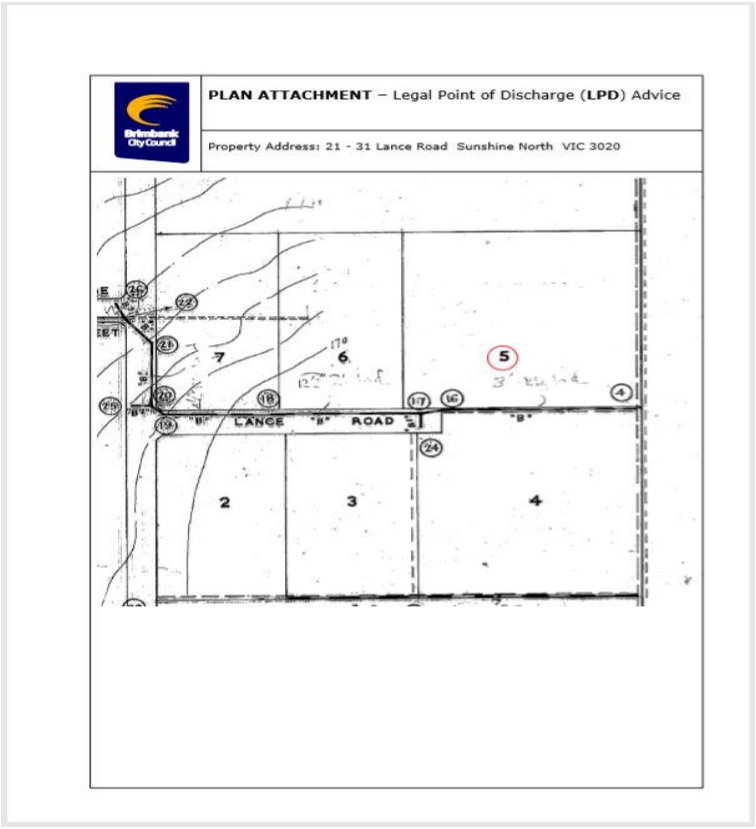
The 6.61m3/sec Q100 flow discharge requirement is not achieved with overland flow path capacity alone Munro Avenue (1.20m3/sec) and Bunnett Street (1.10m3/sec) giving a total 2.3m3/sec combined overland flow path capacity lesser than the required. A combined Munro Avenue gap flow analysis of overland flow path and pipe capacity of 3.15+1.20=4.35m3/sec still does not achieve requirements. A combined Bunnett Street gap flow analysis of overland flow path and pipe capacity of 1.48+1.10=2.58m3/sec does not achieve catchment requirements also. The recommendation is to

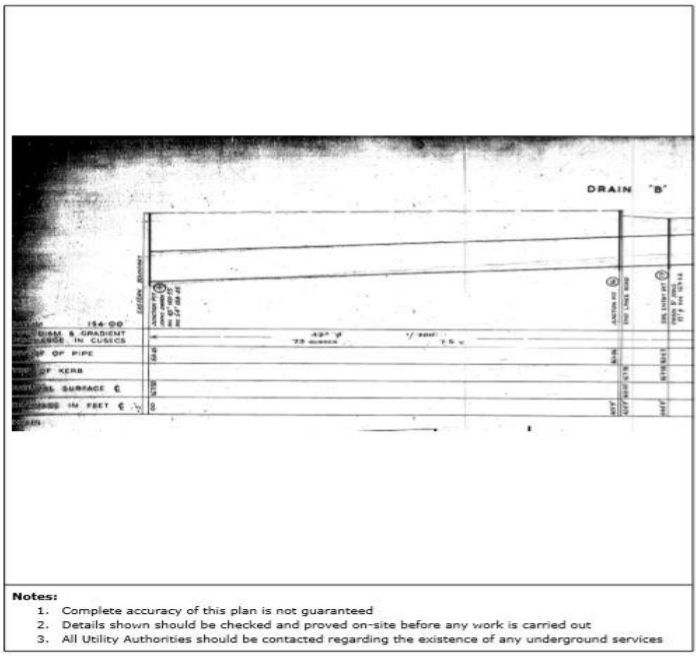
split the Q100 catchment into two diverting the overland flow path down Bunnett Street at the intersection of Munro Avenue and Bunnett Street. This would give a combined gap flow analysis outfall capacity of 4.35m3/sec and 2.58m3/sec = 6.93m3/sec. This is greater than the required 6.61m3/sec.

Appendix A. Melbourne Water Outfall Drainage Assets Plan



Appendix B. Brimbank City Council Legal Point of Discharge





Appendix C. Bureau of Meteorology Design Rainfall Data

Australian Government
Bureau of Meteorology

Location

Label: Munro Avenue, Sunshine

Latitude: 37° 45' 29"
[Nearest grid cell: 37.7625 (S)]

Longitude: 144° 50' 25"
[Nearest grid cell: 144.8375 (E)]

IFD Design Rainfall Intensity (mm/h)

Issued: 06 May 2020

Rainfall intensity for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).
FAQ for New ARR probability terminology

Unit: mm/h

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	86.6	98.9	141	172	205	252	292
2 min	72.9	82.7	117	142	169	208	242
3 min	65.6	74.6	105	128	153	188	218
4 min	60.2	68.5	96.9	118	141	173	200
5 min	55.7	63.5	90.0	110	131	161	186
10 min	41.5	47.5	67.8	82.9	98.7	121	140
13 min	36.3	41.6	59.5	72.8	86.7	107	123
15 min	33.7	38.6	55.1	67.5	80.4	98.9	114
20 min	28.6	32.8	46.8	57.3	68.3	84.2	97.2
25 min	25.0	28.7	40.9	50.1	59.8	73.7	85.2
30 min	22.4	25.6	36.5	44.7	53.3	65.8	76.1
45 min	17.3	19.8	28.1	34.3	41.0	50.6	58.7
1 hour	14.4	16.3	23.1	28.3	33.8	41.8	48.5
1.5 hour	11.0	12.5	17.6	21.4	25.6	31.7	36.9
2 hour	9.13	10.3	14.4	17.6	21.0	26.1	30.4
3 hour	7.01	7.90	11.0	13.4	16.0	19.8	23.1
4.5 hour	5.39	6.07	8.42	10.2	12.2	15.2	17.7
6 hour	4.48	5.04	6.99	8.50	10.1	12.5	14.6
9 hour	3.44	3.88	5.39	6.56	7.80	9.65	11.2
12 hour	2.85	3.22	4.49	5.46	6.50	8.00	9.26
18 hour	2.17	2.46	3.46	4.21	5.01	6.13	7.05
24 hour	1.77	2.02	2.86	3.49	4.15	5.05	5.78
30 hour	1.51	1.72	2.46	3.00	3.57	4.32	4.92
36 hour	1.31	1.51	2.16	2.64	3.14	3.79	4.30
48 hour	1.05	1.21	1.75	2.14	2.55	3.06	3.45
72 hour	0.759	0.878	1.27	1.56	1.86	2.21	2.48
96 hour	0.596	0.689	0.997	1.22	1.45	1.72	1.92
120 hour	0.492	0.567	0.814	0.998	1.19	1.40	1.57
144 hour	0.421	0.482	0.684	0.839	0.998	1.18	1.31
168 hour	0.369	0.420	0.587	0.721	0.856	1.01	1.13

Note:
The 50% AEP IFD **does not** correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.
* The 20% AEP IFD **does not** correspond to the 5 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 4.48 ARI.