STORMWATER MANAGEMENT PLAN FOR PROPOSED SERVICE STATION AT 353 MAIN STREET, LITHGOW NSW

Request for:
Main Street Cap Pty Ltd

Neilly Davies & Partners Pty. Ltd.
ABN: 711 216 235 50
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CONTENTS

1 INTRODUCTION

Our client (Main Street Cap Pty Ltd) has engaged Neilly Davies & Partners Pty Ltd to prepare a stormwater management plan including stormwater quantity and quality analysis for the proposed Service Station at 353 Main Street, Lithgow, NSW 2790. A hydraulic analysis and investigation as well as water quality assessment have been accordingly carried out to to ensure the generated stormwater from the site causes minimal nuisance, danger and damage to people, property and the environment. This report identifies the stormwater quantity management measures required for the operational phase of the proposed development.

This assessment report has been prepared based on the following documents and aims to report the observations of the assessment with necessary recommendations according to Lithgow City Council regulations.

- Existing site survey
- Site layout plan of the proposed development
- Lidar data obtained from (https://elevation.fsdf.org.au)
- Meteorological data from BOM.
- Council Mapping

The following terminology has been used in the report and are as described below:

- Finished Floor Level (FFL)
- Annual Exceedance Probability (AEP)
- Average Recurrence Interval (ARI)
- Flood Planning Level (FPL)
- Estuary Planning Levels (EPL)
- Probable Maximum Flood (PMF)
- Local Government Area (LGA)

2 Site Condition

The proposed site is currently vacant and covered by short grass. The site is located in a medium density residential area at the low point and north of Enfield Avenue. The site is bounded by residential development to south, west, Enfield Avenue to east and Main Street to north.

The site survey data indicates the general terrain fall is from west to the east of the subject site. There are two existing stormwater pits on street located east and north of the site. **Figure 1** shows the proposed property location and **Figure 2** shows the existing stormwater pit in Endfield Avenue at east of subject site.

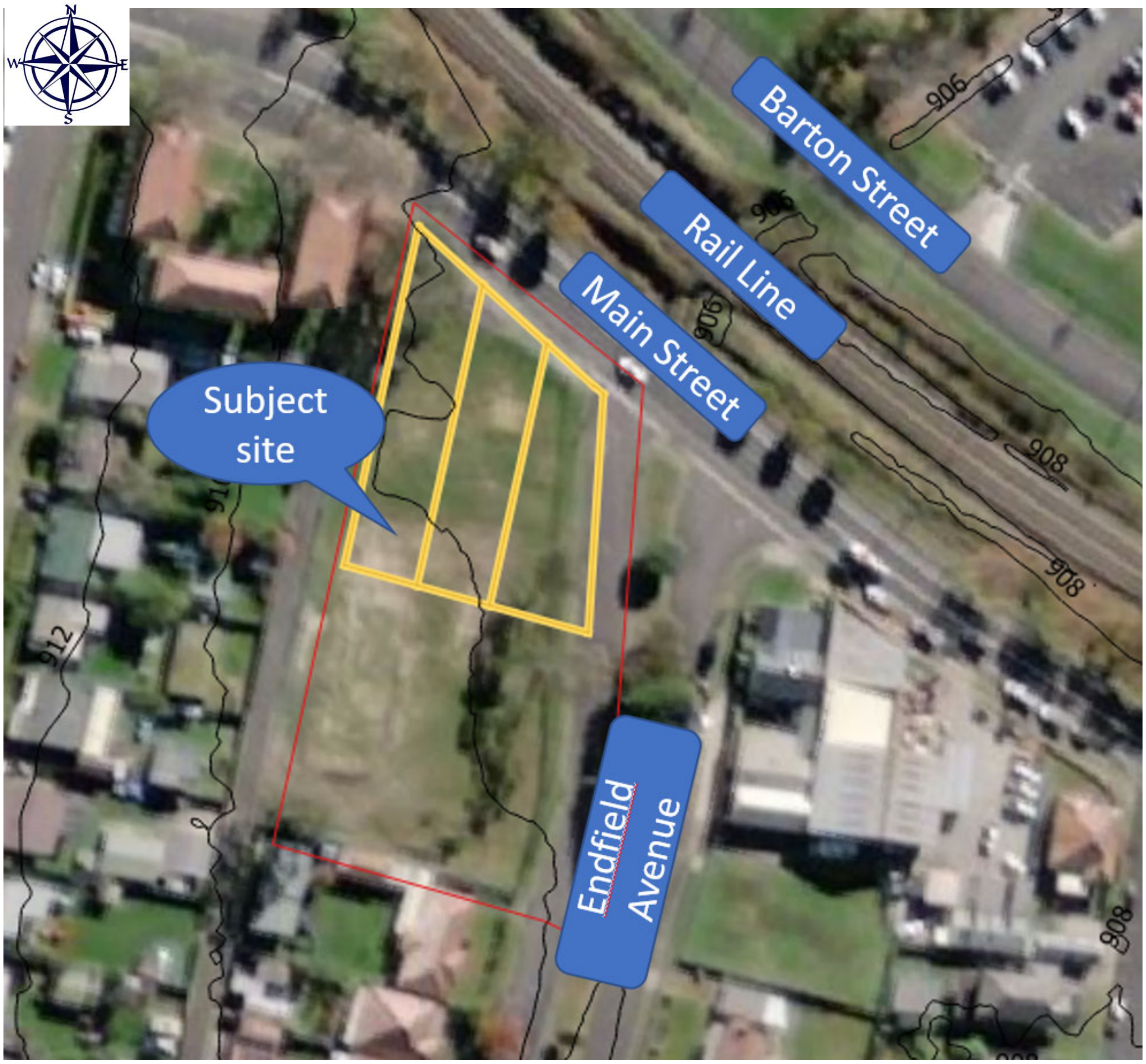

Figure 1: Location of the Property

Figure 2: Existing Stormwater Pit in Endfield Street

3 Model Inputs

The following information were used for undertaking this stormwater management plan:

- Existing site survey data
- Site layout plan of the proposed development
- Lidar data obtained from (https://elevation.fsdf.org.au)
- Council Mapping.

The references used in the development of the project are as follows:

- Australian Rainfall and Runoff Guideline
- Hec-Ras user manual.
- DRAINS manual
- MUSIC X guideline

4 Scope of Work

Conduct stormwater management plan, assessment and reporting and includes the following as listed below:

- Develop a DRAINS model to estimate the peak flow runoff from the existing and developed site.
- Develop a MUSIC model for numerous treatment trains to estimate the pollutant reduction post development.

5 Stormwater Quantity Management Plan

The formulation and implementation of the stormwater quantity management plan for the proposed development is based on the following key principles:

- Utilization of existing drainage flow paths to reduce any post development impacts.
- Structures to provide no increase in peak flows downstream of the site.

5.1 Design Philosophy and Methodology

The DRAINS program performs design and analysis calculations for stormwater drainage systems and models the flood behaviour of rural and urban catchments. DRAINS displays the components of a drainage system as "objects", and presents information about these and the results of calculations pictorially.

DRAINS adopts ILSAX method for hydrological calculations which is based on time-area method and Horton infiltration procedure. ILSAX method is an event model, in which the sub-catchments of a stormwater drainage area are divided into the following land uses:

- Impervious areas directly connected to the main drainage system,
- Impervious areas not directly connected (supplementary), and
- Pervious areas (grassed areas).

For each land use, a time of travel of stormwater is specified or may be calculated by the program. The infiltration model for pervious areas is based on Horton's equation as used in the ILSAX method.

The model employs parameters that define the soil type and its antecedent moisture condition. These can be defined from knowledge of the local soils and climate.

DRAINS calculates the full hydrographs of flows resulting from the specified rainfall hyetographs. Multiple storm burst patterns can be selected, with the worst case results reported.

DRAINS models for the existing and developed phases were developed to calculate the peak runoff from the site's sub-catchments. The sub-catchments were defined as paved areas (e.g. roof, car park and drive way) and grassed areas.

The Time of Concentration for each sub-catchment was calculated using Friend's equation for overland sheet flow in accordance with the Queensland Urban Drainage Manual (QUDM).

The Intensity, Frequency and Duration chart was generated for the region using the most recent Australian Bureau of Meteorology website tools.

5.2 Stormwater Quantity

The proposed development must demonstrate that the development shall have a lawful point of stormwater discharge and the proposed development must not cause 'actionable nuisance', or, 'non-worsening' must be achieved.

Attenuation of stormwater to pre-developed conditions is required due to the expected increase in the peak flows of stormwater run-off caused by increasing the paved area. To achieve this 'non-worsening', the development was modelled with DRAINS for the pre-development and post-development conditions for Annual Exceedance Probability of 63, 50, 20, 10, 5, 2 and 1%.

The fraction impervious values and catchment area used in the DRAINS model were based on the survey plan, aerial images.

5.3 Existing Condition

The existing site is vacant and covered with short grass, there is no building or paved area within the lot. The time of concentration for the subject site includes the travel time of sheet flow over the grassed surface with an average grade of 1%. The rainfall intensity, frequency and duration (IFD) is given in **Appendix A**. The calculation of time of concentration for the existing site is given in **Appendix B**.

Friend's equation was used to estimate the time of concentration of existing site. The calculated time were then used in DRAINS software to estimate the peak flow from the site. The runoff generated in the pre-development condition was calculated for the site as detailed in **Table 1Error! Reference source not found.**.

Table 1 – Existing Peak Discharges

AEP (%)	DRAINS (m^3/s)
63	0.007
50	0.012
20	0.026
10	0.038
5	0.049
2	0.063
1	0.074

5.4 Proposed Development Conditions

The proposed development site has been assessed in accordance with QUDM for minor and major storms of Annual Exceedance Probability of 63, 50, 20, 10, 5, 2 and 1%. The fraction impervious for the site was obtained from site layout plans provided by Go Go Petroleum.

According to the provided plan a new building, loading dock, fill point, landscape area and driveway will be built at subject site. The site entry and exit will be from Endfield Avenue.

On this basis, the total developed impervious areas for the post development stage will be increased to 1877 m2 from the 200 m2 existing impervious area. The summary of the developed sub-catchment areas and fraction impervious of the developed site for each stage is given in **Table 2**.

Table 2 – Proposed Service Station Sub-catchments

Sub-catchment	Area (m^2)	Fraction impervious (%)	Time of concentration (min)
1	340	95	5
2	325	95	5
3	422	100	5
4	974	95	5

The summary of peak discharges for pre and post development stages off site without attenuation practices using the DRAINS model is given in **Table 3**.

Table 3 –Discharges for Existing and Developed Phases without Attenuation

Peak flow	Subject site	
	Existing	Post Development
Q1 – Discharge (m^3/s)	0.007	0.037
Q2 – Discharge (m^3/s)	0.012	0.042
Q5 – Discharge (m^3/s)	0.026	0.061
Q10 – Discharge (m^3/s)	0.038	0.076
Q20 – Discharge (m^3/s)	0.049	0.09
Q50 – Discharge (m^3/s)	0.063	0.11
Q100 – Discharge (m^3/s)	0.074	0.125

The increase in impervious area in the post development phase causes an increase in peak discharges which requires attenuation.

The time of concentration for the developed component of the catchment has been calculated using the methodologies in QUDM and the proposed site plan. The proposed attenuation devices were inserted into DRAINS program for peak flow calculation and numerous model iterations have been undertaken to estimate the optimum detention tank size.

It is proposed to capture all runoff generated from the building roof and driveway areas and direct it to a 65,000-liter underground tank (OSD 1 & OSD 2). This tank will be located east of site and proposed building and discharge to the existing pit in Endfield Avenue.

The invert level of existing council's pit was not available during preparation of this report; 1m depth was assumed for the pit depth in drainage network modelling.

The runoff from developed site will be captured by grated pits and directed to the tank for peak flow attenuation. The proposed stormwater management plan is given in **Appendix C**.

The proposed tank (OSD 1 & OSD 2) will have a 70 mm orifice each at an elevation of 906.06 mAHD and a 225 mm high outlet pipe as spillway at 906.66 mAHD.

The summary of peak of peak discharges for the investigated storm events for the developed catchment undertaken in DRAINS model is given in **Table 4**.

Table 4 – Comparison of Discharges after Attenuation Practices

Peak flow	Subject site		
	Existing	Post Development	Decreased discharge (%)
Q1 – Discharge (m^3/s)	0.007	0.006	-14
Q2 – Discharge (m^3/s)	0.012	0.007	-42
Q5 – Discharge (m^3/s)	0.026	0.008	-69
Q10 – Discharge (m^3/s)	0.038	0.017	-55
Q20 – Discharge (m^3/s)	0.049	0.035	-29
Q50 – Discharge (m^3/s)	0.063	0.052	-17
Q100 – Discharge (m^3/s)	0.074	0.071	-4

As shown in **Table 4** the DRAINS modelling results indicate that the peak discharges from the developed catchments have been successfully attenuated to non-worsening levels compared to the existing situation for all investigated return periods with no additional overland flow discharging into the adjacent properties.

6 STORMWATER QUALITY MANAGEMENT

The Council Planning Policy and Water NSW (2023) require development with large impervious areas greater than 2,500 m^2 to provide stormwater quality treatment. This requires that stormwater quality improvement works be provided to achieve target. This policy requires that we protect receiving water environmental values from adverse development impacts by managing development and construction activities in accordance with various stormwater design objectives. The subject site area is smaller than 2,500 m^2 , thus the water quality modelling is not applicable to this development.

Since the service station area is generally considered to be a fuel dispensing area, there is high risk of stormwater pollution by fuel. To prevent the stormwater pollution the fuel dispensing area must be bunded the surface graded to a low point within dispensing area. Furthermore, a grated pit and pipe system must be provided to convey liquid waste, contaminated water and spills to an oil separator tank.

Therefore, an oil/water separator device was considered in the design to ensure the hydrocarbon content of runoff generated from service station under canopy area will not discharge to downstream drainage network.

7 Oil/Water Separator Tank

Atlan manufacturers provided the design specifications, operation and maintenance guideline for the oil separator device for the proposed site. This device is reinforced plastic including a primary and a secondary separation chamber, oil sensing probe and an Automatic Closure Device (A.C.D). Atlan engineers have advised that for the oil/water separator at this service stations, a 8kL Spill capacity storage would be sufficient as this covers the standard tanker truck. This would be the P.040.8.C1.2C, see Atlan manual for the Spillceptor in **Appendix D** of this report.

8 Conclusion

In preparing this stormwater management plan, a stormwater quantity and quality analysis were undertaken for the subject site.

The main objective of the stormwater quantity analysis was to limit the post–development peak discharge to the equivalent pre-developed peak flow discharging off-site for rainfall events up to and including a 1% AEP event.

It is proposed to capture all runoff generated from the building, carpark and driveway areas and direct it to a underground tank with size of 65,000 litre (OSD 1 & OSD 2). The water depth within the OSD will be varying between 0.45m – 0.60m, a 70 mm orifice and 225 mm spillway.

The minor runoff from the covered car park will be captured by grated inlet pits located at the lowest points discharging into the proposed pipe. The outflow from the tank discharge into an existing pit in Endfield Avenue.

It is apparent from the modelling results that there will be no increase in peak flows discharging from the developed site.

It is noted that the site is smaller than 2,500 m2. Hence, stormwater quality analysis is not applicable to the site as per Water NSW guideline (2023).

Since the service station area is generally considered to be a fuel dispensing area, there is high risk of stormwater pollution by fuel. To prevent the stormwater pollution the fuel dispensing area must be bunded the surface graded to a low point within dispensing area. Furthermore, a grated pit and pipe system must be provided to convey liquid waste, contaminated water and spills to an oil separator tank.

As the investigations for this conceptual stormwater management plan were preliminary only, all analysis will be confirmed during the detailed design stage of the development to ensure compliance as some building and civil design may necessitate amendments.

9 REFERENCES

- Bureau of Meteorology website, IFD chart creation tool
- Developments in the Sydney Drinking Water Catchment – Water Quality Information Requirements - A WaterNSW Current Recommended Practice- February 2023
- Department of Natural Resources and Water, Queensland Urban Drainage Manual,
- 4th Edition, Brisbane, QLD. (2017)
- Geoffrey O'Loughlin and Bob Stack, Drains User Manual, Watercom PTY Ltd, August, 2018.
- Healthy Waterways 2006, Water Sensitive Urban Design- Technical Design Guidelines for
- South East Queensland, Version 1 -June 2006, Brisbane, QLD.

Appendix A – IFD

Rainfall Intensity (mm/hr)							
DURATION	1 year	2 years	5 years	10 years	20 years	50 years	100 years
1 min	107	120	162	191	221	261	292
2 min	87.3	97.2	130	153	175	205	229
3 min	81	90.3	121	143	163	191	213
4 min	76.5	85.5	114	135	155	182	203
5 min	72.5	81.2	109	129	148	174	194
10 min	57.5	64.6	87.2	103	119	141	158
15 min	47.7	53.5	72.4	85.7	99.1	118	132
30 min	40.8	45.8	62	73.4	84.9	101	113
1 hour	20.2	22.5	30.2	35.6	41.1	48.5	54.5
2 hour	12.5	13.9	18.5	21.7	24.9	29.3	32.8
3 hour	9.48	10.5	14	16.4	18.7	22	24.6
6 hour	6.06	6.75	8.94	10.5	12	14.1	15.7
12 hour	3.98	4.45	5.97	7.03	8.12	9.55	10.7
24 hour	2.63	2.96	4.07	4.87	5.7	6.73	7.53
48 hour	1.69	1.92	2.71	3.31	3.94	4.68	5.24
72 hour	1.27	1.45	2.06	2.55	3.07	3.64	4.08
96 hour	1.03	1.17	1.66	2.06	2.49	2.96	3.32
120 hour	0.864	0.979	1.39	1.71	2.08	2.47	2.77
144 hour	0.745	0.843	1.18	1.45	1.76	2.09	2.34

Appendix B – Time of Concentration

Developed Time of Concentration

Time of concentration - Friend's equation - Grass

Hydrological parameters	Value	Unit	Description
Overland sheet fow length, L	70	m	
Hortons roughness, n	0.035		from Table 1
Slope of surface, S	1	%	
Time of concentration, Tc =	15	min	

Table 1 - Horton's roughness coefficient n

Surface Type	n
gravelled surface	0.012 - 0.030
bare clay-loam soil (eroded)	0.012 - 0.033
spares vegetation	0.053 - 0.130
short grass paddock	0.100 - 0.200
lawns	0.170 - 0.480

Appendix C

- **Proposed Stormwater Plan**

Appendix D

Oil – Water Separator Specification