CONCEPTUAL STORMWATER MANAGEMENT PLAN

Proposed Subdivision

133-193 Dulguigan Road, Dulguigan

Lot 8 on DP755685, Lot 1 on DP364474, Lot 1 on DP410859, Lot 1 on DP328107, Lot 1 on DP376131 & Lot A on DP174886

For John Tilton c/- B & P Surveys

8 May 2024

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Synopsis:	This *Conceptual Stormwater Management Plan* describes the existing site characteristics, and corresponding stormwater quantity and quality management controls to be implemented during the construction and operational phase of the development.

Reviewed by RPEQ	Reg. No.	Signed	Date
Thomas Watt	16222		8 May 2024

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1.0 INTRODUCTION

1.1 Background

OSKA Civil Consultants has been commissioned by John Tilton c/- B & P Surveys to prepare a Conceptual Stormwater Management Plan (CSWMP) to support a Development Application for the proposed Subdivision situated at 133-193 Dulguigan Road, Dulguigan.

The subject site is described as Lot 8 on DP755685, Lot 1 on DP364474, Lot 1 on DP410859, Lot 1 on DP328107, Lot 1 on DP376131 & Lot A on DP174886 and has a total site area of 100.5ha.

1.2 Scope

This CSWMP details the conceptual planning, layout and design of the stormwater management infrastructure for both the construction and operational phases of this development.

This CSWMP aims to:

- Establish the required performance criteria for both the existing and proposed stormwater quantity and quality improvement systems;
- Provide a conceptual design of stormwater infrastructure including stormwater quality improvement devices and stormwater quantity management controls;
- Demonstrate the modelled post-development stormwater quality discharging from the site does not adversely impact on the water quality and ecological values of downstream watercourses;
- Demonstrate stormwater runoff is conveyed through the site to a Lawful Point of Discharge (LPOD) in accordance with the Queensland Urban Drainage Manual (QUDM); and
- Provide reporting and monitoring mechanisms whereby the performance of this system can be measured enabling identification of corrective actions/alterations required to ensure the above mentioned objectives are maintained.

This CSWMP has been prepared in accordance with the IEAust *Australian Runoff Quality: Guide to Water Sensitive Urban Design; Tweed Shire Council Development Design Specification, D5 – Stormwater Drainage Design & D7 – Stormwater Quality; and* IPWEA *Queensland Urban Drainage Manual (QUDM) Fourth Edition (2017).*

2.0 SITE DESCRIPTION

2.1 Location

The subject site is located on 133-193 Dulguigan Road, Dulguigan. The site fronts Dulguigan Road to the south and is surrounded by rural properties to the north, east and west. The site covers a total combined area of 100.5ha, with details as summarised in Table 1 and as located in Figure 1.

Table 1: Site Description

Client	Lot and Property Description	Street Address
John Tilton c/- B & P Surveys	*Lot 8 on DP755685, Lot 1 on DP364474, Lot 1 on DP410859, Lot 1 on DP328107, Lot 1 on DP376131 & Lot A on DP174886*	*133-193 Dulguigan Road, Dulguigan*

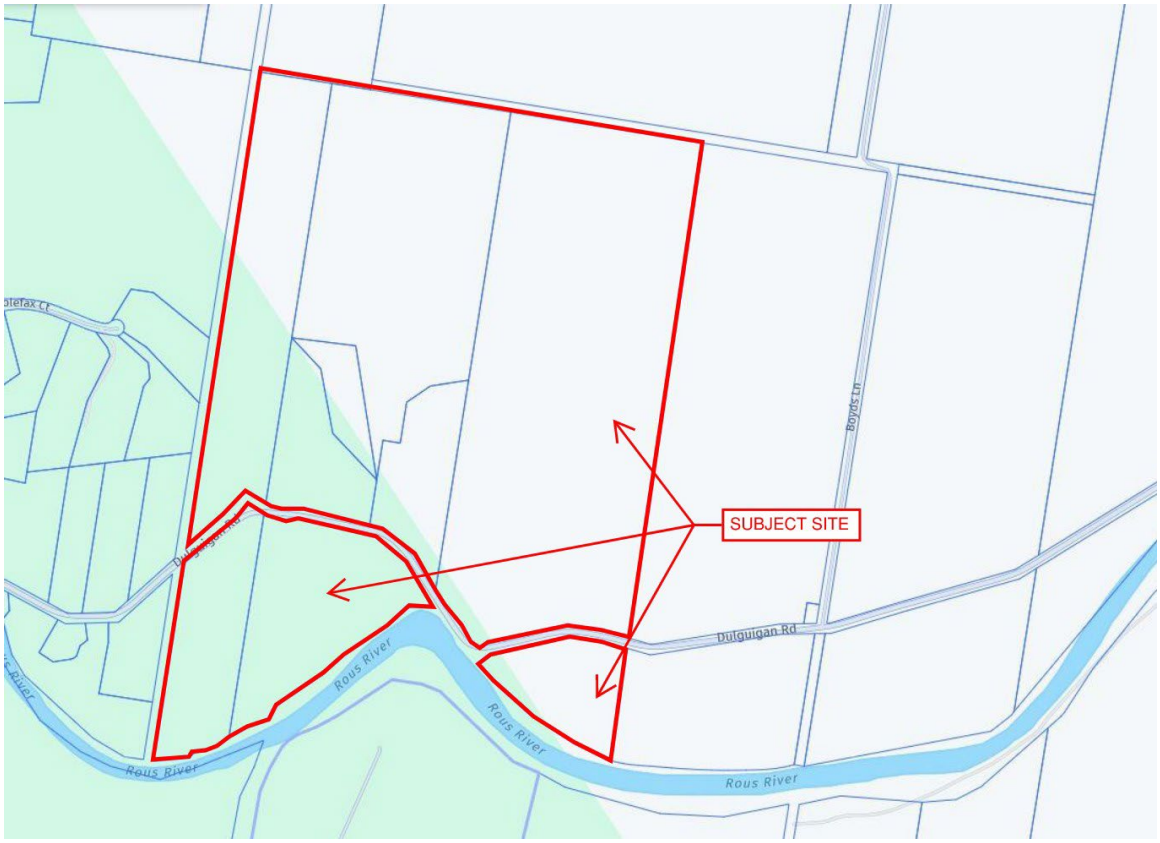


Figure 1: Locality Plan (Source: Nearmap)

2.2 Site Topography

The western area of the existing site is relatively steep with spot heights ranging from approximately RL 47m AHD to 1m AHD. The eastern and southern areas are relatively flat with spot heights ranging from approximately RL 3m AHD to 1m AHD. The site generally slopes in three directions, to the north, west and south. Based on the provided survey and aerial information, any stormwater runoff ultimately drains to the existing North Arm Tweed River to the south.

Further information of the site survey has been provided by B & P Surveys, Proposed Subdivision Plan (Ref: 25464-B) included as Appendix A.

2.3 Vegetation and Land Use

The subject site currently consists of grass/open space to the west and south, and farmland to the east. There is an existing channel that runs from the northeastern corner of the site to the existing North Arm Tweed River to the south. Access to the site is gained via Dulguigan Road to the south.

An aerial photograph taken on the 22 January 2024 of the subject site is included in Figure 2.

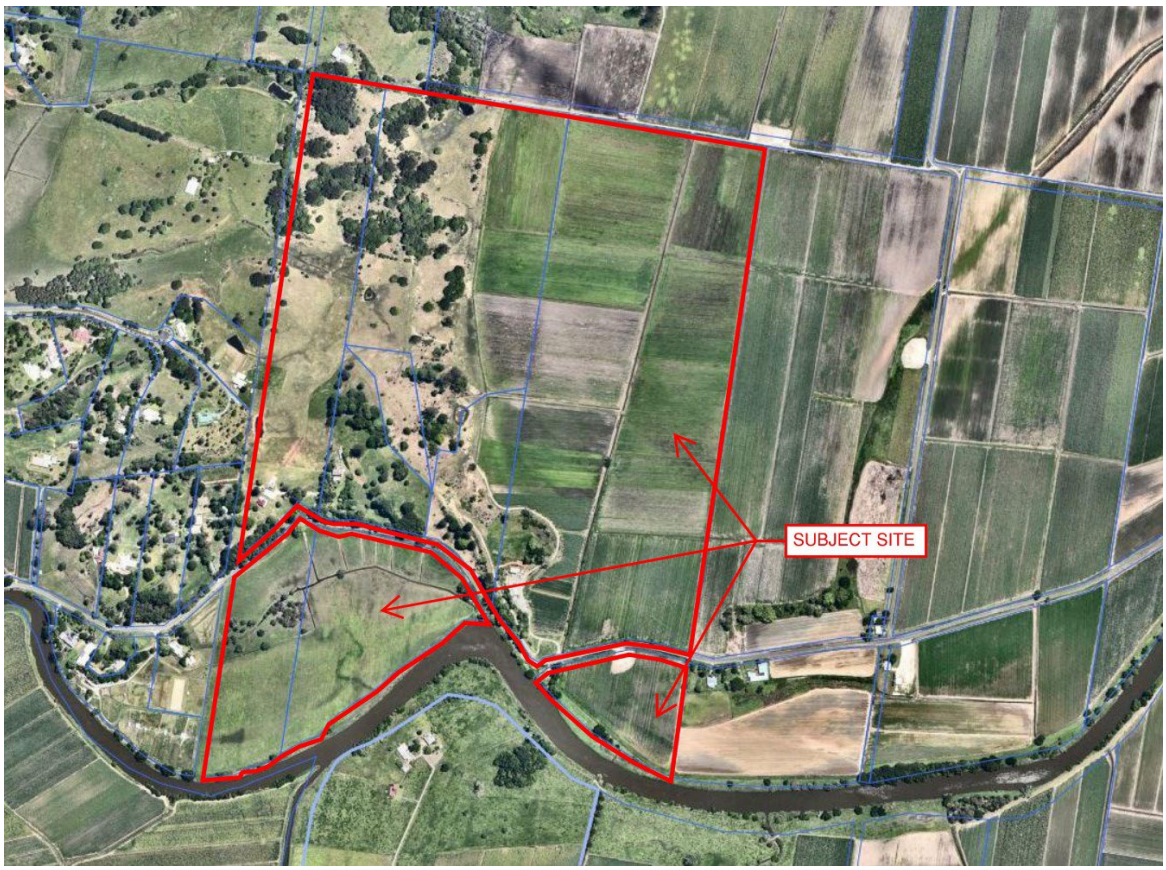


Figure 2: Aerial Image of the Site (Source: Nearmap – Image taken 22 January 2024)

2.4 Proposed Development

The proposed development for the site consists of a 6 lot subdivision. Access to the lots will be gained via Duilguigan Road and internal accesses.

Refer to Appendix A for further proposed subdivision layout prepared by B & P Surveys, Proposed Subdivision Plan (Ref: 25464-B)**.**

2.5 Proposed Conceptual Drainage

It is proposed that the site's captured stormwater will maintain the existing drainage regime, i.e., to convey any flows to the existing North Arm Tweed River via existing drainage paths.

2.6 Rainfall Data

Rainfall intensity data has been obtained from the Australian Bureau of Meteorology's 2016 Design IFD Rainfall System. The data has been extracted for the nearest grid cell at Latitude 28.2875 (S) and Longitude 153.3875 (E). The IFD data and average rainfall intensities used in this report are in accordance with the procedures outlined in Geosciences Australia, Australian Rainfall and Runoff 2019.

3.0 DATA

Data which has been sourced or provided, in order to prepare this report for the site, was gathered from the following sources:

- Detailed site survey provided by B & P Surveys, Proposed Subdivision Plan (Ref: 25464-B) included as Appendix A;
- LIDAR data for the subject site sourced from Australian Government Elevation and Depth Foundation Spatial Data (ELVIS), Date Source: 2014, DEM Data;
- Rainfall and Meteorological 2016 IFD Data by the Australian Bureau of Meteorology;
- Aerial Imagery by Nearmap (Accessed on 22 January 2024).

4.0 SITE HYDROLOGY

4.1 Background

The following sections define the method and parameters utilised within the hydrologics of the site, in order to establish a simulation of the anticipated flow regime and peak discharge at the Lawful Point of Discharge (LPOD). A Rational Method calculation has been provided for comparison of the pre and post-development peak flow rates.

The Rational Method (Section 4.3 of the Queensland Urban Drainage Manual - QUDM 2017) is a suitable estimation technique, given its flexibility in its data requirements and is able to produce satisfactory estimates of peak site discharges based on the following data input:
specific intensity frequency duration (IFD) data;

- length/type of flow path;
- contributing catchment areas; and
- coefficient of discharge.

4.2 Pre-Development

4.2.1 Catchment Definition and Lawful Point of Discharge

The pre-development site has been analysed as 17 internal catchments (A1-A9, B1-B2, C, D, E, F and G1-G2) with a total contributing area of 104.8 ha. A breakdown of each internal catchment parameters and respective Lawful Point of Discharge are presented in Table 1.

Table 2: Pre-Development Catchment Parameters

Catchment	Area (ha)	% Impervious	LPOD
A1	46.3	0	LPOD A
A2	3.35	0	LPOD A
A3	1.53	0	LPOD A
A4	1.69	0	LPOD A
A5	2.18	0	LPOD A
A6	1.4	0	LPOD A
A7	0.94	0	LPOD A
A8	1.47	0	LPOD A
A9	4.59	0	LPOD A
B1	3.64	0	LPOD B
B2	0.38	0	LPOD B
C	1.78	0	LPOD C
D	8.3	0	LPOD D
E	1.6	0	LPOD E
F	4.17	0	LPOD F
G1	5.02	0	LPOD G
G2	16.43	0	LPOD G

The catchment area and LPOD for the subject site are shown on OSKA Consulting Group, Pre-Development Catchment Plan (Ref: OSK6539/P001/A) included as Appendix B.

4.2.2 Coefficient of Runoff

The pre-development coefficient of runoff (C year) was determined based on table 4.5.4 specified in QUDM and table D5.4 – Frequency Factor for non-coastal areas from the Development Design Specification: D5 – Stormwater Drainage Design. Based on the provided survey information, all catchments have a fraction impervious (fi) of 0.0. Using a one-hour, ten-year rainfall intensity ($^1I_{10}$) of 65.6 mm/hr and Table 5.4.4 in QUDM (poor grass cover, medium permeability), a C_{10} value of 0.70 has been adopted for all pre-development catchments.

The following pre-development coefficients of runoff (as shown in Table 2) have been adopted in accordance with Table D5.4, which apply the frequency factors for the standard Annual Exceedance Probability (AEP) design storms of 39%, 18%, 10%, 5%, 2% and 1% (corresponding to the 2, 5, 10, 20, 50 and 100-year Average Recurrence Interval (ARI) storms).

Table 3: Pre-Development Coefficient of Runoff

C_2	C_5	C_{10}	C_{20}	C_{50}	C_{100}
0.57	0.64	0.70	0.75	0.71	0.71

4.2.3 Time of Concentration

The Time Of Concentration (TOC) for the pre-development catchments has been calculated in accordance with QUDM Section 4.6.6 – Overland Flow and 4.6.11 - Time of concentration for rural and creek catchments. Friend's Equation ($t = (107*n*L^{0.333})/S^{0.2}$) has been used to calculate the initial travel time using sheet flow and Bransby-Williams' ($t = (58 * L)/(A^{0.1} * Se^{0.2})$ equation has been used to calculate the travel time using channel flow.

Please refer to Table 4 for the calculated time of concentration for the pre-developed catchments.

Table 4: Pre-Development Time of Concentration

Catchment	Catchment Area (ha)	Overland flow Friend's Equation	Concentrated Overland Flow Bransby-Williams	Total Tc
A1	46.3	Horton's (n) = 0.0275 Length (m) = 150 Slope = 0.67% Tc = 16.9 min	Length (km) = 1.02 Slope = 0.67 Tc = 43.7 min	60 min
A2	3.35	Horton's (n) = 0.035 Length (m) = 20 Slope = 31% Tc = 5.1 min	Length (km) = 0.163 Slope = 26.2% Tc = 4.3 min	9 min
A3	1.53	Horton's (n) = 0.035 Length (m) = 20 Slope = 19% Tc = 5.6 min	Length (km) = 0.114 Slope = 22.5% Tc = 3.4 min	9 min
A4	1.69	Horton's (n) = 0.035 Length (m) = 20 Slope = 14.5% Tc = 5.9 min	Length (km) = 0.202 Slope = 25.6% Tc = 5.8 min	11 min
A5	2.18	Horton's (n) = 0.035 Length (m) = 20 Slope = 14.5% Tc = 5.9 min	Length (km) = 0.242 Slope = 28% Tc = 6.6 min	12 min

A6	1.4	Horton's (n) = 0.035 Length (m) = 50 Slope = 12.4% Tc = 8.3 min	Length (km) = 0.068 Slope = 27.3% Tc = 1.97 min	10 min
A7	0.94	Horton's (n) = 0.035 Length (m) = 20 Slope = 23.5% Tc = 5.4 min	Length (km) = 0.064 Slope = 30.6% Tc = 1.8 min	7 min
A8	1.47	Horton's (n) = 0.035 Length (m) = 20 Slope = 16.5% Tc = 5.8 min	Length (km) = 0.133 Slope = 33.8% Tc = 3.6 min	9 min
A9	4.59	Horton's (n) = 0.0275 Length (m) = 150 Slope = 0.67% Tc = 16.9 min	Length (km) = 0.078 Slope = 0.67 Tc = 4.2 min	21 min
B1	3.64	Horton's (n) = 0.035 Length (m) = 20 Slope = 31.5% Tc = 5.1 min	Length (km) = 0.256 Slope = 26.9% Tc = 6.7 min	11 min
B2	0.38	Horton's (n) = 0.035 Length (m) = 20 Slope = 21% Tc = 5.5 min	Length (km) = 0.056 Slope = 25.5% Tc = 1.8 min	7 min
C	1.78	Horton's (n) = 0.035 Length (m) = 20 Slope = 23.50% Tc = 5.4 min	Length (km) = 0.149 Slope = 30.6% Tc = 4.1 min	9 min
D	8.3	Horton's (n) = 0.035 Length (m) = 20 Slope = 16% Tc = 5.8 min	Length (km) = 0.329 Slope = 24.5% Tc = 8.1 min	13 min
E	1.6	Horton's (n) = 0.035 Length (m) = 20 Slope = 16.3% Tc = 5.8 min	Length (km) = 0.201 Slope = 18.9% Tc = 6.1 min	11 min
F	4.17	Horton's (n) = 0.035 Length (m) = 20 Slope = 13.5% Tc = 6 min	Length (km) = 0.253 Slope = 18.6% Tc = 7.1 min	13 min
G1	50.2	Horton's (n) = 0.035 Length (m) = 20 Slope = 17.5% Tc = 5.7 min	Length (km) = 0.154 Slope = 29% Tc = 3.8 min	9 min
G2	16.43	Horton's (n) = 0.0275 Length (m) = 150 Slope = 0.67% Tc = 16.9. min	Length (km) = 0.4 Slope = 0.67 Tc = 19 min	35 min

4.2.4 Design Flow Rates

Pre-development peak flow rates have been estimated for the adopted storms using design rainfall intensities from the Bureau of Meteorology IFD Data. The Rational Method (Q = 2.78 x 10^{-3} CIA) has been used to estimate the subject site's design peak flow rates. The pre-development peak flows for the subject site are presented in Tables 5.

Table 5: Pre-Development LPOD A Peak Flow Estimation – Rational Method

Catchment A1							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	46.3	46.3	46.3	46.3	46.3	46.3
Average Rainfall Intensity (mm/h)	**I**	45	56	66	76	91	103
Peak Flow Rate (m^3/s)	**Q**	0.323	0.463	0.588	0.730	0.823	0.938
Catchment A2							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	3.350	3.350	3.350	3.350	3.350	3.350
Average Rainfall Intensity (mm/h)	**I**	119	148	171	196	228	252
Peak Flow Rate (m^3/s)	**Q**	0.57	0.64	0.70	0.75	0.71	0.71
Catchment A3							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	1.500	1.500	1.500	1.500	1.500	1.500
Average Rainfall Intensity (mm/h)	**I**	119	148	171	196	228	252
Peak Flow Rate (m^3/s)	**Q**	0.57	0.64	0.70	0.75	0.71	0.71
Catchment A4							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	1.690	1.690	1.690	1.690	1.690	1.690
Average Rainfall Intensity (mm/h)	**I**	111	137	158	181	210	231
Peak Flow Rate (m^3/s)	**Q**	0.295	0.416	0.520	0.636	0.697	0.776
Catchment A5							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	2.180	2.180	2.180	2.180	2.180	2.180
Average Rainfall Intensity (mm/h)	**I**	107	133	152	174	202	223
Peak Flow Rate (m^3/s)	**Q**	0.367	0.517	0.647	0.791	0.865	0.964
Catchment A6							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	1.400	1.400	1.400	1.400	1.400	1.400
Average Rainfall Intensity (mm/h)	**I**	115	143	164	188	218	241
Peak Flow Rate (m^3/s)	**Q**	**0.254**	**0.358**	**0.448**	**0.548**	**0.601**	**0.670**

Catchment A7							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	0.940	0.940	0.940	0.940	0.940	0.940
Average Rainfall Intensity (mm/h)	**I**	130	162	187	214	251	279
Peak Flow Rate (m^3/s)	**Q**	**0.192**	**0.272**	**0.342**	**0.420**	**0.464**	**0.521**
Catchment A8							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	1.470	1.470	1.470	1.470	1.470	1.470
Average Rainfall Intensity (mm/h)	**I**	119	148	171	196	228	252
Peak Flow Rate (m^3/s)	**Q**	**0.277**	**0.391**	**0.489**	**0.600**	**0.659**	**0.736**
Catchment A9							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	4.590	4.590	4.590	4.590	4.590	4.590
Average Rainfall Intensity (mm/h)	**I**	82	102	117	134	155	172
Peak Flow Rate (m^3/s)	**Q**	**0.594**	**0.837**	**1.046**	**1.279**	**1.403**	**1.565**
LPOD A Peak Flow Rate (m^3/s)	**Q**	**3.215**	**4.542**	**5.694**	**6.983**	**7.683**	**8.597**

Table 6: Pre-development LPOD B Peak Flow Estimation – Rational Method

Catchment B1							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	3.640	3.640	3.640	3.640	3.640	3.640
Average Rainfall Intensity (mm/h)	**I**	111	137	158	181	210	231
Peak Flow Rate (m^3/s)	**Q**	**0.636**	**0.895**	**1.120**	**1.370**	**1.500**	**1.672**
Catchment B2							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	0.380	0.380	0.380	0.380	0.380	0.380
Average Rainfall Intensity (mm/h)	**I**	130	162	187	214	251	279
Peak Flow Rate (m^3/s)	**Q**	**0.078**	**0.110**	**0.138**	**0.170**	**0.187**	**0.210**
LPOD B Peak Flow Rate (m^3/s)	**Q**	**0.713**	**1.005**	**1.258**	**1.540**	**1.688**	**1.882**

Table 7: Pre-development LPOD C Peak Flow Estimation – Rational Method

Catchment C							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	1.780	1.780	1.780	1.780	1.780	1.780
Average Rainfall Intensity (mm/h)	**I**	119	148	171	196	228	252
LPOD C Peak Flow Rate (m^3/s)	**Q**	0.335	0.473	0.593	0.726	0.798	0.891

Table 8: Pre-development LPOD D Peak Flow Estimation – Rational Method

Catchment D							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	8.300	8.300	8.300	8.300	8.300	8.300
Average Rainfall Intensity (mm/h)	**I**	103	128	147	168	195	215
LPOD D Peak Flow Rate (m^3/s)	**Q**	1.352	1.903	2.379	2.908	3.179	3.540

Table 9: Pre-development LPOD E Peak Flow Estimation – Rational Method

Catchment E							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	1.600	1.600	1.600	1.600	1.600	1.600
Average Rainfall Intensity (mm/h)	**I**	111	137	158	181	210	231
LPOD E Peak Flow Rate (m^3/s)	**Q**	0.279	0.394	0.492	0.602	0.660	0.735

Table 10: Pre-development LPOD F Peak Flow Estimation – Rational Method

Catchment F							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	4.170	4.170	4.170	4.170	4.170	4.170
Average Rainfall Intensity (mm/h)	**I**	103	128	147	168	195	215
LPOD F Peak Flow Rate (m^3/s)	**Q**	0.679	0.956	1.195	1.461	1.597	1.778

Table 11: Pre-development LPOD G Peak Flow Estimation – Rational Method

Catchment G1							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	**C**	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	**A**	5.000	5.000	5.000	5.000	5.000	5.000
Average Rainfall Intensity (mm/h)	**I**	119	148	171	196	228	252
Peak Flow Rate (m^3/s)	**Q**	**0.941**	**1.329**	**1.665**	**2.040**	**2.240**	**2.503**
Catchment G2							

Annual Exceedance Probability	AEP	0.5EY	0.2EY	10%	5%	2%	1%
Coefficient of Runoff	C	0.57	0.64	0.70	0.75	0.71	0.71
Area of Catchment (ha)	A	16.430	16.430	16.430	16.430	16.430	16.430
Average Rainfall Intensity (mm/h)	I	62	77	89	102	120	134
Peak Flow Rate (m^3/s)	Q	1.600	2.266	2.847	3.502	3.881	4.368
LPOD G Peak Flow Rate (m^3/s)	Q	**2.542**	**3.594**	**4.512**	**5.542**	**6.121**	**6.871**

4.3 Post-Development

4.3.1 Catchment Definition and Lawful Point of Discharge

The post-development scenario has been analysed as described in the pre-development scenario, with 17 internal catchments (A1-A9, B1-B2, C, D, E, F and G1-G2) and a total contributing area of 100.8ha. Refer to Table 1 in section 4.2.1 for a breakdown of each internal catchment parameters and respective Lawful Point of Discharge.

The post-development catchment area and LPOD are detailed on OSKA Consulting Group, Post-Development Catchment Plan (Ref: OSK6539/P002/A) included as Appendix C.

4.3.2 Coefficient of Runoff

The post-development coefficients of runoff (C year) were determined as described in the pre-development scenario, based on table 4.5.4 specified in QUDM and table D5.4 – Frequency Factor for non-coastal areas from the Development Design Specification: D5 – Stormwater Drainage Design.

Based on the proposed subdivision plan information, catchments A1-A5, A7, A9, G1 and G2 will remain unchanged in the post-development scenario, and in catchments A6, A8, D, E and F a proposed dwelling of approximately $300m^2$ will be added to each catchment. This proposed impervious area, when compared to the respective catchment area is considered insignificant and results in a fraction impervious (fi) of 0.02. Using a one-hour, ten-year rainfall intensity ($^1I_{10}$) of 65.6 mm/hr and Table 5.4.4 in QUDM (poor grass cover, medium permeability), a C_{10} value of 0.70 has been adopted for all post-development catchments.

The following post-development Coefficients of Runoff (as shown in *Table 6*) have been adopted in accordance with QUDM Table 4.5.2, which apply the frequency factors for the standard Annual Exceedance Probability (AEP) design storms of 39%, 18%, 10%, 5%, 2% and 1% (corresponding to the 2, 5, 10, 20, 50 and 100-year ARI storms).

Table 12: Post-Development Coefficient of Runoff

C_2	C_5	C_{10}	C_{20}	C_{50}	C_{100}
0.57	0.64	0.70	0.75	0.71	0.71

4.3.3 Time of Concentration

The Time of Concentration for the post-developed catchment has been calculated as described in the pre-development scenario, in accordance with QUDM Section 4.6.6 – Overland Flow and 4.6.11 - Time of concentration for rural and creek catchments. Friend's Equation ($t = (107*n*L^{0.333})/S^{0.2}$) has been used to calculate the initial travel time using sheet flow and Bransby-Williams' ($t = (58 * L)/(A^{0.1} * Se^{0.2})$ equation has been used to calculate the travel time

using channel flow. Please refer to Table 4 in section 4.2.3 for the calculated time of concentration for the post-developed catchments.

4.3.4 Design Flow Rates

Post-development peak flow rates have been calculated for the adopted storms using design rainfall intensities from the Bureau of Meteorology 2016 IFD Data. The Rational Method ($Q = 2.78 \times 10^{-3}$ CIA) has been used to estimate the required design peak flow rates for the subject site. Given the catchment areas, coefficient of runoff and time of concentration of the post-development catchments are equal to the pre-development scenario, the post-development peak flows for the subject are the same as the ones in the pre-development scenario, with results summarised in Table 13.

Table 13: Post-development Peak Flow Estimation – Rational Method

LPOD	Annual Exceedance Probability (AEP)					
	0.5EY	0.2EY	10%	5%	2%	1%
LPOD A Peak Flow Rate Q (m^3/s)	3.215	4.542	5.694	6.983	7.683	8.597
LPOD B Peak Flow Rate Q (m^3/s)	0.713	1.005	1.258	1.540	1.688	1.882
LPOD C Peak Flow Rate Q (m^3/s)	0.335	0.473	0.593	0.726	0.798	0.891
LPOD D Peak Flow Rate Q (m^3/s)	1.352	1.903	2.379	2.908	3.179	3.540
LPOD E Peak Flow Rate Q (m^3/s)	0.279	0.394	0.492	0.602	0.660	0.735
LPOD F Peak Flow Rate Q (m^3/s)	0.679	0.956	1.195	1.461	1.597	1.778
LPOD G Peak Flow Rate Q (m^3/s)	2.542	3.594	4.512	5.542	6.121	6.871

4.4 Change in Flow Rates

The difference in peak flow rates calculated from the total pre and post-developed site has been estimated via The Rational Method, with the results summarised in Table 14.

Table 14: Change in Peak Flow Rates Estimation – Rational Method

LPOD A							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Pre-Developed Peak Flow Rate (m^3/s)	**Q**	0.679	0.956	1.195	1.461	1.597	1.778
Post-Developed Peak Flow Rate (m^3/s)	**Q**	0.679	0.956	1.195	1.461	1.597	1.778
Change in Peak Flow Rate (m^3/s)	**Q**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
LPOD B							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Pre-Developed Peak Flow Rate (m^3/s)	**Q**	0.713	1.005	1.258	1.540	1.688	1.882
Post-Developed Peak Flow Rate (m^3/s)	**Q**	0.713	1.005	1.258	1.540	1.688	1.882
Change in Peak Flow Rate (m^3/s)	**Q**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

LPOD C							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Pre-Developed Peak Flow Rate (m^3/s)	**Q**	0.335	0.473	0.593	0.726	0.798	0.891
Post-Developed Peak Flow Rate (m^3/s)	**Q**	0.335	0.473	0.593	0.726	0.798	0.891
Change in Peak Flow Rate (m^3/s)	**Q**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
LPOD D							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Pre-Developed Peak Flow Rate (m^3/s)	**Q**	1.352	1.903	2.379	2.908	3.179	3.540
Post-Developed Peak Flow Rate (m^3/s)	**Q**	1.352	1.903	2.379	2.908	3.179	3.540
Change in Peak Flow Rate (m^3/s)	**Q**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
LPOD E							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Pre-Developed Peak Flow Rate (m^3/s)	**Q**	0.279	0.394	0.492	0.602	0.660	0.735
Post-Developed Peak Flow Rate (m^3/s)	**Q**	0.279	0.394	0.492	0.602	0.660	0.735
Change in Peak Flow Rate (m^3/s)	**Q**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
LPOD F							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Pre-Developed Peak Flow Rate (m^3/s)	**Q**	0.679	0.956	1.195	1.461	1.597	1.778
Post-Developed Peak Flow Rate (m^3/s)	**Q**	0.679	0.956	1.195	1.461	1.597	1.778
Change in Peak Flow Rate (m^3/s)	**Q**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
LPOD G							
Annual Exceedance Probability	**AEP**	0.5EY	0.2EY	10%	5%	2%	1%
Pre-Developed Peak Flow Rate (m^3/s)	**Q**	2.542	3.594	4.512	5.542	6.121	6.871
Post-Developed Peak Flow Rate (m^3/s)	**Q**	2.542	3.594	4.512	5.542	6.121	6.871
Change in Peak Flow Rate (m^3/s)	**Q**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

The Rational Method assessment has demonstrated that there is no increase in peak flow rates discharging from the subject site and therefore, no on-site detention measures will be required for this development.

4.5 External Catchments

The subject site and the surrounding area were examined to determine if any localised external catchments will contribute to the subject site. The site is deemed to not contain any influencing localised external catchments.

4.6 Flood Liable Land

In accordance with the Tweed Development Control Plan – Section A5: Subdivision Manual, rural subdivision buildings are required to be set to a minimum level of at least the 1% AEP flood level and have a high level evacuation above the probable maximum flood (PMF) level. Refer to Appendix E for minimum design flood levels obtained from Tweed Shire Council, Property Flood Reports.

All proposed residential dwellings comply with the minimum flood levels and are summarised in Table 15.

Table 15: Minimum and Proposed Flood Levels

Lot number	Design Flood Level (1% AEP)	Probable Maximum Flood Level (PMF)	Proposed dwelling pad level
Lot 1	4.4m	9.2m	Existing building = 5m Proposed building = 21m
Lot 2	4.4m	9.2m	Proposed building = 21m
Lot 3	4.4m	9.2m	Existing building = 18m
Lot 4	4.4m	9.2m	Proposed building = 23m
Lot 5	4.4m	9.2m	Proposed building = 21m
Lot 6	4.4m	9.2m	Proposed building = 23m

Note: Proposed dwelling pad levels are approximate only at this stage and are to be finalised at building application stage.

In accordance with the Tweed Development Control Plan – Section A5: Subdivision Manual, all lots will have high level road and/or pedestrian access to land above the probable maximum flood level at RL 9.2m.

5.0 STORMWATER QUALITY ASSESSMENT

5.1 Background

The development of the land has the potential to increase the pollutant loads within stormwater runoff and downstream watercourses. During the construction phase of the development, disturbances to the existing ground have the potential to significantly increase sediment loads entering downstream drainage systems and watercourses. The operational phase of the development will potentially increase the amount of sediments and nutrients washing from the site.

The following sections describe the construction and operational phase controls and water quality modelling of the proposed treatment train in compliance with Council guidelines.

5.2 Construction Phase

A high risk of stormwater pollution will occur from the site during the construction phase due to erosion and sediment transportation off-site to the receiving environment. The majority of this risk results from construction activities disturbing the site and exposing areas of soil to the direct erosive influence of the environment.

The following section outlines the procedures necessary to minimise erosion and control sediment during construction in accordance with Development Design Specification D7 – Stormwater Quality and its Annexure A – “Code of Practice for Soil and Water Management on Construction Works”.

5.2.1 Key Pollutants

The key pollutants have been identified for the Construction Phase of this development.

Table 16: Key Pollutants, Construction Phase

Pollutant	Sources
Litter	Paper, construction packaging, food packaging, cement bags, material offcuts.
Sediment	Exposed soils and stockpiles during earthworks and building works.
Hydrocarbons	Fuel and oil spills, leaks from construction equipment and temporary car park areas.
Toxic Materials	Cement slurry, asphalt primer, solvents, cleaning agents, and wash waters (e.g., from tile works).
Acids or Alkaline substances	Acid sulphate soils, cement slurry and wash waters.

5.2.2 Sediment and Erosion Controls

Sediment and Erosion Control devices (S&EC) employed on the site shall be designed and constructed in accordance with the Development Design Specification D7 – Stormwater Quality and its Annexure A – “Code of Practice for Soil and Water Management on Construction Works” as shown on OSKA Consulting Group, Sediment and Erosion Control Plan (Ref: OSK6539/P003/A) & Sediment and Erosion Control Details (Ref: OSK6539/P004/A) included as Appendix F.

Pre-Construction

- Stabilised site access/exit onto Dulguigan Road;
- Sediment fences to be located around the perimeter of the site;
- Sediment trap to be installed as required;
- Dust fencing to be installed if required; and
- Educate site personnel to the requirements of Erosion and Sediment Control Plan.

Initial Construction

- Maintain construction access/exit, sediment fencing, dust fences and all other existing controls as required;
- Construct diversion drains to convey disturbed site run-off to the temporary sediment traps; and
- Confine construction activities to stages to minimise areas of disturbance at any given time.

Second Stage Construction

- Maintain construction access/exit, sediment fencing, dust fences, diversion drain and all other existing controls as required;
- Progressively revegetate finished areas where applicable;
- Divert runoff from undisturbed areas around disturbed areas; and
- Drainage structure protection around field inlets and gully pits.

During construction, all areas of exposed soils allowing dust generation are to be suitably treated. Treatments will include covering the soil and watering. Road accesses are to be regularly cleaned to prevent the transmission of soil on vehicle wheels and eliminate any build-up of typical road dirt and tyre dust from delivery vehicles.

Adequate waste disposal facilities are to be provided and maintained on the site to cater for all waste materials such as litter, hydrocarbons, toxic materials, acids or alkaline substances.

5.2.3 Water Quality Monitoring and Inspections

To ensure that the water quality objectives are being met during the construction phase of the development, water quality monitoring shall be conducted. Water quality monitoring shall use a calibrated probe or sampling and testing at a NATA registered laboratory.

Location: Monitoring Stations MS1 shown on OSKA Consulting Group, *Sediment and Erosion Control Plan* (Ref: OSK6539/P003/A).

Parameters: Site discharge criteria.

Frequency: Following at least 30 mm of rainfall in a 24-hour period.

The contractor shall be responsible for the inspection and maintenance of all sediment and erosion control devices. Additional controls and review of existing controls shall be undertaken in response to the results of the above-mentioned monitoring program.

5.2.4 Reporting

An inspection report shall be written by a suitably qualified and experienced scientist/engineer following each water quality monitoring episode. The report shall include at least the following information:

- Name, address and real property description for the development site;
- Council file reference number (if known);
- Monitoring locations;
- Performance criteria;
- Results for each monitoring location, identifying any breaches of performance criteria;
- Recommended corrective actions to be taken and additional sediment and erosion controls, if required; and
- Inspection reports shall be provided to the contractor for their action and compilation in an on-site register.

If the above-mentioned performance criteria are exceeded and results from the downstream monitoring stations show significant deterioration from upstream results (if applicable), the contractor shall implement all recommendation of the inspection report within one (1) working day of receipt of the report.

5.3 Operational Phase

The development site is situated in a rural area in Dulguigan. Under the Tweed Development Control Plan – Section A5.5 – Rural Subdivision Guidelines, the development must comply with the Development Design Specification D7 for erosion and sediment control only.

6.0 CONCLUSIONS

OSKA Civil Consultants has been commissioned by John Tilton c/- B & P Surveys to prepare a Conceptual Stormwater Management Plan (CSWMP) to support a Development Application (DA) to the Tweed Shire Council for the proposed residential building situated at 133-193 Dulguigan Road, Dulguigan. This CSWMP intends to provide an optimised stormwater management system that would be compatible and readily integrated into the proposed site use.

This CSWMP details the conceptual planning, layout and design of the stormwater management infrastructure for both the construction and operational phases of this development and satisfies the requirements of the Tweed Shire Council Development Control Plan.

A hydrological analysis demonstrated that the anticipated post-development peak flow rates discharging from the site are the same the pre-development flow rates. Therefore, onsite stormwater detention will not be required for the site.

An investigation of flooding affecting the subject site has demonstrated that all proposed residential dwelling pads comply with the minimum design flood levels, i.e. the 1% AEP flood levels at 4.4m and will have high level road and/or pedestrian access to land above the probable maximum flood level at RL 9.2m.

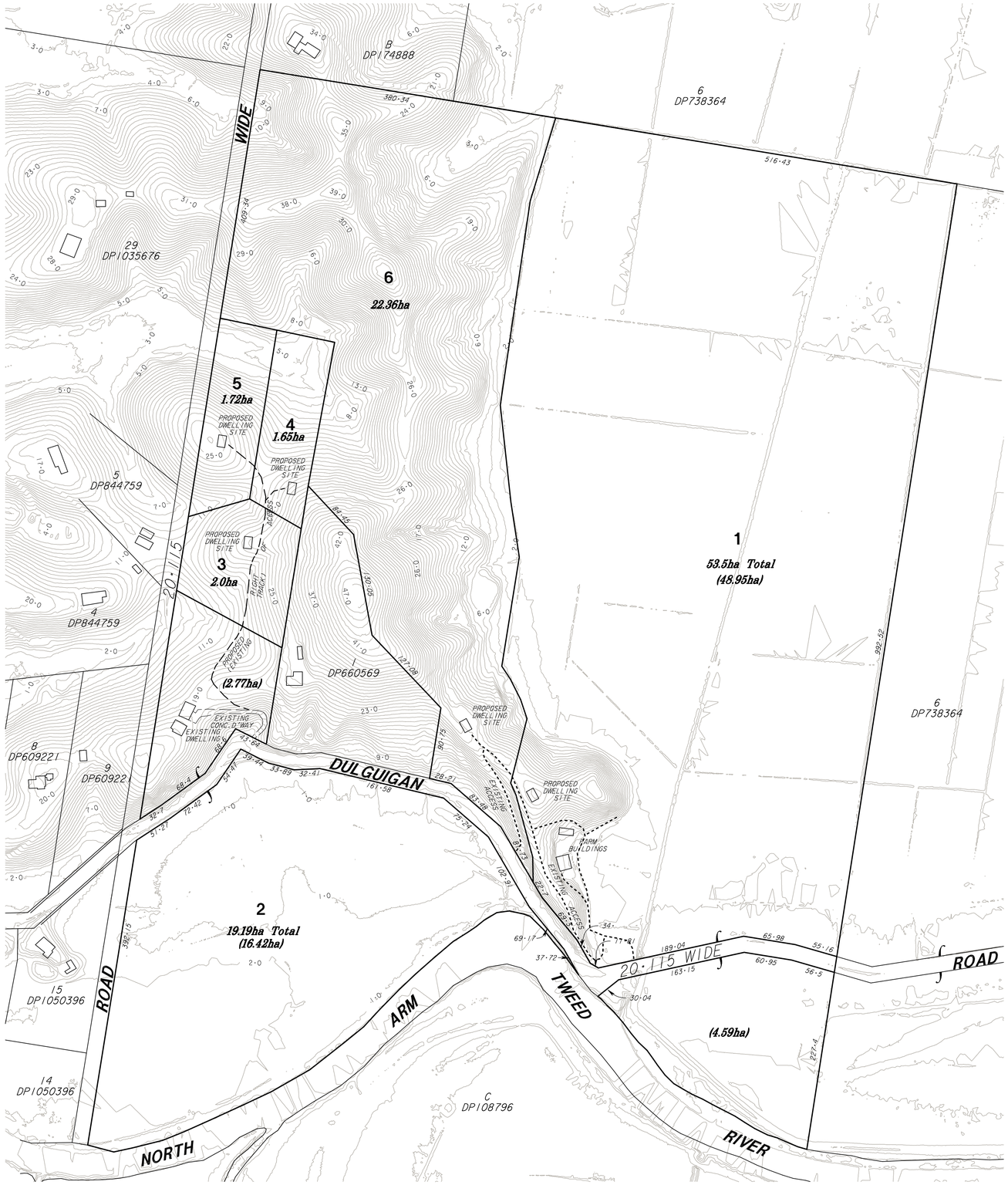
A monitoring and maintenance plan for the proposed infrastructure has been included. A concept sediment and erosion control plan is provided for the construction phase of the development and shall be implemented by the contractor and developer during construction.

APPENDIX

A

B & P Surveys, Proposed Subdivision Plan (Ref: 25464-B)

PRELIMINARY
ONLY
29/8/2023



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M.G.A.

PRELIMINARY
ONLY
29/8/2023

Revision | Chk

Client:

MR JOHN TILTON

IMPORTANT NOTES :

THE PROPOSED BOUNDARIES AS SHOWN HEREON ARE PRELIMINARY ONLY AND ARE SUBJECT TO FINAL DESIGN, LOCAL AUTHORITY APPROVAL AND REGISTRATION WITH NSW LAND REGISTRY SERVICES.

DIMENSIONS & AREAS SHOWN HEREON ARE SUBJECT TO FIELD SURVEY AND LOCAL AUTHORITY APPROVAL.

CONTOUR INTERVAL - 1m

CONTOURS HAVE BEEN DERIVED FROM NSW SPATIAL SERVICES 1m LIDAR DATA GATHERED APRIL 14.

PROPOSED SUBDIVISION PLAN

LOT 8 IN DP755685,
LOT 1 IN DP364474,
LOT 1 IN DP410859,
LOT 1 IN DP328107,
LOT 1 IN DP376131
& LOT A IN DP174886

DULGUIGAN ROAD
DULGUIGAN

Parish of BERWICK County of Rous

B & P SURVEYS
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SCALE AT A1	Level DATUM	Drawn	Chk'd	F.Bk	L.Bk
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REF. No.	DATE	DRAWING No./Size	Sheet	Of	Rev.
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PRELIMINARY
ONLY
29/8/2023

M.G.A.

PRELIMINARY
ONLY
29/8/2023

Revision | Chk

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M31754	29/3/2023	25464 B	2	2	-

APPENDIX

B

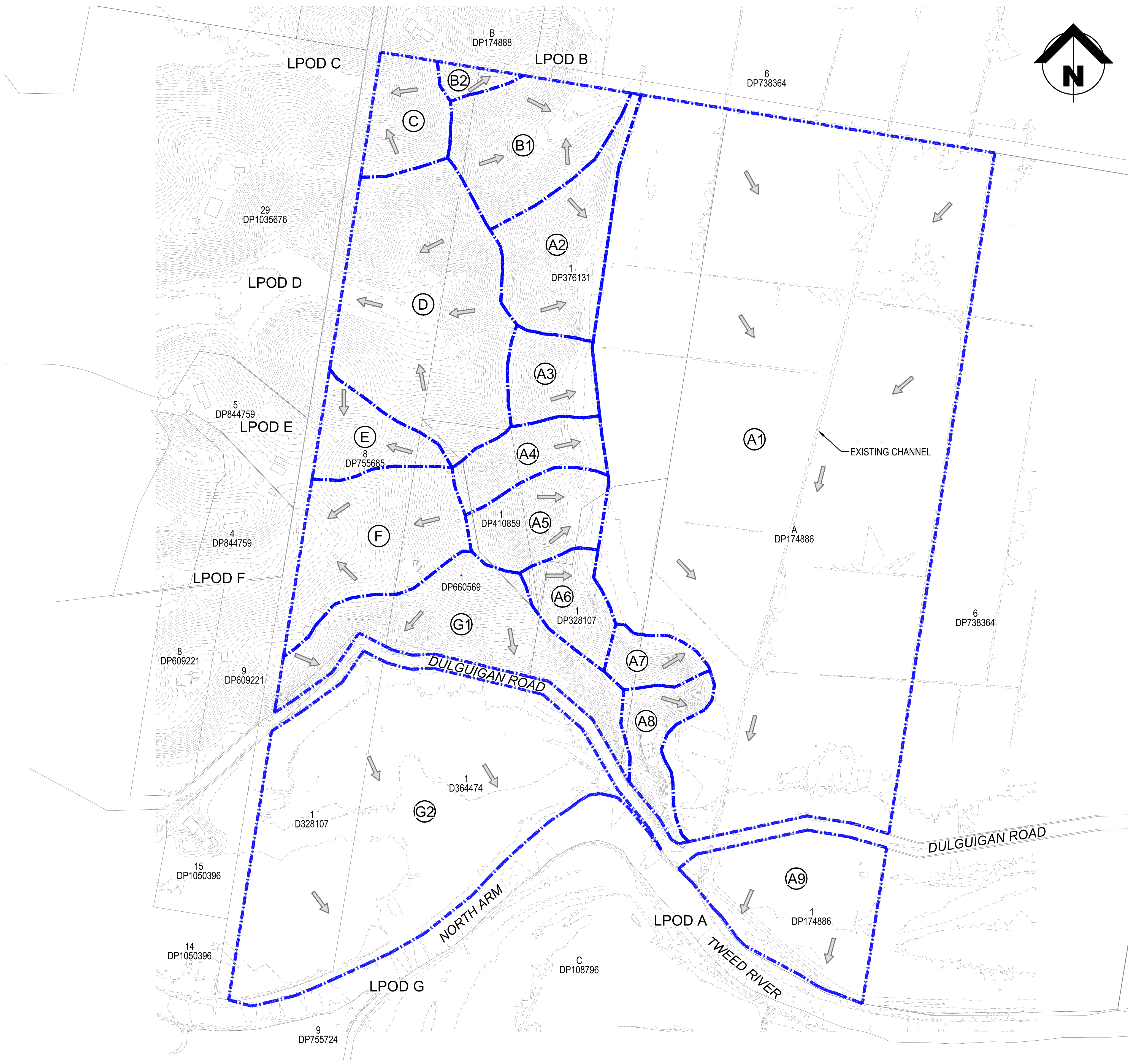
OSKA Consulting Group,
Pre-Development Catchment Plan
(Ref: OSK6539/P001/A)

PRE-DEVELOPMENT CATCHMENT PLAN

LEGEND

- STORMWATER CATCHMENT BOUNDARY
- (A) STORMWATER CATCHMENT I.D.
- EXISTING SURFACE CONTOURS
- LPOD — LAWFUL POINT OF DISCHARGE
- FLOW DIRECTION
- EXISTING BOUNDARY

STORMWATER CATCHMENT TABLE	
STORMWATER CATCHMENT I.D.	AREA (ha)
A1	46.3
A2	3.35
A3	1.53
A4	1.69
A5	2.18
A6	1.4
A7	0.94
A8	1.47
A9	4.59
B1	3.64
B2	0.38
C	1.78
D	8.30
E	1.60
F	4.17
G1	5.02
G2	16.43
TOTAL	104.8



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DRAWN: ES | DESIGN: ES | APPROVED:

SIGNED

DATE

OSKA CONSULTING GROUP

DRAWING IS NOT TO BE SCALED

SCALE
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1:6000 AT A3
0 — 100m

CLIENT
JOHN TILTON
c/- B & P SURVEYS

PROJECT
PROPOSED SUBDIVISION
133-193 DULGUIGAN ROAD
DULGUIGAN, NSW, 2484

STAGE / PHASE
FOR INFORMATION ONLY — NOT FOR CONSTRUCTION

TITLE
PRE-DEVELOPMENT CATCHMENT PLAN

DRAWING NUMBER
OSK6539-P001

REVISION
1

APPENDIX

C

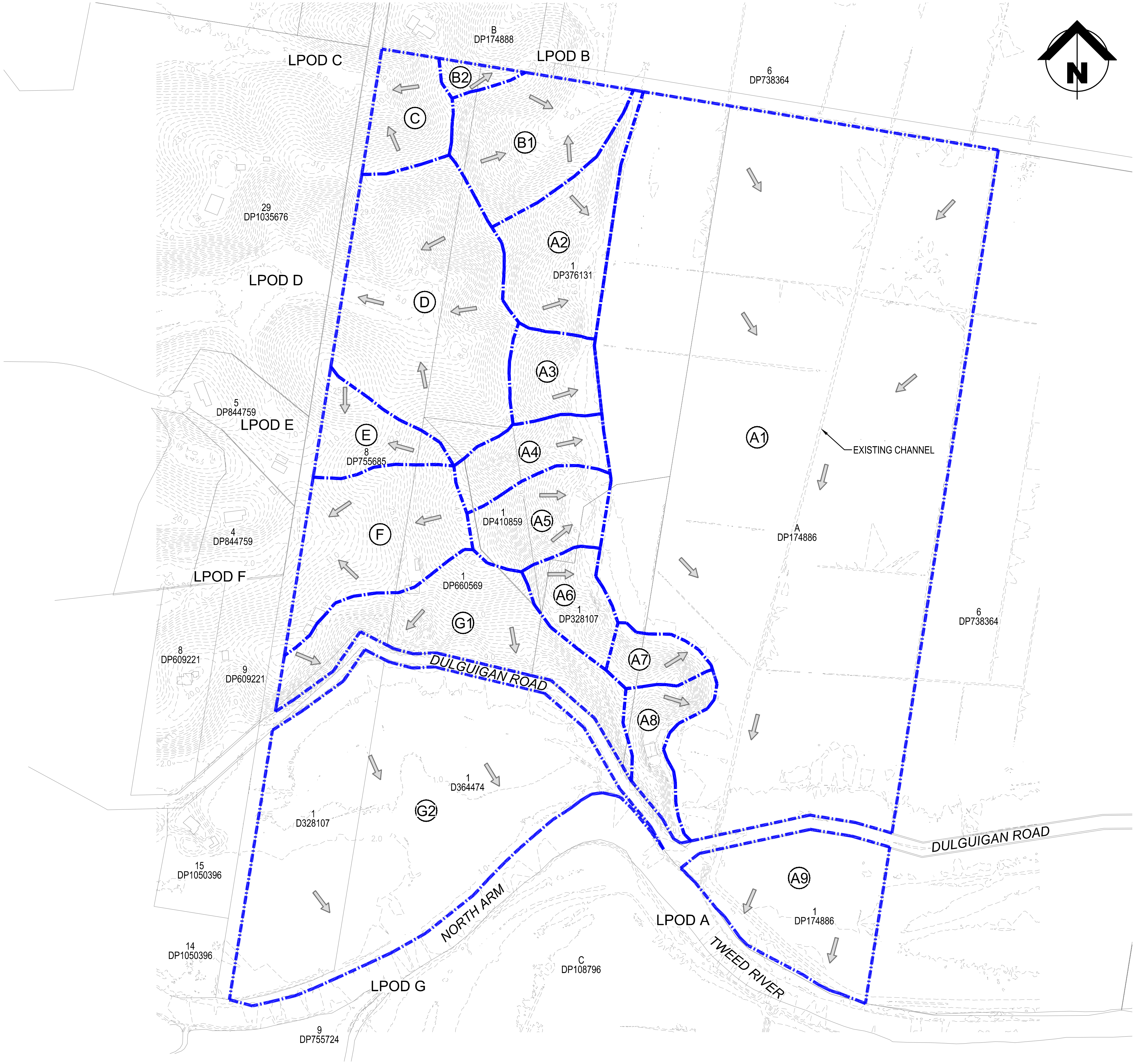
OSKA Consulting Group, Post-Development Catchment Plan (Ref: OSK6539/P002/A)

PRE-DEVELOPMENT CATCHMENT PLAN

LEGEND

- STORMWATER CATCHMENT BOUNDARY
- (A) STORMWATER CATCHMENT I.D.
- EXISTING SURFACE CONTOURS
- LPOD — LAWFUL POINT OF DISCHARGE
- FLOW DIRECTION
- EXISTING BOUNDARY

STORMWATER CATCHMENT TABLE	
STORMWATER CATCHMENT I.D.	AREA (ha)
A1	46.3
A2	3.35
A3	1.53
A4	1.69
A5	2.18
A6	1.4
A7	0.94
A8	1.47
A9	4.59
B1	3.64
B2	0.38
C	1.78
D	8.30
E	1.60
F	4.17
G1	5.02
G2	16.43
TOTAL	104.8



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OSKA CONSULTING GROUP

DRAWING IS NOT TO BE SCALED

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CLIENT: JOHN TILTON c/- B & P SURVEYS

PROJECT: PROPOSED SUBDIVISION 133-193 DULGUIGAN ROAD DULGUIGAN, NSW, 2484

STAGE / PHASE: FOR INFORMATION ONLY — NOT FOR CONSTRUCTION

TITLE: PRE-DEVELOPMENT CATCHMENT PLAN

DRAWING NUMBER: OSK6539-P001

REVISION: 1

APPENDIX

D

OSKA Consulting Group, Sediment and Erosion Control Plan (Ref: OSK6539/P003/A) & Sediment and Erosion Control Details (Ref: OSK6539/P004/A)

LEGEND

—/—SF—	SEDIMENT FENCE
MS1	WATER QUALITY MONITORING STATION
- - 80.0 - -	EXISTING SURFACE CONTOURS
LPOD	LAWFUL POINT OF DISCHARGE
⇨	FLOW DIRECTION
——	SITE BOUNDARY

REV	DESCRIPTION	DRAWN	DATE
1	ISSUED FOR REPORT	ES	08-05-24

DRAWN: ES | DESIGN: ES | APPROVED:

SIGNED

DATE

OSKA CONSULTING GROUP

DRAWING IS NOT TO BE SCALED

SCALE
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1:6000 AT A3
0 100m

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c/- B & P SURVEYS

PROJECT
PROPOSED SUBDIVISION
133-193 DULGUIGAN ROAD
DULGUIGAN, NSW, 2484

STAGE / PHASE
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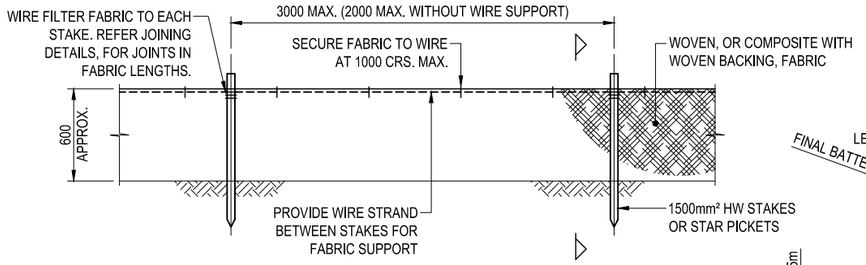
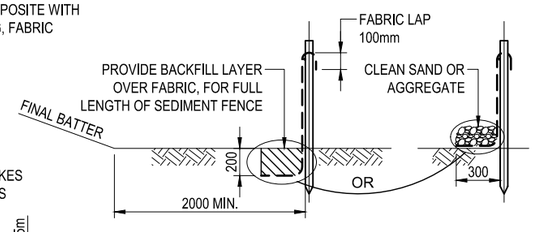
TITLE
SEDIMENT AND EROSION CONTROL PLAN

DRAWING NUMBER
OSK6539-P003

REVISION
1

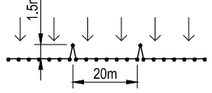


ELEVATION



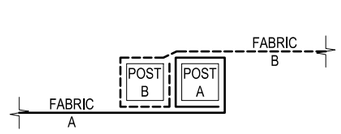
SECTION

NOTE: INSTALL 1.5m (MIN.) DEEP 'RETURNS' AT 20m SPACING (MAX.) ON UPSLOPE SIDE OF FENCELINE (5-10m MAX SPACING IF FENCE ALIGNED AT ANGLE TO CONTOUR). EG:



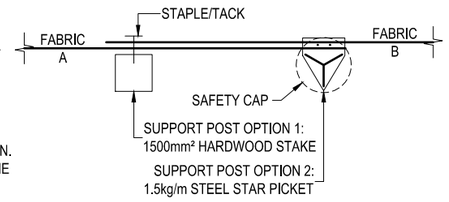
SEDIMENT FENCE DETAILS

N.T.S. —/—SF— DENOTES SEDIMENT FENCE. REFER PLAN FOR LOCATION AND EXTENTS.



FABRIC TO FOLD AROUND EACH STAKE ONE FULL TURN. STAKE B TO BE DRIVEN TIGHTLY AGAINST STAKE A. THE TOPS OF BOTH STAKES TO BE SECURED WITH WIRE.

METHOD 1



METHOD 2

SEDIMENT FENCE FABRIC JOINING DETAILS

N.T.S.

REV	DESCRIPTION	DRAWN	DATE
1	ISSUED FOR REPORT	ES	08-05-24

DRAWN ES | DESIGN ES | APPROVED

SIGNED

DATE

OSKA CONSULTING GROUP

SCALE: NOT TO SCALE

CLIENT: JOHN TILTON c/- B & P SURVEYS

PROJECT: PROPOSED SUBDIVISION 133-193 DULGUIGAN ROAD DULGUIGAN, NSW, 2484

STAGE / PHASE: FOR INFORMATION ONLY NOT FOR CONSTRUCTION

TITLE: SEDIMENT AND EROSION CONTROL DETAILS

DRAWING NUMBER: OSK6539-P004

REVISION: 1

APPENDIX

E

Tweed Shire Council, Property Flood Reports

Property Flood Report

This Property Flood Report tells you what you need to know about this property and its flood risk. It shows flood and ground levels and provides information on nearby levees and river gauges, if applicable. To understand the terms used, please see the Flood Terms and Definitions section at the end of this report.

Property Address: **133 Dulguigan Road DULGUIGAN 2484**

Lot/Section/Deposited Plan: 8//DP755685

Date Prepared: 12/08/2020

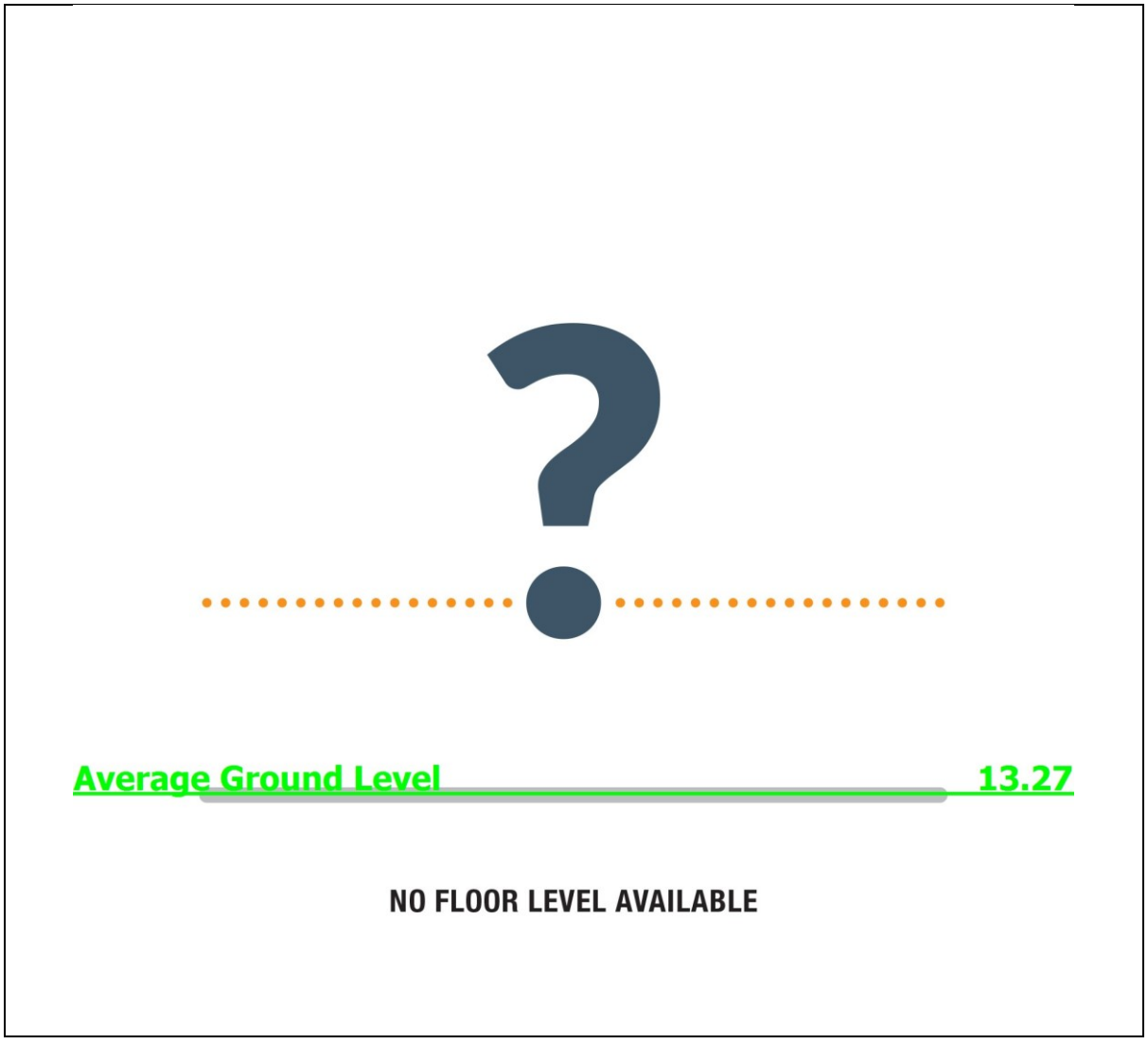


Figure 1: Flood and Ground Levels at 133 Dulguigan Road DULGUIGAN 2484

The ground level provided above is taken at the centre of the property and is approximate only. If accurate levels are required this should be confirmed by a registered surveyor.

Be Prepared

Flood Warnings are issued by the Bureau of Meteorology (BoM). Warnings and real-time rainfall and river level information can be viewed on the BoM website (www.bom.gov.au).

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Website: www.ses.nsw.gov.au

Flood & Storm Emergency: 132 500

Life Threatening Situations: 000

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Should you require any further information, please contact Council on (02) 6670 2400 or email us at tsc@tweed.nsw.gov.au

Technical Information

The below information is for those who are flood savvy or have a technical need to know more about Council's building development controls, such as surveyors, builders, certifiers, architects and engineers.

Property Address: **133 Dulguigan Road DULGUIGAN 2484**

Lot/Section/Deposited Plan: 8//DP755685

Property Levels

Description	Minimum (m AHD)	Maximum (m AHD)
Approximate Ground Level	0.1	39.0
Approximate Floor Level (2012)	Not Available	

Planning Levels

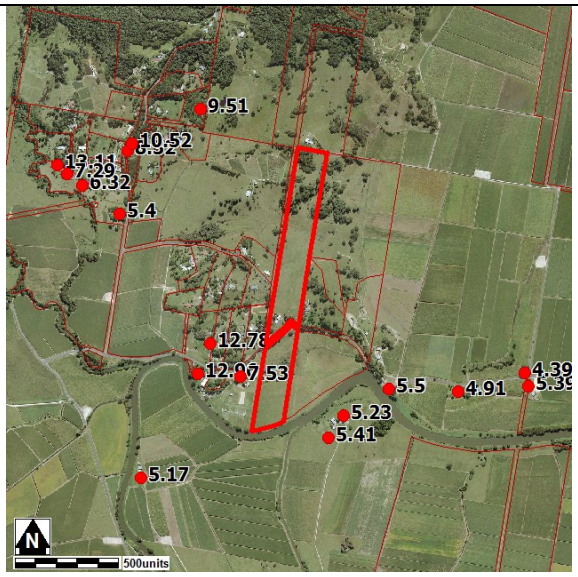
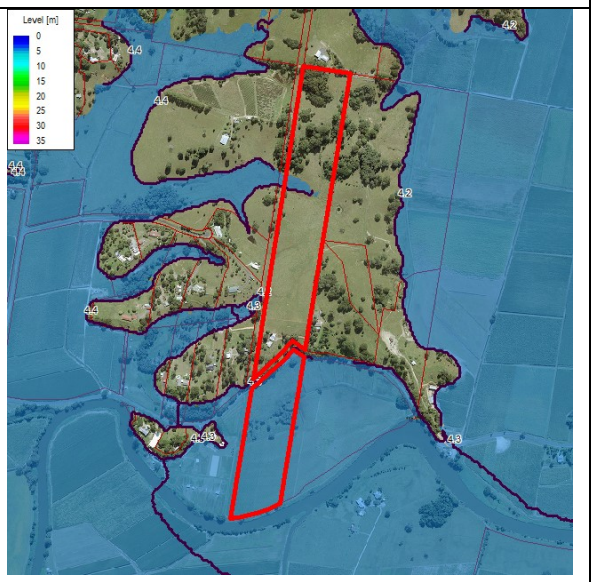
Planning Level	Level (m AHD)
Design Flood Level	4.4
Minimum Habitable Floor Level (Flood Planning Level)	4.9
Climate Change Design Flood Level*	4.6
Climate Change Habitable Floor Level*	5.1
High Flow Area	Part Lot
High Hazard Area	No

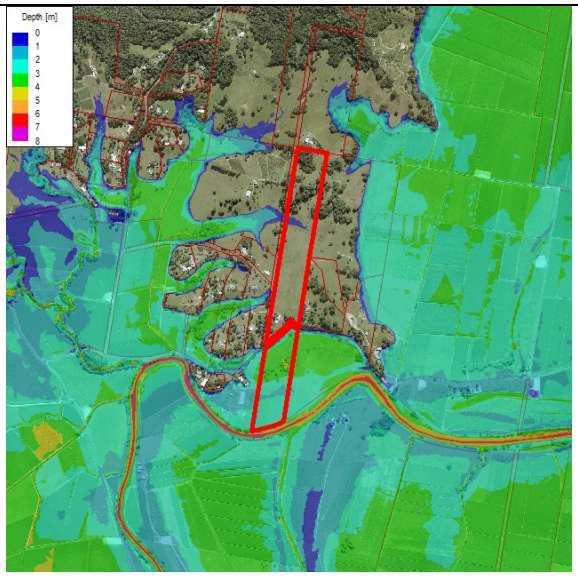
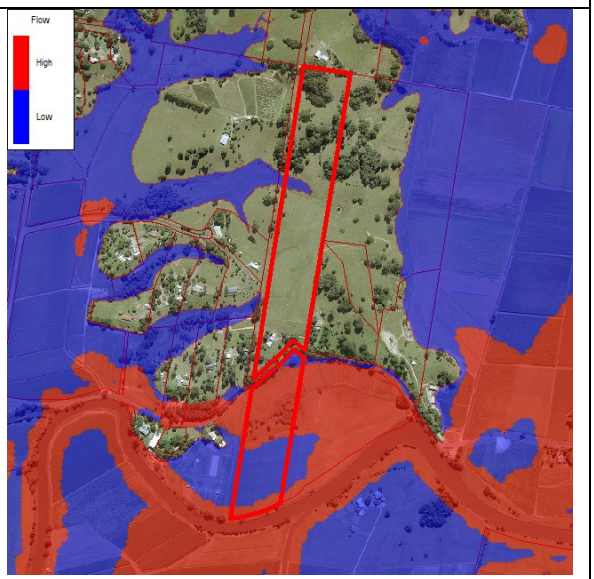
* Climate Change Levels are compulsory in new urban land release subdivision areas

Flooding Levels

Flood Event	Minimum Level (m AHD)	Maximum Level (m AHD)
20% AEP	3.2	3.2
5% AEP	3.6	3.7
1% AEP	4.4	4.4
Climate Change 2100 1% AEP	4.6	4.6
0.2% AEP	5.5	5.5
Probable Maximum Flood (PMF)	9.2	9.2

Mapping

Overview and Locality	Design Flood (1% AEP) - Height
	

Design Flood (1% AEP) - Depth	High/Low Flow Classification
	

Detailed mapping data, including flood mapping, can be sourced at Council's open data hub: www.tweed.nsw.gov.au/Mapping

For more information on Tweed Shire Flood Planning controls see the Tweed Local Environment Plan and Development Control Plan Section A3 – Development of Flood Liable Land at www.tweed.nsw.gov.au/PlanningPolicies

Information Sources

- **Ground Levels:** 2014 Airborne Laser Survey (LiDAR)
- **Existing Floor Levels:** 2011 and 2012 Floor Level Survey (Tweed Shire Council)
- **Flooding Levels:** Tweed Valley Flood Study Update 2009 and Tweed Byron Coastal Creeks Flood Study 2010 (BMT WBM)

Flood Terms and Definitions

- **Annual Exceedance Probability (AEP):** The probability of a flood event of a given size occurring in any one year, usually expressed as a percentage annual chance.
- **Average Recurrence Interval (ARI):** Similar to AEP. The long-term average number of years between the occurrence of a flood as big as (or larger than) the selected event.
- **metres above Australian Height Datum (m AHD):** The reference level for defining ground levels in Australia. The level of 0.0m AHD is approximately mean sea level.
- **Maximum and Minimum Ground Level** – Highest and lowest ground levels on the property based on available ground level information. A Registered Surveyor can confirm exact ground levels.
- **Surveyed Floor Level** – Approximate floor levels of dwellings, usually taken from the street. These are generally the level of the front step of the habitable level of the building most visible from the street frontage
- **Design Flood Level (DFL)** – A hypothetical flood representing a specific likelihood of occurrence. In Tweed Shire, for residential property, the peak of the modelled 1% AEP (100 Year ARI) flood is the Design Flood Level
- **Minimum Habitable Floor Level** – The minimum level in metres AHD at which habitable areas of development (generally including bedrooms, living rooms, kitchen, study, family and rumpus rooms) must be constructed. In Tweed Shire, this is Design Flood Level plus 0.5m of freeboard. Also known as 'Flood Planning Level'
- **Climate Change Floor Level** – 2100 Climate Change Design Flood Level plus 0.5m of freeboard. Climate Change Design Flood Level is based on reasonable predictions of increased rainfall intensity and sea level rise. See the Tweed Valley Flood Study Update 2009 – Climate Change for more information.
- **Probable Maximum Flood.** An extreme flood deemed to be the largest flood that could conceivably occur at a specific location. It is generally not physically or economically possible to provide complete protection against this flood event, but should be considered for emergency response etc. The PMF defines the extent of flood prone land (i.e. the floodplain).

Disclaimer

Property Flood Report

This Property Flood Report tells you what you need to know about this property and its flood risk. It shows flood and ground levels and provides information on nearby levees and river gauges, if applicable. To understand the terms used, please see the Flood Terms and Definitions section at the end of this report.

Property Address: **143 Dulguigan Road DULGUIGAN 2484**

Lot/Section/Deposited Plan: 1//DP660569

Date Prepared: 12/08/2020

Figure 1: Flood and Ground Levels at 143 Dulguigan Road DULGUIGAN 2484

The ground level provided above is taken at the centre of the property and is approximate only. If accurate levels are required this should be confirmed by a registered surveyor.

Be Prepared

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Website: www.ses.nsw.gov.au

Flood & Storm Emergency: 132 500

Life Threatening Situations: 000

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Should you require any further information, please contact Council on (02) 6670 2400 or email us at tsc@tweed.nsw.gov.au

Technical Information

The below information is for those who are flood savvy or have a technical need to know more about Council's building development controls, such as surveyors, builders, certifiers, architects and engineers.

Property Address: **143 Dulguigan Road DULGUIGAN 2484**

Lot/Section/Deposited Plan: 1//DP660569

Property Levels

Description	Minimum (m AHD)	Maximum (m AHD)
Approximate Ground Level	4.9	47.6
Approximate Floor Level (2012)	Not Available	

Planning Levels

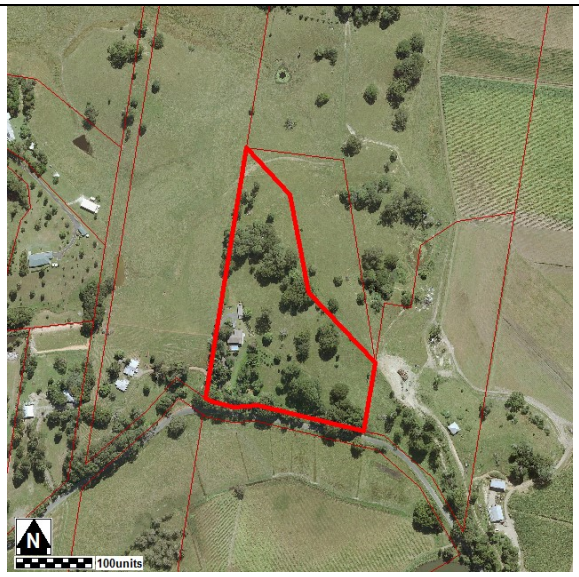
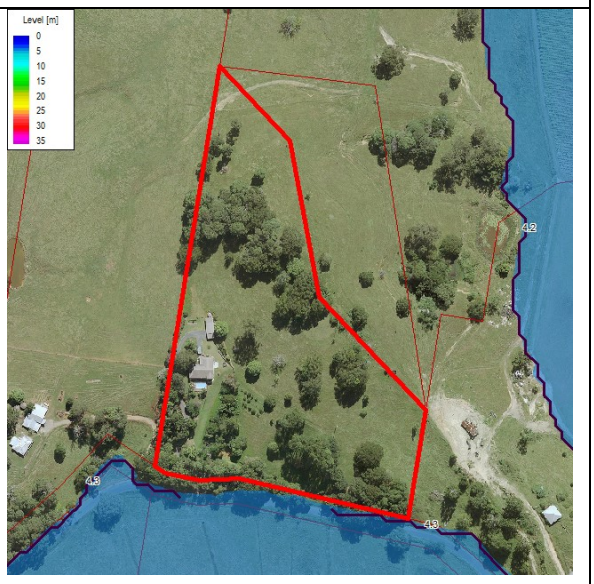
Planning Level	Level (m AHD)
Design Flood Level	4.4
Minimum Habitable Floor Level (Flood Planning Level)	4.9
Climate Change Design Flood Level*	4.6
Climate Change Habitable Floor Level*	5.1
High Flow Area	No
High Hazard Area	No

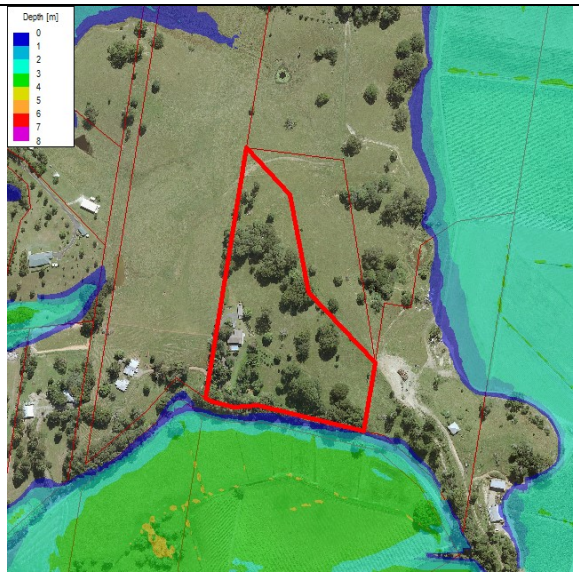
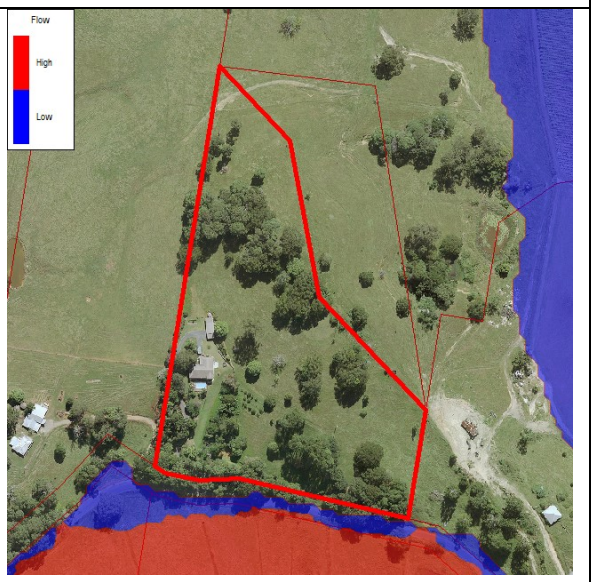
* Climate Change Levels are compulsory in new urban land release subdivision areas

Flooding Levels

Flood Event	Minimum Level (m AHD)	Maximum Level (m AHD)
20% AEP	N/A	N/A
5% AEP	N/A	N/A
1% AEP	N/A	N/A
Climate Change 2100 1% AEP	4.6	4.6
0.2% AEP	5.5	5.5
Probable Maximum Flood (PMF)	9.2	9.2

Mapping

Overview and Locality	Design Flood (1% AEP) - Height
	

Design Flood (1% AEP) - Depth	High/Low Flow Classification
	

Detailed mapping data, including flood mapping, can be sourced at Council's open data hub: www.tweed.nsw.gov.au/Mapping

For more information on Tweed Shire Flood Planning controls see the Tweed Local Environment Plan and Development Control Plan Section A3 – Development of Flood Liable Land at www.tweed.nsw.gov.au/PlanningPolicies

Information Sources

- **Ground Levels:** 2014 Airborne Laser Survey (LiDAR)
- **Existing Floor Levels:** 2011 and 2012 Floor Level Survey (Tweed Shire Council)
- **Flooding Levels:** Tweed Valley Flood Study Update 2009 and Tweed Byron Coastal Creeks Flood Study 2010 (BMT WBM)

Flood Terms and Definitions

- **Annual Exceedance Probability (AEP):** The probability of a flood event of a given size occurring in any one year, usually expressed as a percentage annual chance.
- **Average Recurrence Interval (ARI):** Similar to AEP. The long-term average number of years between the occurrence of a flood as big as (or larger than) the selected event.
- **metres above Australian Height Datum (m AHD):** The reference level for defining ground levels in Australia. The level of 0.0m AHD is approximately mean sea level.
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- **Design Flood Level (DFL)** – A hypothetical flood representing a specific likelihood of occurrence. In Tweed Shire, for residential property, the peak of the modelled 1% AEP (100 Year ARI) flood is the Design Flood Level
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- **Probable Maximum Flood.** An extreme flood deemed to be the largest flood that could conceivably occur at a specific location. It is generally not physically or economically possible to provide complete protection against this flood event, but should be considered for emergency response etc. The PMF defines the extent of flood prone land (i.e. the floodplain).

Disclaimer

Property Flood Report

This Property Flood Report tells you what you need to know about this property and its flood risk. It shows house floor and flood levels and provides information on nearby levees and river gauges, if applicable. To understand the terms used, please see the Flood Terms and Definitions section at the end of this report.

Property Address: **193 Dulguigan Road DULGUIGAN NSW 2484**

Lot/Section/Deposited Plan: A//DP174886

Date Prepared: 18/09/2020

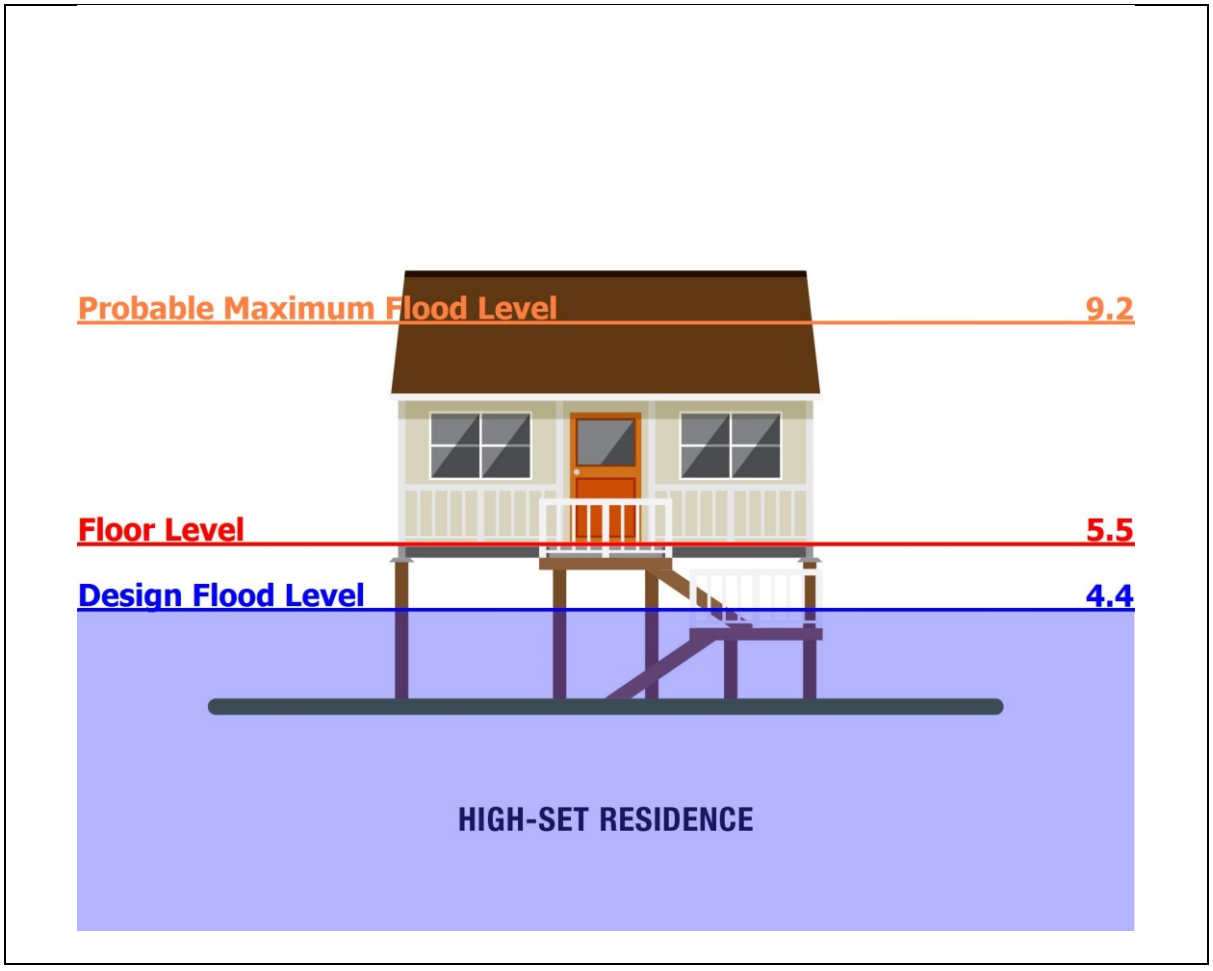

Figure 1: Flood and Floor Levels at 193 Dulguigan Road DULGUIGAN NSW 2484

The house floor level provided above was taken in 2012 and is approximate only. If an accurate floor level is required this should be confirmed by a registered surveyor.

Be Prepared

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Website: www.ses.nsw.gov.au

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Technical Information

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Property Address: **193 Dulguigan Road DULGUIGAN NSW 2484**

Lot/Section/Deposited Plan: A//DP174886

Property Levels

Description	Minimum (m AHD)	Maximum (m AHD)
Approximate Ground Level	-0.1	22.9
Approximate Floor Level (2012)	5.50	

Planning Levels

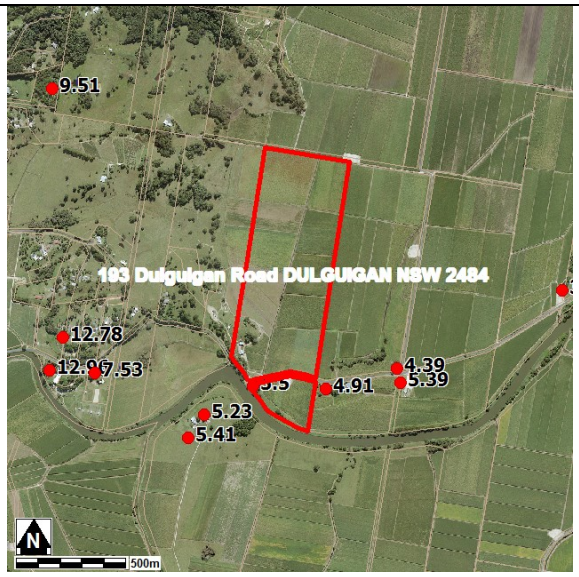
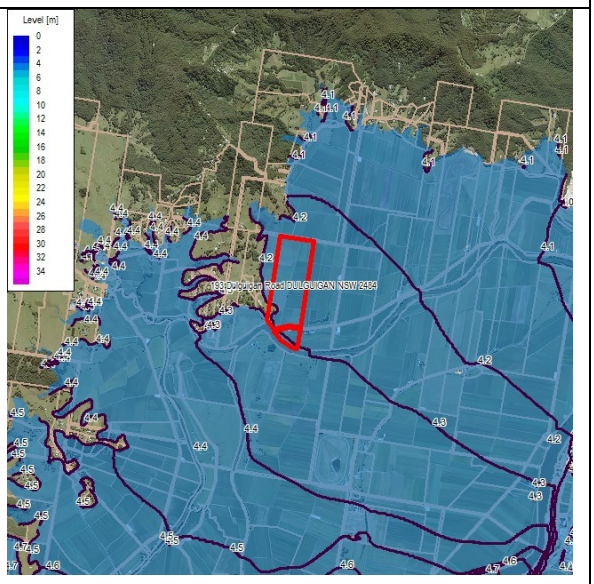
Planning Level	Level (m AHD)
Design Flood Level	4.4
Minimum Habitable Floor Level (Flood Planning Level)	4.9
Climate Change Design Flood Level*	4.6
Climate Change Habitable Floor Level*	5.1
High Flow Area	Part Lot
High Hazard Area	NA

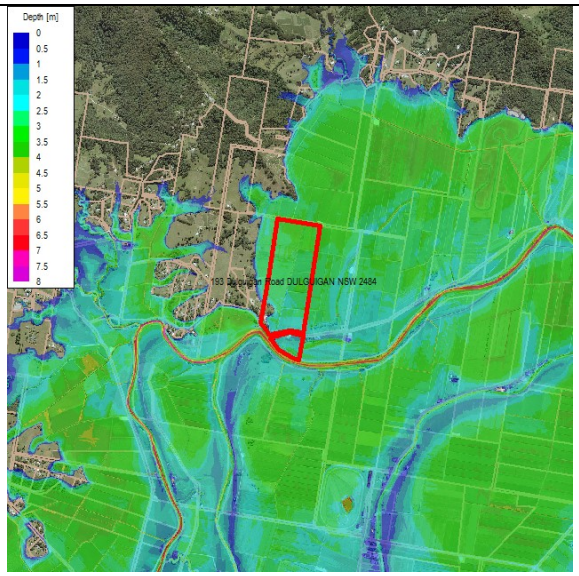
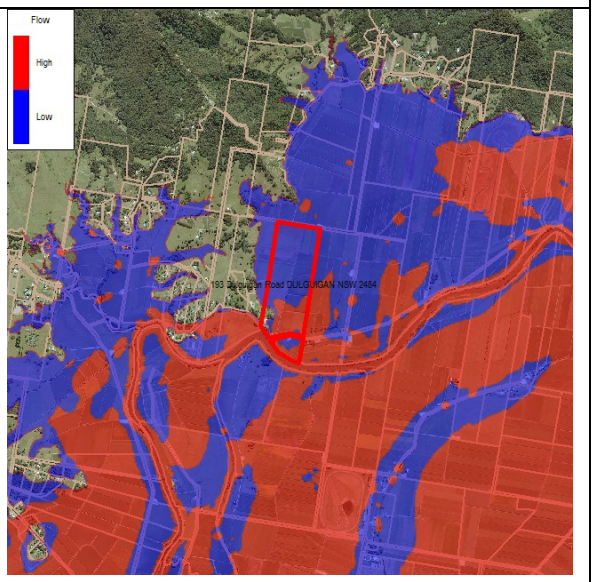
* Climate Change Levels are compulsory in new urban land release subdivision areas

Flooding Levels

Flood Event	Minimum Level (m AHD)	Maximum Level (m AHD)
20% AEP	2.9	3.2
5% AEP	3.5	3.6
1% AEP	4.2	4.4
Climate Change 2100 1% AEP	4.5	4.6
0.2% AEP	5.4	5.5
Probable Maximum Flood (PMF)	9.1	9.2

Mapping

Overview and Floor Level Survey Location	Design Flood (1% AEP) - Height
	

Design Flood (1% AEP) - Depth	High/Low Flow Classification
	

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Information Sources

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Property Address: **133 Dulguigan Road DULGUIGAN 2484**

Lot/Section/Deposited Plan: 1//DP328107

Date Prepared: 12/08/2020

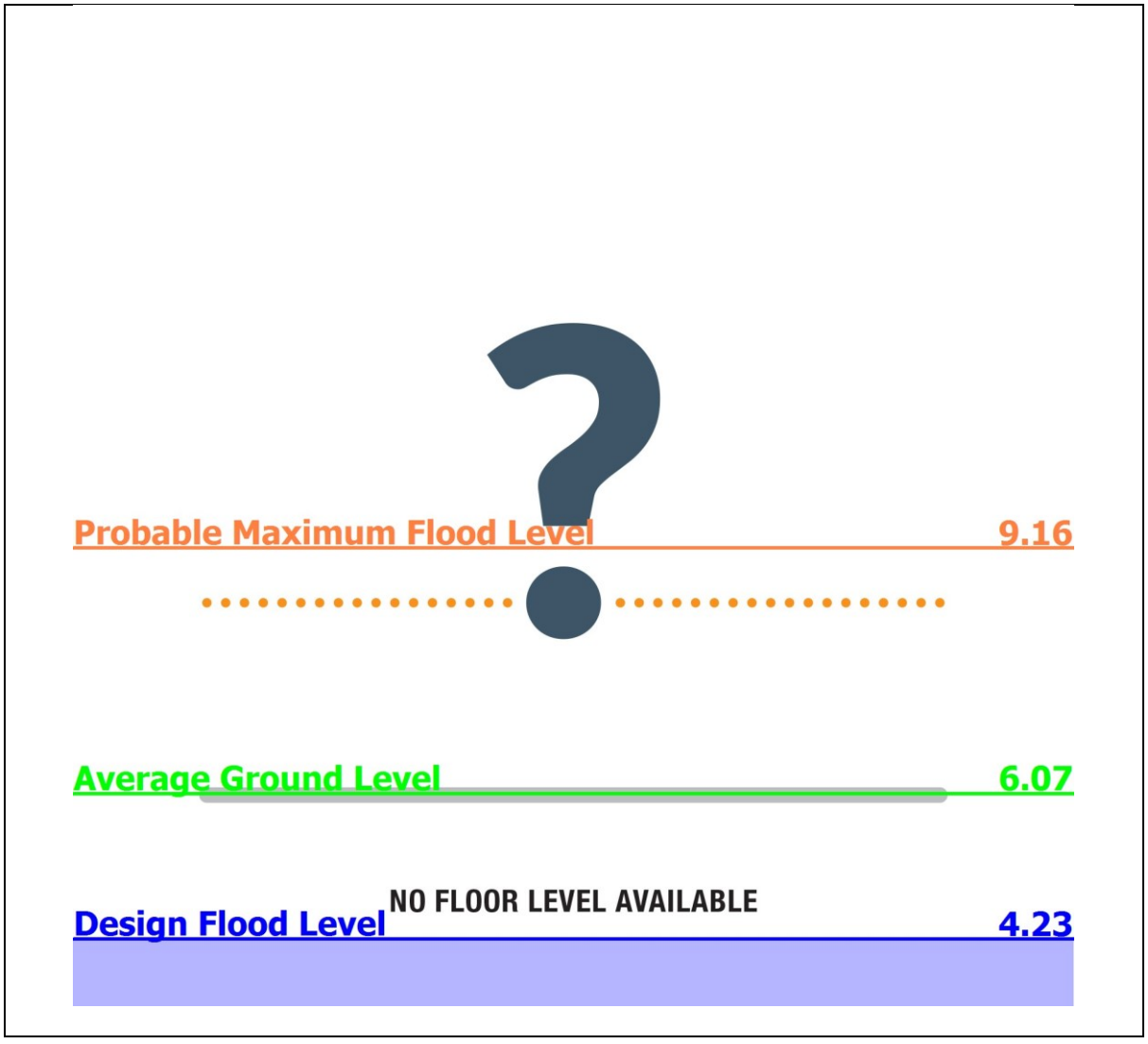

Figure 1: Flood and Ground Levels at 133 Dulguigan Road DULGUIGAN 2484

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Flood & Storm Emergency: 132 500

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Technical Information

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Property Address: **133 Dulguigan Road DULGUIGAN 2484**

Lot/Section/Deposited Plan: 1//DP328107

Property Levels

Description	Minimum (m AHD)	Maximum (m AHD)
Approximate Ground Level	1.1	23.8
Approximate Floor Level (2012)	Not Available	

Planning Levels

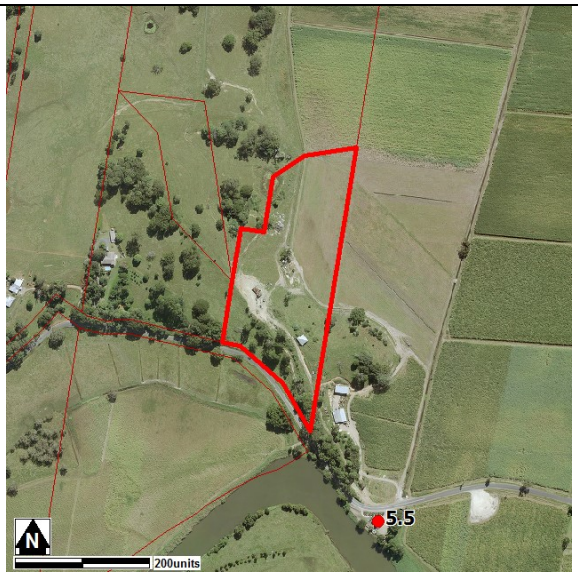
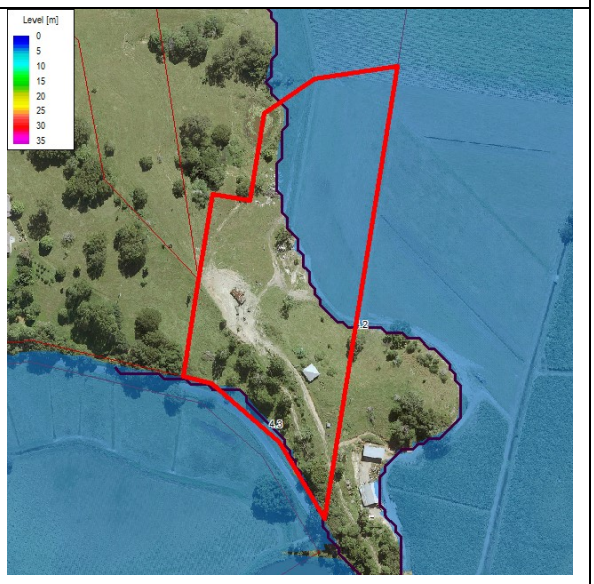
Planning Level	Level (m AHD)
Design Flood Level	4.4
Minimum Habitable Floor Level (Flood Planning Level)	4.9
Climate Change Design Flood Level*	4.6
Climate Change Habitable Floor Level*	5.1
High Flow Area	No
High Hazard Area	No

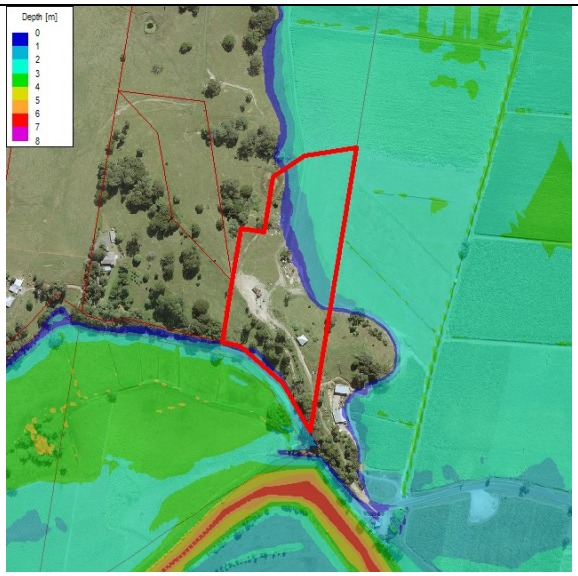
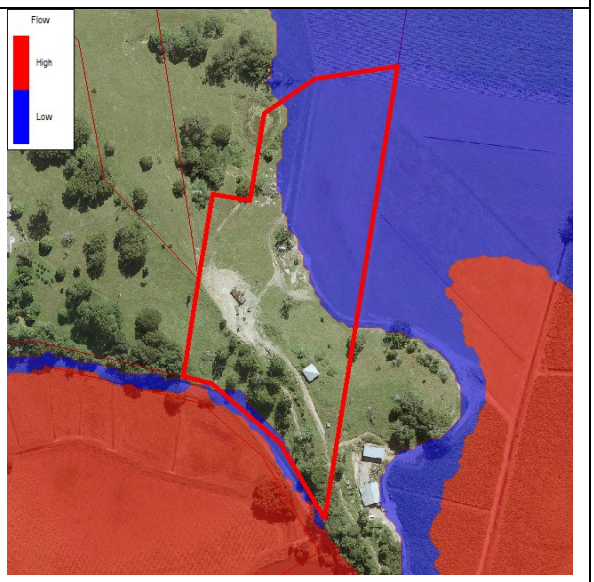
* Climate Change Levels are compulsory in new urban land release subdivision areas

Flooding Levels

Flood Event	Minimum Level (m AHD)	Maximum Level (m AHD)
20% AEP	2.9	3.2
5% AEP	3.5	3.6
1% AEP	4.2	4.4
Climate Change 2100 1% AEP	4.5	4.6
0.2% AEP	5.4	5.5
Probable Maximum Flood (PMF)	9.1	9.2

Mapping

Overview and Locality	Design Flood (1% AEP) - Height
	

Design Flood (1% AEP) - Depth	High/Low Flow Classification
	

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For more information on Tweed Shire Flood Planning controls see the Tweed Local Environment Plan and Development Control Plan Section A3 – Development of Flood Liable Land at www.tweed.nsw.gov.au/PlanningPolicies

Information Sources

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Disclaimer

Property Flood Report

This Property Flood Report tells you what you need to know about this property and its flood risk. It shows flood and ground levels and provides information on nearby levees and river gauges, if applicable. To understand the terms used, please see the Flood Terms and Definitions section at the end of this report.

Property Address: **Dulguigan Road DULGUIGAN NSW 2484**

Lot/Section/Deposited Plan: 1//DP364474

Date Prepared: 12/08/2020

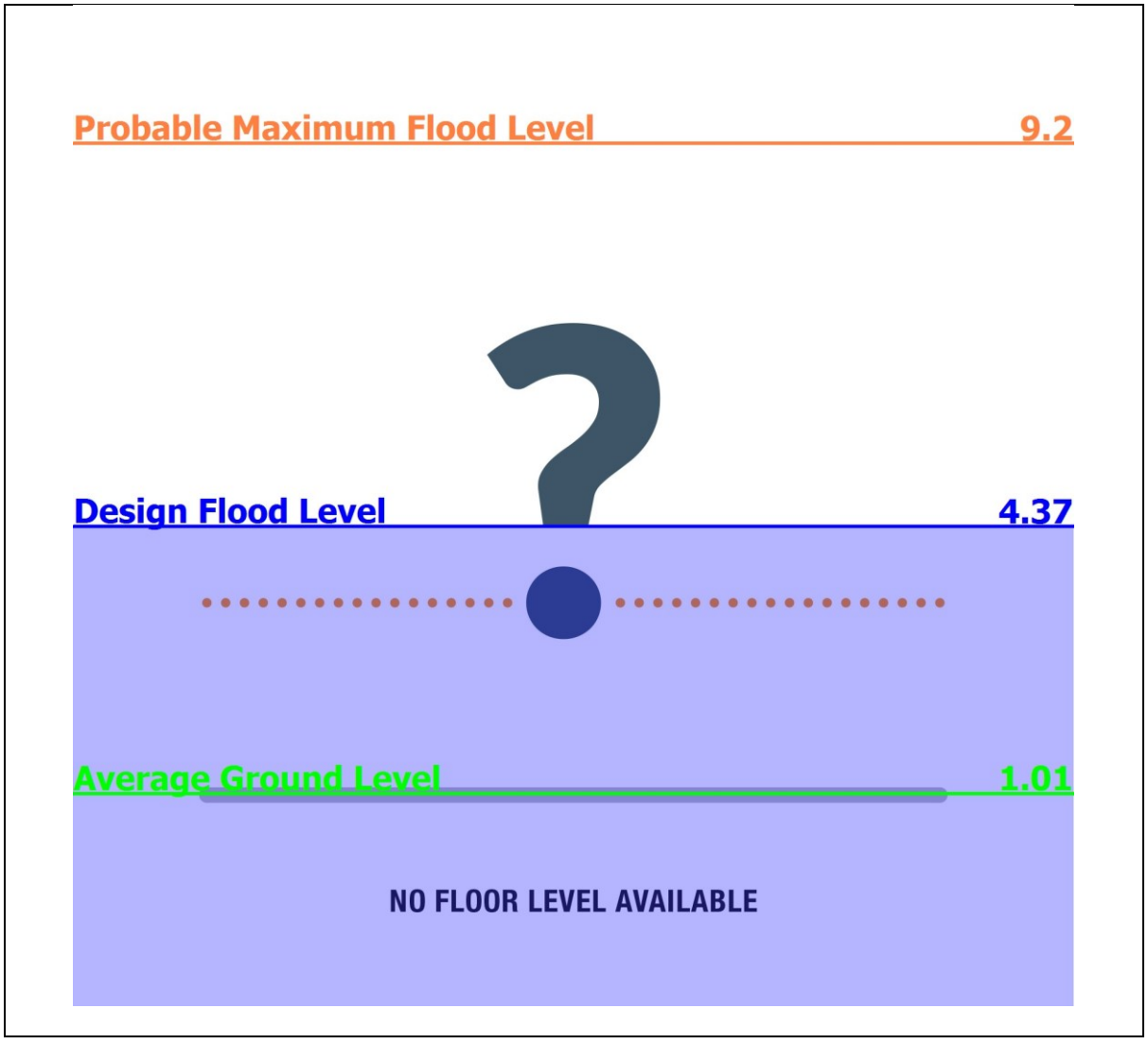

Figure 1: Flood and Ground Levels at Dulguigan Road DULGUIGAN NSW 2484

The ground level provided above is taken at the centre of the property and is approximate only. If accurate levels are required this should be confirmed by a registered surveyor.

Be Prepared

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Website: www.ses.nsw.gov.au

Flood & Storm Emergency: 132 500

Life Threatening Situations: 000

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Technical Information

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Property Address: **Dulguigan Road DULGUIGAN NSW 2484**

Lot/Section/Deposited Plan: 1//DP364474

Property Levels

Description	Minimum (m AHD)	Maximum (m AHD)
Approximate Ground Level	0.1	5.6
Approximate Floor Level (2012)	Not Available	

Planning Levels

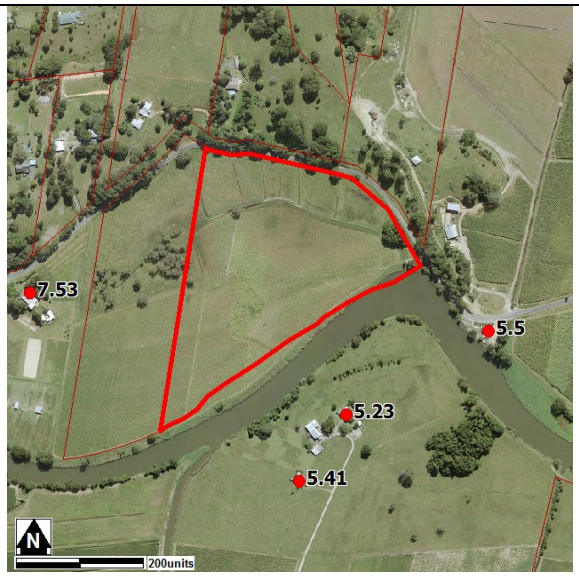
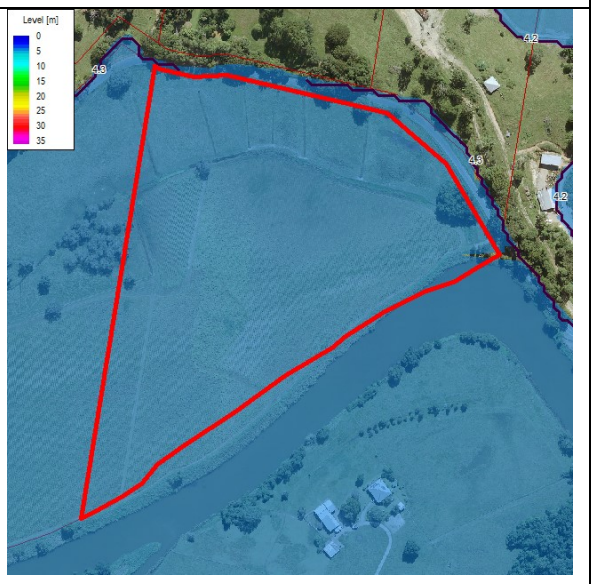
Planning Level	Level (m AHD)
Design Flood Level	4.4
Minimum Habitable Floor Level (Flood Planning Level)	4.9
Climate Change Design Flood Level*	4.6
Climate Change Habitable Floor Level*	5.1
High Flow Area	Yes
High Hazard Area	No

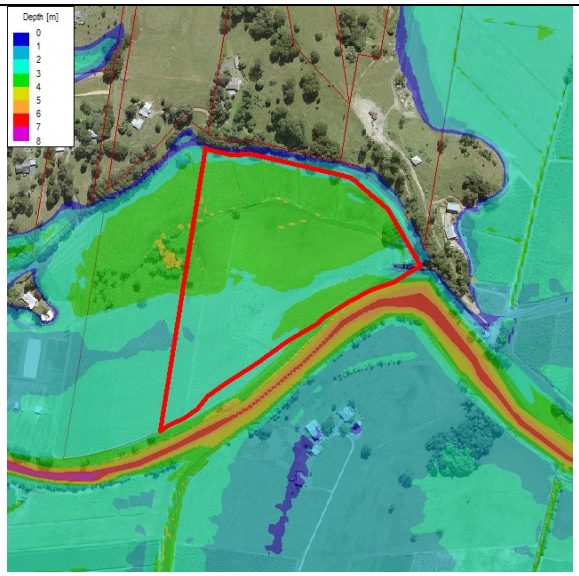
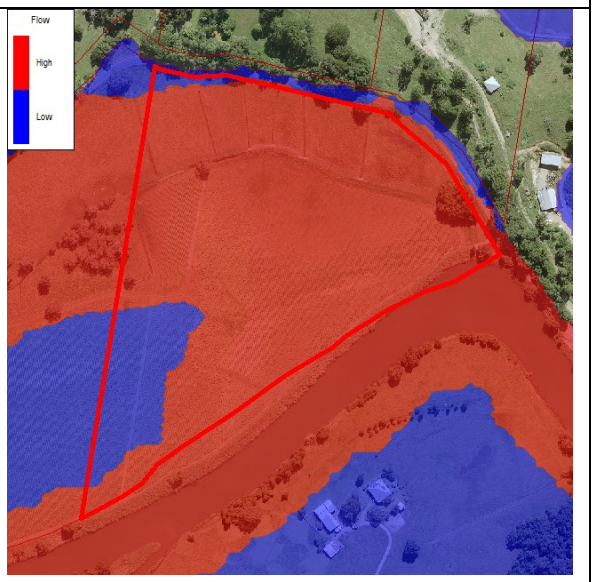
* Climate Change Levels are compulsory in new urban land release subdivision areas

Flooding Levels

Flood Event	Minimum Level (m AHD)	Maximum Level (m AHD)
20% AEP	3.1	3.2
5% AEP	3.6	3.6
1% AEP	4.4	4.4
Climate Change 2100 1% AEP	4.6	4.6
0.2% AEP	5.5	5.5
Probable Maximum Flood (PMF)	9.2	9.2

Mapping

Overview and Locality	Design Flood (1% AEP) - Height
	

Design Flood (1% AEP) - Depth	High/Low Flow Classification
	

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Information Sources

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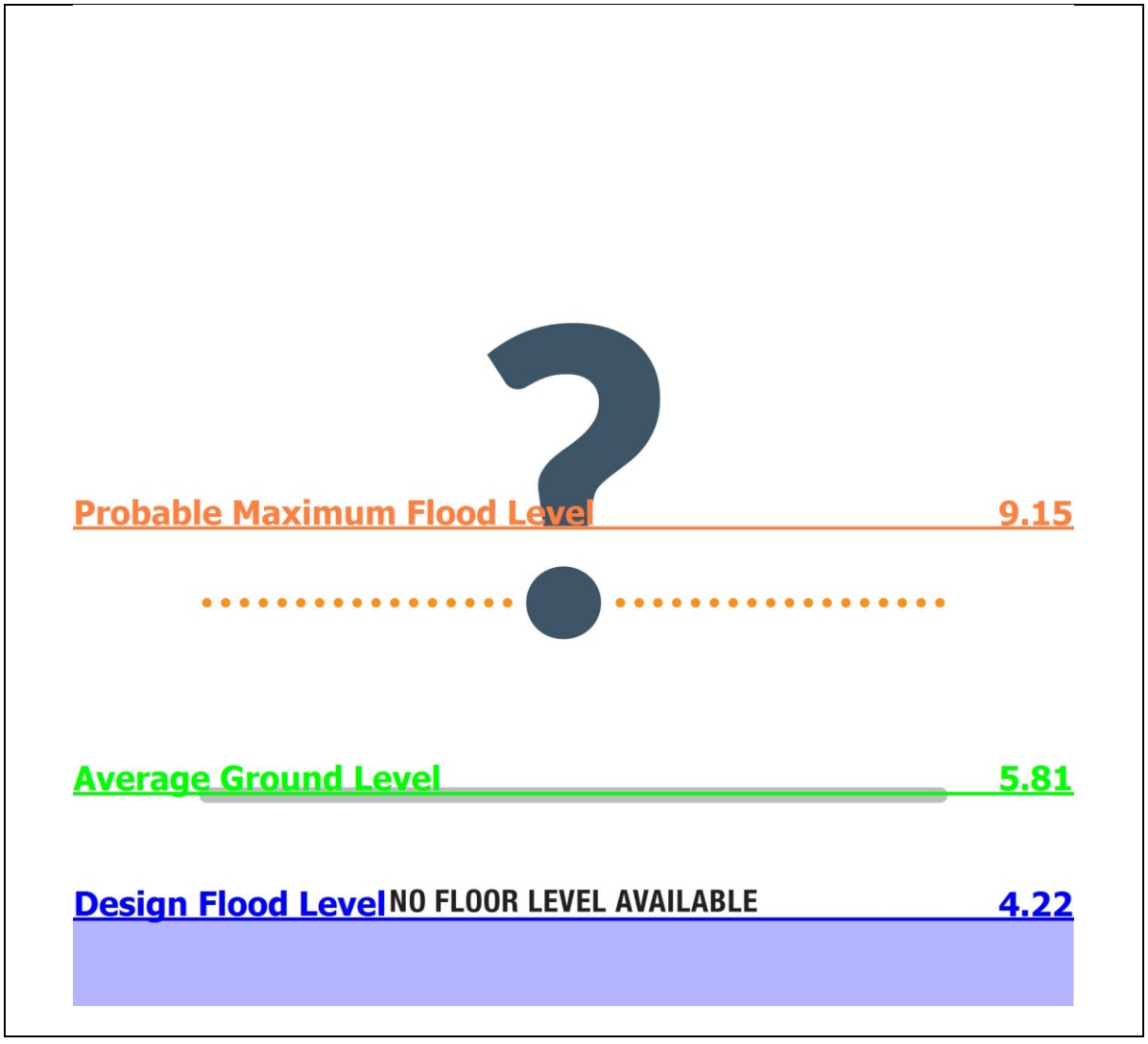
Lot/Section/Deposited Plan: 1//DP376131

Date Prepared: 12/08/2020



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Property Levels

Description	Minimum (m AHD)	Maximum (m AHD)
Approximate Ground Level	0.6	40.7
Approximate Floor Level (2012)	Not Available	

Planning Levels

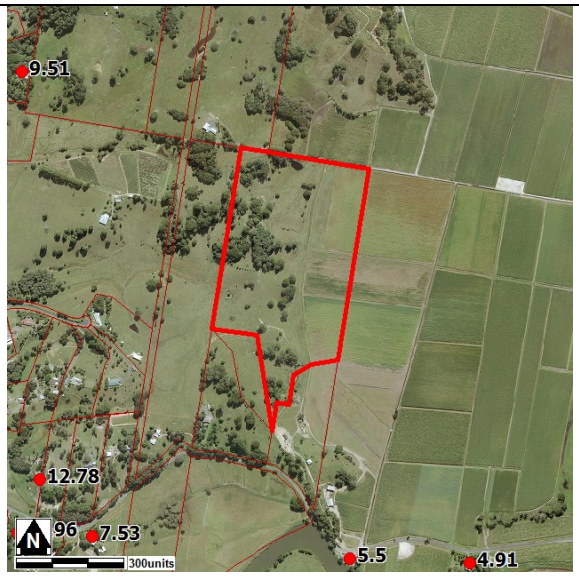
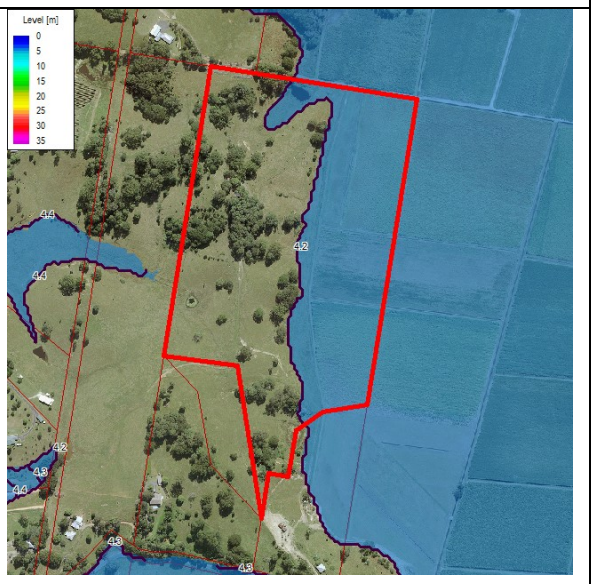
Planning Level	Level (m AHD)
Design Flood Level	4.4
Minimum Habitable Floor Level (Flood Planning Level)	4.9
Climate Change Design Flood Level*	4.6
Climate Change Habitable Floor Level*	5.1
High Flow Area	No
High Hazard Area	No

* Climate Change Levels are compulsory in new urban land release subdivision areas

Flooding Levels

Flood Event	Minimum Level (m AHD)	Maximum Level (m AHD)
20% AEP	2.9	2.9
5% AEP	3.5	3.5
1% AEP	4.2	4.2
Climate Change 2100 1% AEP	4.5	4.5
0.2% AEP	5.4	5.4
Probable Maximum Flood (PMF)	9.1	9.2

Mapping

Overview and Locality	Design Flood (1% AEP) - Height
	

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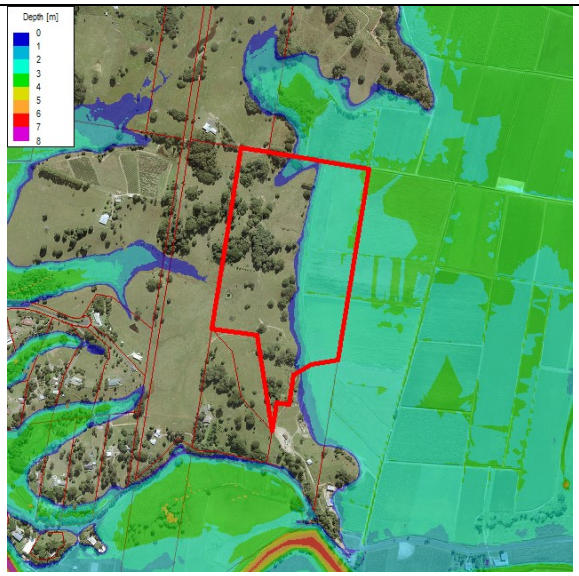	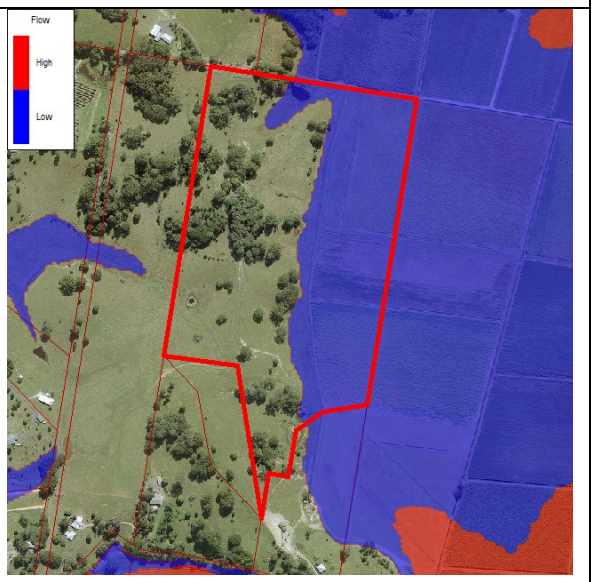

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