Engineering Impact Assessment Report
for
Highway Service Centre Chinderah
For P Guinane Pty Ltd

Engineering Impact Assessment Report

Highway Service Centre Chinderah

For P Guinane Pty Ltd

Revision C

Prepared By

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Status: Revision C

Contents

1 INTRODUCTION

P Guinane Pty Ltd has commissioned Opus International Consultants (Australia) Pty Ltd (Opus) to assess the impacts of the approval of a highway service centre development at Tweed Valley Way, Chinderah, NSW.

The assessment addresses the following issues:

- Stormwater drainage impacts
- Stormwater quality impacts
- Flooding impacts
- Earthworks impacts including erosion control
- Water demand analysis

2 DEVELOPMENT LOCATION

The proposed development site is located on Tweed Valley Way, Chinderah in the Shire of Tweed and is over three lots identified as Lot 11 DP1134229, Lot 1 DP1165676 and Lot 1 DP 210674. The development site has an area of approximately 3.90 hectares. The site locality is given in Figure 1.0 in Appendix C.

3 EXISTING DRAINAGE

The proposed development site is currently vacant land covered in grass.

The existing ground levels vary within the proposed development area from approximately R.L 1.10m AHD to R.L -0.60m AHD. The development site is bounded by the Pacific Highway to the east, Tweed Valley Way to the west and agricultural lots to the south.

There is an existing dam located to the south of the development site. The site is currently accessed from Tweed Valley Way.

The development site is generally flat with an average approximate grade of 0.4 %. Currently the site discharges to the west into a table drain along the Tweed Valley Way. The table drain flows south and ultimately discharges into an irrigation channel to the west via a 1500mm diameter pipe culvert under Tweed Valley Way.

The irrigation channel discharges into the Tweed River a further 750m to the west. This is the legal point of discharge.

The survey plan is attached in Appendix A

4 DESCRIPTION OF PROPOSAL

The current proposal is for a commercial service centre development. The proposed service centre contains a service station, 4 leasable tenancies for fast food takeaway outlets, 97 public car spaces, 20 staff car spaces, 5 caravan/ bus spaces and 25 truck (b-double) spaces.

The proposed development will occupy an area of 3.90 ha.

The site layout and subdivision plan is attached in Appendix A.

5 EARTHWORKS

5.1 EXISTING SITE

The site is generally flat and existing ground levels are generally in the range of R.L 1.10 m AHD to R.L -0.6m AHD throughout the proposed development area. Tweed Valley Way and the Pacific Highway are generally higher than the site with levels of R.L 1.60m AHD to R.L 1.90m AHD around the perimeter of the site.

5.2 PROPOSED EARTHWORKS

Tweed Shire Council Development Control Plan A3 Development of Flood Liable Land mapping defines the Q100 flood level at the site to be R.L 3.50m AHD

Filling of the site will be undertaken to provide design floor levels of the service centre and fuel pumps / filling stations above the defined flood level. The remainder of the development site will be filled and graded as necessary to achieve appropriate carpark levels and slopes, and to facilitate stormwater drainage.

Carpark levels grade up across the site from about R.L. 1.8m AHD towards the access off Tweed Valley Way (which is at about R.L. 1.6m AHD), to R.L. 3.65m AHD at the highest point on the northern side of the main building. Slopes throughout the carpark area are a maximum of 2.5%.

The minimum level in the vicinity of the pumps is R.L.3.5 AHD (the design Q100 flood level). On-site effluent disposal areas are at R.L. 2.9 AHD (the defined Q50 flood level).

The entire service centre site will be higher than both adjoining roads - Tweed Valley Way and the Pacific Highway. The centre will not operate when the surrounding roads are flooded.

The proposed fill footprint and preliminary levels are indicated on the proposed Bulk Earthwork plan attached in Appendix C.

The type of imported fill material will preferably be of a granular nature and will be required to comply with engineering criteria to limit sensitivity due to moisture such that any building foundation can be designed for an “S” or “M” soil classification. Furthermore, the soil required for road subgrade construction will also be specified to have characteristics to minimise pavement

depths. There are a range of soil types available which will meet the above criteria. Sources will be advised prior to construction.

The upper 1m of the fill to be used in the effluent disposal area will be non-compacted customized profile. The filling in the effluent disposal area will be carried out in accordance with the 'On-site Sewerage Management Report' prepared by HMC Pty Ltd.

Proposed batters along boundaries will have maximum slopes of 1V:2H. Most of the batters will have slopes of 1V:4H.

Retaining walls are proposed along some part of the northern boundary. Retaining walls will be provided in accordance with Tweed Shire Council Development Design Specification D6. Actual retaining wall heights and foundation requirements will be determined as part of a geotechnical investigation during the detailed design stage.

6 FLOODING

6.1 DESIGN FLOOD LEVEL

The Tweed Shire Council (TSC) Development Control Plan (DCP) Section A3 Development of Flood Liable Land Maps identifies the lot within a Q100 flood zone with a flood level of RL 3.40m AHD. The proposed design flood level in accordance with the DCP is the next flood contour being RL 3.50m AHD.

6.2 FLOOD HAZARD ASSESSMENT

BMT WBM has been commissioned to undertake a flood impact assessment to assess the impact of the proposed development on the existing flood levels.

BMT WBM developed a regional flood model as part of the Tweed Valley Flood Study Update (TVFS) in 2009 for Tweed Shire Council (Council), which has been used for the analysis.

This regional model had a 40m grid resolution and was used as a basis for this flood impacts assessment. The TVFS model resolution of 40m was considered to be too coarse to capture the details of the proposed development. The model was refined to 10m resolution from about 1.4km upstream of the site to about Barneys Point, (where the Pacific Motorway crosses the Tweed River just north of Kingscliff).

For the developed case, the topography of the area has been updated with the proposed site layout and proposed elevations. The entire site has been modelled with a roughness value of 1.0 (consistent with the regional model) representing urban areas. The base case and proposed development options have both been simulated for the 100 year ARI event only.

WBM BMT flood analysis confirms that the peak flood levels do not increase more than 0.01m due to the impact of the proposed development. This is considered as negligible.

The flood impact assessment is appended to this report in Appendix D.

7 STORMWATER QUANTITY MANAGEMENT

7.1 EXISTING DRAINAGE

The proposed development site is currently vacant land covered in grass. The development site is generally flat with an average approximate grade of 0.4 %. Currently the site discharges to the west into a table drain along the Tweed Valley Way. The table drain flows south and ultimately discharges into an irrigation channel to the west via a 1500mm diameter pipe culvert under Tweed Valley Way.

The irrigation channel discharges into the Tweed River a further 750m to the west. This is the legal point of discharge.

7.2 CALCULATION OF PEAK RUNOFF

7.2.1 RATIONAL METHOD CALCULATIONS

The proposed development site forms part of a single catchment (Catchment A) that contributes runoff into the existing 1500mm culvert under Tweed Valley Way. The catchment consists of the proposed site area and the adjacent areas to the south including the dam and two buildings.

The total catchment area is 7.94 ha. Catchment plans are attached in Appendix B.

Rational Method calculations (as per Section 4.01a of the QUDM 2007 guidelines), were undertaken to estimate the peak discharge during various storm events for both the existing site and the proposed development.

A time of concentration of 33min has been calculated for Catchment A as summarised in Table 7.1 below.

Table 7.1 – Catchment A Time of Concentration

Catch-ment	Flow component	method	QUDM (2007) ref.	Length (m)	Slope (%), Stream Velocity (m/s),	Travel Time (min)	Time of Concentration (min)
A	sheet	Friend's Equation	Figure 4.07	50	0.5%	12	33
	channel	Stream velocity method	Table 4.06.5	386	0.3 m/s	21	

An IFD chart for the subject site was created, a copy of which is available for review in Appendix B. It was compared and found to be consistent with Table D5.1 from the Tweed Shire Council Development Design Specification D5 – Stormwater Drainage Design.

Runoff coefficients were sourced from the same document.

Impervious fractions were calculated from the existing site survey, aerial photographs and the proposed site layout. The percentage impervious area for Catchment A was calculated as approximately 1% for the existing case and approximately 45% for the developed case.

Due to the increase in impervious area, an increase in peak discharge off site, post development, is anticipated.

Table 7.2 below summarises the existing and developed case peak flows from the total catchment and the increase of flow towards the culvert to the west. For detailed Rational Method calculations for all storm events refer to Appendix B.

Table 7.2 –Catchment A Peak Runoff

ARI (years)	Peak Runoff (m^3/s)	
	Existing	Developed
1	0.59	0.66
2	0.90	1.02
5	1.27	1.43
10	1.53	1.72
20	1.85	2.09
50	2.33	2.63
100	2.81	3.13

As demonstrated in Table 7.2, peak flows discharging to the west from Catchment A are slightly increased when compared to the existing situation.

7.2.2 Partial Area Effect Calculation

The partial area effect has been considered for the catchment.

The time of concentration for runoff from the sealed development area is shorter than that for the whole catchment. This results in higher design intensities for that area. Whilst the contributing area is less, the higher intensity and higher fraction impervious might give higher calculated peak discharges.

The time of concentration for the sealed area has been calculated as 20 minutes. The total catchment contributing runoff into the culvert in that time has been calculated as 6.4 ha. The developed peak 100 year ARI runoff for this area has been calculated as 3.15 m^3/s.

This is very similar to, but slightly larger than, the developed peak flow from the entire catchment.

The developed peak flow (Q100) for the hydraulic analysis has been adopted as 3.15 m^3/s.

7.3 CULVERT CAPACITY CALCULATION

The entire Catchment A discharges into the existing 1500 diameter culvert under Tweed Valley Way. The existing culvert is currently preceded by a 600mm diameter pipe which is to be removed.

The capacity of the existing culvert has been calculated as approximately 3.5 m^3/s. The culvert therefore has the capacity to convey the 100 year ARI runoff from the developed catchment without requiring an upgrade.

Due to the flat gradient of the site, the runoff from the catchment will pond around the inlet of the culvert. The increase in the ponded water level for 100 year ARI flow has been calculated using the design nomograph for pipe culverts from the Department of Main Roads Road Drainage Manual.

Calculated inlet depths are presented in Table 7.3 below.

Table 7.3 – Tweed Valley Way Culvert Inlet Depths

	Q100 Peak Runoff (m3/s)	Existing culvert Diameter (mm)	Water level in Culvert above invert (mm)
Existing	2.81	1500	1320
Developed	3.15	1500	1410

Post development, the water level immediately upstream of the culvert will be increased approximately 90 mm for the ARI 100 year event. This increase is unlikely to have any significant impact.

7.4 STORMWATER DRAINAGE SUMMARY

As demonstrated in the Tables 7.2 and 7.3 above, there is minor increase in the runoff from the proposed development compared to the runoff under existent conditions.

The total peak runoff from the developed catchment will be contained in the 1500mm culvert under Tweed Valley Way without requiring an upgrade.

There will be an increase of 90 mm in the ponded water level immediately upstream of the culvert during a100 year ARI event. This is considered insignificant.

The proposed development will have no impact on the existing drainage capacity and negligible impact on downstream properties.

As part of the proposed development it is recommended that the existing 600mm culvert be removed to improve flow conditions through the culvert under Tweed Valley Way.

The internal drainage network will provide sufficient stormwater drainage for the site and will be designed during detailed design stage to Tweed Shire Council Development Design Specification D5.

The proposed Stormwater Plan is attached in Appendix C.

8 STORMWATER QUALITY MANAGEMENT

8.1 CONSTRUCTION PHASE SEDIMENT AND EROSION CONTROL

A number of measures or best management practices (BMP) should be implemented to reduce soil erosion and achieve discharge water quality in compliance with Tweed Shire Council Design Specification D7 Stormwater Quality.

The best management practices should be implemented according to the Department of Housing Manual 'Managing Urban Stormwater, Soils and Construction' (2004 'Blue Book'). These measures include hay bales, silt fencing and diversion channels which should be placed in accordance with the proposed management plan during both the construction and re-vegetation phases. Disturbed areas should generally be controlled to drain to these features.

There are no external catchments which flow through the site.

Earthworks to the development site will create approximately 3.90 Ha of disturbed area during construction. Design Specification D7 indicates that for disturbed areas of greater than 1.0 ha provision of sediment basins is required. Other sediment and erosion controls to be employed are silt fencing, hay bales, rock check dams, cut off drains and diversion channels.

The Revised Universal Soil Loss Equation (RUSLE) will be used to size proposed sediment basins. Stabilised construction site entry will be located off Tweed Valley Way.

Figure 4.0 attached in Appendix C demonstrates the sediment and erosion control measures likely for proposed development.

Due to the low lying nature of the existing surface of the site it is likely that groundwater will be encountered during the excavation of services trenches. The possible presence of acid sulphate soils also indicates that the ground water (and any stormwater) removed from open trenches may require treatment prior to discharge from site. The discharged water must satisfy Tweed Shire Council requirements.

An acid sulphate soil investigation has been undertaken by HMC Pty Ltd to identify the risk of acid sulphate soils and mitigation measures. The investigation report will be submitted separately.

8.2 PROPOSED OPERATIONAL PHASE TREATMENT MEASURES

Development of the site will increase the concentrations of suspended solids, nitrogen and phosphorous in stormwater runoff compared to the existing undeveloped catchment if untreated.

Pollutants from commercial areas generally comprise gross pollutants (trash and sediments), biological pollutants (decaying vegetable matter and animal excreta) and nutrients (nitrogen and phosphorus). Road areas typically collect oil products and sediments from vehicles and drain rapidly to the stormwater system.

Tweed Shire Council specify "Deemed to Comply" stormwater treatment requirements in Tweed Shire Council Design Specification D7 – Stormwater Quality.

Design Specification D7 indicates that litter/gross pollutant collection devices and oil/grit separators are generally suitable for treatment of surface runoff from road areas for a 3 month ARI storm event. The nominated requirements for proprietary stormwater treatment devices are storage capacities of 9 m^3 per impervious hectare and 2 m^3 per impervious hectare for sediment and oil respectively.

The proposed development will provide suitable "Deemed to Comply" treatment devices. Proprietary GPT devices such "Humeceptor" (Humes) are proposed to treat the stormwater runoff in accordance with the "Deemed to Comply" requirements.

The proposed development area of 3.90 ha will require GPT's with a combined equivalent storage capacity of 35.1 m^3 for sediment and 7.8 m^3 for oil. This will be achieved by having a combination of one STC 9 and two STC 18 Humeceptors.

A fuel and oil separator is proposed to treat stormwater within the vicinity of the fuel pumps and tank filling points. Discharge will be in accordance with Tweed Shire Council waste disposal guidelines.

8.3 WATER QUALITY CONCLUSION

Implementing the proposed Stormwater Quality Improvement Devices with Water Sensitive Urban Design strategies such as grassed swales and vegetated buffers, incorporated within the landscape, will mitigate the potential increase in pollution attributable to development of this site.

The proposed measures will ensure the development achieves compliance with Council's stormwater quality objectives in accordance with the Tweed Shire Council Design Specification D7 Stormwater Quality.

9 WATER RETICULATION

9.1 EXISTING WATER RETICULATION

The existing lot is serviced by a water connection with a water meter coming off the 300 trunk main running along the western side of Tweed Valley Way. The water connection is 15mm in diameter. The number of the water meter is 05W881358.

Tweed Shire Council has advised that they would not provide a new connection for the proposed development from the existing DN300 trunk water main in Tweed Valley way. Therefore, alternative options for the provision of potable water and fire fighting for the proposed service station have been investigated.

9.2 WATER DEMAND CALCULATION

9.2.1 Generic Demand Rates

Using values obtained from Tweed Shire Council Fees and Charges 2012-2013 and Design Specification D11 – Water Supply, the proposed 3.90 ha development will result in Equivalent Tenements (ET) and demand rates as outlined in Table 9.1.

Table 9.1 - Maximum Daily Water Supply Demand – Generic Demand Rates

Development Type	Quantity	ET Rate	ET	Maximum Daily Demand (kL/day) *
Service Station	12 lanes	0.6 ET/lane	7.2	14.1
Fast Food/Takeaway	400 m2	0.03 ET/ m2	12	23.5
Total			**43**	**37.6**

* Where maximum daily demand = 700 L/EP/day and 1 ET = 2.8EP

The required fire fighting flow in accordance with Council Design Specification D11 is 22L/s and a minimum residual fire fighting head of 15m concurrent with the peak hour demands.

9.2.2 Historical Demand Rates – Similar Development

Tweed Shire Council have been contacted for some water consumption data for the existing BP Service Station at Chinderah which is similar in size to the proposed service station.

Their water consumption is presented in Table 9.2 below.

Table 9.2 - Annual Water Supply Demand – Historical Demand Rates

Year	Water consumption (kL/year)
2009/10	4045
2010/11	4605
2011/12	5267

9.2.3 Adopted Demand Rates

As per Table 9.2 above, an average water consumption of 5000 kL/year (14kL/day) has been adopted as a realistic estimate of the likely demand of the proposed development based on the available historical demand rates from a nearby similar development.

This is consistent with the On-site Sewerage Management Report prepared by HMC Pty Ltd, which should be consulted for greater detail on the estimated consumption. It is noted that water reduction fixtures will be fitted throughout the facility.

9.2.4 Fire Fighting Requirements

As per Tweed Shire Council Development Design Specification D11 – Water Supply Fire Fighting requirement for a commercial site is 22 L/s.

If fire supply is provided by storage, the minimum storage required to supply the demand for 4 hours will be 317 kL.

9.2.5 Existing Connection

The proposed development will use the existing DN 15 connection for Lot 11 DP 11344229. It is currently situated about 350 metres south of the Highway Service Centre Site and on the western side of Tweed Valley Way. This existing connection will be extended to the development area.

Using the existing connection to refill the proposed tanks, the average daily demand will require a flow from the existing connection of 0.16 l/s. The existing connection is capable of providing the peak daily flow from this connection. However, subject to approval by Tweed Shire Council, upgrading of the existing connection is proposed to provide a higher level of supply security.

9.3 PROPOSAL

9.3.1 Potable water

- A 22.5 kL tank for potable water supply will be provided on site with appropriate pressure pumps. This will provide for peak demand flow and provide 1.5 days of storage in the event that the trunk water main is not available for maintenance. An additional 22.5 tank could be provided to provide additional security of supply, if necessary

- A DN50 supply main will be provided between the existing connection and the proposed tanks. If approved, increasing the size of the DN15 connection to DN50 (or greater) is preferred, however the existing connection can provide adequate service for potable water.

9.3.2 Fire demand

- There is currently an existing dam on site which historically holds much more water than the required amount for fire fighting even in drought conditions. The existing dam is proposed to provide fire fighting supply for the proposed development.
- Power supply and existing pumps capable of providing the required supply of 22 l/s are currently available on site.
- The use of the dam supply is subject to approval of the Fire Service. If this approval is not obtained, a dedicated fire storage tank with a capacity of 320kL will be provided.
- Based on the above, adequate fire fighting capacity can be provided for the development.

10 CONCLUSIONS

The proposed development will require filling and regrading to construct building pads, provide compliant car parking grades and to facilitate stormwater drainage. The proposed filling will provide design floor levels of the service centre and fuel pumps / filling stations above the Q100 flood level of R.L 3.50m AHD as defined by Tweed Shire Council Development Control Plan.

The proposed earthworks and filling of the site will have no measurable impact on the potential for flood damage, nuisance or hazard of adjacent properties as outlined in the BMT-WBM Flood modelling.

There will be a minor increase in the runoff from the proposed site compared to the runoff under existing conditions. However, the peak discharge from the catchment in a 100 year ARI storm event will be contained in the existing 1500mm culvert under Tweed Valley Way. Tweed Valley way will not be overtopped due to the proposed development.

There will be an increase of 90 mm in the ponded water level immediately upstream of the culvert. This is considered insignificant. The existing 600mm culvert will be removed to improve the existing flow condition through the culvert under Tweed Valley Way.

Overall, the proposed development will have a negligible impact on existing drainage capacity and on downstream properties.

The proposed development has potential to increase stormwater pollutants in runoff leaving the site. The potential increase will be reduced by gross pollutant traps such as 'Humeceptor' and water sensitive urban design strategies such as grassed swales and vegetated buffers. The proposed measures will ensure compliance with Council's stormwater quality objectives in accordance with the Tweed Shire Council Design Specification D7 Stormwater Quality.

The existing lot of which the proposed site forms part, is currently serviced by an existing DN 15mm connection and water meter coming off the DN 300mm trunk main running along the western side of Tweed Valley Way. This existing connection will be used solely for the proposed development. A dedicated line is to be installed from the water meter and extended in to the site.

It has been demonstrated that the existing DN15 connection will be adequate for the potable water demand for the proposed development. The existing dam on site will be capable of providing fire fighting supply.

11 REFERENCES

QUEENSLAND GOVERNMENT NATURAL RESOURCES AND WATER	(2007)	Queensland Urban Drainage Manual Volume 1, Second Edition
TWEED SHIRE COUNCIL	(2004)	Development Design Specification D5 – Stormwater Drainage Design
	(2005)	Development Design Specification D7 – Stormwater Quality
	(2006)	Development Design Specification D6– Site Regrading
	(2011)	Development Design Specification D11 - Water Supply
	(2010)	Tweed Development Control Plan Section A.3
	(2012)	Tweed Shire Council Fees and Charges 2012/2013

APPENDIX A

SITE AREA SCHEDULE:

SITE:	39003m²
BUILDING (ENCLOSED):	1270m²
LANDSCAPING:	12334m²
PAVEMENT/CONCRETE:	26928m²
AREA UNDER CAR CANOPY/LINK:	880m²
AREA UNDER TRUCK CANOPY:	280m²

PARKING SCHEDULE:

CAR:	97
STAFF CAR:	20
TRUCK (B-DOUBLE):	25
BUS/CARAVAN:	5

REAL PROPERTY DESCRIPTION

LOT 11 IN DP1134229 PART LOT 1 DP1165676
PART LOT 1 DP210674
LOCAL AUTHORITY: TWEED SHIRE COUNCIL

1 SITE PLAN
1 : 500 @ A1

0 10 30m

building designers' association of queensland inc.
Membership No. 563
QBSA Lic. No. 637576

ISS	DATE	AMENDMENT	CKD
A	19.02.13	PRELIMINARY ISSUE FOR CLIENT REVIEW	JC
B	20.02.13	REVISED ISSUE FOR CLIENT REVIEW	JC
C	08.03.13	REVISED ISSUE FOR APPROVAL	JC
D	22.03.13	PRELIMINARY ISSUE FOR CLIENT	JC
E	28.03.13	ISSUE FOR TENANTS INFORMATION	JC
F	04.04.13	ISSUE FOR APPROVAL	JC
G	08.04.13	UPDATED ISSUE FOR APPROVAL	JC
H	05.06.13	REVISED SITE BOUNDARY	NGR
J	12.06.13	REVISED AS PER TRAFFIC ENG. REQUIREMENTS	NGR
K	25.06.13	FINAL DRAFT ISSUE	JC
L	02.07.13	ISSUE FOR DA	JC
M	04.07.13	ISSUE FOR DA	JC

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ISSUED FOR DEVELOPMENT APPROVAL

40/7/2013 9:41:56 AM

CADWAY PROJECTS
24/115 Wickham Street, PO Box 724
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T (07) 3257 2755 ■ F (07) 3257 2882
www.cadway.com.au
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acn: 106 382 227
abn: 72 106 382 227

FULL SIZE @ A1

project description
PROPOSED HIGHWAY SERVICE CENTRE

project address
CHINDERAH NORTHBOUND
PACIFIC HIGHWAY & TWEED VALLEY WAY
CHINDERAH NSW

client
IMPEXON AUSTRALIA PTY LTD

drawing title
CONCEPT SITE LAYOUT

1 : 500 @ A1	scale
19.02.2013	date
JC	drawn
DA	checked
10948	job no.
10948 SK02	dwg no.
M	issue

M.G.A

2
DP1163038

1011·7

331·957

(VARIABLE WIDTH)

RIVER

TWEED

110
29·02 ha

1
DP210674

314·40

WAY

SEE
DIAGRAM

77·39

71·58

65·55

122·43

112
3·90 ha

11
DP1134229

1
DP1165676

BOUNDARY

EXISTING

11
DP1134229

PROPOSED
ACCESS

31·10

19·62

11
DP1134229

90·33

HIGHWAY

70·47

750·95

91·60

45·01

57·57

(A)

45·63

175·71

90·93

PROPOSED
ACCESS

PART
111

160·93

ROAD

382·95

224·22

11
DP1134229

10
DP1134229

115·47

(E)

216·39

590·97

326·90

282·87

VALLEY

1

EXISTING BOUNDARY

DP1165676

2
DP612314

288·15

PART
111

50·84 ha
(TOTAL, BY DEDN)

11
DP1134229

TWEED

297·55

149·08

782·34

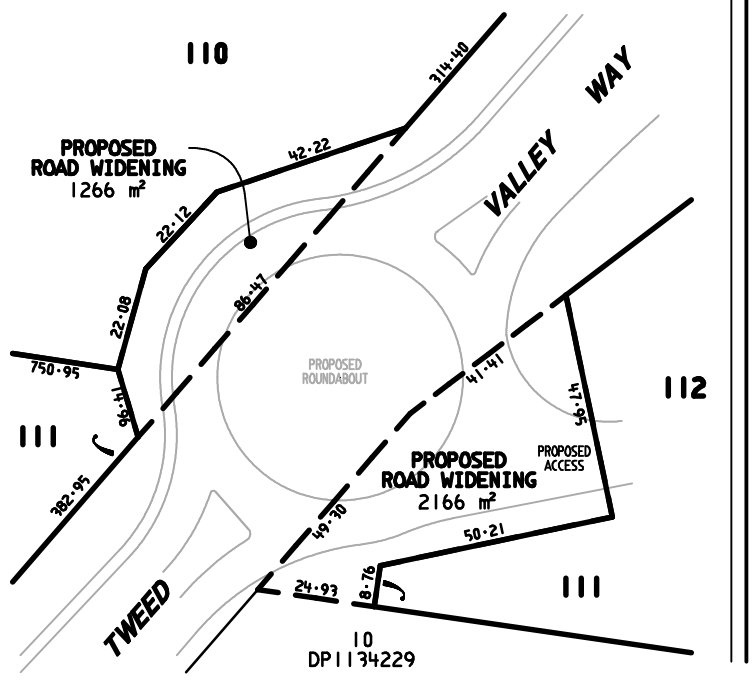
167·26

PACIFIC

707
DP1000580

DIAGRAM

SCALE 1 : 1600



(A) ... EASEMENT FOR OVERHEAD POWERLINES 20 WIDE AND VARIABLE, APPROXIMATE POSITION (DP1165676)
(E) ... EASEMENT FOR OVERHEAD POWERLINES 20 WIDE & VARIABLE (DP1134229)

Revision	Chk'd

Client

P. GUINANE PTY LTD

Important Notes:

THE PROPOSED BOUNDARIES AND AREAS AS SHOWN HEREON ARE PRELIMINARY ONLY AND ARE SUBJECT TO FINAL DESIGN, LOCAL AUTHORITY APPROVAL AND REGISTRATION IN THE LAND TITLES OFFICE (NSW).

PRELIMINARY ONLY 24/5/2013

THIS NOTE IS AN INTEGRAL PART OF THIS PLAN.

PROPOSED SUBDIVISION

Of Lot 11 in DP1134229, Lot 1 in DP1165676 and Lot 1 in DP210674

Tweed Valley Way – Chinderah

Parish of CUDGEN County of ROUS

B & P SURVEYS
CONSULTING SURVEYORS
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A QUALITY ASSURED COMPANY
Offices Also At :
Nerang Ph.(07)55960370
Murwillumbah Ph.(02)66721924

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Scale	Level Datum	Drawn	Chk'd	F.Bk	L.Bk
1 : 5000 @ A3	–	BJG		L/L	–
REF. No.	Date	Drawing No./Size			Rev.
T15950	03.05.2013	19582 D			-

Full Name	Code
SLAB LEVEL	BSLAB
CHECK	CKS
DUMPY	CDY
CONC NAIL	CN
SCREW	CS
CULV BOX	DB
CULV PIPE	DC
CONC. DRAIN	DCD
DRAIN EARTH	DE
FIELD INLET	DF
DRAIN HW	DH
Drain IL-Plastic	DIP
DRAIN OBVT	DP
Elec Stay pole	EN
Elec Pole	EP
Fence	FC
BOTTOM OF BANK	NB
CHANGE OF GRADE	NC
Natural Surface	NS
TOP OF BANK	NT
Edge of Bitumen	RB
ROAD EDGE	RE
Line Mark	RJ
Edge of Concrete	LE
WITNESS MARKER	TW
WATER Unknown	WY

IMPORTANT NOTE

- *This Plan was prepared for P Guinane Pty Ltd. It's purpose is for preliminary design. It is not to be used for any other purpose, particularly demolition, construction or excavation.*
- *No underground services are shown on this plan. Visible surface features only have been shown. Prior to any construction or excavation additional enquiries need to be undertaken, particularly with Tweed Shire Council, and Dial Before You Dig.*
- *This note is an integral part of the plan. The plan must not be reproduced without the inclusion of said note.*

DIAL 1100
BEFORE YOU DIG

TWEED VALLEY WAY

11
DP1134229

(A)

11
DP1134229

Notes & Disclaimers

No	Amendments & Additions	Date

Client: P Guinane Pty Ltd

Title: Plan of Level Survey of Part of Lot 11 In DP1134229, Part of Lot 1 in DP1165676 and Parts of Adjoining Roadways

Parish of Cudgen
County of Rous

Level Datum: AHD
Origin: PM85132
RL:2.261

Azimuth: MGA

Contour Interval:

DATE	25/9/11
JOB NO	2590
GEOCIVIL	
SURVEYED	PCC-DJP
CHECKED	
GT	

Scale: 1:1500

CHAPMAN SURVEYS
PTY LTD
ABN 21 050 445 211
Registered: N.S.W. & Qld.
CONSULTING SURVEYORS
5 Tallows Ave
Kingscliff NSW 2487
Postal:
PO Box 34 Tweed Heads
NSW 2485
TELEPHONE: 02 6674 0033
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Plan No: 2590-6

APPENDIX B

ARR 1987
FREQUENCY DURATION RELATIONSHIPS

INPUT		REFER
2 YEAR 1 HOUR	52	MAP 1.
2 YEAR 12 HOUR	9.8	MAP 2.
2 YEAR 72 HOURS	3.4	MAP 3.
50 YEAR 1 HOUR	94	MAP 4.
50 YEAR 12 HOUR	20	MAP 5.
50 YEAR 72 HOURS	6.9	MAP 6.
SKEWNESS (G)	0.0400	MAP 7.
GEO FACT. (F2)	4.42	MAP 8
GEO FACT. (F50)	17.25	MAP 9
2i6	154.8	mm/hr
50I6	263.4	mm/hr

Location: TWEED HEADS

	INTENSITY mm/hr						
D min/hrs	1 year ARI	2 year ARI	5 year ARI	10 year ARI	20 year ARI	50 year ARI	100 year ARI
5	130.62	164.68	200.04	219.42	246.72	281.71	307.88
6	122.47	154.49	187.93	206.30	232.11	265.22	290.00
7	115.66	145.98	177.81	195.32	219.88	251.41	275.02
8	109.85	138.71	169.15	185.92	209.41	239.57	262.17
9	104.80	132.39	161.61	177.73	200.28	229.25	250.96
10	100.35	126.82	154.96	170.51	192.23	220.14	241.06
11	96.39	121.86	149.03	164.07	185.04	212.00	232.22
12	92.84	117.40	143.70	158.27	178.56	204.67	224.25
13	89.62	113.36	138.87	153.01	172.69	198.01	217.02
14	86.68	109.68	134.46	148.21	167.33	191.94	210.42
15	83.99	106.31	130.42	143.81	162.41	186.36	204.35
16	81.52	103.20	126.69	139.75	157.87	181.22	198.76
17	79.23	100.32	123.24	135.99	153.67	176.45	193.57
18	77.10	97.66	120.04	132.50	149.76	172.02	188.74
19	75.12	95.17	117.05	129.24	146.12	167.88	184.24
20	73.27	92.84	114.25	126.19	142.70	164.00	180.02
21	71.53	90.66	111.63	123.33	139.50	160.36	176.06
22	69.90	88.61	109.16	120.64	136.49	156.94	172.33
23	68.37	86.68	106.84	118.10	133.65	153.71	168.81
24	66.92	84.86	104.64	115.70	130.96	150.66	165.48
25	65.54	83.13	102.56	113.43	128.41	147.76	162.33
26	64.24	81.50	100.59	111.27	126.00	145.02	159.34
27	63.01	79.94	98.71	109.22	123.70	142.40	156.49
28	61.83	78.47	96.93	107.27	121.52	139.92	153.78
29	60.71	77.06	95.23	105.41	119.43	137.55	151.19
30	59.64	75.71	93.60	103.64	117.44	135.28	148.72

Location: TWEED HEADS

	INTENSITY mm/hr						
D min/hrs	1 year ARI	2 year ARI	5 year ARI	10 year ARI	20 year ARI	50 year ARI	100 year ARI
31	58.62	74.43	92.05	101.94	115.54	133.11	146.36
32	57.65	73.20	90.57	100.32	113.71	131.04	144.09
33	56.71	72.02	89.14	98.76	111.97	129.05	141.92
34	55.81	70.89	87.78	97.26	110.29	127.14	139.84
35	54.95	69.81	86.46	95.83	108.68	125.30	137.84
36	54.13	68.77	85.20	94.45	107.13	123.54	135.91
37	53.33	67.77	83.99	93.12	105.64	121.84	134.06
38	52.57	66.80	82.82	91.84	104.20	120.20	132.27
39	51.83	65.87	81.70	90.61	102.82	118.62	130.55
40	51.12	64.98	80.61	89.42	101.48	117.10	128.88
41	50.43	64.11	79.56	88.27	100.19	115.63	127.27
42	49.77	63.28	78.55	87.16	98.94	114.20	125.72
43	49.13	62.47	77.57	86.08	97.73	112.83	124.22
44	48.51	61.69	76.62	85.04	96.57	111.49	122.76
45	47.91	60.93	75.70	84.04	95.43	110.20	121.35
46	47.33	60.20	74.81	83.06	94.34	108.95	119.98
47	46.76	59.49	73.95	82.11	93.27	107.74	118.66
48	46.22	58.80	73.11	81.20	92.24	106.56	117.37
49	45.69	58.13	72.30	80.30	91.24	105.42	116.12
50	45.17	57.48	71.51	79.44	90.27	104.30	114.91
51	44.67	56.85	70.74	78.60	89.32	103.22	113.73
52	44.19	56.24	70.00	77.78	88.40	102.17	112.58
53	43.71	55.64	69.27	76.99	87.51	101.15	111.46
54	43.26	55.06	68.57	76.21	86.64	100.16	110.37
55	42.81	54.50	67.88	75.46	85.79	99.19	109.31
56	42.37	53.95	67.21	74.72	84.96	98.24	108.28
57	41.95	53.42	66.56	74.01	84.16	97.32	107.28
58	41.54	52.89	65.93	73.31	83.37	96.43	106.30
59	41.13	52.39	65.31	72.63	82.61	95.55	105.34
60	40.74	51.89	64.70	71.97	81.86	94.70	104.41
90	32.20	41.09	51.51	57.46	65.51	75.98	83.92
2hrs	25.65	32.84	41.52	46.51	53.23	61.99	68.66
2.5	22.03	28.25	35.88	40.29	46.20	53.93	59.82
3	19.45	24.97	31.83	35.82	41.13	48.10	53.42
4	15.96	20.54	26.34	29.73	34.23	40.15	44.67
4.5	14.72	18.97	24.38	27.55	31.75	37.28	41.51
6	12.09	15.61	20.18	22.87	26.43	31.12	34.72
9	9.16	11.87	15.47	17.61	20.42	24.15	27.01
12	7.53	9.77	12.81	14.63	17.01	20.17	22.61
18	5.70	7.43	9.82	11.26	13.14	15.65	17.58
24	4.67	6.10	8.11	9.33	10.91	13.03	14.68
30	3.99	5.22	6.97	8.04	9.42	11.28	12.72
36	3.50	4.58	6.14	7.10	8.34	10.00	11.29
48	3.40	4.41	5.77	6.27	7.65	9.07	10.16
72	2.61	3.39	4.44	4.74	5.88	6.96	7.80

PROJECT Chinderah
JOB NO. N-T1033

CATCHMENT NAME Partial Area Subcatchmnet CASE Pre development

CATCHMENT AREA 6.4 ha

tc 20 min

ARI	I mm/hr	C	Q cu.m/sec
1	73.00	0.54	0.70
2	93.00	0.66	1.09
5	113.00	0.75	1.50
10	125.00	0.81	1.80
20	141.00	0.87	2.17
50	161.00	0.95	2.71
100	177.00	1.00	3.15

C10 0.81

Rational Method Calculation - Partial Area Effect

PROJECT: Chinderah Service Station
JOB NO.: N-T1033

CATCHMENT NAME: A CASE: Pre development

CATCHMENT AREA: 7.94 ha

tc: 33 min

ARI	I mm/hr	C	Q cu.m/sec
1	56.71	0.47	0.59
2	72.02	0.57	0.90
5	89.14	0.64	1.27
10	98.76	0.70	1.53
20	111.97	0.75	1.85
50	129.05	0.82	2.33
100	141.92	0.90	2.81

C10: 0.7

CATCHMENT NAME: A CASE: Post development

CATCHMENT AREA: 7.94 ha

tc: 33 min

ARI	I mm/hr	C	Q cu.m/sec
1	56.71	0.53	0.66
2	72.02	0.64	1.02
5	89.14	0.73	1.43
10	98.76	0.79	1.72
20	111.97	0.85	2.09
50	129.05	0.92	2.63
100	141.92	1.00	3.13

C10: 0.79

Rational Method Calculation - Peak Runoff

LEGEND

- EXISTING STORMATER DRAINAGE
- EXISTING CONTOURS
- PROPERTY BOUNDARY
- EXISTING CATCHMENT BOUNDARY
- EXISTING CATCHMENT LABEL

CATCHMENT	AREA (ha)
A	7.94

150 mm
100
50
0
10 mm

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RRM	RRM	MM	JUN 2013

Project No.	Scale
N-T1027.00	1:1000

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HIGHWAY SERVICE CENTER, CHINDERAH

Sheet
EXISTING CATCHMENT PLAN

Drawing No.	Sheet No.	Revision
FIGURE 5.0	05	R0

LEGEND

DEVELOPED CATCHMENT BOUNDARY

A — DEVELOPED CATCHMENT LABEL

CATCHMENT	AREA (ha)
A	7.94

150 mm
100
50
10 mm
0

N

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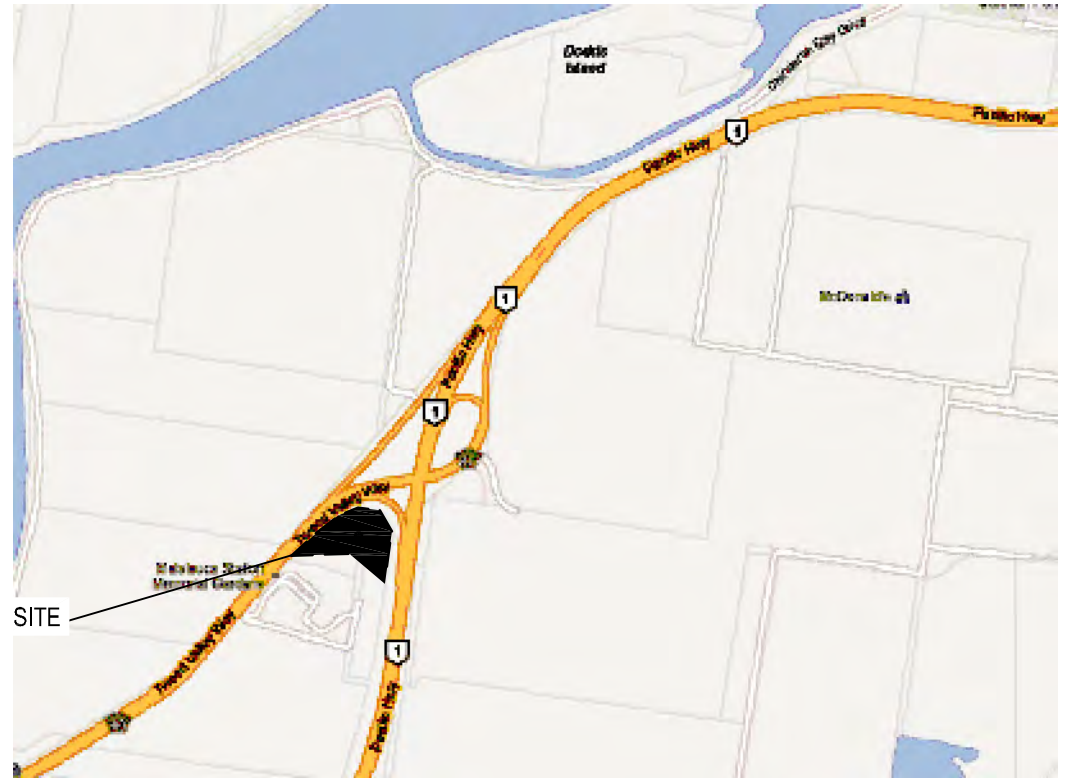
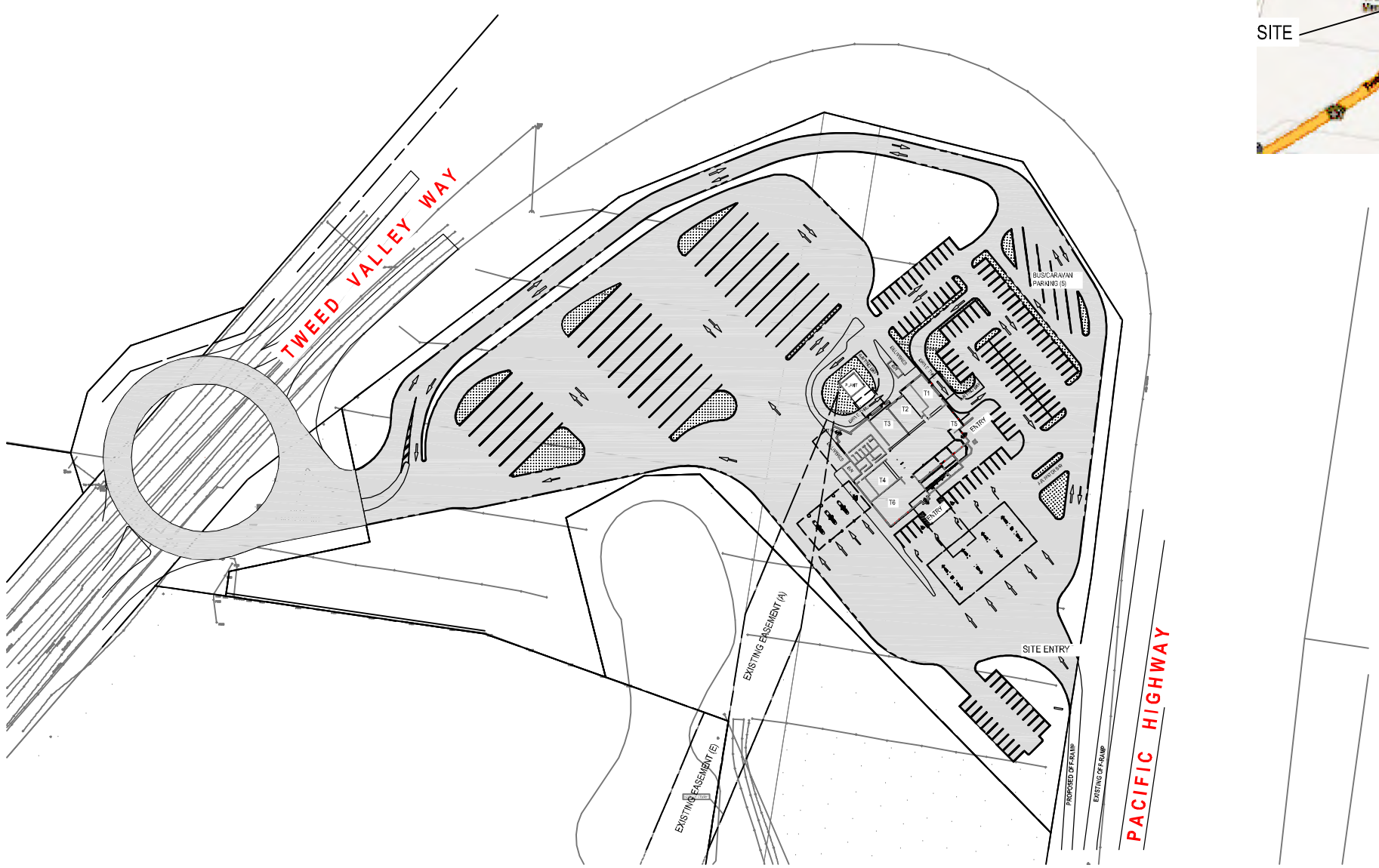
Sheet
DEVELOPED CATCHMENT PLAN

Drawing No.	Sheet. No.	Revision
FIGURE 7.0	01	R0

APPENDIX C





150 mm
100
50
10 mm
0

N

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Sheet
SITE LAYOUT AND LOCALITY

Drawing No.	Sheet No.	Revision
FIGURE 1.0	01	R0

(A)~EASEMENT FOR OVERHEAD POWER LINE 20 WIDE & VARIABLE WIDTH (APPROX. POSITION) (DP1165646)

(B)~EASEMENT FOR OVERHEAD POWERLINES 20 WIDE & VARIABLE WIDTH (DP1134229)

1
DP129741

11
DP1134229

11
DP1134229

11
DP1134229

10
DP1134229

1
DP1165676

TWEED VALLEY WAY

PACIFIC HIGHWAY

EXISTING
1500Ø
CULVERT

EXISTING
1500Ø
CULVERT

EXISTING 600Ø
CULVERT

EXISTING DAM

EXISTING
1/ 1500 x 900
& 2/ 1500 x 750
CULVERTS

EXISTING SHED
/ TEA TREE
PROCESSING

MELALUECA STATION
MEMORIAL GARDENS

(A)

(B)

IL -0,80
IL -0,81
IL -0.72
IL -0.73
IL -0.56
IL -0.57
IL 0.52
IL 0.50

LEGEND

- EXISTING STORMATER DRAINAGE
- EXISTING CONTOURS
- PROPERTY BOUNDARY
- EXISTING EASEMENTS

1:750 @A1
0 10 20 30 40 50 60 70 80 90 100 m

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Project No.	Scale
N-T1033.00	1:750

Project
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Sheet
EXISTING FEATURES PLAN

Drawing No.	Sheet No.	Revision
FIGURE 2.0	02	R0

Original Sheet Size A3 [420x297] Plot Date 12/06/2013 G:\PROJECTS 2011\N-T1033 - P Guinane Pty Ltd\N-T1033.00 - Highway Service Centre, Chinderah (lmf)\Deliver Civil

EARTHWORKS LEGEND

- PROPOSED PAVED AREA
- 2.00m — PROPOSED EARTHWORKS LEVEL
- 2.25 — PROPOSED FINISHED CONTOURS
- PROPOSED TOP OF BATTER
- PROPOSED TOE OF BATTER
- PROPOSED RETAINING WALL
- FFL 3.80m — PROPOSED FINISH FLOOR LEVEL
- PROPOSED EFFLUENT DISPOSAL AREA - RL 2.90m

TWEED VALLEY WAY

PACIFIC HIGHWAY

EXISTING EASEMENT (A)

EXISTING EASEMENT (E)

PROPOSED OFF-RAMP

EXISTING OFF-RAMP

SITE ENTRY

BUS/CARAVAN PARKING (5)

PLANT

DELIVERIES

WAITING BAY

DRIVE THRU

ENTRY

T1 T2 T3 T4 T5 T6

FFL 3.80m

RL 2.90m

1.90m 2.00m 2.20m 2.40m 2.65m 2.90m 3.40m 3.50m 3.30m 3.675m 3.65m 2.35m 2.30m 2.10m 2.00m 1.90m 1.80m 1.70m 2.00m 2.20m 2.70m 2.10m 1.80m 1.70m 3.50m 3.675m 3.65m 3.50m 3.675m 3.675m 3.50m 3.50m 3.05m 3.55m 3.50m 3.20m 3.00m

1:500 @ A1 — 0 5 10 15 20 25 30 35 40 45 50 m

Drawn: RRM	Designed: RRM	Approved: MM	Revision Date: JUN 2013

Project No.: N-T1027.00 — Scale: 1:500

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HIGHWAY SERVICE CENTER, CHINDERAH

Sheet: PROPOSED EARTHWORKS AND SITE GRADING

Drawing No.: FIGURE 3.0 — Sheet No.: 03 — Revision: R0

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EROSION & SEDIMENT CONTROL LEGEND

- PROPOSED SEDIMENT FENCE
- PROPOSED SANDBAG INLET SEDIMENT TRAP
- PROPOSED CUT OFF DRAIN
- PROPOSED FIELD INLET SEDIMENT TRAP
- PROPOSED TOP OF BATTER
- PROPOSED TOE OF BATTER
- PROPOSED RETAINING WALL
- PROPOSED FINISHED SURFACE CONTOURS
- PROPOSED STORMWATER DRAINAGE
- SEDIMENT BASIN (INDICATIVE LOCATIONS ONLY. TO BE CONFIRMED AT LATER STAGE.)
- SEDIMENT BASIN OUTLET

CHECK DAM SPACING DETAILS

DRAIN GRADE (%)	SPACING (m)
1	61.0
2	30.5
4	15.0
6	10.0
8	7.5
10>	6.0

SEDIMENT FENCE SHOWN ON THE OUTSIDE OF THE BOUNDARY FOR CLARITY ONLY.

SEDIMENT FENCE SHOWN ON THE OUTSIDE OF THE BOUNDARY FOR CLARITY ONLY.

TWEED VALLEY WAY

PACIFIC HIGHWAY

S.B.1

S.B.2

BUS/CARAVAN PARKING (5)

PLANT

WAITING BAY

DELIVERIES

BIN

DRIVE THRU

T1

T2

T3

T4

T5

T6

ENTRY

AIR/WATER BAY

TEMPORARY STABILIZED SITE ENTRY/EXIT

SITE ENTRY

TEMPORARY STABILIZED SITE ENTRY/EXIT

EXISTING EASEMENT

EXISTING EASEMENT (E)

SEDIMENT FENCE AND CUT OFF DRAIN SHOWN ON THE OUTSIDE OF THE BOUNDARY FOR CLARITY ONLY.

PROPOSED OFF-RAMP

EXISTING OFF-RAMP

1:500 @ A1

0 5 10 15 20 25 30 35 40 45 50 m

150 mm 100 50 10 mm 0

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Project No.	Scale
N-T1027.00	1:500

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Sheet
PROPOSED SEDIMENT AND EROSION CONTROL PLAN

Drawing No.	Sheet No.	Revision
FIGURE 4.0	04	R0

TWEED VALLEY WAY

BUS/CARAVAN PARKING (5)

PLANT

DELIVERIES

BIN

WAITING BAY

DRIVE THRU

T1

T2

T3

T4

T5

T6

ENTRY

AIR/WATER BAY

THE EXISTING CULVERT TO BE EXTEND

EXISTING EASEMENT (A)

EXISTING EASEMENT (E)

SITE ENTRY

PROPOSED OFF-RAMP

EXISTING OFF-RAMP

STORMWATER DRAINAGE LEGEND

SW	PROPOSED STORMWATER DRAINAGE PIPE
	PROPOSED STORMWATER FIELD INLET
	PROPOSED STORMWATER GULLY PIT
	PROPOSED STORMWATER MANHOLE
	PROPOSED TOP OF BATTER
	PROPOSED TOE OF BATTER
	PROPOSED BOULDER RETAINING WALL

1:500 @ A1

0 5 10 15 20 25 30 35 40 45 50 m

150 mm 100 50 10 mm 0

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Sheet
PROPOSED STORMWATER PLAN

Drawing No.	Sheet No.	Revision
FIGURE 6.0	06	R0

Original Sheet Size A3 [420x297] Plot Date 14/06/2013 G:\PROJECTS 2011\N-T1033 - P Guinane Pty Ltd\N-T1033.00 - Highway Service Centre, Chinderah (lmf)\Deliver Civil

APPENDIX D

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ABN 54 010 830 421

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Our Ref: MH: L.B20285.002.docx

19 June 2013

P. Guinane Pty Ltd
C/O Opus International Consultants Australia Pty Ltd
PO BOX 6389
Tweed Heads South
NSW 2486

Attention: Rodrigo Manenti

RE: FINAL REPORT FOR THE FLOOD IMPACT ASSESSMENT FOR THE PROPOSED HIGHWAY SERVICE CENTRE, CHINDERAH

This letter report outlines the background, methodology and results for the flood impact assessment for the proposed highway service centre in Chinderah.

1 Background

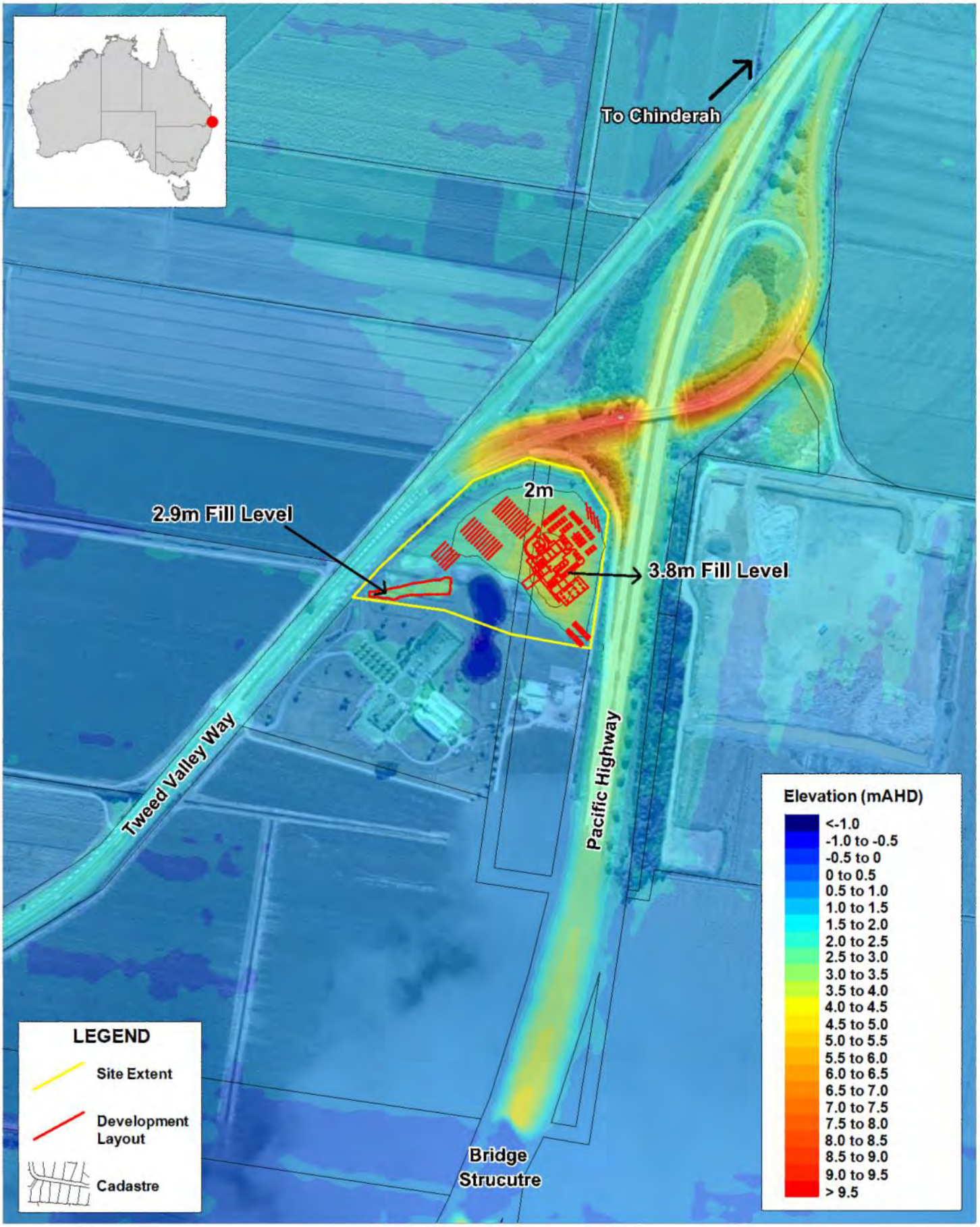
The proposed highway service centre in Chinderah is located on Lot 11 DP 1134229 (the Site). The lot is approximately 5 hectares, and is located between the Pacific Highway and the Tweed Valley Way in Chinderah, as shown in Figure 1. It is located approximately 850m to the east of the Tweed River and is currently undeveloped. The southernmost part of the Site includes part of a dam, which extends from the Site to the adjoining site. The Site currently has numerous drains running in an east-west direction, which are presented in the aerial photography and the survey data.

The Site is quite flat, with elevations ranging from 0.5 to 1.2m AHD and the local drains reaching a minimum level of approximately 0.2m AHD.

Figure 1 Site Location (Source: Google Earth)

The proposed development comprises a highway service station, which includes large car/truck parking areas, a service building, fuel pumps and an area of approximately 2,000m^2 (near the southern site boundary) used for effluent disposal, as shown in Figure 2. The Site will become mostly impervious as a result of this development.

The pad for the service station and bowsers is designed to have at least 100 year ARI flood immunity; whereas the effluent disposal area is designed to have a minimum of 40 year ARI flood immunity. Therefore, the proposed layout includes elevations between approximately 1.7m AHD for the car park area, 2.9mAHD for the effluent disposal area and 3.5m AHD in the vicinity of the bowsers, ramping up to a maximum of approximately 3.8m AHD around the service centre buildings. A level of 2.9m AHD at the Site represents a 50 year ARI event, based on the regional Tweed Valley Flood Study (TVFS) model results.



Title:

Proposed Development

Figure: 2

Rev: A

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

N

0 125 250m

Approx. Scale

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Filepath : I:\B20285_I_Chinderah\DRG\FLD_001_Site_Location.wor

2 Methodology

The proposed service centre site is within the Tweed River catchment. BMT WBM developed a regional flood model as part of the Tweed Valley Flood Study Update in 2009 (TVFS), for Tweed Shire Council (Council). This regional model has a 40m grid resolution and was used as a basis for this flood impacts assessment.

The TVFS model resolution of 40m was considered to be too coarse to capture the details of the proposed development; therefore it was refined to 10m resolution from about 1.4km upstream of the Site to about Barneys Point, (where the Pacific Motorway crosses the Tweed River just south of Kingscliff). This 10m model is nested into the coarser model (40m resolution).

The refined model topography was also updated with recently collected detailed survey data of the Site, provided by Opus.

For the developed case, the topography of the area has been updated with the proposed Site layout and proposed elevations. The material layer (i.e. Manning's roughness value) for this area has also been updated for the developed case. The entire site has been modelled with a roughness value of 1.0 (consistent with the regional model) representing urban areas.

The base case and proposed development options have both been simulated for the 100 year ARI event only. As per the adopted 100 year event in the TVFS, the 100 year ARI design flood event is based on two combinations of catchment and storm surge (oceanic flooding), as outline in Table 1. Both events were simulated for a 36 hour storm duration which was identified as the critical duration for the Tweed River catchment based on the TVFS. Stormwater flooding (i.e. from localised short-duration, high-intensity storm events) was not assessed as part of the TVFS and had not been assessed as part of this assessment.

However, the flood impact was assessed separately for each of the events, (not for the envelope of the two events) to ensure that impacts are not masked.

Table 1 Tweed River 100 Year ARI, 36 Hour Flood Event Combination

Dominant Event	Rainfall Event Size	Storm Surge Event Size
Catchment Flooding	100 year ARI rainfall	20 year ARI
Storm Surge	5 year ARI rainfall	100 year ARI

3 Results

The refined base case model (excluding the improved DEM) has been compared to the original Tweed Valley model to ensure consistency to the regional model adopted by Council. The comparison showed that flood levels upstream and downstream of the refined area are within 0.01m. It also showed that the refined model indicates slightly lower flood levels at the Site than the higher resolution model (by up to 0.15m). This was considered to be due to the finer resolution of the model, which allows a finer presentation of the topography affecting flood storage and conveyance.

This difference in flood levels between Council's adopted 40m grid model and the refined 10m model was considered to be negligible because this assessment is used to determine flood impacts and not to set fill levels. The fill levels are based on regional TVFS model adopted by Council.

The flood impact, indicating the change in flood levels and the change in flood extent, and the peak flood levels and velocities for the developed case are presented in Figure 3 to Figure 5.

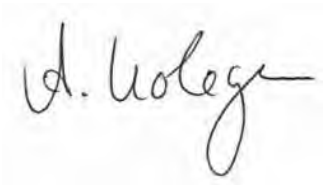
The 100 year ARI catchment event (including a 20year storm surge event) resulted in more pronounced impacts and produced higher flood levels at the Site. Therefore, the figures below are for the 100 year ARI catchment event only.

The difference in peak flood levels, presented in Figure 3, shows no increase in flood levels larger than 0.01m. The model has an accuracy of about 0.01m; therefore the lowest range was set to ± 0.01m. Onsite, there is a localised decrease in levels, of up to 0.05m. Figure 4 shows the peak flood levels of the developed case, which is in the range of 3.3 to 3.4m, across the Site. Figure 5 shows the peak flood velocities across the Site, which range from approximately 0 to 0.20m/s.

We trust that this flood impacts assessment meets your requirements.

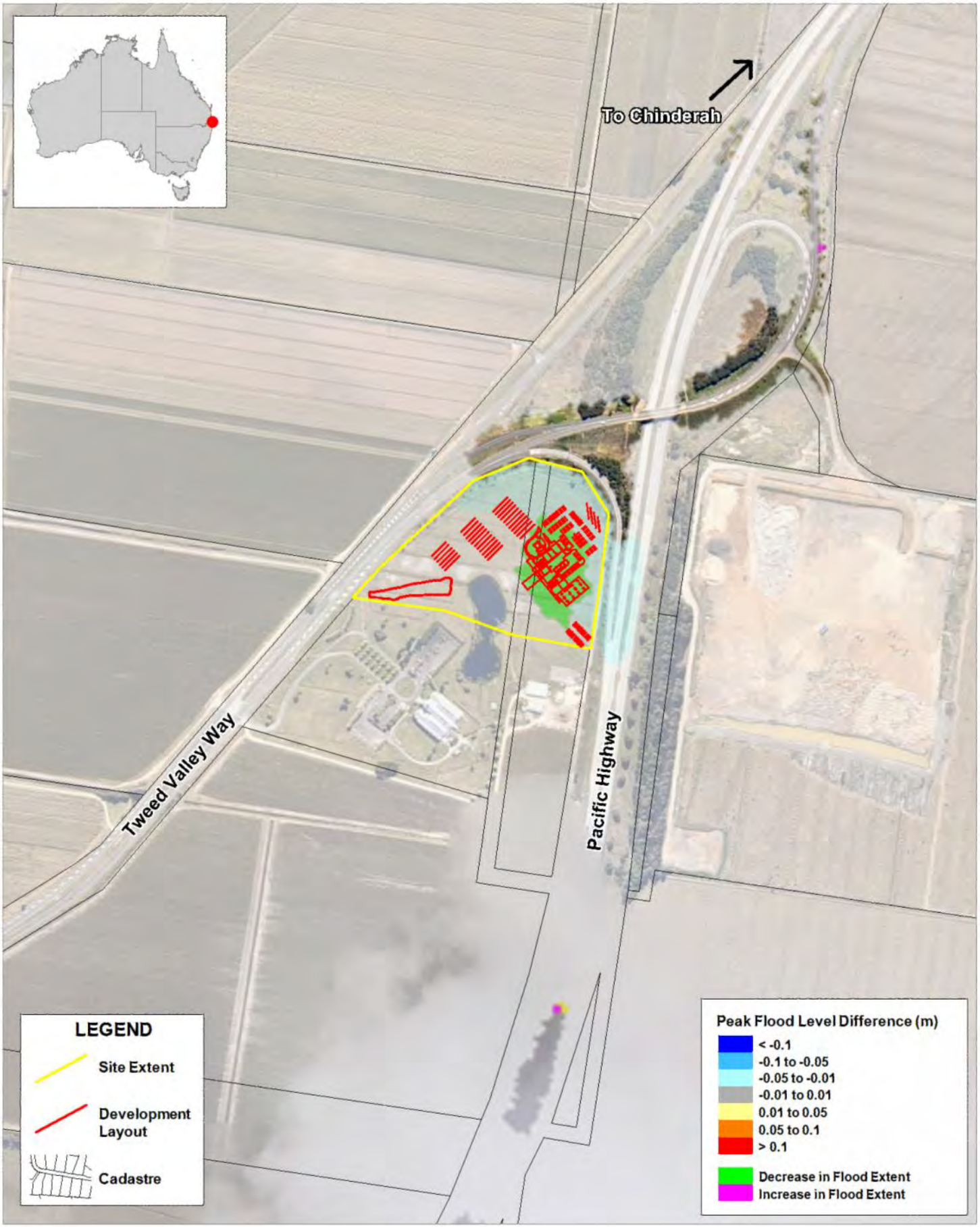
Should you require any additional information, or wish to discuss the contents of this report, please do not hesitate to contact myself or Melissa Hovey on (07) 3831 6744.

Yours faithfully
BMT WBM Pty Ltd



Anne Kolega

Senior Flood Engineer



Title:

Peak Flood Level Impacts
Developed Case Minus Base Case

Figure: 3

Rev: A

N

0 125 250m

Approx. Scale

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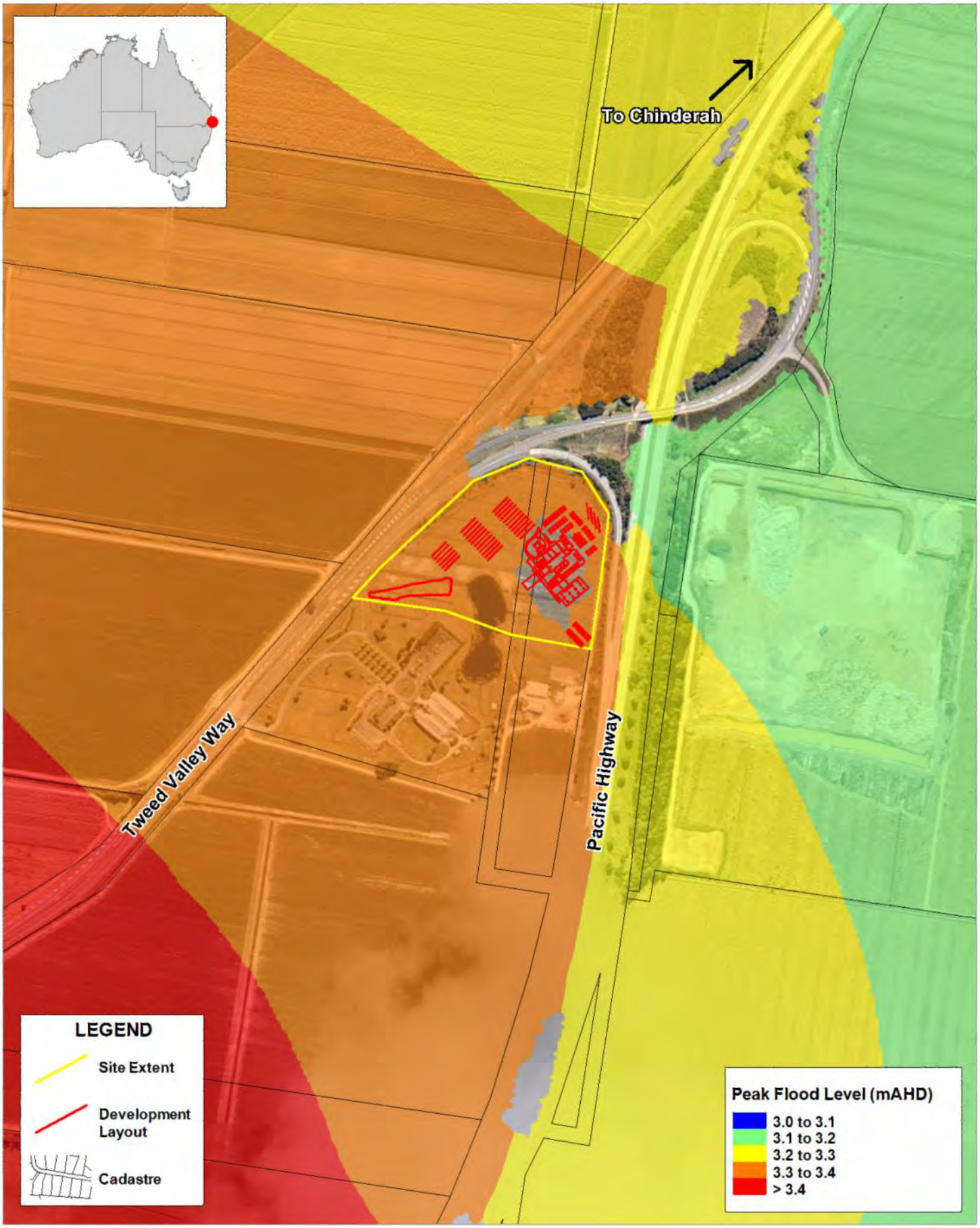
Filepath : I:\B20285_I_Chinderah\DRG\FLD_002_Level_Impacts.wor



Title:

Peak Flood Levels - Developed Case 100 year ARI

Figure: 4

Rev: A

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0 125 250m

Approx. Scale

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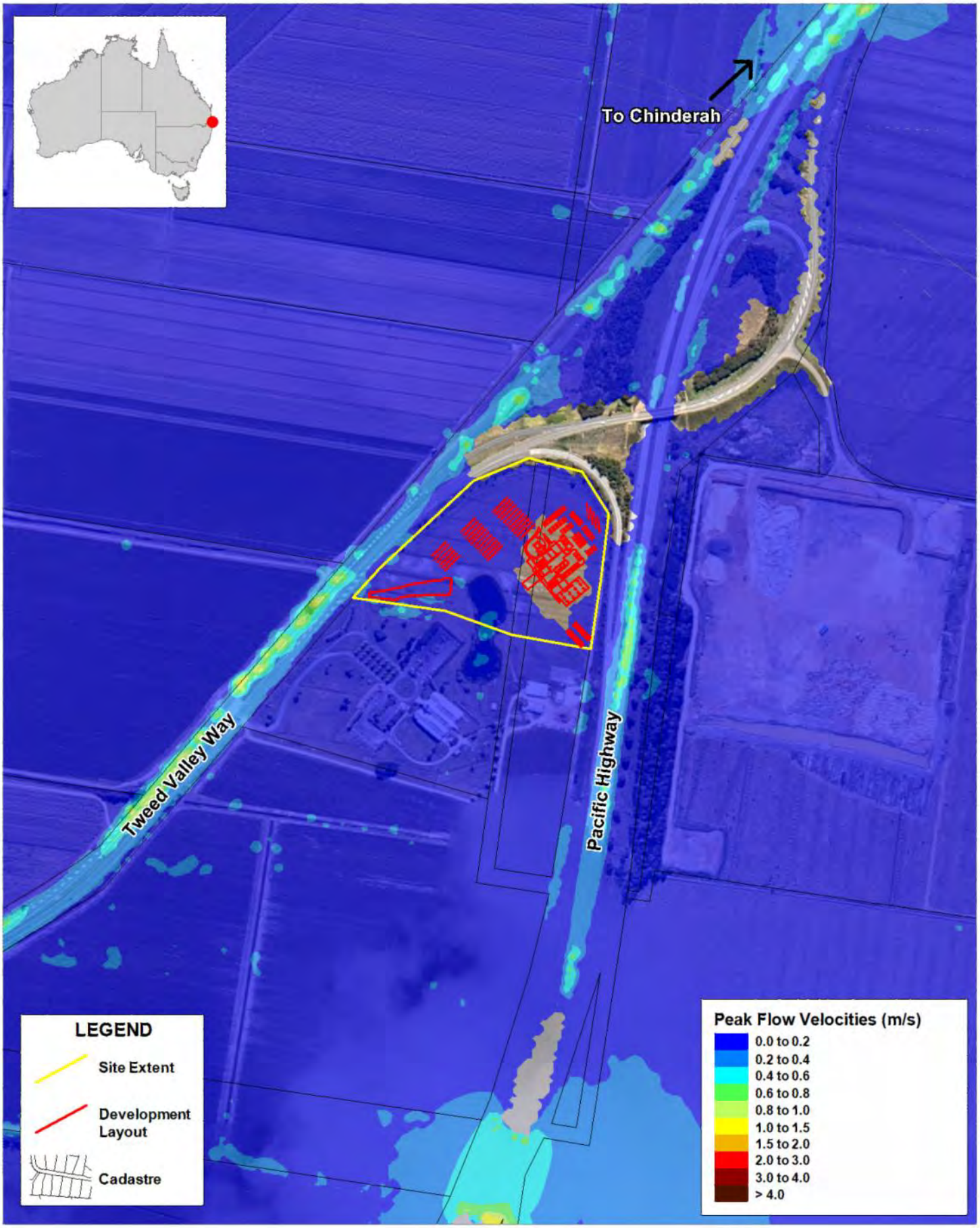
Filepath : I:\B20285_I_Chinderah\DRG\FLD_003_Levels.wor



Title:

Peak Flood Velocities - Developed Case 100 year ARI

Figure: 5

Rev: A

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0 125 250m

Approx. Scale

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Filepath : I:\B20285_I_Chinderah\DRG\FLD_004_Velocities.wor

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