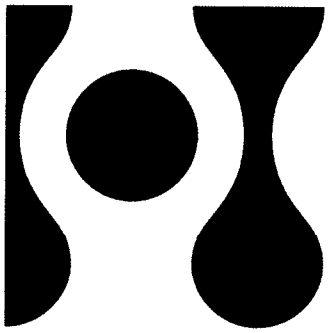
entura
Hydro Tasmania

The power of natural thinking



Investigation and Design of Carisbrook Flood and Drainage Mitigation Treatments

Preliminary Design Report

ENTURA-95365
27 February 2015

Prepared by Hydro-Electric Corporation ABN48 072 377 158
t/a Entura, Level 25, 500 Collins St. Melbourne VIC 3000 Australia

Entura in Australia is certified to the latest version of ISO9001, ISO14001, and OHSAS18001.

Document information

Title	Investigation and Design of Carisbrook Flood and Drainage Mitigation Treatments Preliminary Design Report
Client organisation	Central Goldfields Shire Council
Client contact	Leigh Hendrickson
Document number	ENTURA-95365
Project manager	Mohsen Moeini
Project reference	E304639 - P509364

Revision history

Revision 2.0

Revision description	Incorporating comments from CGSC on Sections 1 and 4		
Prepared by	Talbot Matthews, Aleksandar Jokanovic, Toby Dove, David Procter, Jen McDonnell		20/2/2015
Reviewed by	Paul Southcott, Craig Ludlow		20/2/2015
Approved by	Mohsen Moeini		27/2/2015
	(name)	(signature)	(date)
Distributed to	Leigh Hendrickson	Central Goldfields Shire Council	27/2/2015
	(name)	(organisation)	(date)

Contents

Appendices

Annexure

List of figures

List of tables

1. Introduction

1.1 Background

The township of Carisbrook is located at the confluence of Tullaroop Creek (also referred to as Deep Creek) and McCallum Creek within the Loddon River catchment, in central Victoria, approximately 170 km from Melbourne. Carisbrook experienced severe flooding in January 2011, which was estimated as 1 in 135 AEP flood event. In 2011/12, the North Central Catchment Management Authority (NCCMA) commissioned Water Technology to prepare the Carisbrook Flood and Drainage Management Plan. The Plan identified key flooding issues in the township, determined flood levels for a range of flood events and recommended mitigation works to reduce the risk of future flooding.

Resulting from that study, the flooding of Carisbrook is caused by two mechanisms as follows:

- riverine or main creek flow, the cause of flooding of the major part of the township from overtopping the banks of the McCallums and Tullaroop Creeks with an upstream catchment of about 1,200km^2
- overland flows, from bush areas to the south and west of the township with a local catchment of around 21 km^2

After significant consultation with the community and stakeholders, the community determined their preference was creek vegetation thinning in conjunction with a western levee and drain to protect the town from overland flows.

Based on the Carisbrook Flood and Drainage Management Plan (Water Technology, 2011), there are two flooding phenomena as follows:

- **main creek flows,** for which a vegetation clearing project was defined in order to lower the water levels during flood events in the creek.
- **overland flows** for which a preliminary/detail design study of the two options namely Options A (also known as the Western Levee) and Option B (also known as the Belfast Street Levee) was defined to contain the overland flows and redirect them to the main creek in the best optimised manner.

Entura was awarded a contract by Central Goldfields Shire Council (CGSC) to investigate and cost two flood mitigation options (A and B) in order to consequently develop a detail design for the preferred option in consultation with the council and the community.

1.2 Review of available data

As indicated in the project schedule, the review of available data was undertaken by Entura the details of which can be found in the respective sections of this report. The highlights of the review are as follows:

- The previous hydraulic modelling did not include the Williams Road Levee included for Option A
- A manning's coefficient of 0.013 was used for the existing culverts. It is recommended to use a higher value to account for ageing and debris.

- The biggest flood risk is from the main creeks (McCallum and Tullaroop Creeks) which is 10 times bigger than the flood risk from the overland flows. It is understood that vegetation clearing of the main creek was recommended and is being followed up by CGSC and NCCMA as a separate project.
- Although proper LiDAR was available, feature survey of culverts, drains, and key crossing points at the roads and railway was required.

1.3 Pre-commencement meeting

The pre-commencement meeting was held in the CGSC's office in Maryborough on 9th of December 2014. Leigh Hendrickson, David Sutcliffe, and Ron Potter from CGSC and Mohsen Moeini from Entura attended the meeting.

In brief the key aspects discussed which affect the preliminary design are as follows:

- The vegetation clearing the in the river should not be considered in re-running the hydraulic models.
- Council roads could be raised if required instead of introducing a new levee next to them.

The minutes of Meeting is provided in Appendix A.

It should be noted that later on and during the preliminary stage, CGSC requested to re-run the models with the vegetation clearing as well. For further details refer to Section 3.

1.4 Site visit

Apart from the survey and associated data gathering during 3 days of survey, a site visit was also undertaken by Mohsen Moeini on 9th of December. The likely location of the levees and culverts for Options A and B as well as existing culverts were all subject of this site visit. Leigh Hendrickson from CGSC accompanied Mohsen to ensure that all of the CGSC's knowledge and expectations are discussed in the beginning of the study.

1.5 Structure of the report

The report comprises the following sections:

1. Introduction – describing the background of the project and site visit/pre-commencement meeting
2. Survey – a summary of the feature survey undertaken
3. Hydraulic review – outlining the review undertaken on the previous studies and re-running of the models and new inundation mappings
4. Community and stakeholder consultation – a summary of the road map until the end of the project and the works undertaken in the preliminary stage
5. Environmental, Aboriginal and planning – a brief section on the different environmental and cultural/heritage aspects
6. Preliminary civil design – describing the preliminary design of both options
7. Preliminary cost estimation – a summary of the cost estimation for both options

8. Discussion – a brief comparison between two options based on the pros and cons
9. References
10. Appendices

This is the draft preliminary report and the final version will be issued once the comments from CGSC are received and incorporated as well as any other feedbacks from the property owners and stakeholders.

2. Survey

Topographic survey was undertaken on December 9 through to December 11 in Carisbrook. The following areas were surveyed over the three days.

Proposed levee alignments

(a) 30m wide, ~3km long strip along the proposed Western Levee alignment.

(b) 30m wide, ~500m long strip along the proposed Williams Street Levee alignment.

(c) 30m wide, ~1km long along the proposed Belfast Road Levee alignment.

Culverts

(d) Culvert under Landrigan Road, near intersection with Pyrenees Highway.

(e) Culvert under railway off High Street.

(f) Culvert under Chaplins Road, north of the Maryborough Trotting Club.

(g) Culvert under Southern end of Carisbrook-Eddington Road, approximately 270m from intersection with Chaplins Road.

Note: All culverts within the area specified by the above alignments were also surveyed.

The last two culverts listed above were added to the survey specifications based on further discussions between Entura and Central Goldfields Shire Council on December 9.

The output from the survey was as follows.

- Digital contours (0.2m) of the alignments and areas surrounding the listed culverts
- Detail on each of the listed culverts, including dimensions, inverts and road surface elevation.

Figure 2.1 shows all areas that have been surveyed.

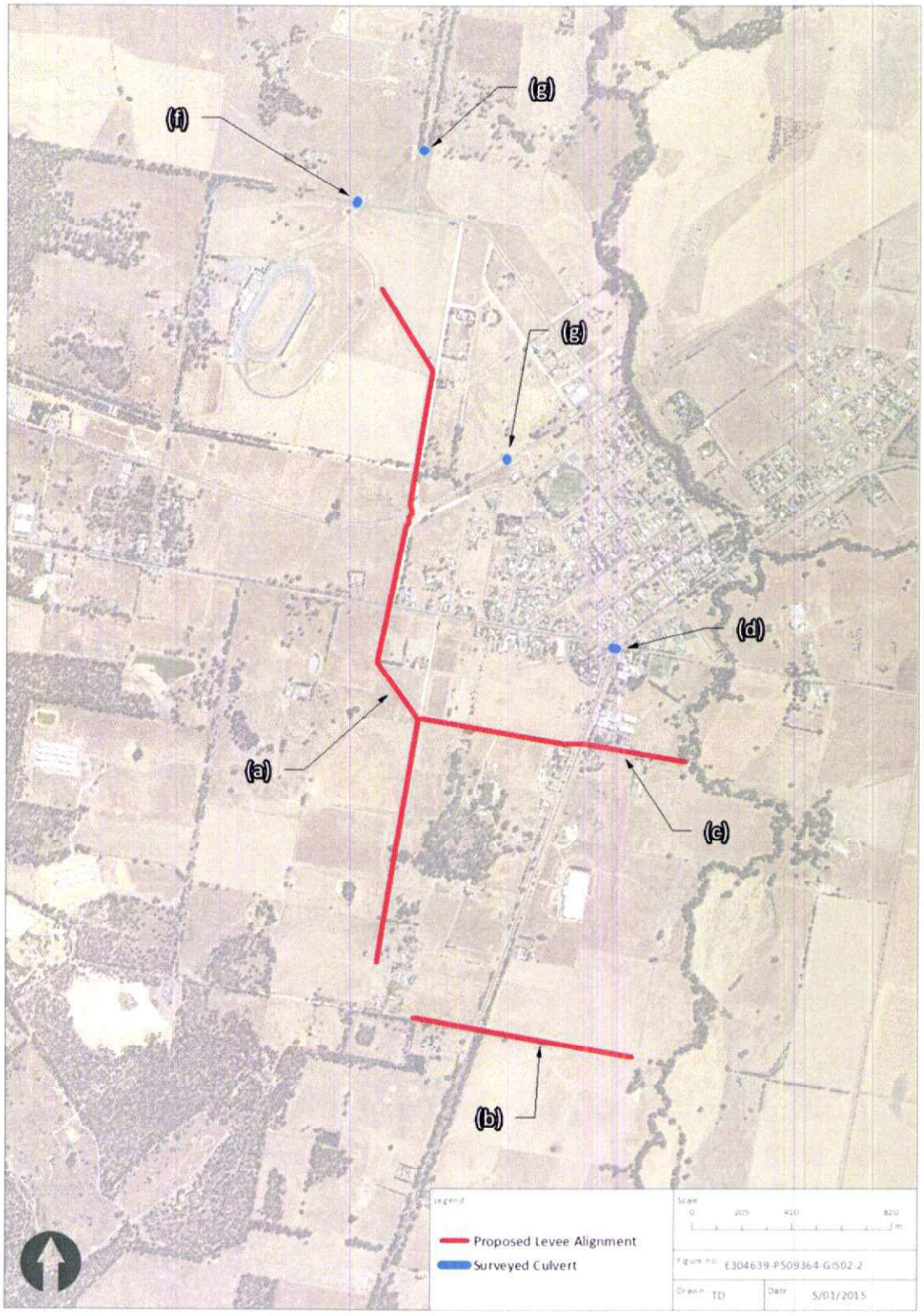


Figure 2.1: Extent of topographic survey.

3. Hydraulic Review

3.1 Introduction

A review of the existing hydraulic model, developed by Water Technology, was conducted to check consistency between the preliminary design and the Carisbrook Flood and Drainage Management Plan (Water Technology, 2011); and to ensure its suitability in the detailed design stage to determine levee height and culvert sizes to achieve the required flood immunity for Options A and B.

3.2 Review outcomes

The original model was developed using the DHI MIKE FLOOD (version 2011) software package. This software package combines both the 1-dimensional (1D) MIKE 11 and 2-dimensional (2D) MIKE 21 software packages into a single model, where the significant river channels or structures are modelled using MIKE 11 and out of channel flooding (i.e. floodplain) is modelled using the MIKE 21 grid.

In the Carisbrook hydraulic model, MIKE 11 was used to represent main drains and culverts in the township and 2D model was used to model floodplain and large waterways (Tullaroop and McCallums Creek). Representing large waterways where cell size is several times smaller than waterway width is standard practice in hydraulic modelling.

A 5m grid size was used was for the MIKE 21 model. Five major drains in the township and 15 structures (bridges and culverts) were modelled in MIKE 11, as shown in Figure 3.1.

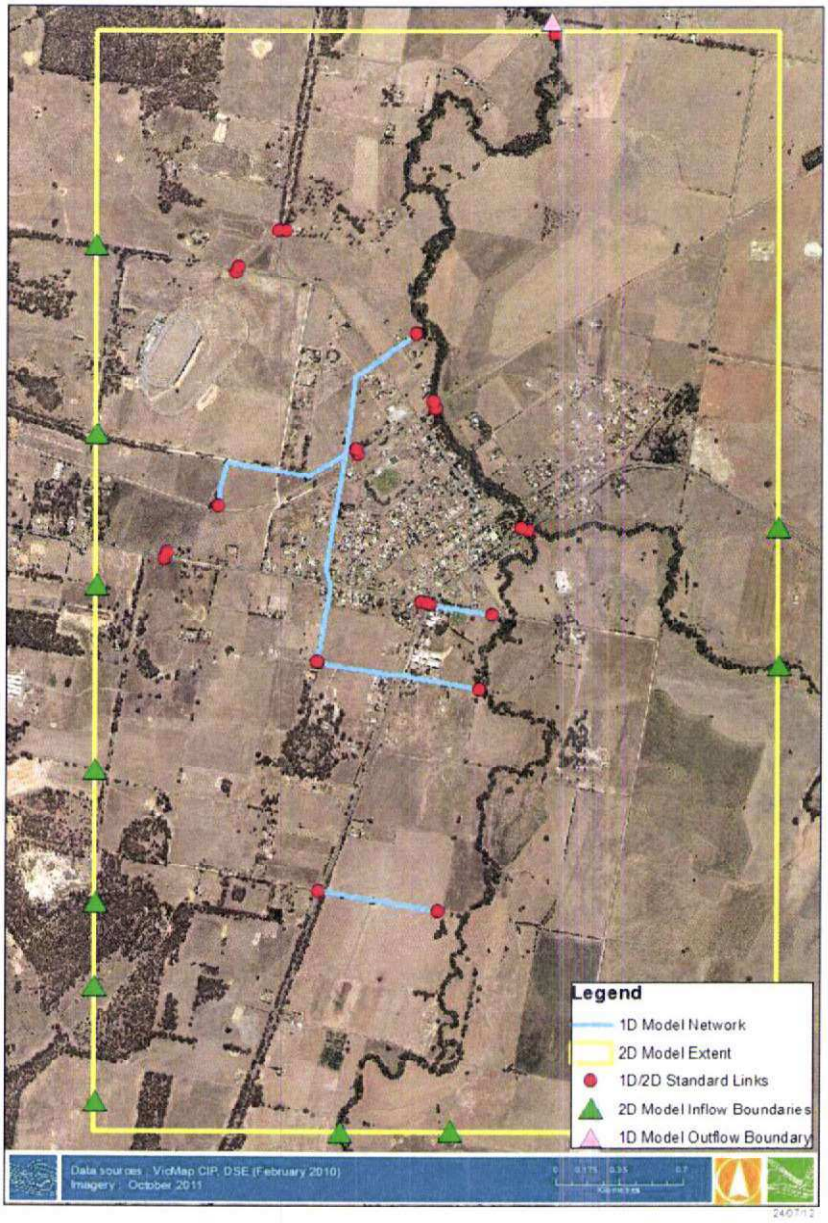


Figure 3.1: Drainage channels and culverts modelled in MIKE 11, shown as blue lines (Water Technology, 2011)

The model was calibrated with two large flood events, in September 2010 and January 2011. A match between modelled and observed flooding was achieved by Water Technology by adjusting terrain roughness number (i.e. Manning's roughness value). The majority of the 2-dimensional model area consists of open grass agricultural areas, which Manning's roughness was increased from 0.04 to 0.05. Based on the literature (Mays, 1999), as shown in Figure 3.2, this value is at the higher end of spectrum (i.e. the hydraulic model is conservative). Entura has retained the original roughness value for the floodplain given that a reasonable calibration was undertaken.

Type of Channel	Minimum	Normal	Maximum
D–2 Floodplains			
a. Pasture, no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees in winter	0.035	0.050	0.060
3. Light brush and trees in summer	0.040	0.070	0.110
4. Medium to dense brush in winter	0.045	0.070	0.110
5. Medium to dense brush in summer	0.070	0.100	0.160

Figure 3.2: Manning's n values for floodplain (Mays, 1999)

The roughness coefficient of culverts and bridges was assumed between 0.013 (new concrete culverts) and 0.08 (railway bridge) in the original model. 0.013 is an average value for concrete culverts (Mays, 1999). However, in order to cater for concrete ageing, possible higher levels of obstructions during high flood events, and flap valves, this value was increased by Entura from 0.013 to more conservative value of 0.018 on all culverts that had value of 0.013.

A comprehensive review of hydrology was beyond the scope of the project. The original models were run for six rainfall durations for each scenario: 2, 4, 6, 9, 12 and 48 hour durations. It was found that the 6-hour rainfall duration was the critical duration, resulting in the highest water levels, depending on the scenario.

Inflow hydrographs in the model were located at eleven locations, of which two represent major creeks (McCallum and Tullaroop Creeks) and the remainder represent overland flow from smaller contributing catchments (east, west and south). The proposed levees in Options A and B, protect Carisbrook township from overland inflows arriving from the west. As shown in Figure 3.3 below, those inflows represent 10% of total inflow into the model; which mean that Options A and B offer no inundation immunity from riverine flooding. This is in line with Entura's understanding based on the discussions with the Council (See Section 1.3).

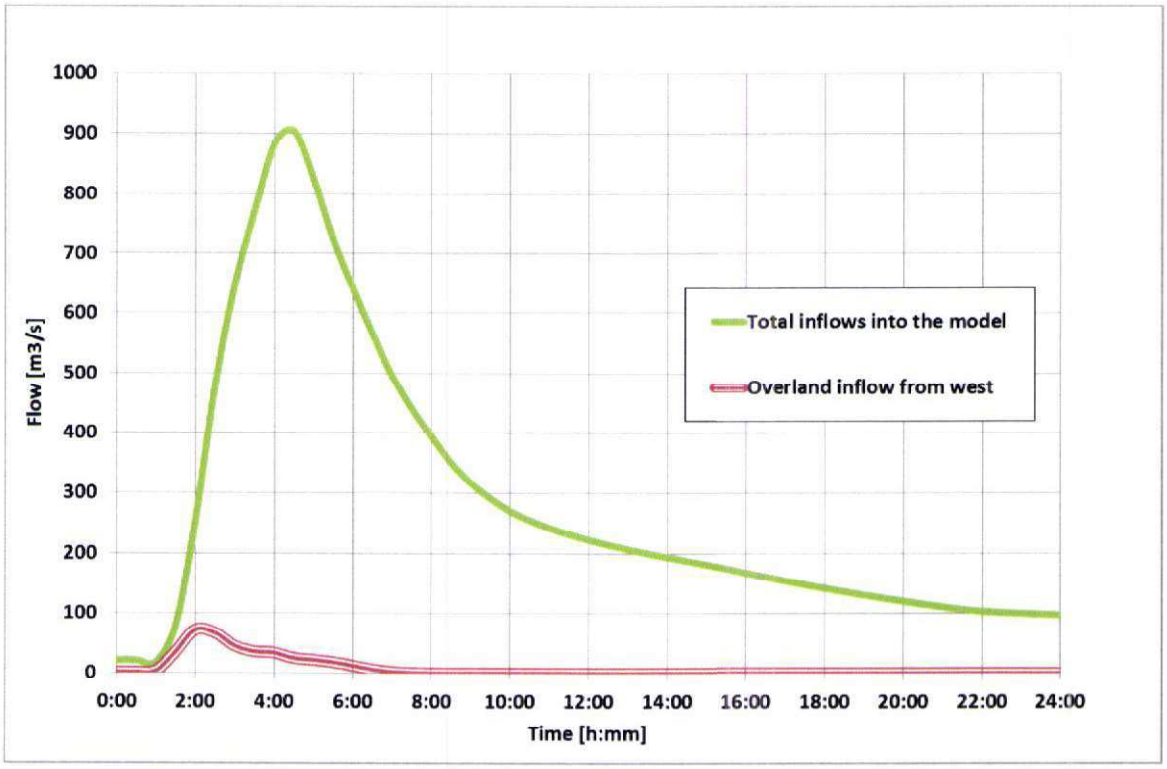


Figure 3.3: Model inflows for 6-hour rainfall duration

As part of hydraulic review the following models were run:

- Existing condition with and without vegetation clearing
- Option A with and without vegetation clearing
- Option B with and without vegetation clearing.

Vegetation clearing is envisaged as being vegetation management works between Camp Street and Railway Line, as described in the flood study (Water Technology, 2011). It is assumed that the vegetation clearing will results in a reduction of 0.02 in Manning's number in the dense vegetation adjacent to the channel and decrease in flood inundation levels in the township.

3.3 Option A - updated arrangement

For mitigation Option A, the original hydraulic model, called "package 4" (Water Technology, 2013), was used and modified to update the preliminary design.

The original hydraulic model provided in "package 4" did not correspond exactly to mitigation Option A presented in the Carisbrook Flood and Drainage Management Plan (Water Technology, 2011). The Williams Road Levee as outlined in the Management Plan was not included in the hydraulic model. The original Option A model been accordingly updated by Entura to:

- Include the Williams Road levee
- Include the modified culvert roughness values
- Allow for vegetation clearing.

The finalised Option A was run with the updates with and without vegetation clearing.

Option A, as finalised by Entura, consists of:

- A 3 km long "Western Levee", shown in Appendix D, extending from the southern end of the Curragh Moor Road Reserve (chainage (ch.) 0m - 1000m) extending northwards past the Pyrenees Highway (ch. 1550m), running parallel to Pleasant Street (ch. 1600m-2500m), past the Railway Line (ch. 1900m) and then into the crown land on which the Maryborough Harness Racing Club lies (ch. 2900m).
- Construction of new culverts under the Pyrenees Highway (ch. 1550m). Three 1.2 m x 0.75 m reinforced concrete box culverts were used in modelling.
- Construction of new culverts under the Railway Line (levee ch. 1900m). Four 1.2 m x 0.45 m reinforced concrete box culverts were used in modelling.
- Extension of the existing two box culverts (0.8 m x 0.4 m), at Pleasant Street, under the levee (ch. 2100m). Wills Street drain runs parallel to Wills Street and crosses Pleasant Street. The drain will also be crossing Western levee and construction of reinforced concrete box new culverts (ie. extension of the exiting culverts at Pleasant Street) is required. The same culvert size that is under Pleasant Street is envisaged under the Western Levee.
- Construction of 0.525m circular concrete culvert under the levee, at the location where levee is closest to Belfast Road drain (ch. 1000m).
- Excavation of a trapezoidal channel adjacent to the Western Levee, between chainages 1300m and 2100m (along the levee), as there is no natural fall in the topography along much of that section of the levee. The depth of the channel varies and is approximately 750 mm at its deepest point. The typical cross section of the upgraded channel is shown in Figure 3.4.
- A smaller levee near Williams Road placed to divert additional overland flow into McCallums Creek through the existing bluestone drain.
- A one way valve constructed on the culvert under Landrigan Rd adjacent to the school to prevent water surcharging back under Landrigan Rd in large flood events.

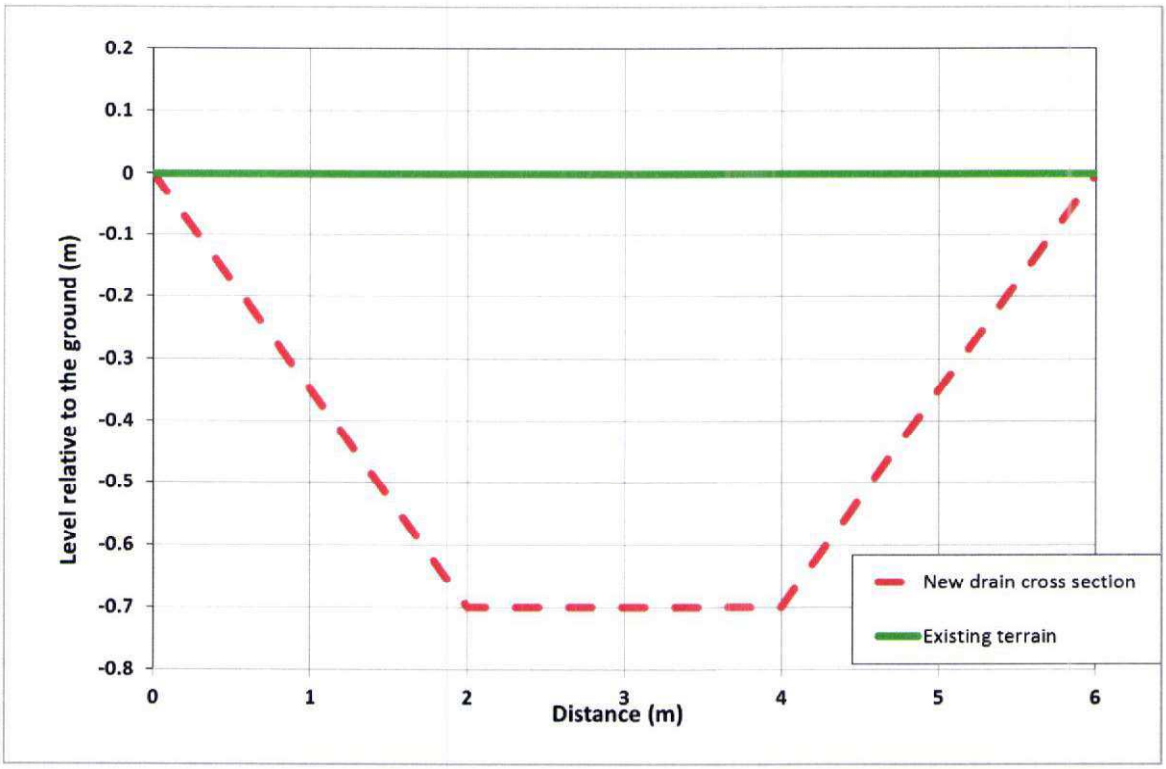


Figure 3.4: New drain parallel to Western Levee- typical cross section

3.4 Option B - updated arrangement

For mitigation Option B, the original model called "package 1" (Water Technology, 2013) was used and modified to update the preliminary design.

The original Option B model has been updated by Entura to:

- Include the adjusted culvert roughness values
- Allow for vegetation clearing

The finalised Option B was run with the updates with and without vegetation clearing.

Option B, as finalised by Entura, includes:

- Belfast Road Levee, shown in the General Layout in Appendix D, extended and height increased to stop and divert overland inflows into McCallums Creek via Belfast Road drain.
- Increase in capacity of Belfast Road drain (which runs south of the Belfast Road Levee) between chainages 600 and 1050m of the levee, by upgrading the existing channel to a trapezoidal drain and deepening the existing invert by approximately 300mm. The typical cross section of the upgraded channel is shown in Figure 3.5.
- Two 0.75m diameter concrete circular culverts placed at the upstream end of the main north-south drain, under Belfast Road Levee at ch.500m (ie. crossing of Belfast Road levee and north-south drain)

- Increase in capacity of the culvert under Landrigan Road at corner of Belfast Road (Belfast levee ch. 950m) to approximately 6m^3/s from an existing capacity of 2.3m^3/s. The culverts have been modelled by upgrading the existing two 1.2 m x 0.6m reinforced concrete box culverts to two 2.1 m x 0.6 m reinforced concrete box culverts.

- A smaller levee near Williams Road (as shown in Appendix D) placed to divert additional overland flow into McCallums Creek through the existing bluestone drain.

- Non-return valves installed at the following four culverts: Primary railway culvert (on north-south drain), Secondary railway culvert (in township), Belfast/Landrigan Road Culvert, Landrigan Rd Culvert (at school).

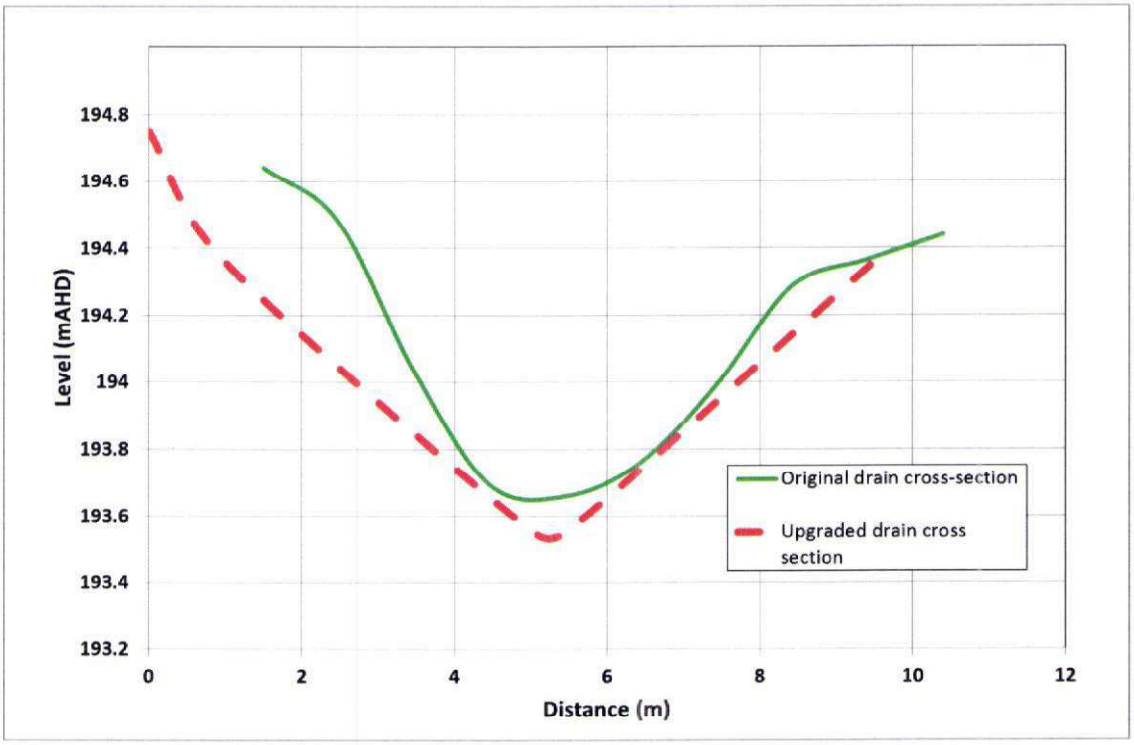


Figure 3.5: Belfast Road Drain Upgrade

3.5 Model results

Flood maps for the modelled scenarios are shown in Appendix C for both with and without vegetation clearing. The following six flood inundation maps are provided:

- Existing condition (without vegetation clearing)
- Option A (without vegetation clearing)
- Option B (without vegetation clearing)
- Existing condition with vegetation clearing
- Option A with vegetation clearing
- Option B with vegetation clearing

The following four maps of 'differences in water levels' are provided to show effectiveness of each mitigation option:

- Map of 'difference in water levels' between Option A and existing condition (without vegetation clearing)
- Map of 'difference in water levels' between Option B and existing condition (without vegetation clearing)
- Map of 'difference in water levels' between Option A and existing condition (without vegetation clearing
- Map of 'difference in water levels' between Option B and existing condition (without vegetation clearing).

Longitudinal water profiles for Option A and B levees (without vegetation clearings) are shown in Appendix B.

3.6 Updated mitigation options – modelling results discussion

Both existing condition and vegetation clearing were modelled using terrain roughness files developed by Water Technology (2013). Vegetation clearing shows lower flood inundation levels in the township. However, result for Option A with vegetation clearing has shown inconsistency with the results shown in the flood study (Water Technology, 2013). Entura contacted Water Technology to ensure latest model files are used. Water Technology re-run their model using 2011 version of the software and confirmed that water spills and goes into the town.

Details of culverts that are impacted by mitigation options are summarised in Table 3.1 and Table 3.2. Information in these tables will be used in the preliminary design of the mitigation options. The tables include culvert dimensions, actions that should be conducted for each culvert and changes in culvert discharges and water levels upstream and downstream of the culverts.

Map of 'difference in water levels' for Option B 'without vegetation clearing' shows an increase in water levels in some parts of the township. The probable reason is because Option B redirects overland flows into the river upstream of the township. Option A redirects overland flows into the river downstream of the township. Therefore, a larger volume of water is redirected toward the township in Option B. This indicates that Option B is a less effective mitigation option than Option A.

Table 3.1: Culverts in the model

Culvert location	Number of culverts	Geometry	Width (m)	Height (m)	Upstream invert (mAHD)	Downstream invert (mAHD)	Length (m)	Manning's n in the model	OPTION A action	OPTION B action
Belfast/Landrigan Road	2	Rectangular	1	0.6	193.63	193.59	12	0.018	None	Upgrade to 2.1 x 0.6; Only Positive Flow
Williams Rd/Landrigan Rd	1	Rectangular	1.2	0.8	196.77	196.71	13	0.018	None	None
Pleasant Street	2	Rectangular	0.8	0.4	192.2	192.15	7	0.018	None	None
Railway Secondary culvert	1	Rectangular	2.4	0.8	191.96	191.89	12	0.03	None	Only Positive Flow
LandrigansRdSchool	2	Rectangular	1.2	0.9	192.95	192.92	20	0.018	Only Positive Flow	Only Positive Flow
Railway primary culvert	1	Rectangular	2.8	0.75	191.53	191.51	10	0.04	None	Only Positive Flow
OPTION A - Pyrenees Hwy	3	Rectangular	1.2	0.75	194.48	194.45	12	0.018	New culvert	Non-existant
OPTION A - Railway	4	Rectangular	1.2	0.45	193.12	193.1	20	0.018	New culvert	Non-existant
OPTION A - Under Western levee/Belfast Road drain	1	Circular	0.5		194.57	194.54	5	0.018	New culvert	Non-existant
OPTION A - Under Western levee/Wills Steer drain/Pleasant street	2	Rectangular	0.8	0.4	192.25	192.2	5	0.018	New culvert	Non-existant
OPTION B - Under Belfast levee/beginning of north-south drain	2	Circular	0.75		194.10	194.10	1	0.018	Non-existant	New culvert

Table 3.2: Maximum water levels around culverts and culvert discharges

	Existing condition			OPTION A			OPTION B		
Culvert location	Upstream water level (mAHD)	Downstream water level (mAHD)	Max discharge (m3/s)	Upstream water level (mAHD)	Downstream water level (mAHD)	Max discharge (m3/s)	Upstream water level (mAHD)	Downstream water level (mAHD)	Max discharge (m3/s)
Belfast/Landrigan Road	194.4	194.2	2.1	194.10	194.10	0.26	194.8	194.5	6.24
Williams Rd/Landrigan Rd	196.8	196.5	0.03	197.49	196.75	1.35	197.5	196.7	1.35
Pleasant Street	193.24	193.23	1.35	193.29	192.99	2.27	193.2	193.2	1.8
Railway Secondary culvert	192.7	192.4	2.4	192.61	192.27	1.79	192.8	192.3	2.48
LandrigansRdSchool	194.0	194.0	2.4	193.48	193.98	0.26	193.6	194.0	0.48
Railway primary culvert	192.7	192.6	2.75	192.38	192.34	1.67	192.579	192.465	2.56
OPTION A - Pyrenees Hwy	N/A			195.66	195.35	6.44	N/A		
OPTION A - Railway	N/A			193.99	193.71	3.64	N/A		
OPTION A - Under Western levee/Belfast Road drain	N/A			195.67	194.74	0.49	N/A		
OPTION A - Under Western levee/Wills Steer drain/Pleasant street	N/A			193.24	193.23	1.35	N/A		
OPTION B - Under Belfast levee/beginning of north-south drain	N/A			N/A			195.0	194.2	1.37

4. Community and stakeholder consultation

This section presents the consultation activities that were carried out during the preliminary design stage for flood mitigation treatments proposed at Carisbrook. It discusses the ongoing work and next steps in regards to the detail design and final community/stakeholder consultation.

4.1 Preliminary design consultation planning

Consultation activities commenced in December 2014 with an initial meeting and follow up discussions with Central Goldfields Shire Council (CGSC) to discuss consultation activities. This achieved the following:

- Gained an overview and history community engagement on this topic with the community.
- Identified challenges or risks of stakeholder or public engagement on this project.
- Discussed what might trigger a reaction, adversarial interaction or opposition to moving forward on this issue (this is related to understanding the history of the community, emotions and experiences in relation to the topic).
- Clarified the role CGSC see itself playing in this process (messaging for the project).

Table 4.1 outlines the key findings from these preliminary discussions for planning in regard to the consultation in the preliminary stage.

Table 4.1: Key findings and messages from preliminary discussions

Questions /Topic	Significant findings/comments
Gain an overview and history community engagement on this topic with the community	There is significant complexity to the relationship between CGSC and the broader community in relation to the flood mitigation treatment program. Consideration awareness required during the consultation process.
Identify challenges or risks of stakeholder or public engagement on this project. Triggers, adversarial interactions.	Potentially a lack of education and understanding in the broader community about the mechanisms that cause the significant flooding. May impact on community members responses to mitigation options/measures suggested etc. Informing the community and key stakeholders in a timely, transparent and respectful manner is recommended.
Clarify the role CGSC see itself playing in this process? Messaging for the project at this stage.	CGSC are the key conduit for communications for consultation and informing community and key stakeholders. All communications will come directly from CGSC. Messaging in regards to activities associated with the current flood mitigation treatments actions are as follows: • CGSC is progressing and 'getting on' with developing designs and plans for the mitigation treatments following on from the Carisbrook Flood and Drainage Management Plan completed in 2013. • Funding has come from State and Federal Government –

	note 12 month delay due to the Federal Government elections which delayed the matching Federal project grants. • North Central Catchment Authority has agreed to manage the creek vegetation thinning work. Commencing mid-2015. • Entura developing detailed construction plans for the Carisbrook Flood Mitigation proposal from the Carisbrook Flood and Drainage Management Plan completed in 2013. Six months to complete. • Detailed design of above to be completed in approximately May/June 2015 and will be presented to the broader community. • Stage 2 - Construction of levies and flood drainage works to the south and west of Carisbrook to occur when funding from State and Federal Government secured. Anticipated 2015/2016.

4.2 Preliminary Design Consultation Activities

The community engagement conducted at the preliminary design stage has been as follows:

- Stakeholder identification
- Notification of landowners to facilitate early survey access
- Development and facilitation with CGSC of a notification program to inform the community and key stakeholders of the progression of the flood mitigation treatments actions and preliminary stage activities of the project (See Appendix E)

The community consultation activities that have been undertaken on this project to date include:

- Preliminary notification letters to key landowners to gain access for survey works (5 December 2014)
- Discussions with 2 landowners during site visits by Entura survey staff (see Table 4.2 for details)
- Press release in local paper to update activities in regards to flood mitigation works
- Website update
- Mail out update letter to the following stakeholders (See Appendix E1 for example of general content):
    - Residents update letter mail out to post code 3464 (Carisbrook)
    - Technical working group update letter
    - Chair of community-based steering committee (Carisbrook Disaster Recovery Committee) update letter

Table 4.2 below outlines these activities, their timing and comments in regards to consultation activities during the preliminary design stage to date.

Table 4.2: Stakeholder engagement to date

Engagement activity	Timing	Details and comments
Preliminary notification letters to key landowners to gain access for survey works	Posted on (CGSC) letterhead 5 December 2014	13 letters in total were posted to landowners. Landowners notified were those that that Entura may require access to during the surveying of Williams Street Levee, Belfast Road Levee, and West alignments.
Preliminary Survey Activity Site visits by Entura survey staff	Tuesday 9th-Thursday 11th December 2014	Following the notification letters delivery, Entura staff commenced survey works. CGSC indicated notification letter was adequate for property access. Throughout survey period only two residents approached the surveyor (these were not notified landowners). These individuals expressed their support of the overall works and aims.
Update letter mail out to all residents update in post code 3464 (Carisbrook)	Posted on (CGSC) letterhead from the Mayor. Week starting 23rd February 2015	All residents in Carisbrook region received an update about the flood mitigation works being carried out currently and planned for Carisbrook.
Update letter mail out to Chair of the community-based steering committee (Carisbrook Disaster Recovery Committee Inc)	Posted on (CGSC) letterhead from the Mayor. Week starting 23rd February 2015	The Chair of the community-based steering committee received update letter about the flood mitigation works being carried out currently and planned for Carisbrook. They were requested to notify the current committee members.
Update letter mail out to all Technical working group members (See Appendix E1 for details) -The Technical working group members represent the follow	Posted on (CGSC) letterhead from the Mayor. Week starting 23rd February 2015	All members of the technical working group received an individual update letter about the flood mitigation works being carried out currently and planned for Carisbrook.

Engagement activity	Timing	Details and comments
key stakeholder organisations: North Central Catchment Management Authority VicRoads BOM SES Goulburn Murray Water DEPI (Department of Environment and Primary Industries) VicTrack Central Goldfields Shire CGSC		This assumes that members of the technical working group will provide updates internally within their organisations in regards to the current and planned activity for the flood mitigation works.
Press release in local paper to update activities in regards to flood mitigation works	Week starting 23rd February 2015	CGSC communications to submit to paper
Website update	Week starting 23rd February 2015	CGSC communications to upload

4.2.1 Potentially affected landowners

Face to face consultation activities in the preliminary stage was recommended but at this stage has not been conducted. This is due to the following:

> "Entura's recommendation was that the update of stakeholders about CGSC's flood mitigation activities via media (web based and local print) and the "notification letter" to the broader community, committees and key organisational stakeholders be sent and received in the first instance."

This process of notification has occurred in the third week of February 2015 and has been conducted by CGSC.

Stakeholder responses will be monitored and shared with the Entura consultation team in order to gauge the level of interest and therefore engagement response. If stakeholders request further information or a face to face visit as a result of receiving the notification letters or media release it will be arranged as soon as possible.

4.2.2 Key organisational stakeholder consultation

Specific discussions and negotiations with a number of key organisational stakeholders outlined in Table 4.2 are necessary.

At this stage these have not been conducted due to the following reason:

- The broad notification process for stakeholders was delayed by CGSC and Entura recommended these formal update letters be received in the first instance before engagement of stakeholders occurred.
- Following receipt of the letter (being sent week starting 23rd February), a key contact will be made and discussions with these stakeholders groups (in particular VicRoads and VicTrack) will be required. Continued consultation with these key stakeholders groups (in particular VicRoads and VicTrack) and will be ongoing throughout the project until completion.
- Following receipt of the letter (being sent week starting 23rd February), contact will be made with the chairs of both the Technical Committee and the Carisbrook Disaster Recovery Committee. Continued notification and consultation (as required) with these key stakeholders groups will be ongoing throughout the project until completion.

4.3 Recommendations for next steps

On the basis of this draft preliminary report from Entura it is recommended that CGSC determine the option they will be selecting as per the project schedule (refer to Appendix F). This decision will allow for clear and concise information to be prepared for communications with all stakeholder groups.

Once this decision has been made a second notification round to inform the community and key stakeholders of the selected option is recommended. Based on discussions with CGSC and the results of previous consultation outcomes (Water Technology, 2011) should option A be selected it is likely to be supported by the broader Carisbrook community.

Communicating the CGSC's decision on the selected option in a transparent and timely manner will be important for the ongoing consultation processes.

4.4 The Plan for Detail Design Stage

Once the preferred mitigation option has been selected and we enter into the detail design stage considerable consultation will be required with directly affected property owners and key stakeholders groups (in particular VicRoads and VicTrack). A community wide consultation process is also recommended to inform the community and support the planning approvals process.

4.4.1 Potentially affected landowners:

Following the mitigation option selection (refer to Appendix F for the project schedule), a mail out to request meetings with all affected property owners will be conducted by CGSC. Entura and CGSC representatives can then commence having constructive and effective face to face discussions with specific landowners that we know will be affected. Rather than early engagement with a larger number of landowners (covering Option A and B), some of who ultimately will not be involved at all (when the final option is selected).

These "face to face kitchen table" discussions with individual affected landowners can achieve the following:

- Inform of the overall plan and benefits of the selected option
- Inform affected landowners of the impact on their specific properties in regards to both construction and inundation

- Explain the protocols and process in regards to compensation/land acquisition individual landowners initially and then work towards successfully achieving agreed sign off on documentation in regards to these matters
- Discuss matter in regards to construction and access
- Manage other questions, concerns and business that arises

By providing clear and concise information, it will develop trust and confidence in the process, in Entura and CGSC (thereby reducing any anxiety for landowners).

It is understood and assumed that CGSC to provide protocols, process and legal documentation in regards to compensation/land acquisition individual landowners for discussion with landowners.

It is assumed that Entura and a CGSC representative will meet face to face with all the affected landowners to discuss the matters outlined above. A proactive approach to meet with landowners will be taken. Entura expects each landowner will likely require at least two visits (possibly more particularly if negotiating compensation or land acquisition).

4.4.2 Key organisational stakeholder consultation

As discussed in 4.2.2 specific discussions and negotiations with a number of key organisational stakeholders will be ongoing.

4.4.3 Broader Carisbrook community engagement

Entura also recommends a community wide consultation process will be conducted to inform the community and support the planning approvals process. The consultation will be carried out collaboratively with CGSC. Entura's original proposal for consultation during the detailed design stage is provide below in Table 4.2.

Table 4.2: Broader community engagement action plan

Goal: Broader Community Engagement Action Plan	Task	Aim	Actions
Broader community engagement as part of the approvals process	Community Information Sessions (minimum 2 sessions at different times). Presenting and sharing information for community to see the outcomes and the package of mitigation works that will be constructed.	Announcement and generation of interest to attend information/consultation sessions, outlining purpose, times and location.	Speak on phone to CGSC representative for each session to discuss: • proposed planning and actions, booking of venues, CGSC materials or information that needed for

	Media releases –a media release will be prepared for each information session (all local papers, community newsletters and local school newsletters) updating community		the sessions • 2 x media release and review process • Additional information inclusions necessary to the website to alert community about the upcoming information sessions.
	Material preparation for Community Information Sessions Information Flyer /bulletin x 2 Information Banner (Generalised explaining project overview and community consultation process and gateways) – used at all sessions.	Information so community can stay informed about project and also take away if they come to a session. (Suggest two mail out updates promoting information session dates throughout the life of the project).	• One page double sided flyer x 2 • One banner

It is recommended that the above broader community engagement action plan be reviewed as the project progress and determine if it is adequate and appropriate.

This will be dependent on community response and feedback to the follow activities:

- Notification update letter starting week of 23rd February 2015
- Notification of the mitigation option selected (date to be determined)
- Outcomes from 'face to face meetings' with affected landowners.

The feedback we receive will help us to determine if the planned approach will be suitable for the Carisbrook broader community.

5. Environment, Aboriginal heritage and planning

This section presents the results of the desktop assessment of potential environmental, Aboriginal heritage and planning constraints associated with both Option A and Option B flood mitigation levee alignments proposed at Carisbrook. Environmental constraints were identified through review of the Victorian Biodiversity Atlas datasets and *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool to identify threatened species and vegetation communities listed under the *Flora and Fauna Guarantee Act 1988* and the EPBC Act.

Landskape were commissioned to carry out a desk top due diligence assessment to identify potential Aboriginal heritage constraints under the *Aboriginal Heritage Act 2006* and *Aboriginal Heritage Regulations 2007*. A review of the *Planning and Environment Act 1987* (Central Goldfields Shire Planning Scheme) was undertaken to identify potential planning constraints associated with both options. Potential constraints identified for both Option A and B are presented in Table 5.1.

No significant environmental, Aboriginal heritage or planning issues were identified in the desktop assessment that would constrain the proposed levee alignments for either Option A or Option B. However, further on site ecological and heritage surveys are required to confirm the presence and extent of native vegetation including scattered trees, the presence of listed flora and fauna and their habitats and the presence or absence of cultural heritage constraints. Both options will require a planning permit under the *Planning and Environment Act 1987* as well as potentially permits under the *Water Act 1989* and the *Catchment and Land Protection Act 1994*. A summary of anticipated further work and permit/approval requirements is presented in Table 5.2. Cost estimates to complete further work are contained in Section 7.

Table 5.1: Potential constraints for Carisbrook flood mitigation Option A and B

Potential Constraint	Comment
EPBC listed species or communities	The EPBC Protected Matters Report generated from the EPBC Act Protected Matters Search Tool[1] identified that four listed ecological communities are known to occur, considered likely to occur or may occur within the Carisbrook area including the: • Critically endangered Grassy Eucalypt Woodland of the Victorian Volcanic Plain ecological community • Endangered Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia ecological community • Endangered White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland ecological community • Critically endangered Natural Temperate Grassland of the Victorian Volcanic Plain.

[1] http://www.environment.gov.au/topics/about-us/legislation/environment-protection-and-biodiversity-conservation-act-1999/protected accessed 15/1/2015.

Potential Constraint	Comment
	The report also identified ten listed threatened fauna species and/or their habitats are considered likely to occur or may occur within the Carisbrook area including four bird species, two fish species, two reptile species, one frog species (growling grass frog *Litoria raniformis*) and one invertebrate species (golden sum moth *Synemon plana*). Seven listed threatened flora species and/or their habitats are considered likely to occur or may occur within the area. In addition eleven listed migratory bird species are considered likely to occur or may occur within
FFG Act listed species or communities	Fourteen fauna species listed on the FFG Act has been recorded on the Victorian Biodiversity Atlas from the Carisbrook area, including nine bird species, one mammal species (grey-headed flying fox *Pteropus poliocephalus*), two reptile species and two fish species. One listed flora species, the southern shepherd's purse (*Ballantinia antipoda*), has been recorded from Carisbrook and its surrounds. The FFG Act also protects plant taxa which are not threatened but are protected for other reasons on public land, for example some species which are attractive or highly sought after (e.g. orchids and grass trees). **Both levee options A and B are located in part on Crown Land ('public land') and have the potential to impact on protected plant taxa.**
Aboriginal heritage	No Aboriginal cultural heritage sites have previously been recorded in either Option A or Option B alignments. Predictive modelling shows that there is a low to moderate potential for Aboriginal cultural heritage to occur in the proposed work areas. (refer to Aboriginal Heritage Desktop Due Diligence Assessment contained in Appendix A)
Planning	The development of Option A and Option B are subject to the provisions of the Central Goldfields Planning Scheme under the *Planning and Environment Act 1987*
Land use and development	The construction of a levee is likely to be defined under Clause 74 of the Victorian Planning Provisions (VPP) as a Utility Installation (*Land used to collect, treat, or dispose of storm or flood water, sewage, or sullage*). A Utility Installation is not described as an exempt use under Section 62.01 of the planning scheme. Works may be exempt under section 62.02-1 of the planning scheme if their value is less than $1 million as they are being carried out *by or on behalf of a municipality*. Accordingly, the need for a permit and the process of approval will be identified under the provisions of the zones or overlays.
Zoning	**Option A** The western and Williams Road levee alignments fall within the following zones: • Rural Living Zone (RLZ) • Farming Zone (FZ) • Road Zone (RDZ1) • Public Use Zone – Transport (PUZ4) • Public Use Zone - Other public use (PUZ7)

Potential Constraint	Comment
	A utility installation is not a prohibited use in any of the zones. A utility installation is a Section 2 use in RLZ, FZ and RDZ1 zones and requires a permit. A permit is also required for earthworks within the RLZ that *change the rate of flow or discharge point of water across a property boundary.* A utility installation is a Section 1 use in PUZ4 and PUZ7. **Option B** The Belfast Road and Williams Road levee alignments within the following zones: • FZ • RLZ • General residential zone (R1Z) • RDZ1 A utility installation is not a prohibited use in any of these zones. A utility installation is a Section 2 use in FZ, RLZ, R1Z and RDZ1 zones and requires a permit. A permit is required for earthworks within the RLZ that *change the rate of flow or discharge point of water across a property boundary.*
Overlays	**Option A** The western and Williams Road levee alignments are subject to the following overlays: • Land Subject to Inundation Overlay (LSIO) • Erosion Management Overlay (EMO) • Environmental Significance Overlay (ESO2) • Bushfire Management Overlay (WMO) • Salinity Management Overlay (SMO) A permit is required for the construction of a levee and/or removal of vegetation under the EMO, SMO, and ESO. Flood mitigation works (e.g. a levee) carried out by the responsible authority (Central Goldfields Shire Council) are exempt from requiring a permit under the LSIO. The construction of a levee is not subject to the provision of the WMO. ESO2 establishes an air emissions buffer and the construction of a levee is likely to be considered ancillary to the current use and development. **Option B** The Belfast Road and Williams Road levee alignments are subject to the following overlays: • SMO • LSIO • EMO • WMO • ESO1 • ESO2

Potential Constraint	Comment
	A permit is required for the construction of a levee and/or removal of vegetation under the EMO, SMO, and ESO. Works undertaken by a public authority (Central Goldfields Shire Council) to regulate flooding (levee construction) are exempt from a permit requirement under ESO1. ESO2 establishes an air emissions buffer and the construction of a levee is likely to be considered ancillary to the current use and development.
Local and state policy frameworks	The key State Planning Policy Frameworks (SPPF) that will need to be addressed in the development application for both Option A and Option B are: • Environmental Risks – flood plain management and erosion • Natural Resource Management • Infrastructure – drainage and catchment management • Environmental and Landscape Values – clearing of native vegetation The key Local Planning Policy Frameworks (LPPF) that will need to be addressed in the development application for both Option A and Option B are: • Municipal Strategic Statement • Protection of Land and Water Resources – protection of water resources and remnant vegetation and wildlife corridors
Particular Provisions	The purpose of Section 52.17 of *Central Goldfields Planning Sc*heme (Native Vegetation) is: 'To ensure permitted clearing of native vegetation results in no net loss in the contribution made by native vegetation to Victoria's biodiversity. ' This is achieved by avoiding the removal of native vegetation that makes a significant contribution to Victoria's biodiversity and minimising impacts on Victoria's biodiversity from the removal of native vegetation. A permit is therefore required to remove, destroy or lop native vegetation, including dead native vegetation unless it is specifically stated in the table to Clause 52.17-7 that a permit is not required. An application to remove, destroy or lop native vegetation is classified as following a low, moderate or high risk-based pathway which is defined in the *Permitted clearing of native vegetation – Biodiversity assessment guidelines* (Department of Environment and Primary Industries, September 2013). There is remnant native vegetation mapped along the areas to be affected by the proposed works associated with Options A and B. The removal of native vegetation and the need for approval is dependent upon the nature of the vegetation whether it is exempt, the extent of clearing, the location (and resultant risk classification) and the risk pathway described under the *Permitted clearing of native vegetation – Biodiversity assessment guidelines* (Department of Environment and Primary Industries, September 2013). Any native vegetation removal done for the proposed works is not exempt under the Clause 52.17-7 of the *Central Goldfields Planning*

Potential Constraint	Comment
	Scheme. Both Options A and B are located in Location A of the Native Vegetation Location Risk Map V2 (DEPI 2013) which means that if the extent of clearing of native vegetation is less than 1 ha and less than 15 scattered trees are affected then a low risk-based pathway application for a permit to remove native vegetation will be required. If these thresholds are exceeded then a moderate risk-based pathway application for a permit to remove native vegetation will be required.

Table 5.2: Anticipated further work

Task	Description
Ecological surveys	The selected option will require and on-ground survey to identify if: • listed threatened and protected flora species are present • listed threatened fauna species and their habitats are present • remnant native vegetation or scattered trees are present. This information will inform whether there will be a requirement for applications and approvals under the FFG Act, EPBC Act and the native vegetation provisions of the *Central Goldfields Planning Scheme.*
Aboriginal heritage survey	Both Option A and Option B alignments require inspection to determine whether any areas proposed for development are classified as an area of *cultural heritage sensitivity* as defined by the Victorian *Aboriginal Heritage Regulations 2007.* The presence/absence of areas of cultural significance will determine whether the preparation of a Cultural Heritage Management Plan (CHMP) is required..
Planning and Environment Act 1987 Planning permit and native vegetation clearing	As identified in Table 5.1 the construction of either Option A or Option B triggers the requirement for a planning permit under multiple zones and overlays. A planning permit application will be required to be prepared that addresses the objectives of the relevant SPPFs and LPPFs together with applicable zone and overlay conditions and information requirements. As noted above both Options A and B are located in Location A of the Native Vegetation Location Risk Map V2 (DEPI 2013) and therefore if the area of native vegetation that is to be cleared is less than 1 ha and/or less than 15 scattered trees are affected then a low risk-based pathway application for a permit to remove native vegetation will be required. If these thresholds are exceeded then a moderate risk-based pathway application for a permit to remove native vegetation will be required.
Water Act 1989	Any works on a waterway require a Licence under Section 67 of the *Water Act 1989.* The application for a works license is made through the local water authority (Goulburn Murray Water) however the Act itself is administered by DEPI. Generally a licence is only required for works related to the *use or take* of water (e.g. dam construction) and would not apply to the construction of a levee. Further consultation is required with both DEPI and Goulburn Murray Water during detailed design to determine the potential licence requirements for both Option A and Option B. Note: the *Water Act 1989* will be amended in accordance with the *Water Amendment (Flood Mitigation) Bill 2014*). The bill deals with the maintenance rather than construction of levees and is not considered further here.
Catchment and Land Protection Act 1994	The *Catchment and Land Protection Act 1994* provides for the establishment of the Northern Central Catchment Management Authority (NCCMA). Under the *Water Act 1989* (Waterways Protection By-law) the NCCMA is obligated to issue a permit for works on waterways. However, Options A and B are likely to be exempt from requiring a permit as they constitute works undertaken by a *local*

Task	Description
	council that is required to *prepare for an emergency*. In this case a works proposal is still required to be submitted to the NCCMA prior to commencing works. Further consultation with the NCCMA is required during detailed design to confirm permitting requirements. The NCCMA will also act as a referral body for the planning permit application.
Environmental Protection and Biodiversity Conservation Act 1999	The EPBC Act provides for the protection of matters of national environmental significance and the conservation of Australia's biodiversity. Potential impacts on Matters of National Environmental Significance (MNES) may involve the Australian Governments in the assessment of a project. The assessment of any significant impacts on a Matter of National Environmental Significance is assessed against the guidelines provided in the 'Administrative Guidelines on Significance' (DEWHA 2009). It is unlikely that either options would require referral to the Commonwealth Minster for Environment for consideration of potential impacts on MNES given that the landscape in which both Options A and B are located is highly disturbed and fragmented with little remnant native vegetation and therefore is unlikely to support important populations of listed threatened species and ecological communities or listed migratory species. However, the proposed ecological survey will verify that referral is not required.
Flora and Fauna Guarantee Act 1998	A 'Protected Flora Licence' or Permit from the Regional Offices of DEPI will be required if the works associated with Option A or B occur on public land which might kill, injure or disturb protected native plants. The proposed ecological survey will target public land affected by the preferred option to identify if any protected flora are present which would require a permit for their removal.
Aboriginal Heritage Act 2006	Dependent on the outcome of the site inspection it is possible that a Cultural Heritage Management Plan (CHMP) will be required to be prepared under the *Aboriginal Heritage Act 2006*. The *Aboriginal Heritage Regulations 2007* require that a CHMP be prepared where' all or part of the activity area is in an area of cultural heritage sensitivity and all or part of the activity area is a high impact activity'. A utility installation (levee construction) impacting an area exceeding 25m^2 is defined as a high impact activity. The site inspection will determine whether any areas of high sensitivity exist and thus whether a CHMP is required.
Environmental Protection Act 1970	A levee is not a scheduled premises under the *Environmental Protection Act 1970* and does not require a Works Approval or Licence.
Environmental Effects Act 1978	It is unlikely that the construction of either Option A or Option B would trigger the requirement for the preparation of an Environmental Effects Statement under the EE Act.

6. Preliminary civil design

The preliminary design for both Options A and B is outlined in this section. The options include the following elements:

- New levees
- New culverts
- Upgrade of the existing culverts
- Widening of the existing drains
- Adding one-way valves to some of the existing culverts

Details of the works relating to Options A and B are provided in Sections 3.3 and 3.4 respectively.

The following sketches have been prepared to outline the preliminary design as presented in Appendix D:

- General Layout – Option A
- General Layout – Option B
- Typical Cross Section of the Levee
- Miscellaneous Details of Culverts, Non-return Valves, etc.

6.1 Basis of design

The design criteria used for the preliminary design is based on the following standards and Guidelines:

- Australian Standard (2010), *Precast reinforced concrete box culverts – Part 1: Small culverts*, Standards Australia Limited, AS 1597.1-2010
- USBR (1987), *Design of Small Dams*, U.S. Bureau of Reclamation, Dept. of the Interior, Washington, D.C.

Further details are provided in the respective sections below for different elements. For the water levels and discharge figures, the results of the hydraulic review (Section 6) were used.

6.2 Levees

Given the height of the levees a single preliminary design has been adopted for all the levees in Options A and B which can be listed as follows:

- Option A
  - Western Levee, ~3km long
  - Williams Street Levee, ~500m long
- Option B
  - Belfast Road Levee, ~1km long
  - Williams Street Levee, ~500m long

Geotechnical studies need to be undertaken to find out the local geology, foundation conditions and available fill materials before more tailored levee designs can be performed. The basis of preliminary design for the embankment is outlined below:

Embankment type – for small levees such as Western levee, Belfast Road Levee and Williams Street Levee, it is recommended to construct a homogeneous earthfill embankment. A zoned embankment is uneconomical due to the cost of free-draining materials, small dam height and the length (up to 3km).

Crest width – A nominal crest width of 3.5m has been selected to allow for vehicle access (to perform levee inspections etc.) and ease of construction and access of heavy machinery.

Embankment slopes – without fill material specifications the recommended slopes for small homogenous earthfill dams of 1V:3H (USBR, 1987) has been selected for preliminary design stage.

Upstream and downstream slope protection – a grassed upstream and downstream slope has been selected for preliminary design. Protective materials such as riprap will add considerable cost due to the length of the levees.

Freeboard – the vertical distance between the crest of the embankment and the 1:100 AEP flood event water level surface estimate. The primary function of a freeboard in the case of a retention levee is to prevent overtopping of the embankment by abnormal and severe wave action and provides a safety factor against dam settlement and larger flood levels than estimated. A nominal freeboard of 300mm has been selected for preliminary design.

Basecoarse – a road base crest capping or 'basecoarse' is proposed for the embankment, allowing vehicle access as well as being an appropriate freeboard material. Without material specifications, a standard basecoarse side slope of 1V:2H has been adopted for preliminary design stage.

Topsoil stripping – a nominal topsoil stripping of 300mm has been selected as best practice. Topsoil stripping will be dependent on foundation material and vegetation cover.

A summary of the preliminary design parameters for the levees is shown in Table 6.1.

Table 6.1: Summary of the preliminary design parameters for the levees

Topsoil stripping	**0.3**	**m**
Basecoarse (freeboard)	0.3	m
Basecoarse side slopes	1V : 2H	
Upstream slope	1V : 3H	
Downstream slope	1V : 3H	
Top of fill width	4.7	m
Top of crest width	3.5	m

6.2.1 Alignment and height

For preliminary design, the levees have been divided up into chainages of 50m. At each 50m interval along the length of each levee the surveyed ground levels and estimated water surface levels (1 in 100 AEP flood event) were compared. Using this information the crest level profiles for

each embankment have been designed to minimise levee height while maintaining a minimum freeboard of 300mm along each length.

To work out the crest profile, the levees were divided into relatively large segments depending on the topography. For each segment, a start and end crest level was nominated and the crest levels in between were calculated using linear interpolation. Dividing the levee structure into segments allows for ease of construction as well as uniform gradients along the crest.

The following tables show the large segmentation of each levee and the corresponding gradient.

Table 6.2: Option A – Western Levee crest grading

Segments	Chainage	Crest Level	Segment Crest Grading
1	50	197.90	0.0015
	450	197.30	
2		197.30	0.0036
	800	196.05	
3		196.05	0.0000
	1500	196.05	
4		196.05	0.0042
	1750	195.00	
5		195.00	0.0047
	1900	194.30	
6		194.30	0.0030
	2150	193.20	
7		193.20	0.0011
	2500	192.80	
9		192.80	0.0016
	2933	192.10	

Table 6.3: Option A & B – Williams Road Levee crest grading

Segments	Chainage	Crest Level	Segment Crest Grading
1	100	198.00	0.0030
	500	196.80	
2		196.80	0.0004
	901	196.65	

Table 6.4: Option B – Belfast Road Levee crest grading

Segments	Chainage	Crest Level	Segment Crest Grading
1	100	195.35	0.0001
	500	195.30	
2		195.30	0.0006
	1000	195.00	
3		195.00	0.0010
	1200	194.80	
4		194.80	0.0019
	1412	194.40	

The construction time for the levees in Option A and Option B are estimated as follows:

- Option A – Western and Williams Road Levees – 14 weeks
- Option B – Belfast Road and Williams Road Levees – 11 weeks

The estimated construction time is based on the following construction methodology:

- Divide levees into appropriate construction segments (for example 100m)
- Clear vegetation along path
- Strip topsoil and stockpile for re-use (300mm deep)
- Remove 'crude' levee material and stockpile for re-use
- Supply and place embankment fill
- Supply and place basecourse fill (300mm)
- Topsoil and re-grass
- Levees are constructed in parallel with a lag time between for operation relocation, for example; stripping machinery is relocated to secondary levee (Williams Levee in both cases) immediately after Western / Belfast stripping is complete
- It is assumed that raising the existing roads instead of building a new levee would require the same construction time.

6.2.2 Road/railway crossing levels

Based on the survey results of the road/rail surface levels and water surface levels resulting from hydraulic modelling, a number of roads will be inundated during the 1:100 AEP flood event. The following Table 6.5 compares the road surfaces with the estimated water surface levels and the proposed levee height intersecting the roads. For the location of the crossings refer to the General Layouts in Appendix D.

Table 6.5: Road surface levels and nominated levee crest levels for Option A and B

Levee	I.D.[1]	Chainage	Road / railway level (m)	Water surface level (m)	Nominated levee crest Level (m)	Road/railway location	Proposed Action
Western Levee (Option A)	AC2	1550	195.7	195.4	195.9	Pyrenees Hwy (VicRoads)	OK
	AC3	1900	193.8	194.0	194.3	Railway	Increase the culvert capacity
	AC4	2150	192.9	192.9	193.2	Wills Rd	Raise the road level
Belfast Levee (Option B)	BC2	1000	194.5	Below road	195.0[2] (either side of road)	Carisbrook Talbot Rd (VicRoads)	OK
Williams Levee (Both Options A and B	AC6 BC6	250	197.4	Below road	197.6[2] (freeboard above ground level RL197.3)	Carisbrook Talbot Rd (VicRoads)	OK

[1] See General Layouts in Appendix D

[2] Based on chainage design method outlined in section 6.2.1 the freeboard at the road locations have been included in Table 6.5 and the levee crest RL levels will be optimised in detailed design to minimise the effect on roads.

From Table 6.5 the railway line, Wills road and Curragh Moor Rd will be inundated during the design flood event. Pyrenees highway just exceeds the freeboard height of 300mm and does not need to be raised. It is proposed to raise Wills Rd and Curragh Moor Rd to meet the nominated crest level. For preliminary design stage it is proposed to raise the railway to meet the nominated crest level and prevent the flood overtopping through this section of the levee.

6.2.3 Raising the roads

It was understood based on the discussions with CGSC that the roads other than the main roads (VicRoads) can be raised, if required, in lieu of the construction of a new levee. As such a review was undertaken on both options the summary of which is provided in Table 6.6 for any location where the levees are running in parallel to the roads.

Table 6.6: Summary of the review on road raising instead of building a new levee

Levee	Road	Chainages	Comments	Proposed Action
Western Levee (Option A)	Pleasant Street	CH 1550 to CH 2550	For about 1km, the levee runs in parallel to the Pleasant Street along which the road level is almost similar to the foundation level of the levee. On average the height of the levee need to be 0.9m with a maximum height of 1.1m in this section.	Raising the road
Williams Road Levee (both options)	Williams Road	CH 000 to CH 200	There is an existing drain running on the southern side of the levee especially from CH 250 onwards. This means the road can be raised to behave as a levee. From CH 250 onwards the road reserve can be used for building a levee.	Raising the road
Belfast Road Levee (Option B)	Belfast Road & Virginia Street	CH 300 to the end (CH 1400)	There is an existing drain running on the southern side of the levee along the Belfast Road and Virginia Street. In order to raise the roads in lieu of building a new levee, the entire drain needs to be rebuilt on the southern side. Based on the results of Option B model (Table 3.2), the capacity of the drain is around 6 m^3/s.	Building a new levee.

It should be noted that no road raising is assumed possible for the two main roads (Pyrenees Highway and Landrigan Road) and the railway. As such, a typical 0.3m high concrete parapet wall is assumed along their shoulders wherever water level exceeded their top levels.

In the current cost estimation, the cost of road raising per metre is assumed to be identical with building a new levee with 3.5m wide crest. Should the council and stakeholders agree with the proposed works in Table 6.6, a new road raising design would require to be undertaken complying with the associated road standards. Currently the General Layouts in Appendix D are not showing road raising for the Western Levee of Option A.

6.3 Culverts

Other than two small circular pipes, precast (crown and base unit) box culvert design is proposed for new installations and upgrades for Options A and B outlined in Table 6.7 and [1]Should the proposed road raising be considered, this culvert would not require an extension under the levee.

Table 6.8, respectively. Precast box culverts are recommended for minimal traffic disruption and ease of installation. A typical box culvert section is shown in Figure 6.1.

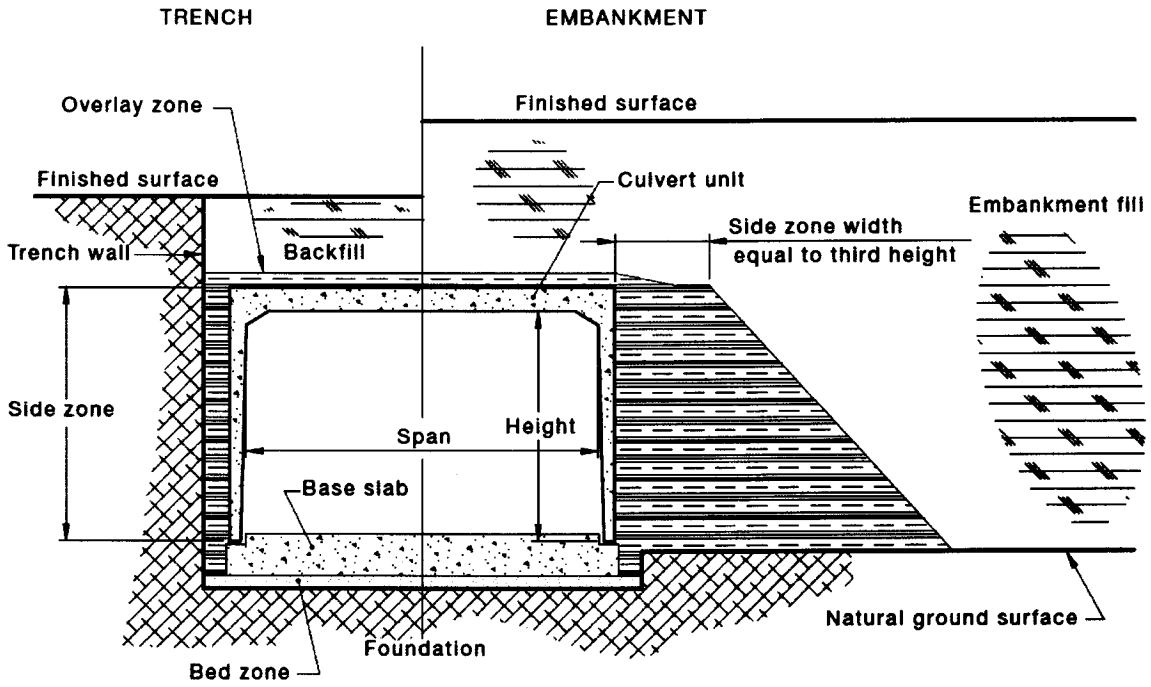


Figure 6.1: Typical inverted U-shaped box culvert (AS 1597.1-2010)

Typical culvert loading from the roads/railway is assumed at this stage based on the Australian Standards. In the detail design stage, for the selected option, VicRoads and VicTrack will be consulted for the loading and final arrangement of the culverts as well as the construction methodology and traffic management.

The following tables summarize the culvert works to be carried out for each option. The culvert locations are shown on the General Layouts in Appendix D. The length of the culverts/pipes will be finalised in the detail design stage but for preliminary cost estimation the lengths shown on the General Layouts have been used.

Table 6.7: Option A culvert works

Levee/Location	Label	Culvert Type	Works	Dimensions	Location
Western Levee	AC1	Circular Pipe	Install	One 500mm diameter	Southern end of levee
	AC2	Box	Install	Three 1.2 x 0.75 m, 600mm cover	Pyrenees Hwy (VicRoads)
	AC3	Box	Install	Seven 1.2 x 0.45 m, 600mm cover	Railway (VicTrack)
	AC4	Box	Extend under the levee[1]	Two 0.8 x 0.4 m	Through levee parallel to Wills Rd

Levee/Location	Label	Culvert Type	Works	Dimensions	Location
Williams Levee	Nil (there is an existing under Landrigan Road which does not require an upgrade)				
Township	AC5	Box	One-way flap	Two 1.2 x 0.9m culverts	Carisbrook Talbot Rd (VicRoads) near school

[1]Should the proposed road raising be considered, this culvert would not require an extension under the levee.

Table 6.8: Option B Culvert works

Levee/Location	Label	Culvert Type	Works	Dimensions	Location
Belfast Levee	BC1	Circular Pipe	Install	Two 750mm diameter	Curragh Moor Rd
	BC2	Box	Upgrade & one-way flap	Two 2.1 x 0.6m (upgraded from existing two 1.2m x 0.6m)	Carisbrook Talbot Rd (VicRoa
Williams Levee	Nil (there is an existing under Landrigan Road which does not require an upgrade)				
Township	BC3	Box	One-way flap	Two 1.2 x 0.9m culverts	Carisbrook Talbot Rd (VicRoa near school
	BC4	Box	One-way flap	One 2.4m x 0.8m	Railway
	BC5	Box	One-way flap	One 2.8m x 0.75m	Railway

Compared to the culvert sizes used in the hydraulic modelling (see Section 3 or Tables 3.1 and 3.2), it was identified that the culvert under the railway (AC3) requires a bigger size and capacity. Based on the results of the MIKE 11/21 model, assuming 4 box culverts of 1.2m wide by 0.45m high at an invert level of RL 193.12 m, the railway gets overtopped. Based on a simplified calculation using the orifice formula and assuming that the water level on the northern side of the culvert remains unchanged, 7 culverts of the same size seem adequate. The model was re-run with 7 culverts and the results confirmed the simplified calculation which resulted in 5.6m^3/s capacity and a water level of RL 193.85m on the southern side of the railway.

6.4 Floodgates (Non-return valves)

Floodgates or one-way flap valves are proposed in Option A and B to prevent water surcharging up the drains in large riverine flood events. Typical floodgates operate using a top hinge and in a flood event water rises on the downstream face will push the floodgate against the culvert structure to form a seal. Under normal operating conditions a floodgate will limit flow, requiring a minimum water level upstream to overcome the weight of the gate before it can open. For this reason smaller rain events may result in pooling of water on the upstream side.

It is recommended to use commercially available box culvert floodgates with the following specifications:

- Moulded fibreglass reinforced polyester floodgate material

- High tensile stainless steel hinge and hinge pin
- Replaceable neoprene seal around the culvert face
- Minimum 300mm freeboard from ground level to the base of the flap

There are a number of Australian suppliers of floodgates, two examples are Humes and AWMA Water Control. A typical box culvert floodgate is shown in Figure 6.2.

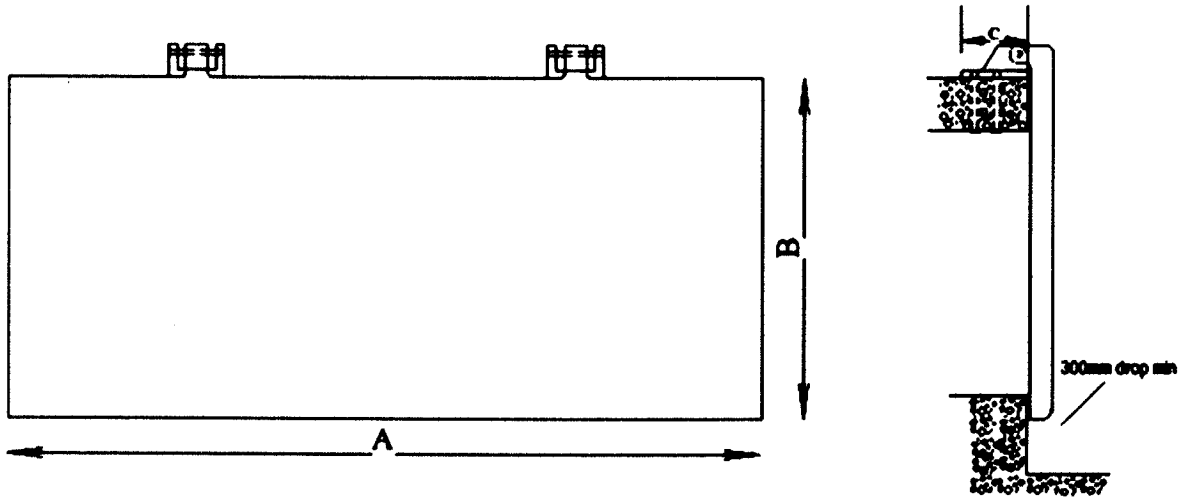


Figure 6.2: Typical box culvert floodgate (Prime Composites Aust. Pty. Ltd. 2014)

The main culverts that require additional floodgate design are the railway primary and secondary (BC4.1 & BC4.2) culverts and Carisbrook Talbot Rd (BC2) culvert in Option B, see [1]Should the proposed road raising be considered, this culvert would not require an extension under the levee.

Table 6.8.

The railway culverts are masonry abutments supporting a suspended deck over an unlined channel section. The current arrangement does not easily allow the fixing of floodgates to the existing structure and major works will be required. Two options are recommended:

- Construct a support frame structure onto the existing culvert to provide a structure to fix the floodgate onto. This option involves:
    - Casting a concrete toe underneath the floodgate to prevent scouring of the channel as well as a surface for the bottom floodgate lip to seal up against and;
    - Fixing a steel frame to the masonry abutments for the floodgate to seal up against (depending on the angle of the masonry wall relative to the support beam the end flap would be restricted, requiring a steel plate to be welded in place pushing the neighbouring floodgate out from the wall) and;
    - Fixing the floodgate hinges to the current support beam (I-Beam) of the railway track.
- Remove the existing structure (including the railway) and replace with two precast box culverts and backfill (and replace the railway segment if required). This option may prove more economical with the availability of existing heavy machinery for other major works.

Entura's recommendation is to go with the second option and install typical precast box culverts with floodgates for BC4.1 and BC4.2.

The Carisbrook Talbot Rd culvert is proposed to be upgraded to two 2.1 x 0.6m box culverts. Due to the large size of the culverts, restricted normal flow conditions would result in pooling on the upstream sized, as discussed above. Two options are recommended to prevent pooling on the upstream side of the floodgates:

- Leave a small gap (approximately 300mm) at the base of the flood gate for the culvert to free drain in small rain events.
- Design a floodgate with a hinged lower section for smaller flows to open with less resistance.

It is Entura's recommendation to leave a small gap at the base of the flood gate. The gap size will be designed such that in a flood event the backflow has a negligible effect on any upstream inundation.

6.5 Affected services during construction

During the site visit and survey the presence of underground services was noted in two locations;

- Intersection of Pyreness Highway and Pleasant Street, presence of gas, water and an unclassified service.
- Intersection of Wills Street and Pleasant Street, presence of water.

Overall, it appears that the affected services are not that different for both options. Dial Before You Dig enquiries have been undertaken along each of the levee alignments in order to gain a further understanding of services in the vicinity of the project. In the detailed design stage, this information will be used determine the implications, if any, on the levee design.

7. Preliminary cost estimation

Preliminary cost estimation was undertaken based on the preliminary design and sketches for both options. Key exclusions from the preliminary cost estimate are as follows:

- Excavation and haulage of embankment materials from the borrow area.
- The cost associated with land acquisition and compensation to the property owners.
- Insurances
- The construction works interfacing with the railway and main roads would not encounter any unexpected issues other than normal traffic management and some fencing/protection wall inclusion

A contingency amount of 30% has been included. The following assumptions were made:

- Sub-total costs per rounded up to the nearest $1000
- Fence line installed on one side of each levee over the full length.
- To reinstate the railway line is comparable to reinstating the VicRoads highway.
- Project management costs are estimated to be ~10% of direct costs.

Rates are based on Rawlinsons, quotations from suppliers and past experience. The summary of the cost estimation for each option is provided in Table 7.1 and Table 7.2.

Table 7.1: Summary of cost estimation for Option A

Option A - Items	**Cost**
Mobilisation / demobilisation	79,020
Western levee	1,292,000
Williams road levee	243,000
Culverts & floodgates	142,000
Project management	190,000
Sub total	**1,946,020**
Contingency (30%)	583,800
Geotechnical investigation	37,050
Detailed design	45,650
Environmental assessments and approvals	60,000
Cultural heritage management plan	21,250
Total Estimated Cost (Excl. GST) rounded to the nearest $1,000	**$2,694,000**

Table 7.2: Summary of cost estimation for Option B

Option B - Items	**Cost**
Mobilisation / demobilisation	73,350
Belfast levee	438,000
Williams road levee	243,000
Culverts & floodgates	79,000
Project management	100,000
Sub total	**933,350**
Contingency (30%)	280,005
Geotechnical investigation	31,460
Detailed design	45,650
Environmental assessments and approvals	60,000
Cultural heritage management plan	21,250
Total Estimated Cost (Excl. GST) rounded to the nearest $1,000	**$1,372,000**

8. Discussion

Options A and B were studied in further details as outlined in the previous sections. Both options were compared based on a number of parameters to assist the council in selecting the best alternative for flood mitigation. The results are presented in Table 8.1. The following assumptions were made:

- The best option in relation to each parameter was given the highest score of 5 and the other option was score equal or lower comparatively.
- The weightings given to the parameters were selected based on their importance to the community and the council.

Table 8.1: Option comparison

Parameters	Weighting	Option A	Option B	Comments
Design	5%	4	5	Option A has more road raising and culvert design
Construction	10%	4	5	Option A requires more traffic management and slightly longer duration
Operation	5%	5	4	Option B has more non-return valves
Environmental/cultural heritage	10%	5	5	Minimal differences
Social/Stakeholder management	10%	5	4	Option B is less likely to be the favourite from the community and stakeholders perspective. Option A is likely to be accepted more easily by the community based on previous consultation processes and recent Council discussions. Therefore it is likely to minimise any conflict in the community over the mitigation measures and may assist in negotiations with affected landowners.
Township inundation risk	30%	5	3	Inundation maps show that Option B without vegetation clearing increases inundation in some parts of the township adjacent to the main creek.
Cost	20%	3	5	Option B is less expensive
Compensation/land acquisition	10%	3	5	Option B intrudes the private properties 40% more than Option A
Total weighted score		4.25	4.15	Option A has a higher weighted score

Appendices

A Aboriginal Cultural Heritage - Desktop Due Diligence Assessment

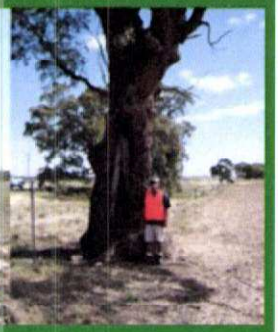
Central Goldfields Shire Council

Carisbrook Flood Mitigation Works

Aboriginal Cultural Heritage Desktop Due Diligence Assessment

DRAFT



Draft report to Entura

12 January 2015

Landskape

a division of ML Cupper Pty Ltd
ABN 48 107 932 918

PO Box 246 Red Cliffs 3505

e mail: landskape@telstra.com

tel: 0408 006 690

fax: 03 5025 2549

Central Goldfields Shire Council

Carisbrook Flood Mitigation Works

Aboriginal Cultural Heritage Desktop Due Diligence Assessment

Draft report to Entura

Landskape

Natural and Cultural Heritage Management

a division of M.L. Cupper Pty Ltd

ABN: 48 107 932 918

Author: Dr Matt Cupper

Date: 12 January 2015

PO Box 246 Merbein 3505
e mail: landskape@telstra.com
tel: 0408 006 690
fax: 03 5025 2549

Executive Summary

Central Goldfields Shire Council proposes to undertake works to mitigate flooding at Carisbrook in central Victoria.

As part of the planning approvals process preceding the proposed infrastructure upgrade Landskape's principal research scientist Dr Matt Cupper was engaged by Entura on behalf of Central Goldfields Shire Council to conduct a due diligence investigation to identify any possible Aboriginal cultural heritage issues that might need to be addressed prior to construction of the proposed infrastructure. Dr Cupper is a qualified archaeologist and geoscientist, with 16 years experience as a cultural heritage practitioner and high-level expertise in geomorphology and soil science.

No Aboriginal cultural heritage sites have previously been recorded in the work areas proposed for flood mitigation works. Predictive modelling shows that there is a low to moderate potential for Aboriginal cultural heritage to occur in the proposed work areas.

This due diligence study concludes that inspection of the proposed work areas is required to determine if they are areas of cultural heritage sensitivity according to the *Aboriginal Heritage Regulations* 2007, and thus ascertain whether the works require a mandatory Cultural Heritage Management Plan (CHMP) under Section 46 of the *Aboriginal Heritage Act* 2006.

Contents

List of Tables

List of Abbreviations

CHMP – Cultural Heritage Management Plan

OAAV – Office of Aboriginal Affairs Victoria

RAP – Registered Aboriginal Party

VAHR - Victorian Aboriginal Heritage Register

1 Introduction

Central Goldfields Shire Council proposes to undertake works to mitigate flooding at Carisbrook in central Victoria.

As part of the planning approvals process preceding the proposed infrastructure upgrade Landskape's principal research scientist Dr Matt Cupper was engaged by Entura on behalf of Central Goldfields Shire Council to conduct a due diligence investigation to identify any possible Aboriginal cultural heritage issues that might need to be addressed prior to construction of the proposed infrastructure. Dr Cupper is a qualified archaeologist and geoscientist, with 16 years experience as a cultural heritage practitioner and high-level expertise in geomorphology and soil science.

1.1 Aims of the Investigation

The aim of this preliminary cultural heritage investigation was to prepare a general statement identifying known Aboriginal cultural heritage places and objects and any areas of archaeological potential within the proposed flood mitigation work areas. Statutory requirements pertaining to Aboriginal cultural heritage were also examined to determine their applicability to the proposed development.

Preparation of this due diligence study involved review of the *Aboriginal Heritage Act* 2006 and the *Aboriginal Heritage Regulations* 2007 (last amended 2009). Any Aboriginal cultural heritage places or objects recorded previously in the proposed work areas were identified by searching the Victorian Aboriginal Heritage Register (VAHR) site database maintained by the Office of Aboriginal Affairs Victoria (OAAV).

A general predictive model examining possible cultural heritage site locations within the proposed infrastructure areas was formulated from this and other relevant archaeological and environmental data. Preparation of this model also involved the use of topographic and geological maps and aerial photographs to identify landscape features likely to contain archaeological sites.

2 Contextual Information

2.1 Legislative Context

All Victorian registered and unregistered Aboriginal cultural heritage sites are protected by the *Aboriginal Heritage Act* 2006 (commenced 28 May 2007). This Act prohibits the wilful destruction or disturbance of any Aboriginal cultural heritage site, place or object, whether on private or public land.

The Office of Aboriginal Affairs Victoria is the Victorian State Government agency that administers this Act.

2.1.1 *Aboriginal Heritage Act* 2006

The *Aboriginal Heritage Act* 2006 and its *Aboriginal Heritage Regulations* 2007 (last amended 2009) are of particular relevance to the proposed development. A core component of this Act is the preparation of Aboriginal Cultural Heritage Management Plans (CHMPs), which are required under certain circumstances for high impact activities. Aboriginal Cultural Heritage Management Plans must meet prescribed standards and be approved by the Office of Aboriginal Affairs Victoria before they can be used to support permit applications to local government or other agencies.

The Act also established the Aboriginal Heritage Council, which invites Aboriginal community groups with cultural heritage interests in particular parts of the State to become Registered Aboriginal Parties (RAPs). The RAP(s) for a given area must endorse an Aboriginal Cultural Heritage Management Plan before the Office of Aboriginal Affairs Victoria will approve it. The Dja Dja Wurrung Clans Aboriginal Corporation has RAP-status over the activity area for the Carisbrook Flood Mitigation Works.

The regulations can be used to determine if an Aboriginal Cultural Heritage Management Plan is required for an activity. The regulations also detail the standards expected of an Aboriginal Cultural Heritage Management Plan.

2.2 Environmental Context

The proposed works at Carisbrook would be located on gently undulating basalt plains and low bedrock footslopes in the Midlands of Victoria. The geological framework of these dissected uplands comprises hills and plateaux of Ordovician (500-465 million year old) sandstones and late Neogene and Quaternary (past few million year old) volcanic lava flows (VandenBerg 1997). The geology of the western section of the study area is Early Ordovician marine sandstones of the Castlemaine Group. Basalt lava

flows mantle the eastern section. Minor alluvial sediments have been deposited in the narrow valleys of Deep, McCallum and Tullaroop Creeks over the Quaternary (the past 2 million years; Joyce and Webb 2003).

Prior to settlement by Europeans, the basalt plain and foot slopes are likely to have supported a vegetation cover of Eucalypt woodlands with a grassy understorey (DEPI 2015).

Overall, the environment of the proposed work areas have been extensively modified by past land use. Since the establishment of Carisbrook pastoral run in 1839 (Spreadborough and Anderson 1983), Europeans have cleared and levelled the proposed work areas. Extensive earthworks have occurred along their entire lengths to construct infrastructure including roads and fences.

2.3 Aboriginal Cultural Heritage Context

2.3.1 Aboriginal Ethno-History

At the time of first contact with Europeans, Aboriginal people of the Dja Dja Wurrung language group occupied the part of the Victorian Midlands encompassing the study area (Barwick 1984, Clark 1990). The Dja Dja Wurrung were part of the Kulin group of languages, who included peoples of the related Bun wurrung (or Bunurong)–, Daung wurrung (or Taungurong)–, Djab wurrung–, Ngurai-illam wurrung–, Wath wurrung (or Wathaurong) and Woi wurrung (or Woiworung)–speakers (Barwick 1984, Clark 1990). These language groups shared similar language and kinship systems, notably the division members into patrilineal moieties (two-part social classification) termed 'Waa' (raven) and 'Bungil' (eagle) (Clark 1990).

Clark (1990) estimates that there were at least 25 clans in the Victorian Midlands encompassing the study area, with between 40-120 adult men, women, adolescents and children in each, suggesting a total population of around 1000-3000 people.

Aboriginal people caught fish including eels, freshwater crayfish, yabbies and tortoises in the streams and wetlands in the region (Dawson 1881). Fish traps were also constructed, with Chief Protector of Aborigines George Augustus Robinson noting a system of channels and weirs near the Grampians (Bird 1984). Nets were used to catch waterbirds, whose eggs were also collected. Some of the other animals that Aboriginal people of the Midlands hunted include kangaroos, wallabies, emus, possums, echidnas, lizards, snakes and frogs (Dawson 1881, Howitt 1904). Plant foods included native millet, panic grass, pigface fruits, wild cherries, kangaroo apple, tubers, yams, roots and other

grass grains (Dawson 1881, Gott 1983, Zola and Gott 1992).

Aspects of the initial interaction between Europeans and the Aboriginal people of the Midlands led to violent conflict. Aborigines were shot, poisoned and displaced from their land by pastoral settlers and, in retaliation, sheep were speared and settlers threatened (Bride 1898, Clark 1990). In response, the Aboriginal Protectorate system was introduced, with Assistant Protector Edward Park establishing the Mount Franklin Protectorate Station near Daylesford (Clark 1990). The Aboriginal Protectorate recorded a rapid decline in Dja Dja Wurrung numbers, caused by dispossession of land and the consequent destruction of habitat and social networks. Diseases including malnutrition also took their toll.

Many Dja Dja Wurrung continued to live by "fringe dwelling" on the outskirts of mining settlements and survived largely through begging, as their traditional food resources were greatly depleted. Honorary Correspondent depots were set up around Victoria to dispense food and other supplies to Aboriginal people. The Aboriginal Protectorate system was replaced in 1860 by the Central Board for the Protection of Aborigines (Barwick 1984). It established Coranderrk Station at Healesville and the Framlingham Mission at Purnim for the surviving Dja Dja Wurrung people.

Today, the interests of Aboriginal cultural heritage are in the custodianship of the Dja Dja Wurrung Clans Aboriginal Corporation.

2.3.2 Previous Aboriginal Archaeological Studies

Previous archaeological studies of sites in the Victorian Midlands have demonstrated Aboriginal occupation dating back to the last glacial period some 26,000 years ago. The oldest archaeological site in the region is a swamp near Lancefield, approximately 100 km east of the study area (Gillespie *et al.* 1978). The deposits of this swamp contain the fossilized bones of extinct giant marsupials or 'megafauna' in association with Aboriginal stone artefacts. These finds indicate that Aboriginal people and megafauna interacted for at least 7,000 years. However, no evidence was recovered to suggest that Aboriginal people had hunted the megafauna or had butchered them for food.

Early Aboriginal occupation of the Western Uplands is also evident from the Drual rockshelter in the Grampians, approximately 100 km west of the study area. Stone artefacts and ochre at the lower levels of the Drual sequence have been radiocarbon dated to 22,140 ± 160 years before present (Beta-88523; Bird *et al.* 1998). The only formal tool types in these early assemblages are thumbnail scrapers, which are present

throughout the sequence. Later mid-Holocene (around 5000 years ago) assemblages include backed microliths and greenstone flakes. This is the oldest, continuous cultural sequence in Victoria.

One of the most impressive Aboriginal sites in Victoria is the Carisbrook Ceremonial Stone Arrangement first described by Massola (1963). It is a large, boomerang-shaped stone arrangement 60 m long and 5 m wide associated with two stone circles and a small rock cairn. The site overlooks Tullaroop Creek some 4 km southeast of Carisbrook. Massola (1956) also recorded three Aboriginal rock wells on the outskirts of Maryborough, west of the study area.

2.3.3 Previously Identified Aboriginal Cultural Heritage in the Study Area

According to the Office of Aboriginal Affairs Victoria's Victorian Aboriginal Heritage Register (VAHR), accessed on 17 December 2014, no Aboriginal cultural heritage places have been located previously in the proposed work areas. The nearest Aboriginal archaeological site is an isolated find of a broken groundstone axe-head (VAHR site number 7623-0024), located by a farmer in his paddock, some 1.5 km west of the proposed work areas. There are also a number of Aboriginal cultural heritage places along Tullaroop Creek, approximately 2.5-4 km east of the proposed work areas. These include a number of stone artefact scatters, a tree scarred by Aboriginal people, and a stone arrangement.

3 Cultural Heritage Predictive Model

Previous archaeological studies indicate that the most frequently recorded Aboriginal cultural heritage places in the Victorian Midlands are stone artefact scatters and scarred trees (OAAV Victorian Aboriginal Heritage Register for Creswick 7623 1:100,000 map sheet area). Earthen features such as mounds have also been identified in the archaeological record. Other site types include stone sources, rock art and rock shelter sites, stone arrangements and burials. Based on these observations of archaeological site types and their distribution and landscape setting, the following predictive model of Aboriginal cultural heritage site locations for the Carisbrook flood mitigation works can be proposed. A summary of the predictive model is presented in Table 1.

Past Aboriginal occupation of the Victorian Midlands would have focussed on the region's creeks and their associated wetlands because these water sources would have offered a richer resource zone than more poorly watered parts of the landscape. Consequently, most archaeological sites can be expected adjacent to water sources. However, the proposed infrastructure areas for the Carisbrook flood mitigation works would largely traverse creek lines perpendicularly, rather than paralleling them, reducing the potential for encountering cultural heritage.

The potential for encountering Aboriginal cultural heritage in the planned infrastructure areas for the Carisbrook flood mitigation works is also substantially reduced by the high degree of previous disturbance of the study area. The past removal the original vegetation lessens the probability that scarred trees would be encountered. Similarly, substantial modification of the original land surface by earthworks associated with previous gold mining, the construction roads, installation of fences, dams, powerlines, telecommunication cables and dwellings, and agricultural clearing and ploughed cultivation would have destroyed earthen features such as mounds and hearths and stone features such as arrangements and ceremonial rings, had they previously existed in the proposed infrastructure areas. However, stone artefacts tend to be dispersed, rather than destroyed, by ploughing.

Table 1. Desktop predictive model of encountering Aboriginal cultural heritage sites in the activity area.

Scarred trees	Stone artefacts	Earthen features	Stone features	Burials	Hearths	Shell middens
Low-Moderate	Low-Moderate	Low	Low	Low	Low	Negligible

4 Assessment of Proposed Development According to *Aboriginal Heritage Regulations* 2007

All Aboriginal cultural heritage is protected by the State *Aboriginal Heritage Act* 2006. Responsibility rests with the proponent of a development to demonstrate that due care and diligence have been taken to identify and avoid impacts on archaeological sites through construction works.

A key component of the Act is Aboriginal Cultural Heritage Management Plans, which are required under certain circumstances for high impact activities.

Using the *Aboriginal Heritage Regulations* 2007 that accompany the *Aboriginal Heritage Act* 2006 it is possible to determine whether the development proposal for the Carisbrook flood mitigation works would trigger the requirement for an Aboriginal Cultural Heritage Management Plan.

The *Aboriginal Heritage Regulations* 2007 (r. 6) stipulate that an Aboriginal Cultural Heritage Management Plan is required for a proposed activity, if:

> (a) all or part of the activity area for the activity is an area of *cultural heritage sensitivity*[1]; and,
> (b) all or part of the activity is a *high impact activity*.

Part (b) of regulation 6 is met because a utility installation impacting an area exceeding 25 square metres is a high impact activity (see r.43[1][b][xxiii][D]).

However, further investigation is required to determine whether the proposed work areas would be located within areas of cultural heritage sensitivity as defined by Division 3 of the Victorian *Aboriginal Heritage Regulations* 2007.

Specifically, parts of the work areas are located within 200 metres of a waterway, areas of cultural heritage sensitivity unless subject to previous significant ground disturbance (r.23[1]).

Inspection of the study area is required to determine whether the work areas have been subject to significance ground disturbance during previous development (significant ground disturbance is defined in the regulations [r.4] and the Office of Aboriginal Affairs Victoria's practice note [Appendix A]).

[1] An area of 'cultural heritage sensitivity' means an area with the potential to contain Aboriginal cultural heritage items, places and/or values.

5 Conclusions and Recommendations

No Aboriginal cultural heritage sites have previously been recorded in the work areas proposed for flood mitigation works. Predictive modelling shows that there is a low to moderate potential for Aboriginal cultural heritage to occur in the proposed work areas.

This due diligence study concludes that inspection of the proposed work areas is required to determine if they are areas of cultural heritage sensitivity according to the *Aboriginal Heritage Regulations* 2007, and thus ascertain whether the works require a mandatory Cultural Heritage Management Plan (CHMP) under Section 46 of the *Aboriginal Heritage Act* 2006.

6 References

Barwick, D.E. (1984). Mapping the past: an atlas of Victorian clans, 1835-1904 Part 1. *Aboriginal History* **8**, 101-131.

Bird, C. (1984). *Aboriginal land use in the Wimmera*. Unpublished report for the Land Conservation Council, Victoria.

Bird, C., Frankel, D. and van Waarden, N. (1998). New radiocarbon determinations from the Grampians-Gariwerd region, western Victoria. *Archaeology in Oceania* **33**, 31-36.

Bride, T.F. (1898). *Letters form Victorian Pioneers*. Government Printer, Melbourne.

Clark, I.D. (1990). *Aboriginal languages and clans: an historical atlas of western and central Victoria 1800-1900*. Monash University, Clayton.

Dawson, J. (1881). *Australian Aborigines: the languages and customs of several tribes of Aborigines in the Western District of Victoria*. Robertson, Melbourne.

Department of Environment and Primary Industries (2015). *Biodiversity Interactive Map pre-1750* (online: http://www.dse.vic.gov.au/DSE/dsencor.nsf/Linkview/).

Gillespie, R., Horton. D., Ladd, P., Macumber, P., Rich, T., Thorne, R. and Wright, R. (1978). Lancefield Swamp and the extinction of the Australian megafauna. *Science,* **200**, 1044-1048.

Gott, B. (1983). Murnong – *Microseris scapigera*: a study of a staple food of Victorian Aborigines. *Australian Aboriginal Studies* **2**, 2-18.

Gunn, R.G. (1983). Langi Ghiran 1 Aboriginal rock art site. *Victorian Archaeological Survey Occasional Report,* Series No. 17. Melbourne.

Gunn, R.G. (1988). *Recording and assessment of BN1 Aboriginal rock art site, Mount Cole State Forest.* Report to the Victorian Archaeological Survey.

Howitt, A.W. (1904). *The Native Tribes of South-East Australia*. Aboriginal Studies Press, Canberra.

Joyce, E.B. and Webb, J.A. (2003). Geomorphology. In *Geology of Victoria*. (Ed. Birch, W.D.), Geological Society of Australia, pp. 553-562.

Massola, A. (1956). Native water wells at Maryborough, Victoria. *Victorian Naturalist* **73**, 73-76.

Massola, A. (1963). Native stone arrangements at Carisbrook. *Victorian Naturalist*

80,177-180.

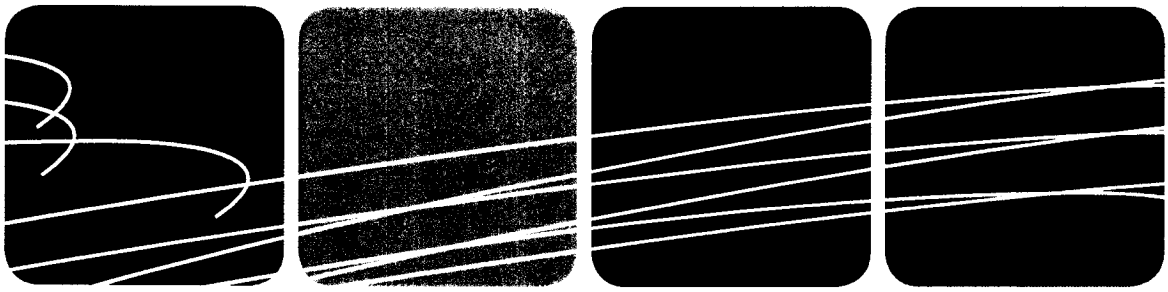
Spreadborough, R. and Anderson, H. (1983). *Victorian Squatters*. Red Rooster Press, Ascot Vale, Victoria.

VandenBerg, A.H.M. (1997). *SJ54-8 Ballarat 1:250,000 geological map, 2nd edition*. Geological Survey of Victoria, Melbourne.

Zola, N. and Gott, B. (1992). *Koorie Plants Koorie People: Traditional Aboriginal Food, Fibre and Healing Plants of Victoria*. Koorie Heritage Trust, Melbourne.

Appendix A.

OAAV Practice Note: Significant Ground Disturbance.



Aboriginal Heritage Act 2006 Practice Note: Significant Ground Disturbance

This Practice Note provides guidance about the meaning of **significant ground disturbance** as it relates to requirements to prepare Cultural Heritage Management Plans under the *Aboriginal Heritage Act 2006**.
The Practice Note covers:

- when a Cultural Heritage Management Plan is required
- why significant ground disturbance should be assessed
- what significant ground disturbance means
- who needs to provide proof
- how to determine significant ground disturbance
- who can determine this
- what is the role of the responsible authority
- how Aboriginal cultural heritage is protected in areas of significant ground disturbance.

Background

The *Aboriginal Heritage Act 2006* (Act) and *Aboriginal Heritage Regulations 2007* (Regulations) provide protection in Victoria for all Aboriginal places, objects and human remains regardless of their inclusion on the Victorian Aboriginal Heritage Register or whether they are located on public or private land.

When is a Cultural Heritage Management Plan required?

A Cultural Heritage Management Plan is required for an activity (i.e. the use or development of land) if the activity:

- is a high impact activity
- falls in whole or in part within an area of cultural heritage sensitivity.

The terms 'high impact activity' and 'cultural heritage sensitivity' are defined in the Regulations.

A Plan must also be prepared when an activity requires an Environmental Effects Statement, or when the Minister for Aboriginal Affairs requires.

High impact activities are categories of activity that are generally regarded as more likely to harm Aboriginal cultural heritage. Most high impact activities provided for in the Regulations are subject to a requirement that the activity results in significant ground disturbance.

Areas of cultural heritage sensitivity are landforms and land categories that are generally regarded as more likely to contain Aboriginal cultural heritage. A registered Aboriginal cultural heritage place is also an area of cultural heritage sensitivity.

If part of an area of cultural heritage sensitivity (other than a cave) has been subject to significant ground disturbance that part is not an area of cultural heritage sensitivity.

If a Cultural Heritage Management Plan is required for an activity it must be approved before the sponsor can obtain any necessary statutory authorisation for the activity and/or before the activity can start. For more information about Cultural Heritage Management Plans see Aboriginal Affairs Victoria's (AAV) website (www.aboriginalaffairs.vic.gov.au).

Why should significant ground disturbance be assessed?

It is important to assess significant ground disturbance when considering whether a cultural heritage management plan is required because:

- A Cultural Heritage Management Plan does not need to be prepared for a high impact activity if all the area of cultural heritage sensitivity within the activity area has been subject to significant ground disturbance.
- Some types of activity will not be a high impact activity, meaning a Cultural Heritage Management Plan would not need to be prepared, if the activity does not cause significant ground disturbance.

The Regulations specify the landforms and land categories that are areas of cultural heritage sensitivity. Areas of cultural heritage sensitivity are displayed in a series of maps available on AAV's website. The areas delineated on these maps however do not take account of the past history of land use and development that may have caused significant ground disturbance in localised areas.

How is significant ground disturbance defined?

'Significant ground disturbance' is defined in r.4 of the Regulations as meaning disturbance of –

(a) the topsoil or surface rock layer of the ground; or

(b) a waterway –
by machinery in the course of grading, excavating, digging, dredging or deep ripping, but does not include ploughing other than deep ripping.

The words 'disturbance', 'topsoil', 'surface rock layer', 'machinery', 'grading', 'excavating', 'digging', 'dredging', 'ploughing' (other than deep ripping) are not defined in the regulations and therefore have their ordinary meanings.

Ploughing (other than deep ripping) to any depth is not significant ground disturbance. Deep ripping is defined in the regulations to mean 'ploughing of soil using a ripper or subsoil cultivation tool to a depth of 60 centimetres or more'. None of the words used in this definition are defined, and therefore have their ordinary meanings. The Victorian Civil and Administrative Tribunal (VCAT) has determined that a ripper or subsoil cultivation tool must be distinguished from conventional ploughs or topsoil cultivation tools such as disc ploughs or rotary hoes which are not sufficient to show significant ground disturbance.

Deep ripping will result in significant ground disturbance regardless of the degree of disturbance caused to the topsoil or surface rock layer of the ground.

Who needs to provide proof that land has been subject to significant ground disturbance?

The burden of proving that an area has been subject to significant ground disturbance rests with the applicant for a statutory authorisation for the activity (or the sponsor of the activity). The responsible authority may assist by providing the applicant access to any relevant records it has about past land use and development.

How can a sponsor determine whether significant ground disturbance has occurred?

The responsible authority should require evidence of support for claims that there has been significant ground disturbance of an area. The levels of inquiry outlined below provide some guidance about what information should be required to satisfy a responsible authority (depending on the circumstances of each case) that significant ground disturbance has occurred. The levels of inquiry are listed in order of the level of detail that may be required. An assessment of whether significant ground disturbance has occurred should be dealt with at the lowest possible level in order to avoid unnecessary delay or cost to applicants.

Little weight should be given to mere assertions by applicants or land owners that an activity area has been subject to significant ground disturbance.

Level 1 – Common knowledge

The fact that land has been subject to significant ground disturbance may be common knowledge. Very little or no additional information should be required from the responsible authority.

For example, common knowledge about the redevelopment of a petrol station with extensive underground storage tanks.

Level 2 – Publicly available records

If the existence of significant ground disturbance is not common knowledge, a responsible authority may be able to provide assistance from its own records about prior development and use of land, or advise the applicant about other publicly available records, including aerial photographs.

These documents may allow a reasonable inference to be made that the land has been subject to significant ground disturbance. In such event, no further inquiries or information would be needed by the responsible authority. The particular records and facts relied upon should be noted by the responsible authority as a matter of record.

For example, a former quarry site subsequently filled, but where the public records show the area of past excavation.

Level 3 – Further information

If 'common knowledge' or 'publicly available records' do not provide sufficient information about the occurrence of significant ground disturbance, the applicant may need to present further evidence either voluntarily or following a formal request from the responsible authority. Further evidence could consist of land use history documents, old maps or photographs of the land or statements by former landowners or occupiers. Statements should be provided by statutory declaration or similar means.

For example, the construction of a former dam on a farm.

Level 4 – Expert advice or opinion

If these levels of inquiry do not provide sufficient evidence of significant ground disturbance (or as an alternative to level 3), the applicant may submit or be asked to submit a professional report with expert advice or opinion from a person with appropriate skills and experience. Depending on the circumstances, this may involve a site inspection and/or a review of primary documents. If there is sufficient uncertainty some preliminary sub-surface excavation may be warranted.

An expert report should comply with VCAT's practice note on expert evidence.

The responsible authority must be reasonably satisfied that the standard of proof presented by the applicant shows that all of the land in question has been subject to significant ground disturbance.

A level 1 or 2 inquiry will commonly provide sufficient information as to whether or not the activity area has been subject to significant ground disturbance, and a level 3 or 4 inquiry should not be required as a matter of course.

There will be cases when the responsible authority is simply not persuaded or where there remains genuine doubt about significance ground disturbance regardless of the level of inquiry. In these circumstances the default position is that a Cultural Heritage Management Plan is required. This is in line with the purpose of the Act and Regulations to provide for the protection of Aboriginal cultural heritage in Victoria.

Who can provide expert advice about significant ground disturbance?

A person needs to have expertise to decide, based upon an inspection of the land or interpreting primary documents, whether the land has been subject to significant ground disturbance.

A cultural heritage advisor may not necessarily have this expertise. Under section 189 of the Act, an advisor must have a qualification directly relevant to the management of Aboriginal cultural heritage such as 'anthropology, archaeology or history' or have extensive experience or knowledge in relation to the management of heritage. An advisor appropriately qualified in archaeology may be able to assist where excavation is required to determine significant ground disturbance.

Other experts such as a land surveyor, geomorphologist or civil engineer could also have the necessary expertise (depending on the circumstances). For example, a civil engineer should have the qualifications and experience to determine the extent of previous engineering works along a watercourse or road, and therefore the extent of significant ground disturbance.

What is the role of the responsible authority?

The responsible authority determines whether a Cultural Heritage Management Plan is required for an activity. It may require the applicant to provide information to satisfy it that an area has been subject to significant ground disturbance.

Evaluating information relating to the occurrence of significant ground disturbance may be critical in deciding whether a Cultural Heritage Management Plan is required and therefore whether a statutory authorisation can be granted. This question should be resolved at an early stage in planning a proposed development. Applicants for statutory authorisations and the responsible authority should therefore seek to agree at an early stage about whether a Cultural Heritage Management Plan is required. In the event of a dispute this can be brought without delay to VCAT for resolution. The responsible authority should take care to document the steps taken in each case.

What if Aboriginal cultural heritage is discovered in an area determined to have been subject to significant ground disturbance?

It is possible that there are Aboriginal cultural heritage places, objects or human remains within areas determined to no longer be areas of cultural heritage sensitivity due to significant ground disturbance. It is also possible that Aboriginal cultural heritage could be harmed by activities which do not amount to high impact activities.

These Aboriginal places are still protected under the Act. In particular, it is an offence under sections 27 and 28 of the Act to harm Aboriginal cultural heritage unless acting in accordance with a Cultural Heritage Permit or approved Cultural Heritage Management Plan (regardless of whether a Plan was required).

** This Practice Note is based on VCAT's determination about significant ground disturbance. For further details see VCAT, Reference No. P1020/2008 – Mainstay Australia vs Mornington Peninsula SC.*

B Longitudinal water profiles

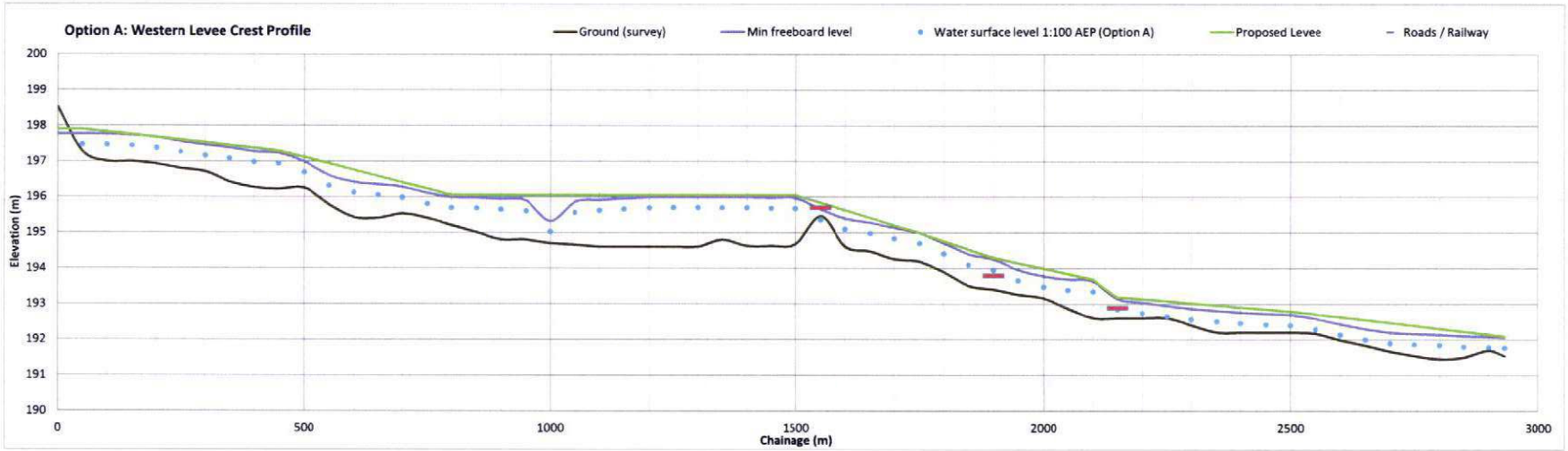


Figure B.1: Option A – Western Levee profile (Appendix B for chainage maps)

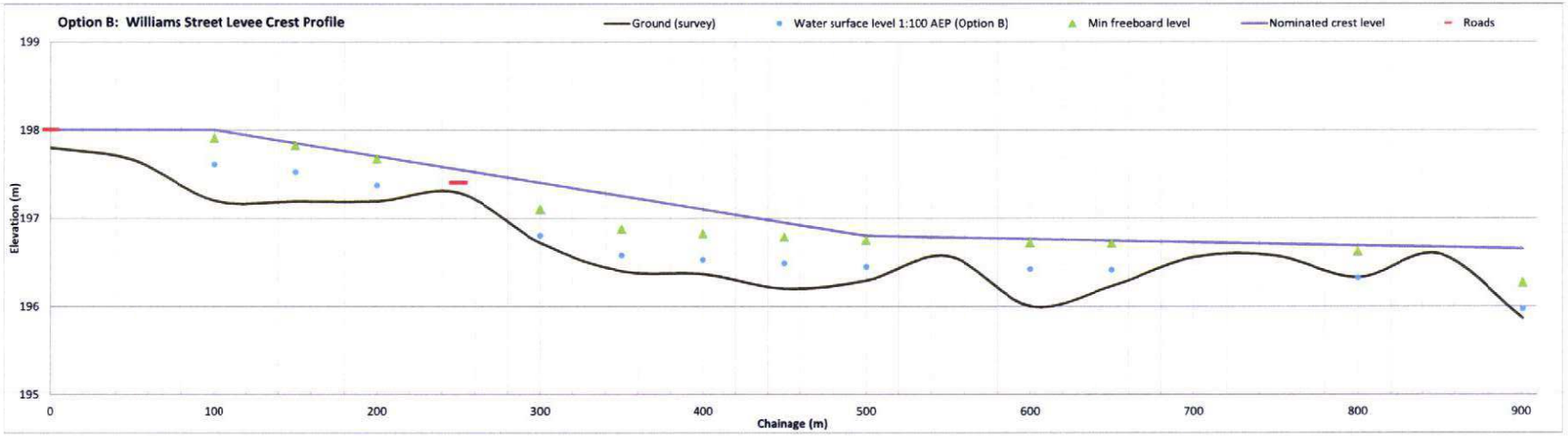


Figure B.2: Option A & B – Williams Street Levee profile (Appendix B for chainage maps)

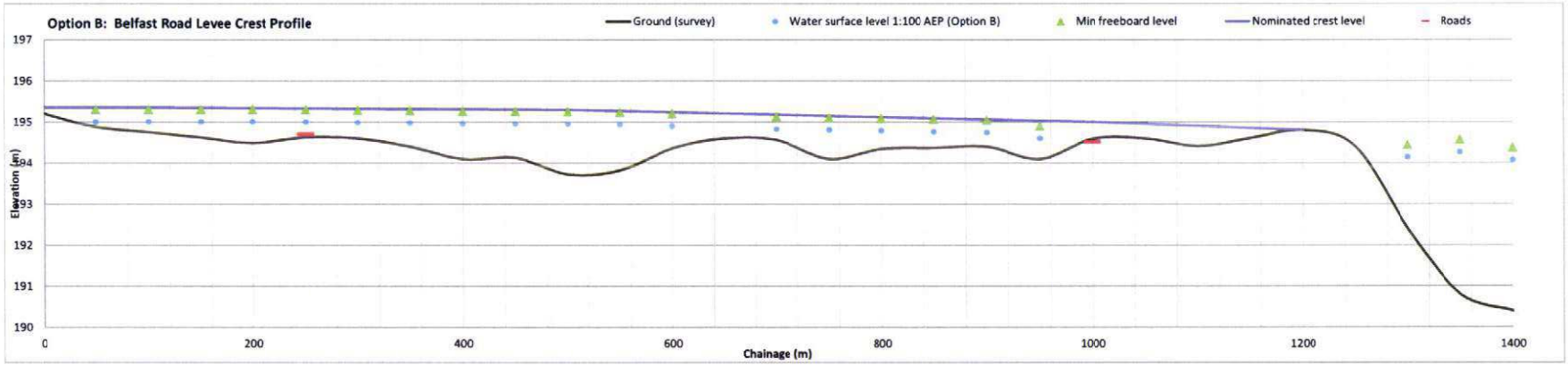
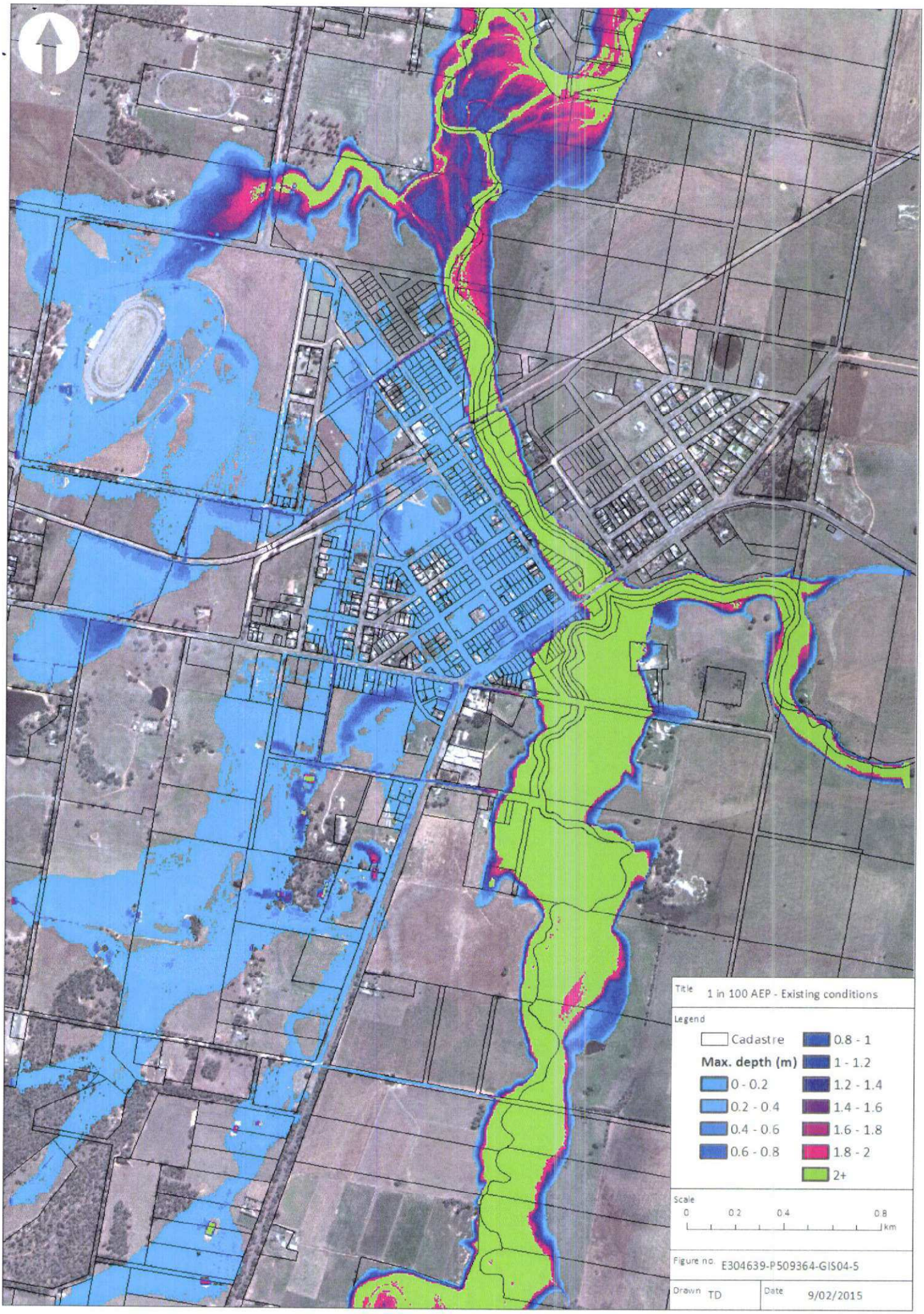
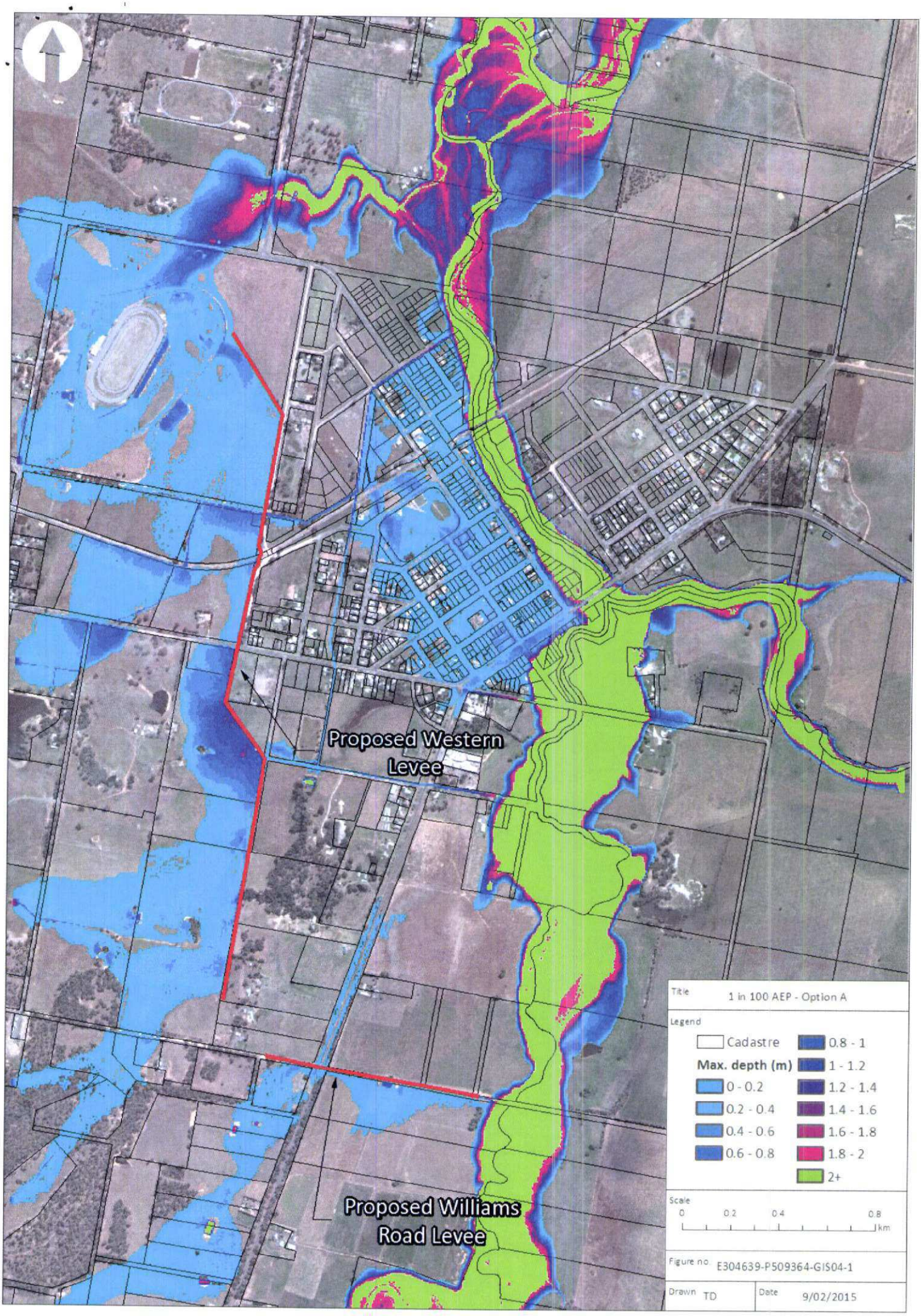
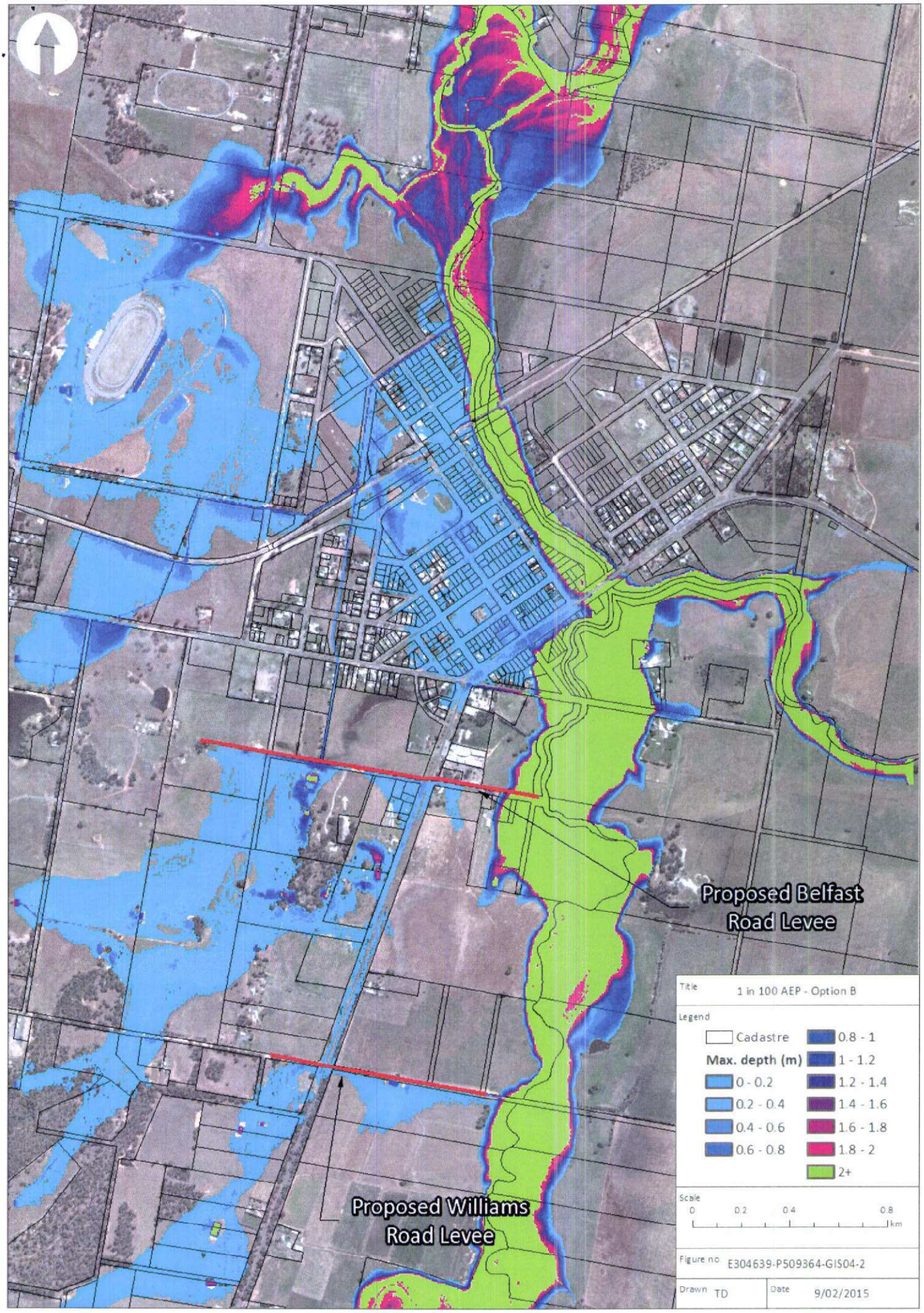


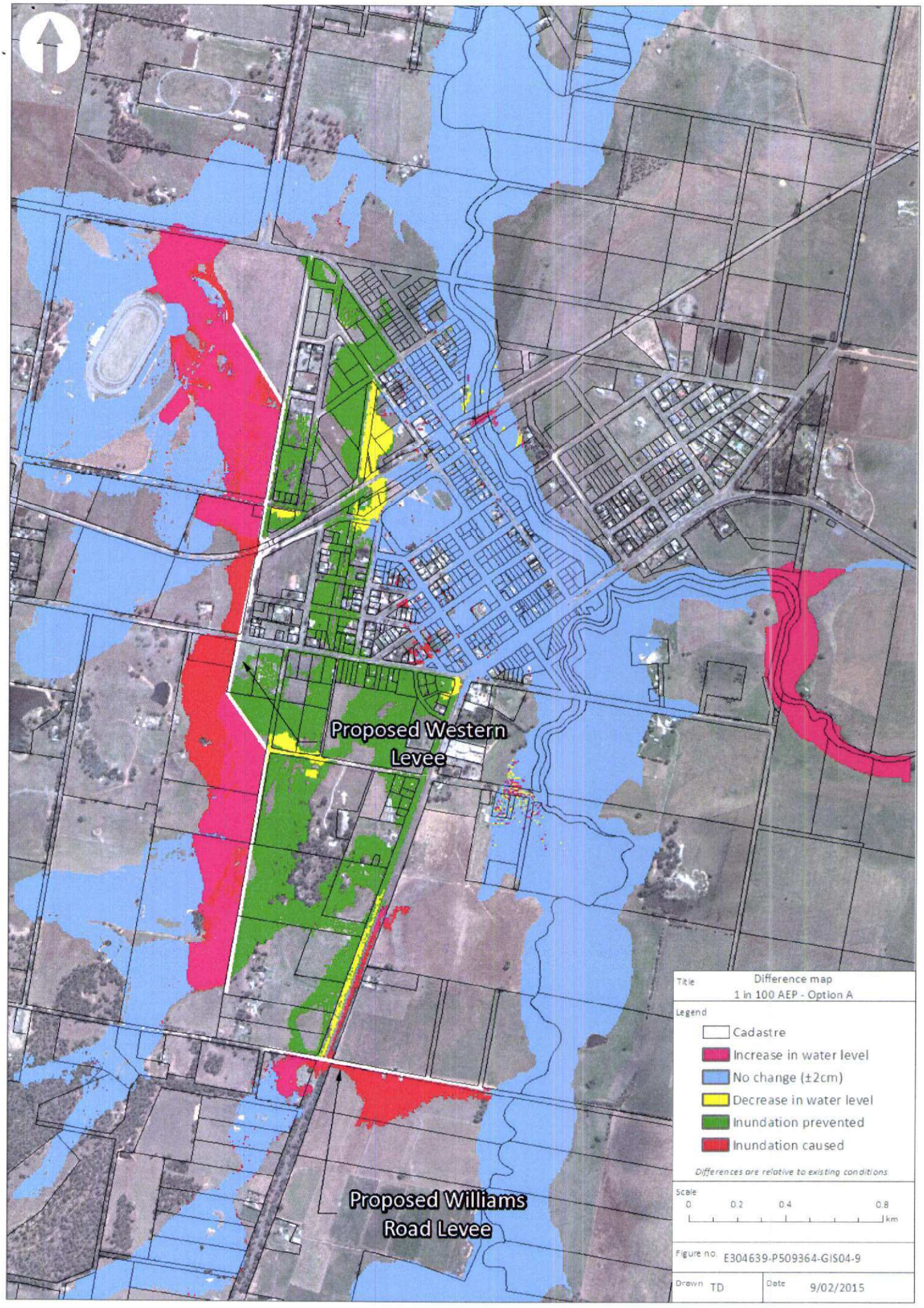
Figure B.3: Option B – Belfast Road Levee profile (Appendix B for chainage maps)

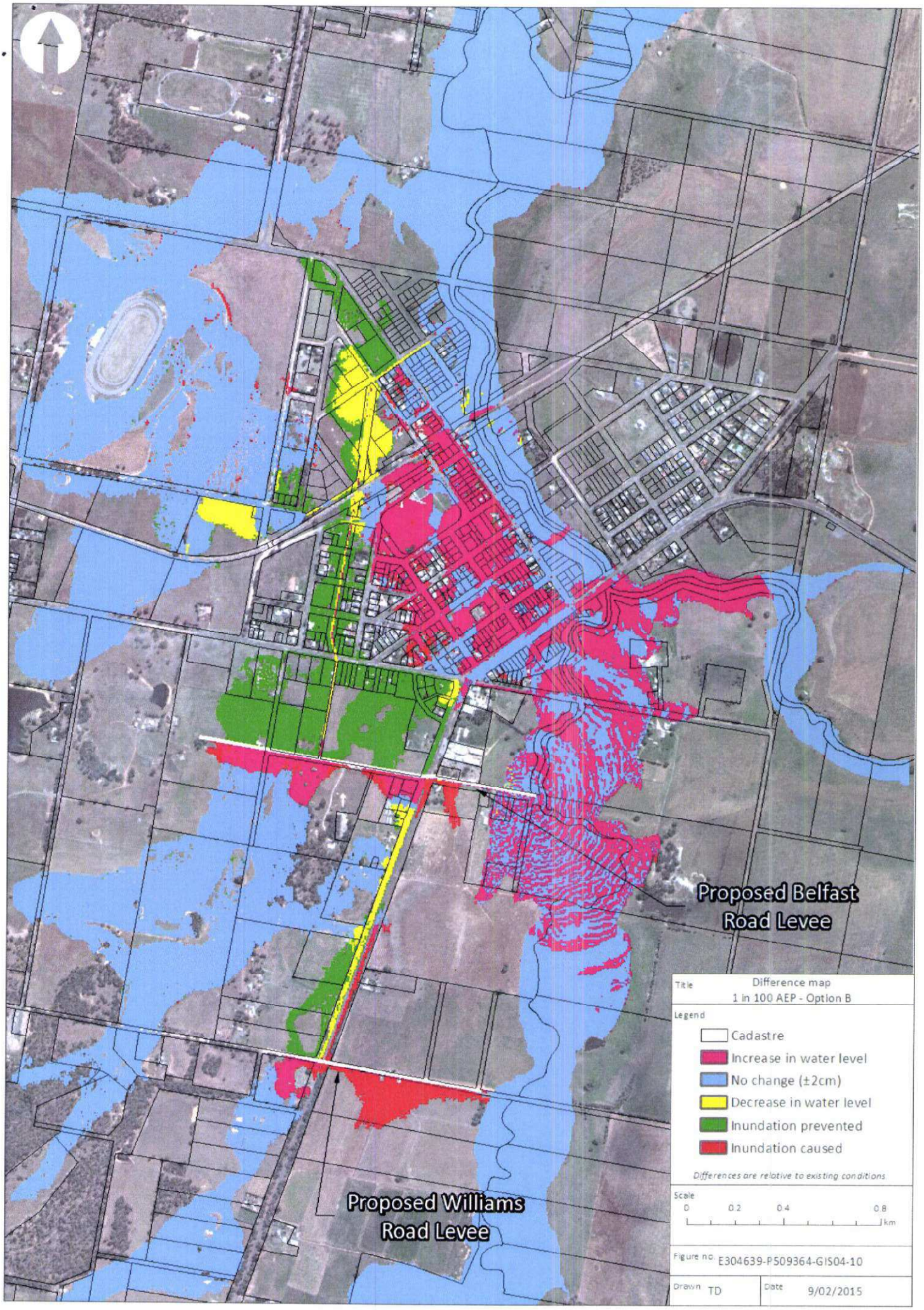
C Flood inundation maps

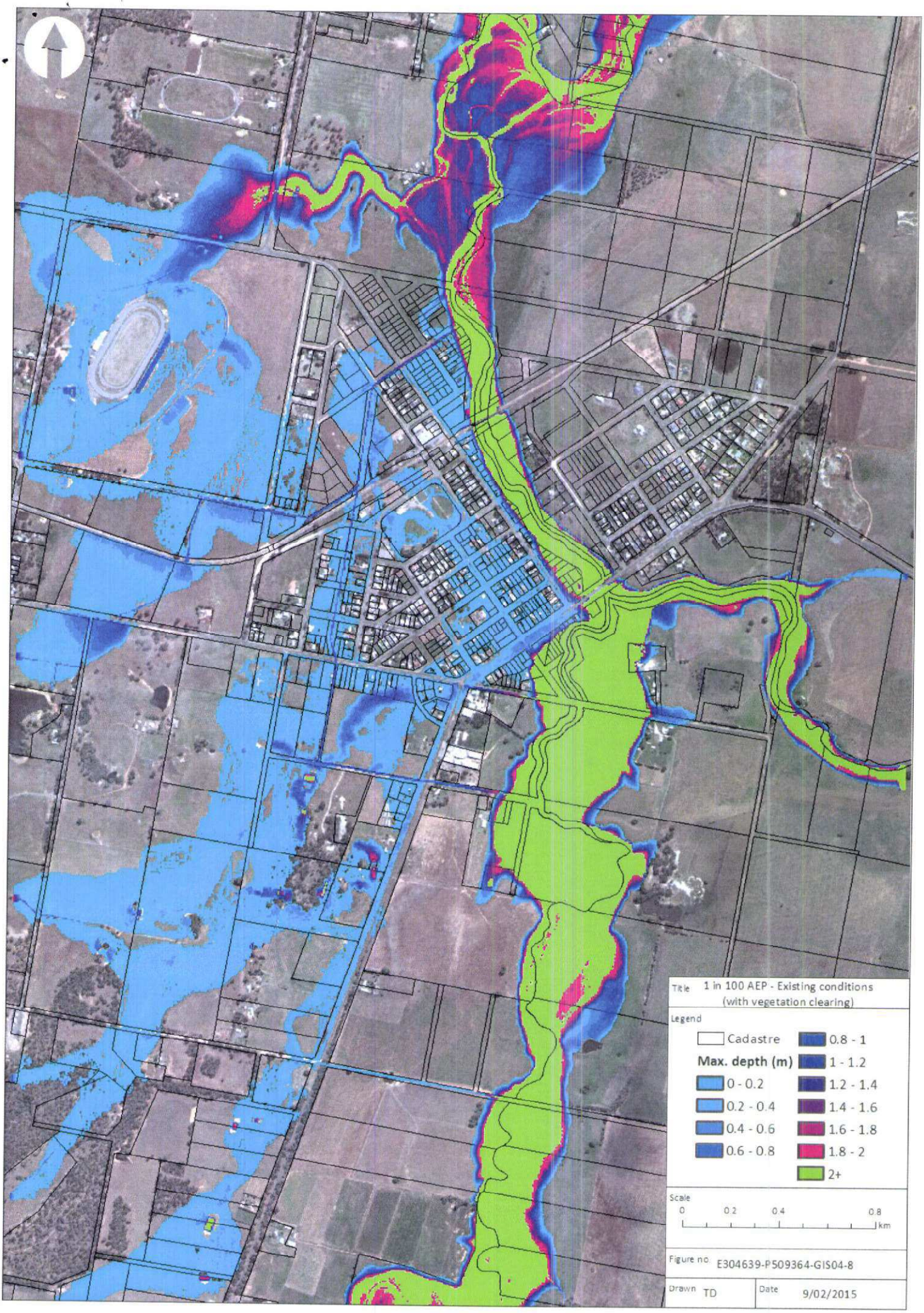

Title
1 in 100 AEP - Existing conditions
Legend
Cadastre
Max. depth (m)
0 - 0.2
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1
1 - 1.2
1.2 - 1.4
1.4 - 1.6
1.6 - 1.8
1.8 - 2
2+
Scale
0
0.2
0.4
0.8
km
Figure no. E304639-P509364-GIS04-5
Drawn TD
Date 9/02/2015

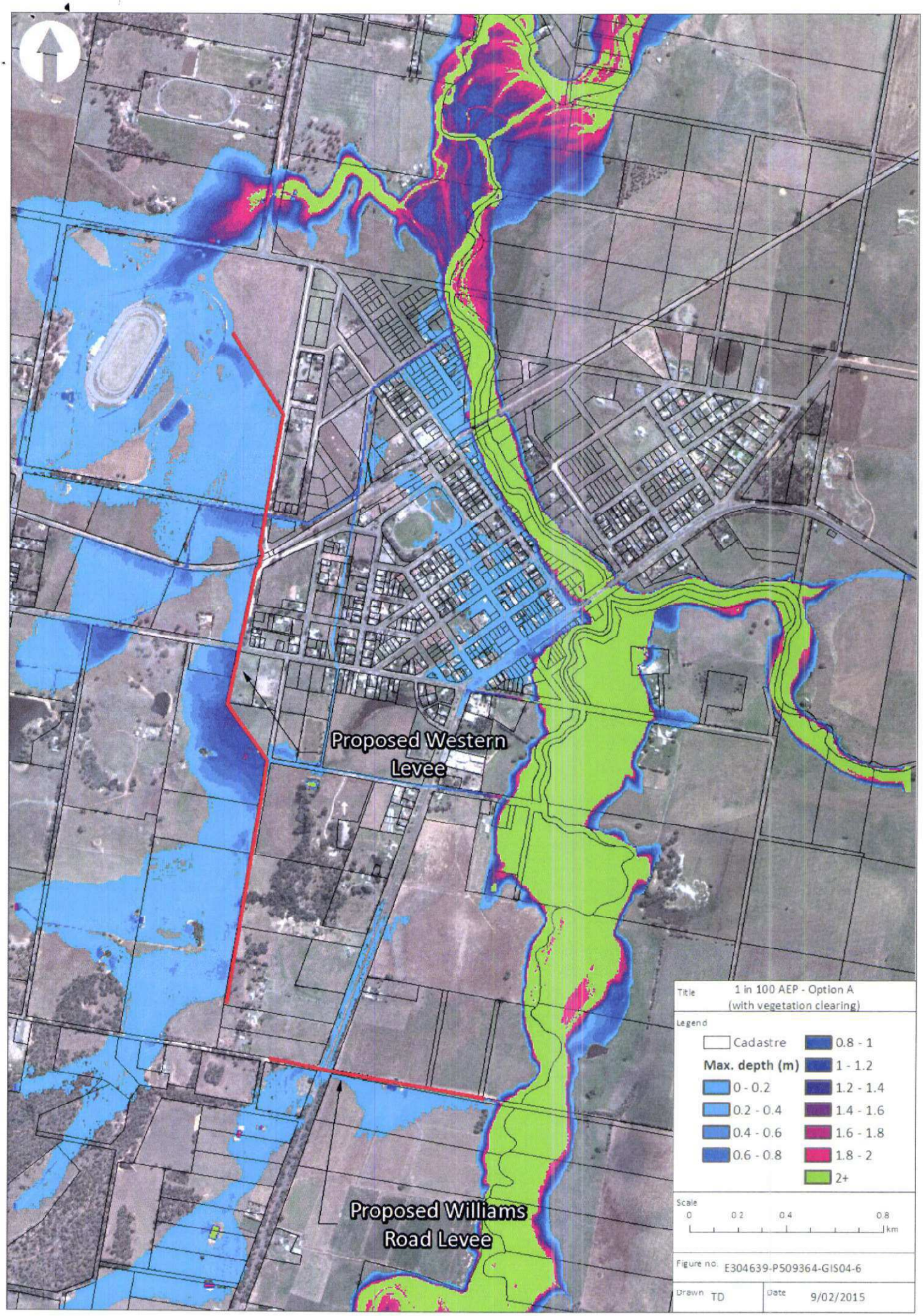

Proposed Western Levee
Proposed Williams Road Levee
Title
1 in 100 AEP - Option A
Legend
Cadastre
Max. depth (m)
0 - 0.2
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1
1 - 1.2
1.2 - 1.4
1.4 - 1.6
1.6 - 1.8
1.8 - 2
2+
Scale
0
0.2
0.4
0.8
km
Figure no. E304639-P509364-GIS04-1
Drawn TD
Date 9/02/2015

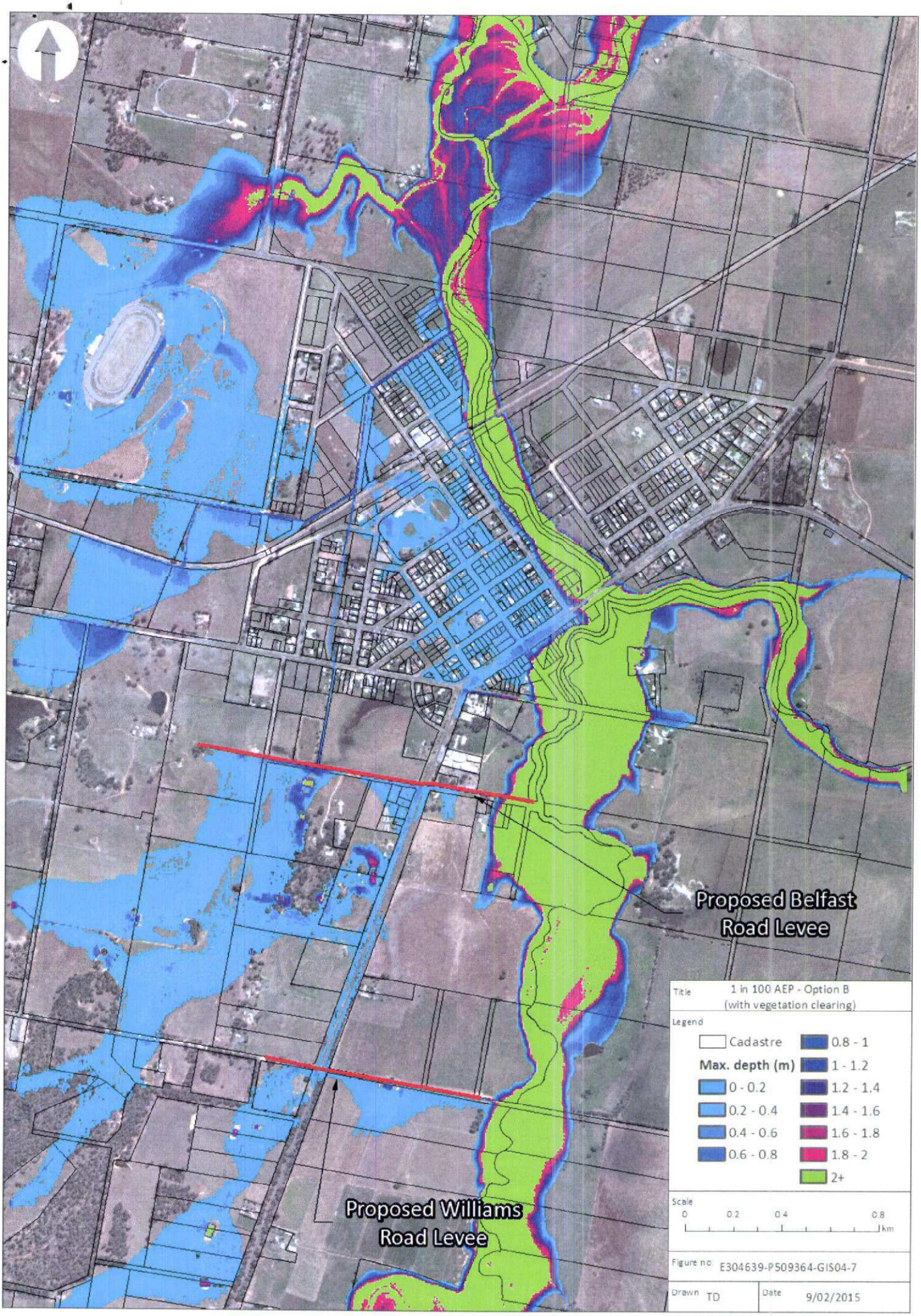

Proposed Belfast Road Levee
Proposed Williams Road Levee
Title
1 in 100 AEP - Option B
Legend
Cadastre
Max. depth (m)
0 - 0.2
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1
1 - 1.2
1.2 - 1.4
1.4 - 1.6
1.6 - 1.8
1.8 - 2
2+
Scale
0
0.2
0.4
0.8
km
Figure no
E304639-P509364-GIS04-2
Drawn
TD
Date
9/02/2015

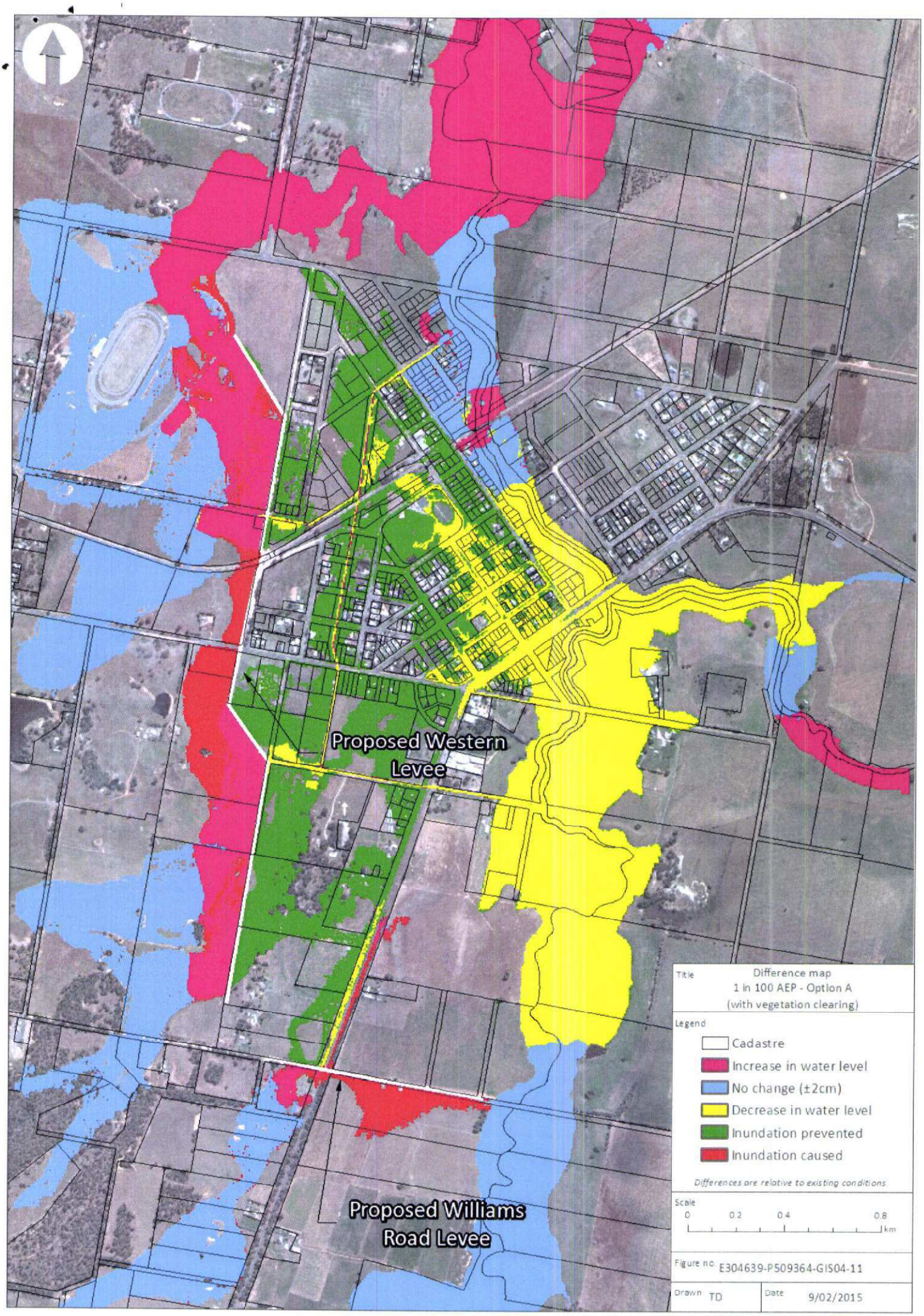

Proposed Western Levee
Proposed Williams Road Levee
Title
Difference map
1 in 100 AEP - Option A
Legend
Cadastre
Increase in water level
No change (±2cm)
Decrease in water level
Inundation prevented
Inundation caused
Differences are relative to existing conditions
Scale
0
0.2
0.4
0.8
km
Figure no. E304639-P509364-GIS04-9
Drawn TD
Date 9/02/2015

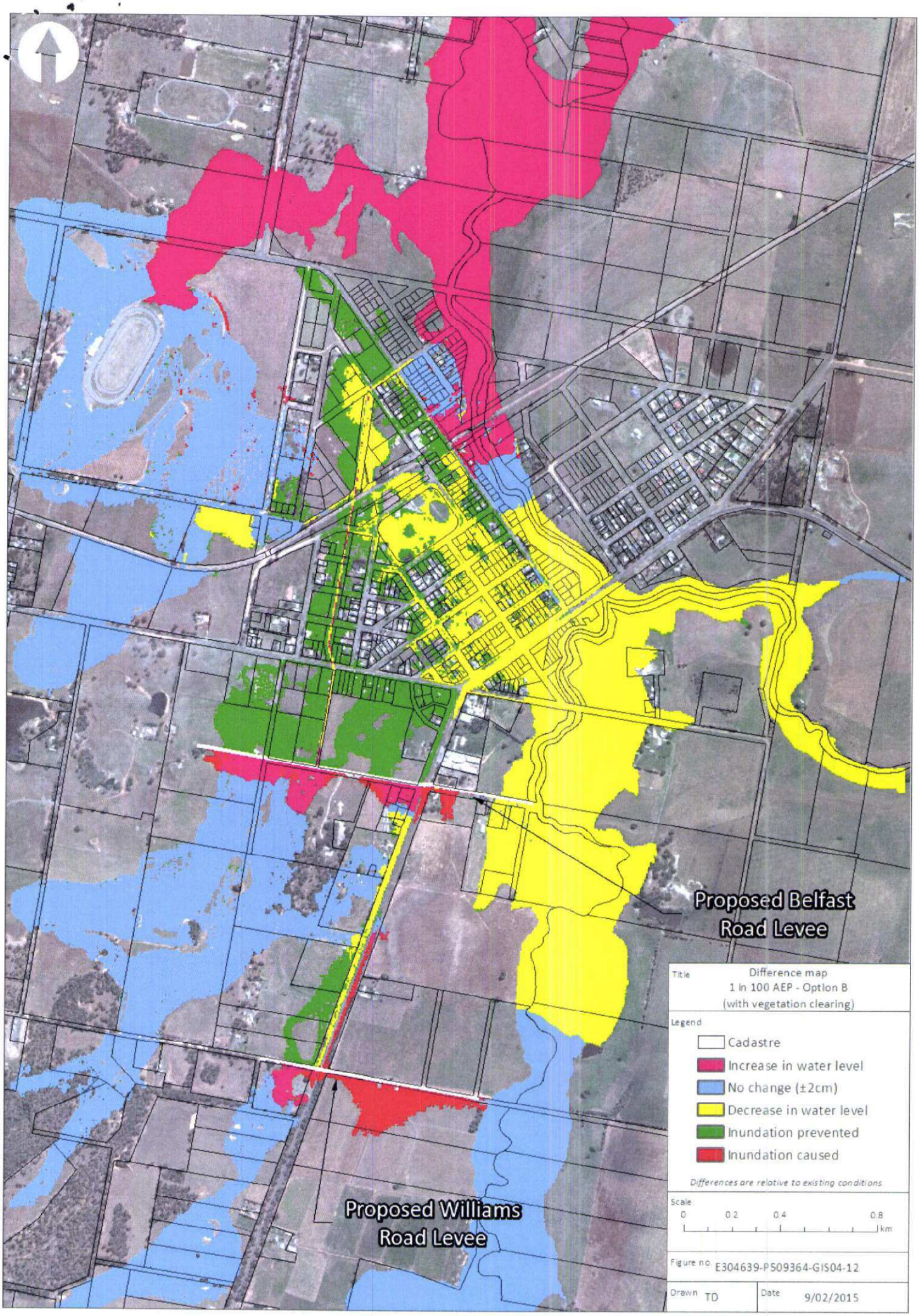

Proposed Belfast Road Levee
Proposed Williams Road Levee
Title
Difference map
1 in 100 AEP - Option B
Legend
Cadastre
Increase in water level
No change (±2cm)
Decrease in water level
Inundation prevented
Inundation caused
Differences are relative to existing conditions
Scale
0
0.2
0.4
0.8
km
Figure no. E304639-P509364-GIS04-10
Drawn TD
Date 9/02/2015


Title
1 in 100 AEP - Existing conditions (with vegetation clearing)
Legend
Cadastre
Max. depth (m)
0 - 0.2
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1
1 - 1.2
1.2 - 1.4
1.4 - 1.6
1.6 - 1.8
1.8 - 2
2+
Scale
0
0.2
0.4
0.8
km
Figure no.
E304639-P509364-GIS04-8
Drawn
TD
Date
9/02/2015

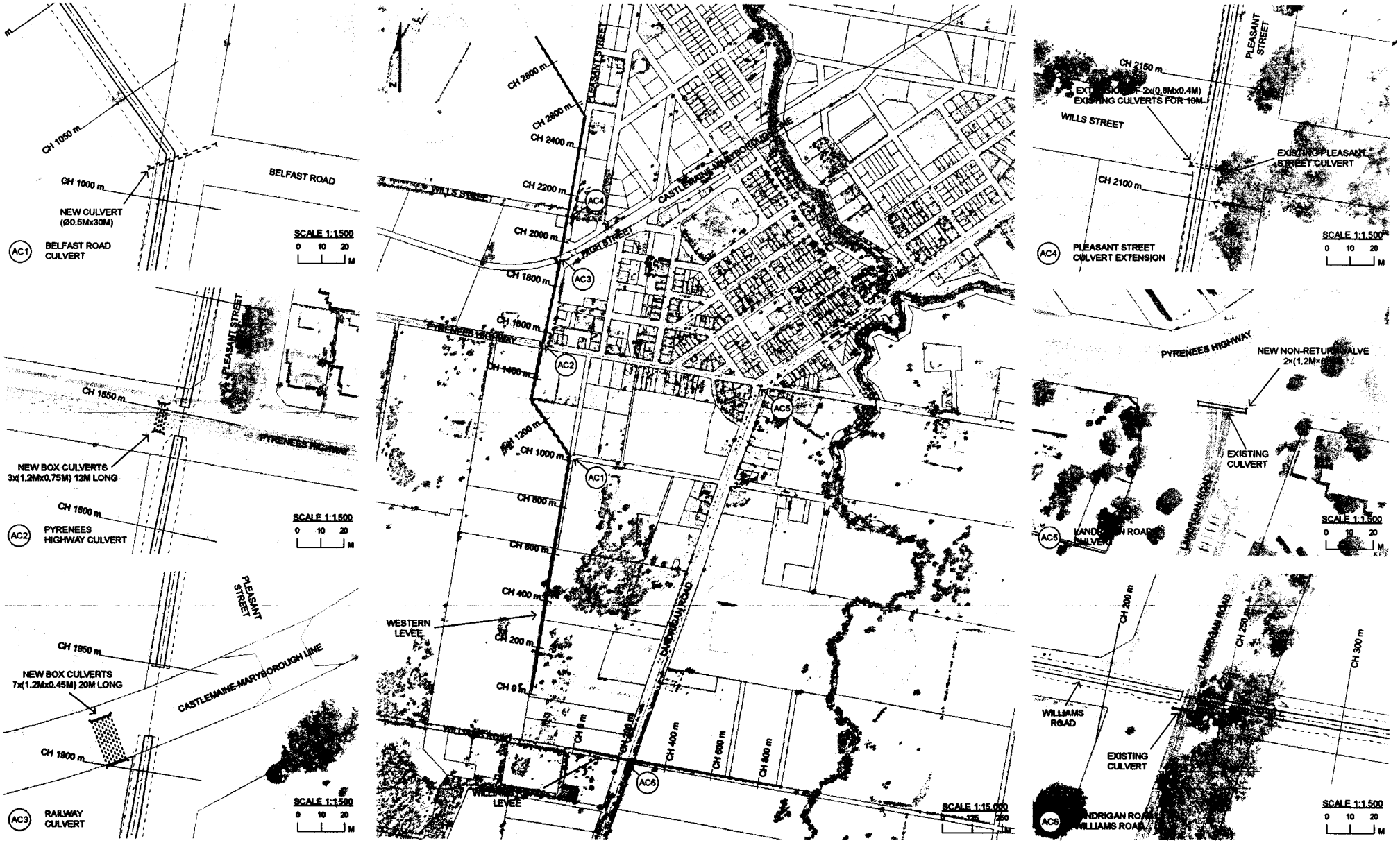

Proposed Western Levee
Proposed Williams Road Levee
Title
1 in 100 AEP - Option A (with vegetation clearing)
Legend
Cadastre
Max. depth (m)
0 - 0.2
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1
1 - 1.2
1.2 - 1.4
1.4 - 1.6
1.6 - 1.8
1.8 - 2
2+
Scale
0
0.2
0.4
0.8
km
Figure no. E304639-P509364-GIS04-6
Drawn TD
Date 9/02/2015


Proposed Belfast Road Levee
Proposed Williams Road Levee
Title
1 in 100 AEP - Option B (with vegetation clearing)
Legend
Cadastre
Max. depth (m)
0 - 0.2
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1
1 - 1.2
1.2 - 1.4
1.4 - 1.6
1.6 - 1.8
1.8 - 2
2+
Scale
0
0.2
0.4
0.8
km
Figure no. E304639-P509364-GIS04-7
Drawn TD
Date 9/02/2015


Proposed Western Levee
Proposed Williams Road Levee
Title
Difference map
1 in 100 AEP - Option A
(with vegetation clearing)
Legend
Cadastre
Increase in water level
No change (±2cm)
Decrease in water level
Inundation prevented
Inundation caused
Differences are relative to existing conditions
Scale
0
0.2
0.4
0.8
km
Figure no. E304639-P509364-GIS04-11
Drawn TD
Date 9/02/2015


Proposed Belfast Road Levee
Proposed Williams Road Levee
Title
Difference map
1 in 100 AEP - Option B
(with vegetation clearing)
Legend
Cadastre
Increase in water level
No change (±2cm)
Decrease in water level
Inundation prevented
Inundation caused
Differences are relative to existing conditions
Scale
0
0.2
0.4
0.8
km
Figure no. E304639-P509364-GIS04-12
Drawn TD
Date 9/02/2015

D Preliminary Design Sketches



FOR PRELIMINARY DESIGN REPORT

REV	NOTE	APP
A		
B		
C		
D		
E		
F		
G		

LEGEND

LEVEE ALIGNMENT | LEVEE FOOTPRINT
LEVEE CREST | CADASTRE

NOTES

1. BETWEEN CH1300 AND CH2000 A NEW DRAIN WITH A MAXIMUM DEPTH OF 0.6M NEEDS TO BE EXCAVATED ON THE WESTERN SIDE OF THE WESTERN LEVEE. FOR DETAIL SEE E304639-P509364-GIS05-3.
2. ALL DIMENSIONS ARE IN METRES UNLES OTHERWISE STATED.
3. FOR THE TYPICAL SECTIONS OF THE LEVEE, CULVERTS AND NON-RETURN VAVLES SEE DRAWINGS E304639-P509364-GIS05-3,4.

DRAWN	TD
REVIEWED	TM
APPROVED	MM
DATE	20/02/2015

entura Hydro Tasmania | The power of natural thinking

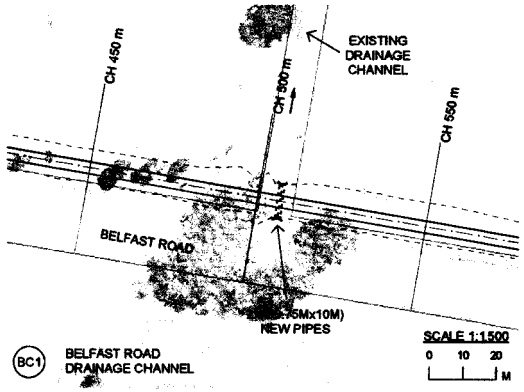
TITLE: CARISBROOK FLOOD AND DRAINAGE MITIGATION TREATMENTS
OPTION A - GENERAL LAYOUT

CLIENT: CENTRAL GOLDFIELDS SHIRE

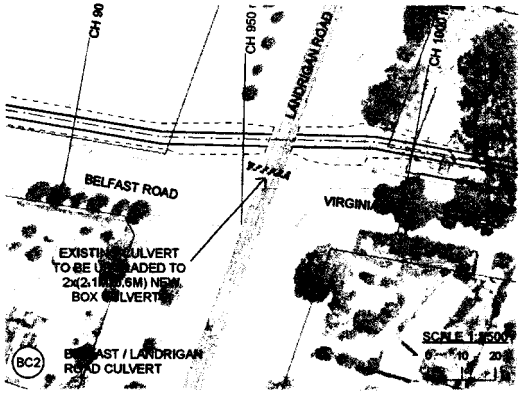
DRAWING NO.: E304639-P509364-GIS05-1

SCALE
1:15,000 @ A3
0 375 750 1,500 M
1:1,500 @ A3
0 25 50 100 M

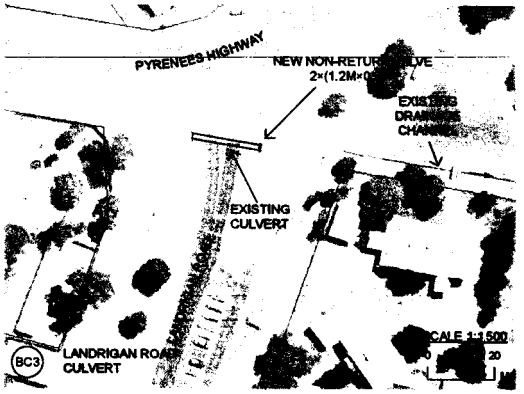
GDA 1994 MGA Zone 54



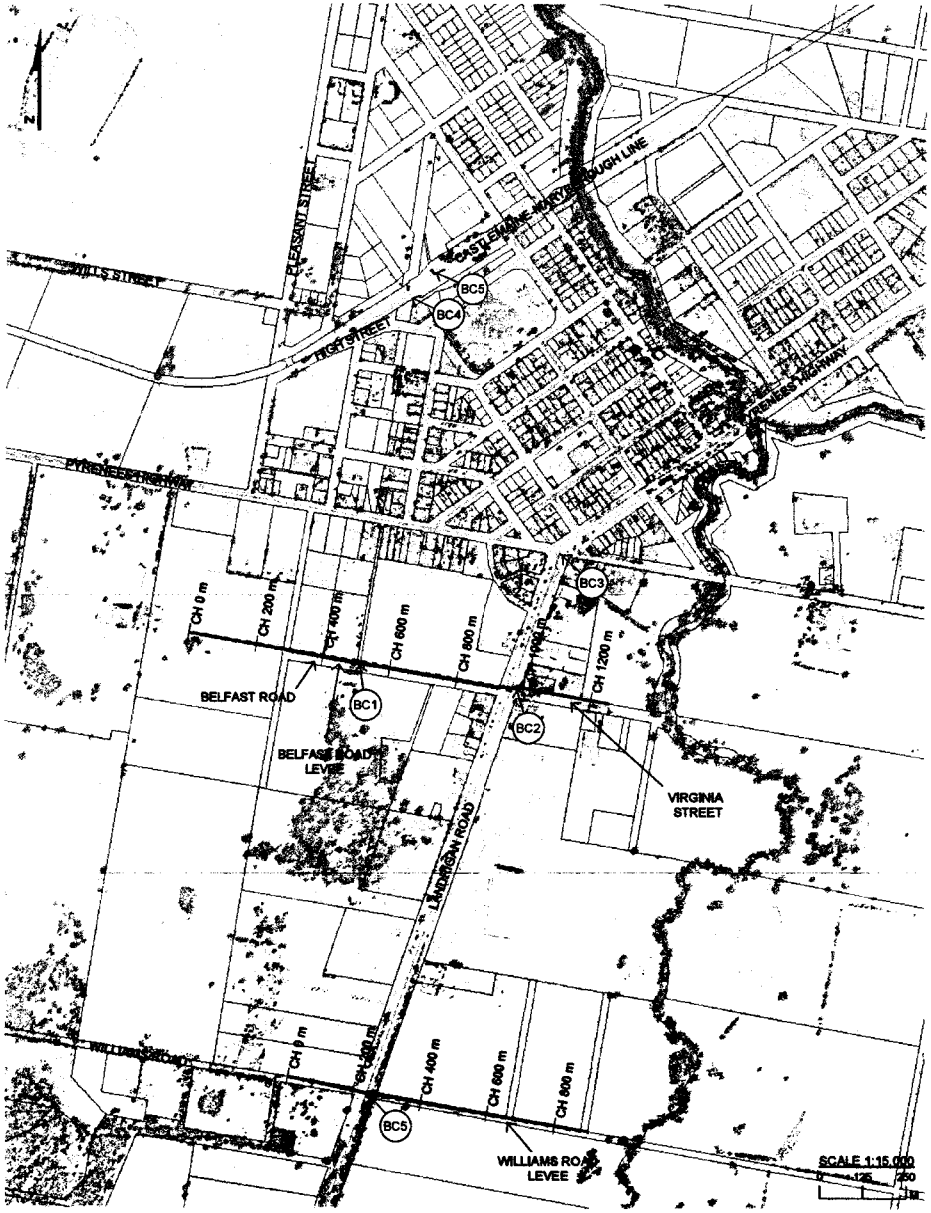
BC1 BELFAST ROAD DRAINAGE CHANNEL

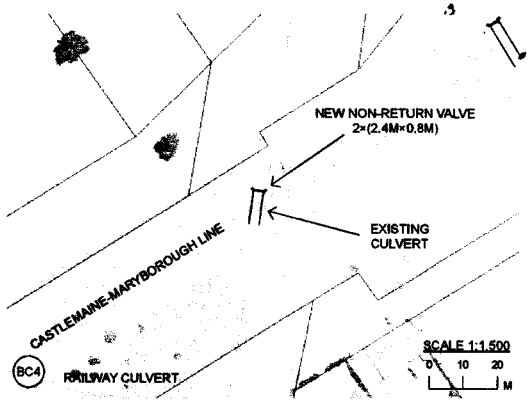


BC2 BELFAST / LANDRIGAN ROAD CULVERT

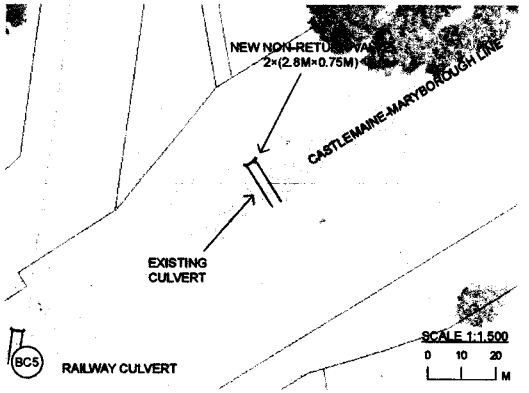


BC3 LANDRIGAN ROAD CULVERT

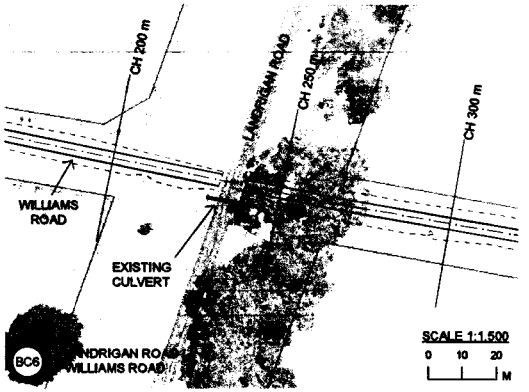




BC4 RAILWAY CULVERT



BC5 RAILWAY CULVERT



BC6 LANDRIGAN ROAD / WILLIAMS ROAD

FOR PRELIMINARY DESIGN REPORT

REV	NOTE	APP
A		
B		
C		
D		
E		
F		
G		

LEGEND

LEVEE ALIGNMENT
LEVEE CREST
LEVEE FOOTPRINT
CADASTRE

NOTES

1. THE EXISTING DRAIN ALONG BELFAST ROAD WILL REQUIRE DEEPENING. FOR DETAIL SEE E304639-P509364-GIS05-3.
2. ALL DIMENSIONS ARE IN METRES UNLES OTHERWISE STATED.
3. FOR THE TYPICAL SECTIONS OF THE LEVEE, CULVERTS AND NON-RETURN VAVLES SEE DRAWING E304639-P509364-GIS05-3,4.
4. CULVERTS ARE ILLUSTRATED INDICATIVELY BASED ON THE RESULTS OF THE PRELIMINARY

DRAWN	TD
REVIEWED	TM
APPROVED	MM
DATE	20/02/2015

entura Hydro Tasmania | The power of natural thinking

TITLE: CARISBROOK FLOOD AND DRAINAGE MITIGATION TREATMENTS
OPTION B - GENERAL LAYOUT

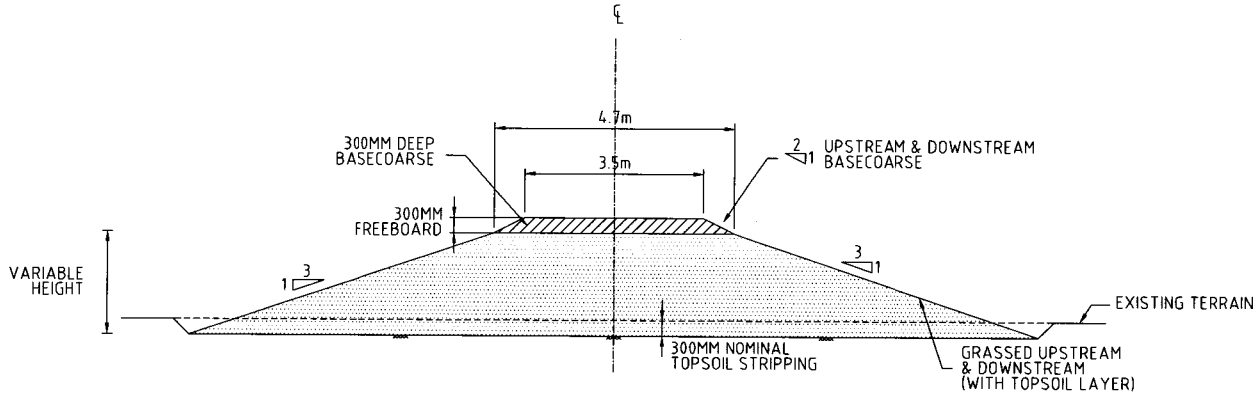
CLIENT: CENTRAL GOLDFIELDS SHIRE

DRAWING NO.: E304639-P509364-GIS05-2

SCALE: 1:15,000 @ A3
0 375 750 1,500 M

1:1,500 @ A3
0 25 50 100 M

GDA 1994 MGA Zone 54



TYPICAL LEVEE SECTION (SCALE 1:10)

WESTERN LEVEE CREST GRADING

SEGMENTS	CHAINAGE	CREST LEVEL (M AHD)	SEGMENT CREST GRADING
1	50	197.90	0.0015
	450	197.30	
2		197.30	0.0036
	800	196.05	
3		196.05	0.0000
	1500	196.05	
4		196.05	0.0042
	1750	195.00	
5		195.00	0.0047
	1900	194.30	
6		194.30	0.0030
	2150	193.20	
7		193.20	0.0011
	2500	192.80	
9		192.80	0.0016
	2933	192.10	

BELFAST ROAD LEVEE CREST GRADING

SEGMENTS	CHAINAGE	CREST LEVEL (M AHD)	SEGMENT CREST GRADING
1	100	195.35	0.0001
	500	195.30	
2		195.30	0.0006
	1000	195.00	
3		195.00	0.0010
	1200	194.80	
4		194.80	0.0019
	1412	194.40	

WILLIAMS ROAD LEVEE CREST GRADING

SEGMENTS	CHAINAGE	CREST LEVEL (M AHD)	SEGMENT CREST GRADING
1	100	198.00	0.0030
	500	196.80	
2		196.80	0.0004
	901	196.65	

NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. LEVELS SHOWN HAVE BEEN DERVIED BASED ON LIDAR AND TOPOGRAPHIC SURVEY.
3. FOR PROPOSED LEVEE ALIGNMENTS, REFER TO DRAWINGS E304639-P509364-GIS05-1,2

FOR PRELIMINARY DESIGN REPORT

DRAWN	TD
CHECKED	MM
DESIGNED	TM
CHECKED	PS
APPROVED	MM
DATE	20/02/2015
CLIENT APP'D	
DATE	

entura Hydro Tasmania | The power of natural thinking

www.entura.com.au

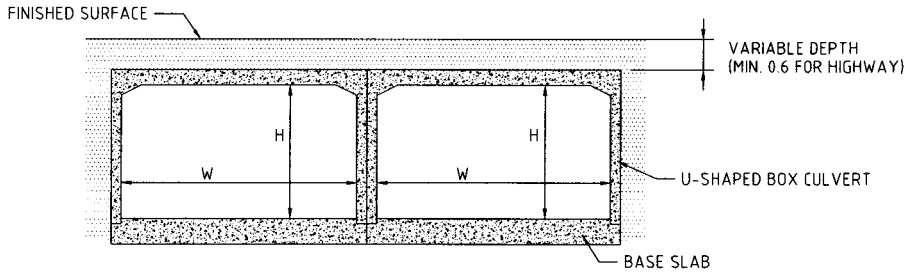
CLIENT CENTRAL GOLDFIELDS SHIRE COUNCIL ENGAGEMENT No: E304639

TITLE

CARISBROOK FLOOD AND DRAINAGE MITIGATION TREAMENTS
PRELIMINARY DESIGN
TYPICAL CROSS SECTION OF THE LEVEE

DRG No. E304639-P509364-GIS05-3 | SHT. 1 | REV. | A3

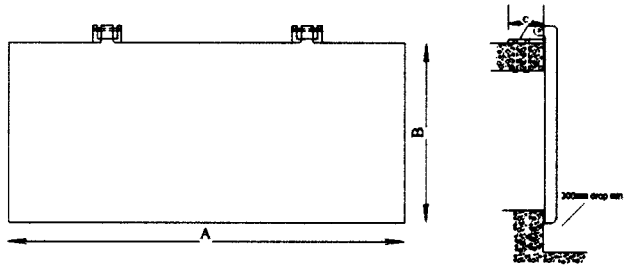
FILENAME: D:\PROJECTS\CONSULTDM\E304639 (CARISBROOK)\P509364\GIS\P509364_GIS05 DRAWINGS\E304639-P509364-GIS05-3 & 4 - PRELIMINARY DESIGN.DWG



TYPICAL INVERTED U-SHAPED BOX CULVERT

CULVERT	TYPE	QUANTITY	DIMENSIONS (M)			
			Ø	H	W	LENGTH
AC1	PIPE	1	0.5	-	-	30
AC2	BOX	3	-	0.75	1.20	12
AC3	BOX	7	-	0.45	1.20	20
AC4	BOX	2	-	0.40	0.80	10
BC1	PIPE	2	0.75	-	-	10
BC2	BOX	2	-	0.60	2.10	2

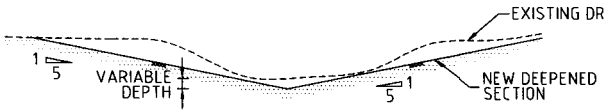
PROPOSED CULVERT DIMENSIONS



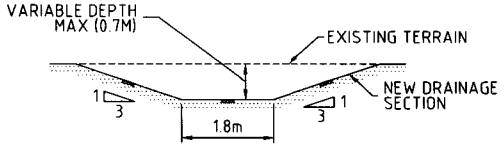
TYPICAL BOX CULVERT FLOODGATE (PRIME COMPOSITES AUST. OR EQUIVALENT)

VALVE	QUANTITY	DIMENSIONS (M)	
		A	B
AC5	2	1.20	0.90
BC2	2	2.10	0.60
BC3	2	1.20	0.90
BC4	2	2.40	0.80
BC5	2	2.80	0.75

PROPOSED NON-RETURN VALVE DIMENSIONS



BELFAST ROAD DRAIN UPGRADE
TYPICAL SECTION (SCALE 1:10)



NEW DRAIN PARALLEL TO WESTERN LEVEE
TYPICAL SECTION (SCALE 1:10)

NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED

FOR PRELIMINARY DESIGN REPORT

DRAWN	TD
CHECKED	MM
DESIGNED	TM
CHECKED	PS
APPROVED	MM
DATE	20/02/2015
CLIENT APP'D	
DATE	

entura Hydro Tasmania | The power of natural thinking
www.entura.com.au

CLIENT CENTRAL GOLDFIELDS SHIRE COUNCIL ENGAGEMENT No: E304639

TITLE
CARISBROOK FLOOD AND DRAINAGE MITIGATION TREAMENTS
PRELIMINARY DESIGN
MISCELLANEOUS DETAILS

DRG No. E304639-P509364-GIS05-4 | SHT. 1 | REV. | A3

FILENAME: D:\PROJECTS\CONSULTDM\E304639 (CARISBROOK)\P509364\GIS\P509364_GIS05 DRAWINGS\E304639-P509364-GIS05-3 & 4 - PRELIMINARY DESIGN.DWG

E Stakeholder Identification/Mail out Letter Example

E.1 Stakeholder Notification Program

Updated (29th January following request from Council)
Approach for Consultation Re: the preliminary design stage for Investigation and Design of Carisbrook Flood and Drainage Mitigation Treatments

Consultation Activity	Timeframe	Current status	Delivered to	Outcome	Information I require
Update letter to all landowners in Carisbrook	29th-5th Feb Jan	Drafted by Jen McDonnell	David Sutcliffe/Leigh Hendrickson	CGS to feedback on letter. Council to send out final letter on letterhead	
Update letter to all Technical Committee Members: Represented on the technical committee are the following groups: North Central Catchment Management Authority (NCCMA) Central Goldfield Shire Council (through Councillors) DEPI Natural Resource Management Committee Vic Roads Vic Track Maryborough SES	29th-5th Feb Jan	Drafted by Jen McDonnell	David Sutcliffe//Leigh Hendrickson	CGS to feedback on letter. Council to send out final letter on letterhead	Individual letters to all members of Tech Committee Members and Chair

Consultation Activity	Timeframe	Current status	Delivered to	Outcome	Information I require
Victorian SES (although member is retired so need another name) Goulbourn-Murray Water BoM					
Update letter to Chair of community-based Steering Committee members	29th-5th Feb	Drafted by Jen McDonnell	David Sutcliffe/Leigh Hendrickson	CGS to feedback on letter. Council to send out final letter on letterhead	Letter to Chair
Website Update	29th-5th Feb	To be drafted by Jen McDonnell	David Sutcliffe/Leigh Hendrickson	CGS to feedback on website paragraph update. CGS to review and post on website	CGS to review and post on website
Update Letter to relevant agencies (if not covered through the Technical Committee Members)	29th-5th Feb	To be prepared by Jen McDonnell – based on feedback from David and Leigh	David Sutcliffe/Leigh Hendrickson	CGS to feedback on letter. Council to send out final letter on letterhead	David and Leigh to comment: Contact names for State and Commonwealth Govt? Additional agencies? Is it ok to use the technical working group representatives as conduits to these agencies?

E.2 Mail out update letter example

X Member Name
Carisbrook Flood and
Drainage Management Plan Technical Working Group
Vic Roads
Address

Dear x,
Re: Carisbrook Flood Mitigation Progress update

As a member of the Carisbrook Flood and Drainage Management Plan Technical Working Group we are writing to keep you informed on the progress of the Carisbrook Flood Mitigation works.

As you are aware following the Carisbrook floods in 2011 the North Central Catchment Management Authority undertook a study with community, council and other representatives. The two key recommendations of the study were:

- creek vegetation thinning work to improve water flow along the creek and;
- the construction of a flood barrier consisting of a drain and levy along the south and western side of Carisbrook to eliminate overland flooding from the farming areas and bush

Council has allocated funds in the 2014/2015 and 2015/2016 budget to match State and Federal grant funds to undertake these works in two stages.

Stage 1 (2014/2015)
Council is pleased to have obtained matching State and Federal Government funding for the following Stage 1 works. (Note: these activities suffered a 12 month delay due to the Federal Government elections which delayed the matching Federal project grants).

The Stage 1 activities will include the following:

1. Undertake creek vegetation thinning works.

   Current progress:
   The North Central Catchment Authority has agreed to manage the creek vegetation thinning work as the creek falls within their statutory responsibility. They will commence the work in mid 2015.

2. Prepare detailed design and construction plans for the works.

   Current progress:
   Central Goldfields Shire Council has appointed specialist consulting civil and hydraulic engineers Entura to develop detailed construction plans for the Carisbrook Flood Mitigation proposal from the Carisbrook Flood and Drainage Management Plan completed in 2013.

   Entura commenced the work in December 2014 and it is anticipated that the process will take approximately 6 months to complete.
   The project will involve:

   - Topographic survey for the mitigation options.
   - Preliminary design for the mitigation options, including heritage and environmental assessment.
   - Preparation of preliminary report evaluating the mitigation options.

- Detailed design of the preferred option, including specifications for construction and design drawings, to allow tendering of the construction phase.

Once the preliminary design is completed in approximately March 2015, it is proposed to call together the former Flood Technical working group for discussion.

Stage 2 (Anticipated 2015/2016 – Timing subject to State and Federal Government Grants)
Stage 2 activity will involve:

- The construction of the levies and flood drainage works to the south and west of Carisbrook.

Council has committed $650,000 in its 2015/2016 budget for the Stage 2 project costs.
Council has again sought State and Federal funding for the balance of the costs toward the Stage 2 construction phase. It is anticipated Council will receive advice on matching funding around June 2015.

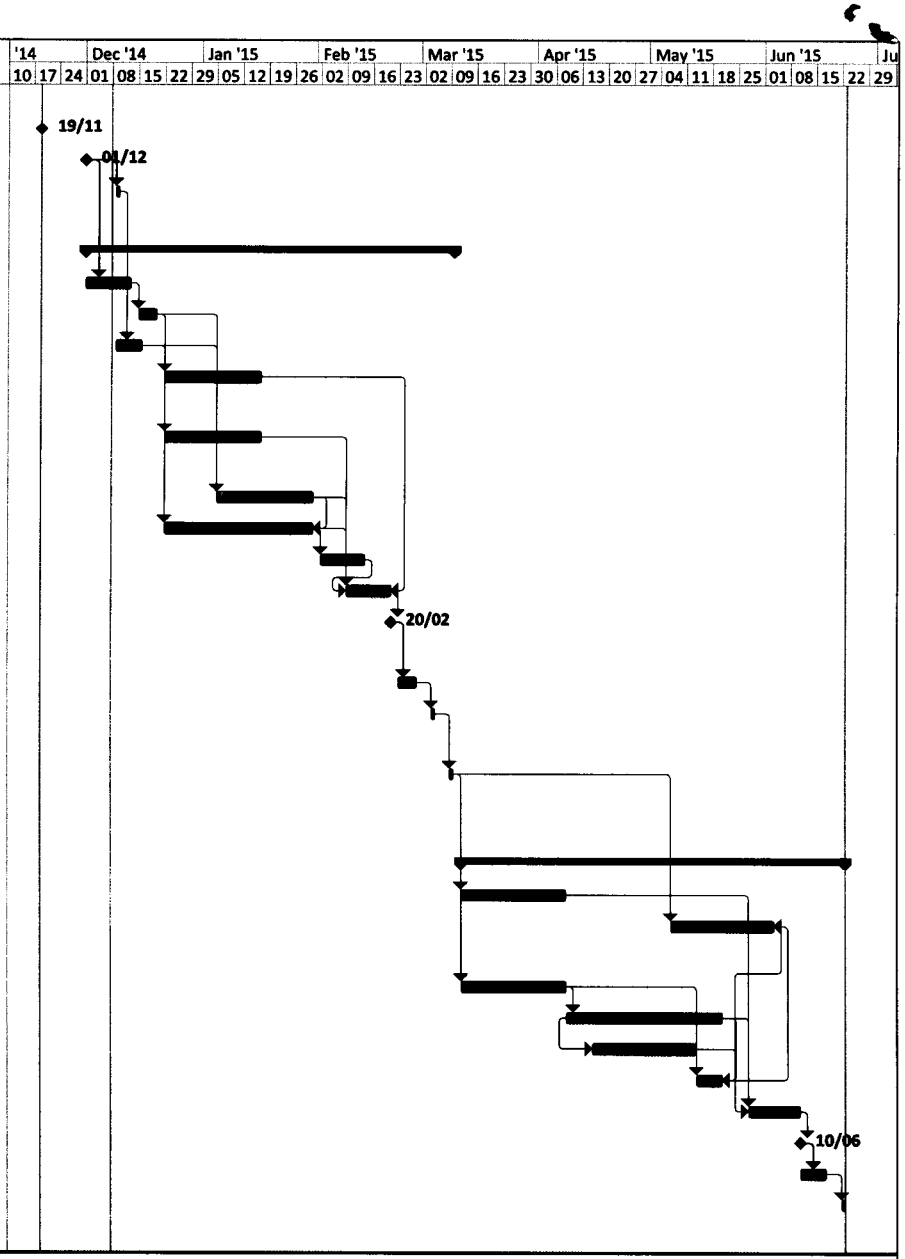
Final timelines on Stage 2 activities will be dependent upon securing funding and the completion of the tender process for construction.

Should you require further information or wish to discuss this matter please contact Leigh Hendrickson at Council on (03) 5461 0634 or visit the Central Goldfields Shire Council website at http://www.centralgoldfields.com.au/

Yours sincerely
Cr Wendy McIvor

F Project Schedule

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1							
2		Letter of Award	0 days	Wed 19/11/14	Wed 19/11/14		
3		Contract Signed - Start of the Project	0 days	Mon 01/12/14	Mon 01/12/14		
4		Pre-commencement Meeting in Maryborough	1 day	Tue 09/12/14	Tue 09/12/14	3FS+6 days	
5		**Preliminary Design**	**71 days**	**Mon 01/12/14**	**Mon 09/03/15**		
6		Data Collection	10 days	Mon 01/12/14	Fri 12/12/14	3	
7		Review of Available Information	5 days	Mon 15/12/14	Fri 19/12/14	6	
8		Survey	5 days	Tue 09/12/14	Mon 15/12/14	4FS-1 day	
9		Consultation with property owners and relevant agencies	20 days	Mon 22/12/14	Fri 16/01/15	7	
10		Review of cultural heritage and environmental aspects	20 days	Mon 22/12/14	Fri 16/01/15	7	
11		Hydraulic review	20 days	Mon 05/01/15	Fri 30/01/15	7FS+2 wks,8	
12		Civil design of both options	30 days	Mon 22/12/14	Fri 30/01/15	7,8,11FF	
13		Preliminary cost estimation	10 days	Mon 02/02/15	Fri 13/02/15	12	
14		Preliminary reporting	10 days	Mon 09/02/15	Fri 20/02/15	9FF-5 days,10FS	
15		Submission of draft preliminary report	0 days	Fri 20/02/15	Fri 20/02/15	14	
16		Review of the report by the Council	5 days	Mon 23/02/15	Fri 27/02/15	15	
17		Presentation of the preliminary design to Council in Maryborough	1 day	Wed 04/03/15	Wed 04/03/15	16FS+2 days	
18		Presentation of the preliminary design to CMA and CFSC in Carisbrook	1 day	Mon 09/03/15	Mon 09/03/15	17FS+2 days	
19		**Detail design**	**73 days**	**Thu 12/03/15**	**Mon 22/06/15**		
20		Stakeholder communication	20 days	Thu 12/03/15	Wed 08/04/15	18FS+2 days	
21		Cultural heritage and environmental assessment	20 days	Thu 07/05/15	Wed 03/06/15	18FS+2 days,25FF+10	
22		Geotechnical investigations	20 days	Thu 12/03/15	Wed 08/04/15	18FS+2 days	
23		Civil detail design	30 days	Thu 09/04/15	Wed 20/05/15	22	
24		Drawing preparation	20 days	Thu 16/04/15	Wed 13/05/15	23SS+1 wk	
25		Specifications	5 days	Thu 14/05/15	Wed 20/05/15	22,23FF,24FF	
26		Final reporting	10 days	Thu 28/05/15	Wed 10/06/15	20FS-5 days,21I	
27		Submission of draft final report	0 days	Wed 10/06/15	Wed 10/06/15	26	
28		Review of the report by the Council	5 days	Thu 11/06/15	Wed 17/06/15	27	
29		Post-contract review meeting in Maryborough	1 day	Mon 22/06/15	Mon 22/06/15	28FS+2 days	



Project: Project Schedule - Carisbr
Date: Mon 08/12/14

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline	
Split	External Tasks	Inactive Summary	Manual Summary	Progress	
Milestone	External Milestone	Manual Task	Start-only		
Summary	Inactive Task	Duration-only	Finish-only		