PREPARED FOR INVESTA RESIDENTIAL GROUP PTY LTD
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ORIGINAL
WATER & ENVIRONMENT

Harmony Subdivision - Preliminary Approval Application
Flood Impact Assessment

COMMERCIAL IN CONFIDENCE

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EXECUTIVE SUMMARY

Calibre Consulting (Qld) Pty Ltd has been commissioned by Investa Residential Group Pty Ltd (the Client) to prepare a *Flood Impact Assessment* as part of a Reconfiguration of Lot (ROL) and Area Development Application for the proposed Harmony development at Palmview.

This report investigates and addresses the impact of the Ultimate Northern Harmony Development on regional flood levels within Sippy Creek and addresses Sunshine Coast Council's (SCRC) Planning Scheme Policy (PSP) Flood Hazard Overlay Code (SC6.9).

This *Flood Impact Assessment* has been updated in response to *Items 1 to 4* of SCRC's *Information Request* dated 29 June 2016 and addresses *Information Request SDA-0516-030478* from the Department of Infrastructure, Local Government and Planning dated 1 July 2016 by demonstrating compliance within PO1 to PO3 of Module 18 of the State Development Assessment Provisions (SDAP).

The basis of our flood investigation has been flood modelling sourced from Sunshine Coast Regional Council. Council's current flood model has used Duration Independent Storms for temporal patterns. Duration Independent Storms are a suitable tool for considering peak water surface levels but where volume is an important consideration, alternative hydrologic methods should be used.

One previous study has been used for this Flood Impact Assessment:

- Council's Mooloolah River TUFLOW model and the corresponding URBS hydrologic model

The results from this modelling have been used to identify the required mitigation strategies in order to demonstrate that the development mitigates any potential adverse hydraulic impacts and does not materially increase the extent or severity of flooding.

The Peter Crosby Way embankment and bridge crossings have previously been analysed and documented in Calibre Consulting's Flood Investigation Report No. B12128.W-02A. This report was submitted as supporting documentation for Operational Works Application No. OPW16/006 which was subsequently approved on 10 May 2016. The Peter Crosby Way embankment and bridge crossings therefore form the base case and are represented in both the existing and developed scenario hydraulic models analysed in this report.

Furthermore, the proposed Springhill Drive Bridge crossing has been included in all developed case hydraulic models.

This Flood Impact Assessment has demonstrated that the filling and excavation works associated with the development can be undertaken within the Sippy Creek floodplain without causing an adverse flood impact in accordance with Council's Flood Hazard Overlay Code (Planning Scheme 8.2.7).

Minimum residential design levels will be located 500mm above the developed 1% AEP + CC DIS flood event level. Collector and higher order roads will be located above the developed regional 1% AEP + CC flood event level (as per Council's Flood Hazard Overlay Code Table 8.2.7.3.1).

With the development above the 1% AEP + CC regional flood event, the development will protect residents and avoids potential adverse impacts to external properties. Therefore the development is compatible with the Sippy Creek floodplain as the development does not materially increase the extent or severity of flooding.

The recommendations of this *Flood Impact Assessment* is that the development is approved as it has been demonstrated that the Ultimate Northern Harmony Development does not directly, indirectly or cumulatively alter the flooding characteristics external to the development site or have any adverse impacts to external properties within Sippy Creek.

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1 INTRODUCTION

Calibre Consulting (Qld) Pty Ltd has been commissioned by Investa Residential Group Pty Ltd (the Client) to prepare a *Flood Impact Assessment* as part of the Reconfiguration of Lot (ROL) and Area Development Application for the proposed Harmony development at Palmview. This report provides details regarding the Flood Impact Assessment items (items 1 to 4) of the *Information Request* dated 29 June 2016. The proposed development is located within the Sunshine Coast Regional Council (SCRC) Local Government Area.

The current ROL application comprises of "Display Village One" which forms part of the overall Phase 1 concept layout (as shown on RPS Drawing No. **22470-306** in **Appendix A**). "Display Village One" consists of 41 residential lots with the remainder of the Phase 1 concept layout to be confirmed during subsequent Development Applications.

For clarity and consistency the proposed ROL application will herein be referred to as the "ROL".

A Flood Impact Assessment has been undertaken for the ultimate northern portion of the Harmony development (as shown in **Figure 1** as the "Ultimate Northern Harmony Development of Area A") to support the ROL application and Area Development Application.

This report investigates and addresses the impact of the Ultimate Northern Harmony Development on regional flood levels within Sippy Creek and addresses Council's Planning Scheme Policy (PSP) flood hazard overlay code (SC6.9).

Planning for the Palmview SPA has been underway for many years. The previous Infrastructure Agreement (IA) was developed based on flood analysis undertaken by Cardno (*Palmview Flood Assessment* (2011)) which set the development footprint for the Palmview SPA.

After the development footprint was set for the Palmview SPA, SCRC have undertaken further flood analyses using updated hydrologic and hydraulic models. This analysis showed minor flood encroachment into the development footprint. SCRC's updated modelling indicated that the Palmview SPA footprint did not result in any increase in extent or severity of flooding within Sippy Creek and as such, no specific mitigation was required.

Flood modelling for the Palmview Area Development Application has now been undertaken based on Council's recent hydraulic analysis which has been updated to reflect the increase in fraction impervious as a result of the development.

One previous study has been used for this Flood Impact Assessment:

- Council's Mooloolah River TUFLOW model and the corresponding URBS hydrologic model

Council's current flood modelling has used Duration Independent Storm (DIS) methodology for temporal patterns. This is consistent with Council's Planning Scheme 2014 – Appendix SC 6.9A. Council's Planning Scheme identifies that for the Design Flood Event, *'the DIS temporal pattern is recommended for the consideration of design peak water levels. Where volume is an important consideration, temporal patterns extracted from significant historic events within the region should be considered.*'

For the flood investigation discussed in this report the modelling and analysis undertaken remains consistent with Council's modelling using the DIS event for determining peak flood water surface levels. However, as per SC6.9A, it is acknowledged that flood volume is an important consideration for assessing the hydraulic impacts of the development on the Sippy Creek floodplain. Consideration of flood volume has been considered as the development is situated at the lower reaches of a large catchment, where there is a wide, shallow floodplain and where encroachment on the fringe of the floodplain occurs.

The use of a more standard hydrologic model is also required to assess the impacts that the development has on the timing of peak flows in the catchment. The DIS event does not adequately reflect urbanisation and the resulting faster

catchment response to rainfall events due to the distribution of the rainfall hyetograph and the inaccuracy of volume estimation. Therefore our analysis will also consider the impacts of flooding for a historic storm. This analysis is explained in more detail in **Section 7**.

As the development is within the lower portion of a large catchment, providing on-site peak flow mitigation (detention) could be detrimental to regional flood levels as a result of coincidental flood peaks. Where peak flow mitigation is proposed the flood modelling undertaken has also analysed the potential for coincidental flood peaks and demonstrated no significant impact to peak flood levels within Sippy Creek.

1.1 REPORT SCOPE

This *Flood Impact Assessment* has been updated in response to *Items 1 to 4* of SCRC's *Information Request* dated 29 June 2016 and provides additional analysis of two (2) historic storm events and associated TUFLOW hydraulic modelling.

The initial scope of this report included the following:

- Undertake a flood assessment for Sippy Creek to determine the minimum flood planning levels for the development in regards to regional flooding. This has been achieved by:

    a) Updating Sunshine Coast Council's (Council) existing Duration Independent Storm (DIS) URBS hydrology model with the proposed changes to land use as part of the Ultimate Northern Harmony Development;

    b) Updating Council's existing TUFLOW hydraulic model with the updated DIS hydrographs, proposed works in the Sippy Creek floodplain, and the Peter Crosby Way bridge and embankment;

    c) Identifying minimum earthworks surface and habitable floor levels from the developed scenario DIS TUFLOW model

Following an assessment using DIS hydrology, it was determined and agreed upon with SCRC that historical storm data would be better suited to determine the impacts of the proposed Harmony development. The following additional scope has been included as a part of this report:

    d) Calibration of three (3) historic storm event using Council's existing URBS model to the existing DIS peak flow values;

    e) Updating Council's existing TUFLOW hydraulic model with existing scenario historic storm inflow hydrographs, proposed filling in the Sippy Creek floodplain, planned Springhill Drive Bridge and embankment and the Peter Crosby Way bridge and embankment;

    f) Identifying and modelling mitigation options to minimise the impact of the development on flood depths, levels and velocities within Sippy Creek;

    g) Documenting the proposed mitigation strategies.

1.2 INFORMATION REQUEST ITEMS

A summary of responses to *Items 1 to 4* of SCRC's *Information Request* dated 29 June 2016 and *Information Request SDA-0516-030478* from the Department of Infrastructure, Local Government and Planning dated 1 July 2016 is provided below.

SCRC's *Information Request*

Item 1: Submit a revised Flood Impact Assessment including model results for all three historic storms. If this cannot be completed, then the impact analysis must be completed using the DIS hydrology.

Response: Section 7 of this report has been updated to include additional hydrologic and hydraulic analysis of all historic storms provided by SCRC. Refer to **Appendix G** and **Appendix H** for historic storm flood mapping results.

Item 2: Submit a revised Flood Impact Assessment including a figure showing the developed scenario DTM and conceptual details of the proposed channel works. The Flood Impact Assessment must include enough detail so as to inform subsequent OPW applications which will deliver the proposed channel works. The adopted Manning's 'n' of the channel works must also be detailed and must not be lowered from that used in Council's model.

Response: Section 7.2.4 details the extent of proposed earthworks within the Sippy Creek floodplain. Additionally, proposed works within the Sippy Creek floodplain have been incorporated on Drawing No. **15-003546-SK101** in **Appendix B**.

Item 3: Submit a revised Flood Impact Assessment including the proposed bridge over the southern channel of Sippy Creek.

Response: The proposed Springhill Drive Bridge abutments have been included within updated hydraulic modelling for all three post-developed historic storm events. The bridge is proposed to span 50m of the Sippy Creek floodplain with an additional 3No. x 3600 x 1500 RCBC located to the south within the embankment. Refer to Drawing No. **15-003546-SK101** in **Appendix B** for details.

Item 4: Submit a revised Flood Impact Assessment including revised Executive Summary which is consistent with the body of the report.

Response: The Executive Summary within this report has been updated to reflect the latest information and results present within the body of this report. This report (Report No. **15-003546-02C**) is the latest version of the *Flood Impact Assessment* for the proposed Harmony development and will supersede previous versions.

Department of Infrastructure, Local Government and Planning *Information Request*

Item 1: To allow the Department to determine compliance of the development application with PO1 to PO3 of Module 18, the applicant is requested to provide a Stormwater/Flood Management Plan.

Response: This report (**15-003546-02C**) has been completed to address the impact of the proposed Harmony development on regional flood conditions within the Palmview Structure Plan Area. This has been undertaken using

hydrological and hydraulic (TUFLOW and URBS) models provided by SCRC. These models utilise the latest flood modelling data of the Sippy Creek catchment. Analysis conducted is based on these models and the configurations adopted by SCRC. Therefore, the impact assessment undertaken is compatible with SCRC requirements.

Hydraulic modelling within **Section 7.2** of this report indicates that there is no adverse impact to the Bruce Highway in the 1% AEP Climate Change design storm event due to inclusion of the proposed Harmony development under SCRC Application No. MCU16/0085. Drawing No. **15-003546-PR-D100CC-D** in **Appendix H** indicates flood level reductions of up to 36mm. Therefore results confirm there will be no adverse impact or actionable nuisance to state controlled roads as a result of the proposed Harmony development.

A local flooding investigation has been conducted as a part of Calibre Consulting's *Concept Stormwater Management Plan Report No.* ***15-003546-01D*** for the proposed Harmony development. As indicated by this report, the proposed Harmony development does not propose to discharge runoff to a state controlled road.

Based on this, compliance within PO1 to PO3 of Module 18 has been achieved.

2 SITE CHARACTERISTICS

2.1 LOCATION AND SITE DETAILS

The proposed development is located in the suburb on Palmview within the SCRC Local Government Area. The proposed Ultimate Northern Harmony Development area is approximately 172 ha and is comprised of a number of existing titles best described as:

- Lot 505 on SP235650
- Lots 1-3 on RP165741
- Lot 345 on CG5011

The Ultimate Northern Harmony Development is bound by the Bruce Highway to the west, the suburb of Sippy Downs to the north, existing open paddocks to the east and the Palmview Conservation Park to the south. **Figure 2-1** illustrates the location of the proposed Palmview Structure Plan Area (SPA), the extents of the s242 application area and approximate location of the proposed ROL.

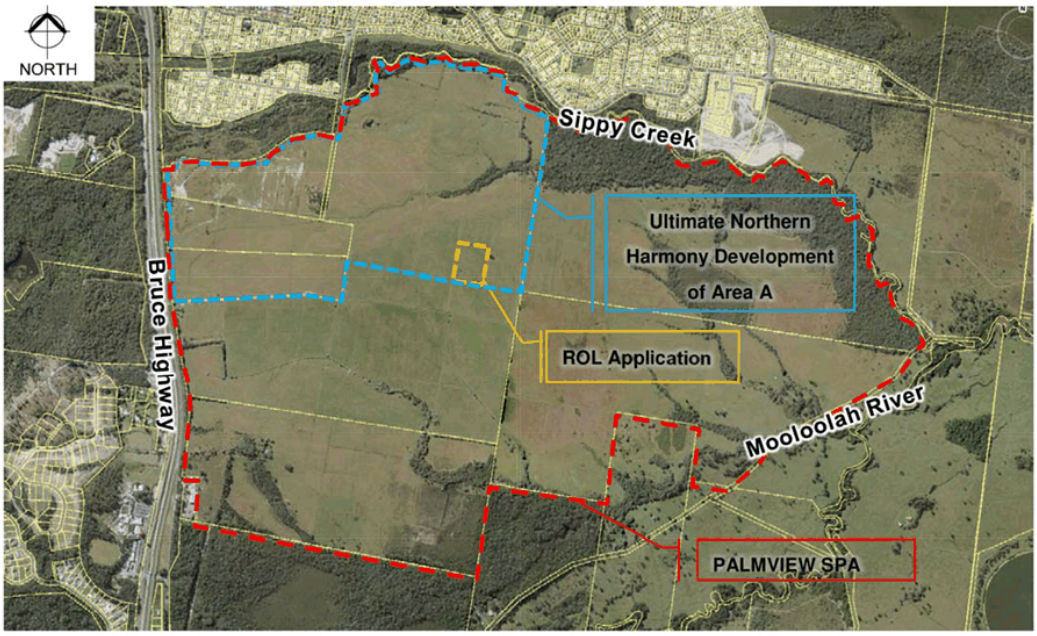

Figure 2-1 - Site Location

2.2 EXISTING TOPOGRAPHY AND DRAINAGE

The site is located on low-lying land adjacent to Sippy Creek and the Mooloolah River and is adjacent to the lower coastal floodplain of the Mooloolah River and the Sippy Creek floodplain. The topography across most of the site is very flat with typical slopes of between 0.5 and 1%. The current land use of the site grazing with the majority of the site cleared to accommodate rural activities.

Under existing conditions, rainfall runoff occurs via sheet flow across much of the site before entering either shallow man-made drains or more natural vegetated channels. There is one major drainage channel through the northern portion of the site which discharges through a vegetated drainage corridor to Sippy Creek and then to the Mooloolah River.

Two major drainage channels exist through the southern portion of the site which drain to the Mooloolah River. These southern drainage lines also receive flows from small external catchments located west of the Bruce Highway. Please note the southern drainage lines do not form part of this investigation.

3 DESIGN OBJECTIVES

The purpose of Council's Flood Hazard Overlay Code (Planning Scheme 8.2.7) is to "*ensure development protects people and avoids or mitigates the potential adverse impacts of flood … inundation on property, economic activity and the environment, taking into account the predicted effects of climate change*".

This can be achieved by demonstrating that the Performance Outcomes (PO) are achieved. These are summarised below:

- (PO9) Development does not directly, indirectly or cumulatively alter the flooding characteristics external to the development site for flood events including the Defined Flood Event;
- (PO3) Development provides that for all flood … inundation events up to and including the DFE:
    a) The safety of people on the site is protected; and
    b) The risk of damage to property on the site is avoided or minimised as far as practicable.
- (PO2) In a flood and inundation area:
    - Achieving flood immunity for the development minimises physical alteration to the floodplain.
- (PO1) Development is undertaken in a manner that ensures:
    - Natural landforms and drainage lines are maintained to protect the hydraulic performance of waterways.

4 METHODOLOGY

To determine the minimum flood planning levels for the development from regional flooding, the following methodology was adopted:

- Update Council's existing DIS URBS model to reflect the Ultimate Northern Harmony Development for the 1% AEP + Climate Change (CC) scenario;
- Update Council's existing TUFLOW model with the developed DIS URBS model hydrographs for the 1% AEP + CC scenario, filling within the Sippy Creek floodplain, and the Peter Crosby Way bridge and embankment;
- Assess the developed scenario TUFLOW model (flood levels, depths and velocities) for the 1% AEP + CC scenario to set minimum floor levels within the development.

To demonstrate that the development mitigates any potential adverse hydraulic impacts and does not materially increase the extent or severity of flooding, the following methodology was adopted:

- Calibrate historic storm events using Council's existing URBS model to the existing DIS peak flow values;
- Update Council's existing TUFLOW hydraulic model with existing scenario historic storm inflow hydrographs, proposed works in the Sippy Creek floodplain (Flame Tree Development), and the Peter Crosby Way bridge and embankment;
- Update Council's existing TUFLOW hydraulic model with developed scenario historic storm inflow hydrographs, proposed works in the Sippy Creek floodplain (Flame Tree Development), the Peter Crosby Way bridge and incorporates Springhill Drive Bridge abutments and proposed mitigation works within the flood plain;
- Identify and model mitigation options to minimise the impact of the development on flood depths, levels and velocities within Sippy Creek;
- Assess the flooding impacts from the existing and developed scenario historic storms and document the proposed mitigation strategies.

5 AVAILABLE DATA SOURCES

The following data was used for this study:

- A cut-down version Council's Mooloolah River TUFLOW model that contains the development site and Sippy Creek. Provided on 28 September 2015. The cut-down model included:
  - Upstream and downstream model boundary conditions;
  - Digital Terrain Model;
  - Structures (culverts and bridges);
  - All related TUFLOW modelling files.
- Council's Mooloolah River URBS model. Provided on 11 February 2016;
- Historic pluviograph data provided by Council for 3 storm events:
  - Crohamhurst (1/05/2015);
  - Mt Bilewilam (23/08/2007);
  - Parrearra (22/03/2012).

No additional calibration was undertaken for this study. The flood modelling undertaken for this assessment was validated against the peak results provided by Council.

6 DIS STORM ANALYSIS

The DIS forms the basis of Council's current hydrologic and hydraulic models. This is consistent with Council's Planning Scheme 2014 – Appendix SC 6.9A. Council's Planning Scheme identifies that for the Design Flood Event, *'the DIS temporal pattern is recommended for the consideration of design peak water levels'*.

Our analysis will remain consistent with Council's Planning Scheme and use the DIS storm analysis to determine peak water surface levels within the Sippy Creek floodplain.

6.1 DIS STORM HYDROLOGIC ANALYSIS

6.1.1 EXISTING SCENARIO DIS STORM URBS MODEL

Hydrologic modelling for the Sippy Creek Catchment was previously undertaken by Council. The previous assessment utilised a calibrated URBS model. A copy of this URBS model was obtained for the purposes of the Flood Impact Assessment.

It should be noted that the URBS modelling used a DIS for all events.

The existing sub-catchments that are impacted by the Ultimate Northern Harmony Development are tabulated below in **Table 6-1**. All other sub-catchments remained as per the original URBS model.

Table 6-1 - Existing Scenario DIS Storm URBS Results

Catchment Name	Area (km^2)	Slope (m/m)	Fraction Impervious (%)	1% AEP + CC (m^3/s)
106	0.805	0.007	8.1	22.3
147	0.887	0.012	18.2	23.0
149	0.862	0.007	17.3	32.2
165	0.803	0.007	11.1	24.1

The delineated sub-catchments used for the existing scenario URBS model within the area of interest is shown on Drawing No. **15-003546-E-CAT** in **Appendix B**.

6.1.2 DEVELOPED SCENARIO DIS STORM URBS MODEL

The existing sub-catchment boundaries were then altered to match the current design surface for the Harmony Development. The revised developed scenario sub-catchments are tabulated below in **Table 6-2**. A lumped fraction impervious value of 80% has been assumed for the development area that falls within the updated sub-catchment boundaries. This has been calculated to include any impervious areas identified in the existing scenario URBS model.

All other sub-catchments remained as per the original URBS model. It should be noted that there is an increase in the overall catchment area contributing to Sippy Creek as a result of the design surface for the Ultimate Northern Harmony Development.

Table 6-2 - Developed Scenario DIS Storm URBS Results

Catchment Name	Area (km²)	Slope (m/m)	Fraction Impervious (%)	1% AEP + CC (m³/s)
106	0.772	0.007	14.7	24.2
147_US	0.733	0.012	46.7	21.9
147_DS	0.494	0.012	51.1	15.1
149	0.897	0.007	22.0	37.1
165	0.645	0.007	89.4	23.8

Sub-catchment 147 was split into 2 separate sub-catchments to more accurately define inflow locations from the Harmony development. The updated sub-catchment boundaries used for the developed scenario URBS model are shown on **15-003546-D-CAT** in **Appendix B.**

6.2 DIS STORM HYDRAULIC ANALYSIS

Hydraulic modelling was undertaken using a cut-down version of the TUFLOW model for the Mooloolah River (provided by SCRC). Modelling was undertaken for the existing and developed DIS 1% AEP + CC scenarios.

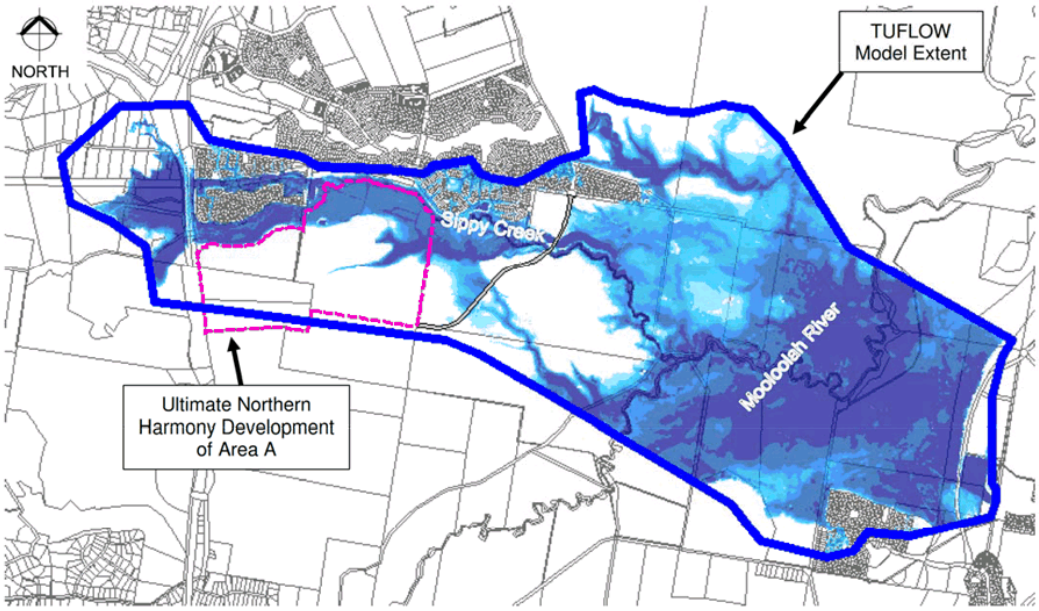

Figure 6-1 - Cut-down TUFLOW Model Extent (shown with DIS 1% AEP + CC existing scenario event)

6.2.1 EXISTING SCENARIO DIS STORM TUFLOW MODEL

The existing scenario DIS storm has been run to validate the cut-down TUFLOW model. The Flame Tree Pocket Development to the east and the Peter Crosby Way embankment and proposed bridges have been incorporated into the existing scenario DIS TUFLOW model. No other additional changes were made to the cut-down version of Council's Mooloolah River TUFLOW model for the existing scenario. The existing scenario flood levels have been determined for the area by re-running the cut-down version of the TUFLOW model.

6.2.2 DEVELOPED SCENARIO DIS STORM TUFLOW MODEL

The proposed design surface associated with the Ultimate Northern Harmony Development has been incorporated into the cut-down version of the TUFLOW model. The Flame Tree Pocket Development to the east and the Peter Crosby Way embankment and proposed bridges have also been incorporated into the model as per the existing scenario.

It should be noted that a separate Flood Impact Assessment for the Peter Crosby Way embankment and bridge has been undertaken by Calibre Consulting and forms part of a separate Operational Works application. The current version of the Peter Crosby Way Flood Impact Assessment is **B12128.W-SFM01** (dated 18 March 2016).

Developed scenario inflow hydrographs for the catchments described in **Section 6.1.2** have been incorporated into the developed scenario TUFLOW model.

6.2.3 DIS RESULTS

Flood depth, level and velocity maps for the existing and developed DIS scenarios are provided in **Appendices E** and **F**, respectively.

Minimum residential design levels will be located 500mm above the developed 1% AEP + CC flood event level with Collector and higher order roads located above the developed 1% AEP +CC flood event level (as per Council's Flood Hazard Overlay Code Table 8.2.7.3.1).

With the development above the 1% AEP + CC regional flood event, the development will protect people and avoids potential adverse impacts to external properties. Therefore the development is compatible with the Sippy Creek floodplain as the development does not materially increase the extent or severity of flooding.

7 HISTORIC STORM ANALYSIS

This section of the Flood Impact Assessment has been updated to address Item 1 of SCRC's Information Request dated 29 June 2016.

Council's current flood modelling has used DIS for temporal patterns. This is consistent with Council's Planning Scheme 2014 – Appendix SC 6.9A. Council's Planning Scheme identifies that for the Design Flood Event, *'the DIS temporal pattern is recommended for the consideration of design peak water levels. Where volume is an important consideration, temporal patterns extracted from significant historic events within the region should be considered.*'

As per SC6.9A, it is acknowledged that flood volume is an important consideration for assessing the hydraulic impacts of the development on the Sippy Creek floodplain. As the development is situated at the lower reaches of a large catchment, where there is a wide, shallow floodplain and where encroachment on the fringe of the floodplain occurs and flood volume is an important consideration.

The use of a more standard hydrologic model is required to assess the impacts that the development has on the timing of peak flows in the catchment. The DIS event does not adequately reflect urbanisation and the resulting faster catchment response to rainfall events. Therefore this analysis will also consider the impacts of flooding for a historic design storm.

As per Australian Rainfall and Runoff (Book 2 Chapter 5, DRAFT), the DIS approach reproduces the rainfall intensity loading and at best, can reproduce aspects of a single storm. '*Such approaches have some applicability for peak flow estimation but cannot reproduce realistic hydrographs'*. Realistic hydrographs are required to fully assess the impact of urbanisation in a catchment.

Our analysis will remain consistent with Council's Planning Scheme and use a historical storm analysis to determine any mitigation requirements within the Sippy Creek floodplain. This corresponds with the Acceptable Outcomes in Council's Flood Hazard Overlay Code (PO9) to demonstrate that there is no loss of on-site flood storage capacity.

7.1 HISTORIC STORM HYDROLOGIC ANALYSIS

As part of the alternative hydrologic analysis, SSC provided 3 historic storm event 5 minute pluviographic data. The 3 historic storms were:

- Crohamhurst (1/05/2015) – main storm burst was equivalent to 253mm in 4.25 hours (average burst intensity of 59.5 mm/hr)
- Mt Bilewilam (23/08/2007) - main storm burst was equivalent to 329mm in 3.5 hours (average burst intensity of 89.7mm/hr)
- Parrearra (22/03/2012) - main storm burst was equivalent to 346mm in 5.0 hours (average burst intensity of 69.2mm/hr)

The raw pluviographic data and the extracted bursts for each historic storm event are provided in **Appendix I**.

7.1.1 HISTORIC STORM CALIBRATION

All three (3) historic storms were assessed on sub-catchments 147 and 164 on Drawing No. **15-003546-C-CAT**. The suitability of each historic storm to match peak flow estimates from the DIS analysis was assessed in order to undertake an impact assessment for the proposed development.

The burst patterns for each historic storm were input into Council's existing URBS model. The burst patterns were run for each respective historic storm and the proportional loss factor (PL) was adjusted until each sub-catchment peak runoff

value matched the peak flow value estimates from Council's DIS values. This is consistent with the methodology agreed between Calibre Consulting and SCRC Officers.

Table 7-1 - 1% AEP + CC Initial Historic Storm Analysis

Scenario	PL	L_147 Peak Flow (m^3/s)	L_165 Peak Flow (m^3/s)
Existing DIS	0.9	23.0	24.1
Crohamhurst	1.15	25.4	24.3
Mt Bilewilam	0.76	24.1	24.2
Parrearra	1.0	24.7	24.0

As can be seen in **Table 7-1**, only the Mt Bilewilam historic storm calibrated to the existing scenario 1% AEP + CC with a proportional loss factor of less than 1. This is a significant result as URBS only applies the proportional loss coefficient to pervious areas. As a result, if the proportional loss coefficient is 1 or more, any increase in impervious areas results in a decrease in peak flow estimates.

In order to use pluviographic data for Crohamhurst and Parrearra, each burst pattern was proportionally increased and calibrated by adjusting PL factors in URBS.

Table 7-2 - 1% AEP + CC Additional Historic Storm Analysis

Scenario	Proportional Increase Factor	PL	L_147 Peak Flow (m^3/s)	L_165 Peak Flow (m^3/s)
Existing DIS	-	0.9	23.0	24.1
Crohamhurst	1.2	0.89	24.4	23.2
Parrearra	1.05	0.92	24.2	23.4

7.1.2 MT BILEWILAM HISTORIC ANALYSIS

The burst pattern from the Mt Bilewilam storm was calibrated for the 39, 10, 1 and 1% AEP + CC for the whole upstream contributing catchment for Sippy Creek to the Bruce Highway (to the outlet of sub-catchment L_148, upstream of the Bruce highway). The URBS model was calibrated to the DIS inflow hydrographs used in the existing scenario TUFLOW model. The results of the calibration are shown below.

Table 7-3 - Mt Bilewilam Calibration to L_148

Event (AEP)	PL	TUFLOW model Peak Flow (m^3/s)	URBS model Peak Flow (m^3/s)	Difference (m^3/s)
39%	0.16	66.9	70.2	+3.3
10%	0.32	118.9	120.8	+1.9
1%	0.69	234.6	239.1	+4.5
1% +CC	0.85	287.9	290.5	+2.6

With the adopted proportional loss factors in **Table 7-3**, the remaining catchments were analysed for the existing and developed scenarios.

Sub-catchment 147 was split into 2 separate sub-catchments in both existing and developed scenarios to more accurately compare increases in peak flow from the Harmony development. The updated sub-catchment boundaries used for the developed scenario URBS model are shown on Drawings Numbered **15-003546-E-CAT** and **15-003546-D-CAT** in **Appendix B.**

Table 7-4 – Mt Bilewilam - Existing Scenario Historic Storm Peak Flow Results

Catchment	39%	10%	1%	1%+CC
L_232	9.4	16.0	31.5	38.4
L_233	7.2	9.1	13.5	15.4
L_234	2.0	4.2	9.3	11.6
L_160	9.0	13.9	25.6	30.7
L_131	16.7	24.2	42.0	49.8
L_161	9.3	10.9	14.6	16.2
L_149	10.9	16.0	27.8	33.0
L_106	6.4	10.8	21.2	25.7
L_165	6.6	10.6	19.9	23.9
L_401	0.8	1.1	1.9	2.3
L_402	0.7	0.9	1.3	1.6

Table 7-5 – Mt Bilewilam - Developed Scenario Historic Storm Peak Flow Results

Catchment	39%	10%	1%	1%+CC
L_232	9.4	16.0	31.5	38.4
L_233	12.4	14.4	19.1	16.4
L_234	11.1	13.0	17.4	19.3
L_160	9.0	13.9	25.6	30.7
L_131	16.7	24.3	42.0	49.8
L_161	9.3	10.9	14.6	16.2
L_149	12.3	16.9	27.9	32.7
L_106	7.3	10.9	19.4	23.2
L_165	23.0	23.6	25.0	25.6
L_401	0.8	1.1	1.9	2.3
L_402	0.7	0.9	1.4	1.6

As shown from **Table 7-4** and **Table 7-5**, increases in peak flow occur for catchments L_233, L_234 and L_165. As delineated on **15-003546-D-CAT** in **Appendix B**, these three catchments are associated with the Harmony development.

7.1.3 CROHAMHURST HISTORIC ANALYSIS

The burst pattern from the Crohamhurst storm was calibrated for the 39, 10, 1 and 1% AEP + CC for the whole upstream contributing catchment for Sippy Creek to the Bruce Highway (to the outlet of sub-catchment L_148, upstream of the Bruce highway). The URBS model was calibrated to the DIS inflow hydrographs used in the existing scenario TUFLOW model. The results of the calibration are shown below.

Table 7-6 - Crohamhurst Calibration to L_148

Event (AEP)	PL	TUFLOW model Peak Flow (m^3/s)	URBS model Peak Flow (m^3/s)	Difference (m^3/s)
39%	0.17	66.9	65.4	-1.5
10%	0.36	118.9	118.5	-0.4
1%	0.77	234.6	233.7	-0.9
1% +CC	0.96	287.9	287.1	-0.8

With the adopted proportional loss factors in **Table 7-6**, the remaining catchments were analysed for the existing and developed scenarios.

As with Mt Bilewilam previously, sub-catchment 147 was split into 2 separate sub-catchments in both existing and developed scenarios to more accurately compare increases in peak flow from the Harmony development. The updated sub-catchment boundaries used for the developed scenario URBS model are shown on Drawings Numbered **15-003546-E-CAT** and **15-003546-D-CAT** in **Appendix B.**

Table 7-7 – Crohamhurst - Existing Scenario Historic Storm Peak Flow Results

Catchment	39%	10%	1%	1%+CC
L_232	8.0	14.0	27.0	33.1
L_233	6.6	8.6	12.8	14.8
L_234	2.0	4.3	9.2	11.5
L_160	7.5	12.0	21.7	26.2
L_131	13.4	19.9	34.1	40.6
L_161	7.4	8.8	11.9	13.3
L_149	8.8	13.4	23.1	27.6
L_106	5.9	10.4	20.1	24.6
L_165	5.9	9.8	18.3	22.2
L_401	0.6	0.9	1.5	1.7
L_402	0.5	0.6	1.0	1.2

Table 7-8 – Crohamhurst - Developed Scenario Historic Storm Peak Flow Results

Catchment	39%	10%	1%	1%+CC
L_232	8.0	14.0	27.0	33.1
L_233	11.1	13.2	17.7	19.8
L_234	10.0	12.0	16.3	18.3
L_160	7.5	12.0	21.7	26.2
L_131	13.4	19.9	34.1	40.6
L_161	7.4	8.8	11.9	13.3
L_149	9.8	14.0	22.9	27.1
L_106	6.6	10.2	18.1	21.8
L_165	19.2	19.8	21.1	21.7
L_401	0.6	0.9	1.5	1.7
L_402	0.5	0.6	1.0	1.2

As shown from **Table 7-7** and **Table 7-8**, increases in peak flow occur for catchments L_233, L_234 and L_165. As delineated on **15-003546-D-CAT** in **Appendix B**, these three catchments are associated with the Harmony development.

7.1.4 PARREARRA HISTORIC ANALYSIS

The burst pattern from the Mt Bilewilam storm was calibrated for the 39, 10, 1 and 1% AEP + CC for the whole upstream contributing catchment for Sippy Creek to the Bruce Highway (to the outlet of sub-catchment L_148, upstream of the Bruce highway). The URBS model was calibrated to the DIS inflow hydrographs used in the existing scenario TUFLOW model. The results of the calibration are shown below.

Table 7-9 – Parrearra Calibration to L_148

Event (AEP)	PL	TUFLOW Model Peak Flow (m^3/s)	URBS Model Peak Flow (m^3/s)	Difference (m^3/s)
39%	0.17	66.9	67.9	+1.0
10%	0.35	118.9	119.4	+0.5
1%	0.75	234.6	234.8	+0.2
1% +CC	0.93	287.9	287.0	-0.9

The remaining catchments were analysed for the existing and developed scenarios with the adopted proportional loss factors provided in **Table 7-9**.

Sub-catchment 147 was split into 2 separate sub-catchments in both existing and developed scenarios to more accurately compare increases in peak flow from the Harmony development. The updated sub-catchment boundaries used for the developed scenario URBS model are shown on Drawings Numbered **15-003546-E-CAT** and **15-003546-D-CAT** in **Appendix B.**

Table 7-10 – Parrearra - Existing Scenario Historic Storm Peak Flow Results

Catchment	39%	10%	1%	1%+CC
L_232	7.8	13.5	26.3	32.4
L_233	6.3	8.1	12.1	14.0
L_234	1.9	4.0	8.6	10.9
L_160	7.4	11.6	21.1	25.6
L_131	13.1	19.3	33.0	39.5
L_161	7.3	8.7	11.7	13.2
L_149	8.8	13.1	22.7	27.3
L_106	5.7	9.8	19.0	23.4
L_165	5.7	9.4	17.5	21.4
L_401	0.6	0.8	1.3	1.6
L_402	0.4	0.6	0.9	1.0

Table 7-11 – Parrearra - Developed Scenario Historic Storm Peak Flow Results

Catchment	39%	10%	1%	1%+CC
L_232	7.8	13.5	26.3	32.4
L_233	10.7	12.6	16.9	18.8
L_234	9.6	11.5	15.5	17.3
L_160	7.4	11.6	21.1	25.6
L_131	13.1	19.3	33.0	39.2
L_161	7.3	8.7	11.7	13.1
L_149	9.8	13.8	22.6	26.6
L_106	6.4	9.7	17.3	20.7
L_165	18.8	19.3	20.6	21.1
L_401	0.6	0.8	1.3	1.6
L_402	0.4	0.6	0.9	1.0

As shown from **Table 7-10** and **Table 7-11**, increases in peak flow occur for catchments L_233, L_234 and L_165. As delineated on **15-003546-D-CAT** in **Appendix B**, these three catchments are associated with the Harmony development.

7.1.5 SUMMARY OF HISTORIC ANALYSIS

On assessment of the historic analysis, it is evident that peak flows to Sippy Creek increase in all three historic storm events as a result of the proposed Harmony development.

Although increases in peak flow to Sippy Creek occur, hydraulic modelling confirms that the increases do not result in an actionable nuisance to adjacent properties or cause adverse impacts on flood conditions within the surrounding area or downstream. TUFLOW hydraulic modelling is discussed within **Section 7.2**.

7.2 HISTORIC STORM HYDRAULIC ANALYSIS

This section of the Flood Impact Assessment has been updated to address Items 2 and 3 of SCRC's Information Request dated 29 June 2016.

Hydraulic modelling was undertaken using the same cut down version of Council's TUFLOW model for Sippy Creek as per **Section 6.2**. Inflow hydrographs were updated with the respective existing and developed 1% AEP + Climate Change historic storm scenarios.

7.2.1 EXISTING SCENARIO HISTORIC STORM TUFLOW MODEL

The Flame Tree Pocket development to the east and the Peter Crosby Way embankment and proposed bridges have been incorporated into the existing scenario historic storm TUFLOW model. Inflow hydrographs have been updated with the historic storm hydrographs at the locations identified in **Section 7.1.2**.

Other additional changes made to the cut down version of Council's Mooloolah River TUFLOW model for the existing historic storm scenario included updating of catchment 147. The source area boundary for Catchment 147 was split into two local catchments (L_233 and L_234) to best compare against the developed scenario TUFLOW. The existing historic storm scenario flood levels have been determined for the area by re-running the cut down version of the TUFLOW model. Existing scenario maximum flood depth and velocity plans for the 1% AEP + CC flood event are presented in **Appendix G** for all three historic storms.

Furthermore, a minor update was made to the Riparian Corridor land use roughness shape file to reflect the riparian corridor as indicated by current aerial imagery. This updated shape file was utilised in both existing and developed scenario hydraulic models. Refer to **Figure 7-1** for details of land use shape files used in both hydraulic model scenarios.

7.2.2 DEVELOPED SCENARIO HISTORIC STORM TUFLOW MODEL

The proposed design surface associated with the Ultimate Northern Harmony Development has been incorporated into the cut-down version of the TUFLOW model. The Flame Tree Pocket development to the east and the Peter Crosby Way embankment and proposed bridges and drainage structures have also been retained in the Developed scenario model. Supplementary excavation within the floodplain has been provided and incorporated into the model as illustrated on Drawing No. **15-003546-D100CC-A**.

Furthermore, in accordance with *Information Request – Item 3,* the future Springhill Drive Bridge abutments have been incorporated within the Developed scenario model. Refer to Drawing No. **15-003546-SK101** in **Appendix B** for details of the crossing structure configuration.

Inflow hydrographs have been updated with historic storm hydrographs at the locations identified in **Section 7.1**.

7.2.3 UPSTREAM CATCHMENT DIVERSION

Two small upstream catchments are conveyed into the development site by 2/450mm RCPs and 1/1200mm RCP under the Bruce Highway. It is proposed to divert this catchment directly north in to Sippy Creek, upstream of the Harmony Development.

The proposed location and extent of the diversion drain is provided on Drawings Numbered **15-000256.04-200** and **15-000256.04-201** in **Appendix D**. Further information regarding the design and capacity of this diversion drain is included within Calibre Consulting's Bulk Earthworks Application Reference No. OPW16/284.

7.2.4 PROPOSED MITIGATION WORKS

This section of the Flood Impact Assessment has been added to address Item 2 of SCRC's Information Request dated 29 June 2016.

To ensure there are no adverse impacts to flood conditions in surrounding areas as a result of the proposed Harmony development, various floodplain works are proposed to improve conveyance of regional flows in the 1% AEP Climate Change storm event. These works include minor excavations in the southern arm of Sippy Creek to the north of the Harmony development, channelization works and smoothing of open space areas to the east of the development.

The proposed mitigation and channel works have retained Manning's 'n' values used in the existing scenario hydraulic model. Values of Manning's 'n' used in the developed scenario TUFLOW flood model are illustrated on **Figure 7-1**. The default Manning's 'n' value for areas not covered by a land use shapefile was adopted unchanged from SCRC as 0.06.

The extent of works proposed within the Sippy Creek floodplain is illustrated on Drawing No. **15-003546-SK101** in **Appendix B**. For conceptual details of the proposed channel works, various cross sections have been extracted from the Digital Terrain Model (DTM) used in developed scenario flood modelling. These cross sections are shown on Drawings Numbered **15-003546-SK102** and **15-003546-SK103** in **Appendix B**.

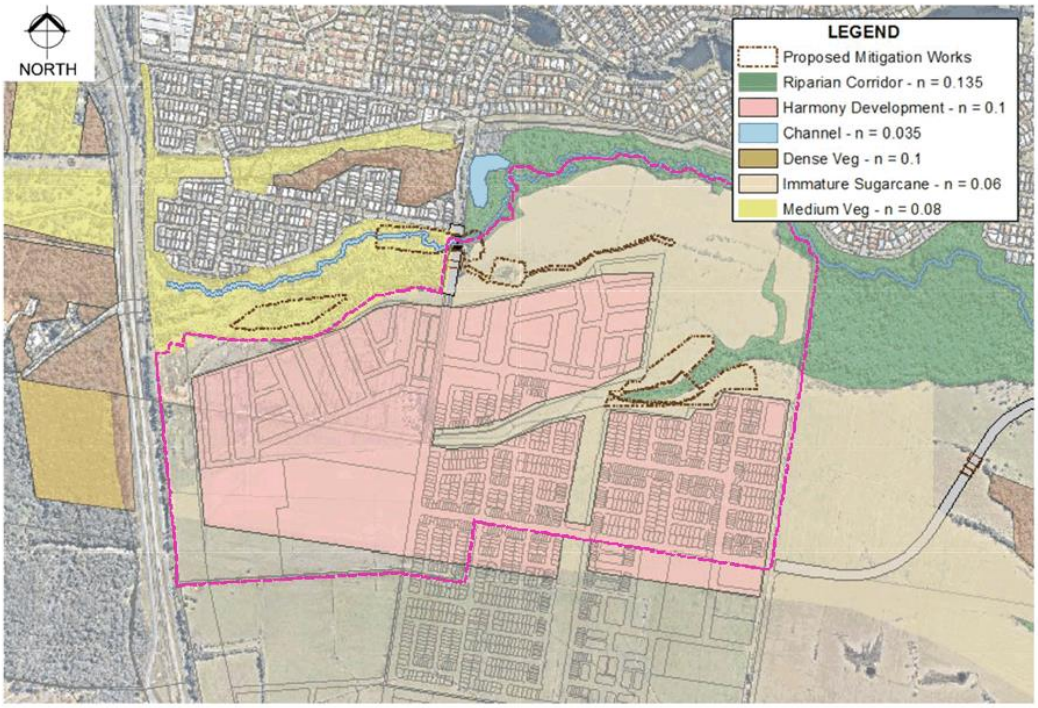

Figure 7-1 - Developed Scenario Land Use Values

7.2.5 HISTORIC STORM RESULTS

Flood depths, levels, velocities and afflux maps for the existing and developed historic storm scenarios are provided in **Appendix G** and **Appendix H**. All three historic storms were analysed hydrologically and hydraulically. As a result, the Parrearra storm has been determined to be the critical scenario as it contains the larger flood extent and higher water surface levels throughout the Sippy Creek floodplain for both existing and developed scenarios.

Difference mapping of the Parrearra historic storm event (Drawing No. **15-003546-PR-D100CC-D** in **Appendix H**) shows no increase in flood level on adjacent properties. Additionally, a flood level reduction is evident north of the Harmony development in both arms of Sippy Creek, and at the Peter Crosby Way culvert crossing to the east. Similar flood level differences are evident in the Crohamhurst historic storm event as shown on Drawing No. **15-003546-CH-D100CC-D** in **Appendix H**. However, post-development water surface levels in the Crohamhurst storm were the lowest of all three historic storm events throughout the Sippy Creek floodplain.

As shown on the Mt Bilewilam flood level difference plan (Drawing No. **15-003546-MB-D100CC-D** in **Appendix H**) for the 1% AEP + CC scenario, post-development flood levels generally remain consistent within the Sippy Creek floodplain with pre-development levels. All three historic storm events show reductions in flood level upstream of the proposed Springhill Drive Bridge crossing. Minor flood increases are evident immediately north of the ultimate northern Harmony development footprint but are contained within the lot boundary. Minor increases of up to 13mm occur on University Way in the Mt Bilewilam event, however, the Parrearra developed scenario flood level is up to 76mm higher in this area.

Difference mapping of the Parrearra historic storm event shows no increase in flood level on adjacent properties. Additionally, a flood level reduction is evident north of the Harmony development in both arms of Sippy Creek, and at the Peter Crosby Way culvert crossing to the east.

As modelling indicates the critical (Parrearra) flood event does not result in an adverse increase in flood levels on adjacent properties, the proposed flood conditions are considered to be acceptable.

The proposed hydraulic impacts of the development as a result of the filling within Sippy Creek and the increase in runoff, could only be assessed using the historic storms provided where volume, timing and duration is more accurately represented. This corresponds with the Acceptable Outcomes in Council's Flood Hazard Overlay Code (PO9) to demonstrate that there is no loss of on-site flood storage capacity and any changes to depth, duration, or velocities are contained within the site.

The proposed development maintains the safety of residents, reduces flood risk to existing flood affected properties, and maintains flooding characteristics external to the site.

8 CONCLUSION

This *Flood Impact Assessment* has been prepared to support the proposed Harmony development ROL and Area Development Application for the proposed Harmony development at Palmview as shown in **Appendix A.** The results of this *Flood Impact Assessment* have demonstrated that the design objectives outlined in **Section 3** have been met with the current development layout.

This *Flood Impact Assessment* has also demonstrated that:

- Development works can be undertaken within the Sippy Creek floodplain without causing any adverse impacts to flood inundation on external property, economic activity and the environment, as per Council's Flood Hazard Overlay Code (Planning Scheme 8.2.7).
- The development is compatible with the Sippy Creek floodplain as the development does not directly, indirectly or cumulatively adversely alter the flooding characteristics external to the development site, as per Council's Flood Hazard Overlay Code PO9.
- With the development above the 1% AEP + CC regional flood event, the development provides safety to residents on the site and that the damage to property on the site is minimised as far as practicable, as per Council's Flood Hazard Overlay Code PO3.

The above outcomes demonstrate compliance with the relevant flooding requirements. Moreover, the analyses and the outcomes address Items 1 to 4 of the *Information Request* to MCU16/0085 dated 29 June 2016, and Item 1 of *Information Request SDA-0516-030478* from the Department of Infrastructure, Local Government and Planning dated 1 July 2016.

9 RECOMMENDATIONS

It is recommended that this Flood Impact Assessment be approved as it has demonstrated that the Ultimate Northern Harmony Development with the identified mitigation measures in place does not result in a material increase in the extent or severity of flood inundation within Sippy Creek. The analysis has shown that the proposed development and mitigation measures result in a positive impact on flooding characteristics within Sippy Creek.

The design strategies presented in this report, including the minimum floor levels, are to be incorporated into future detailed design. Detailed design may result in changes to the proposed management strategies but the design objectives are to be maintained.

10 DISCLAIMER

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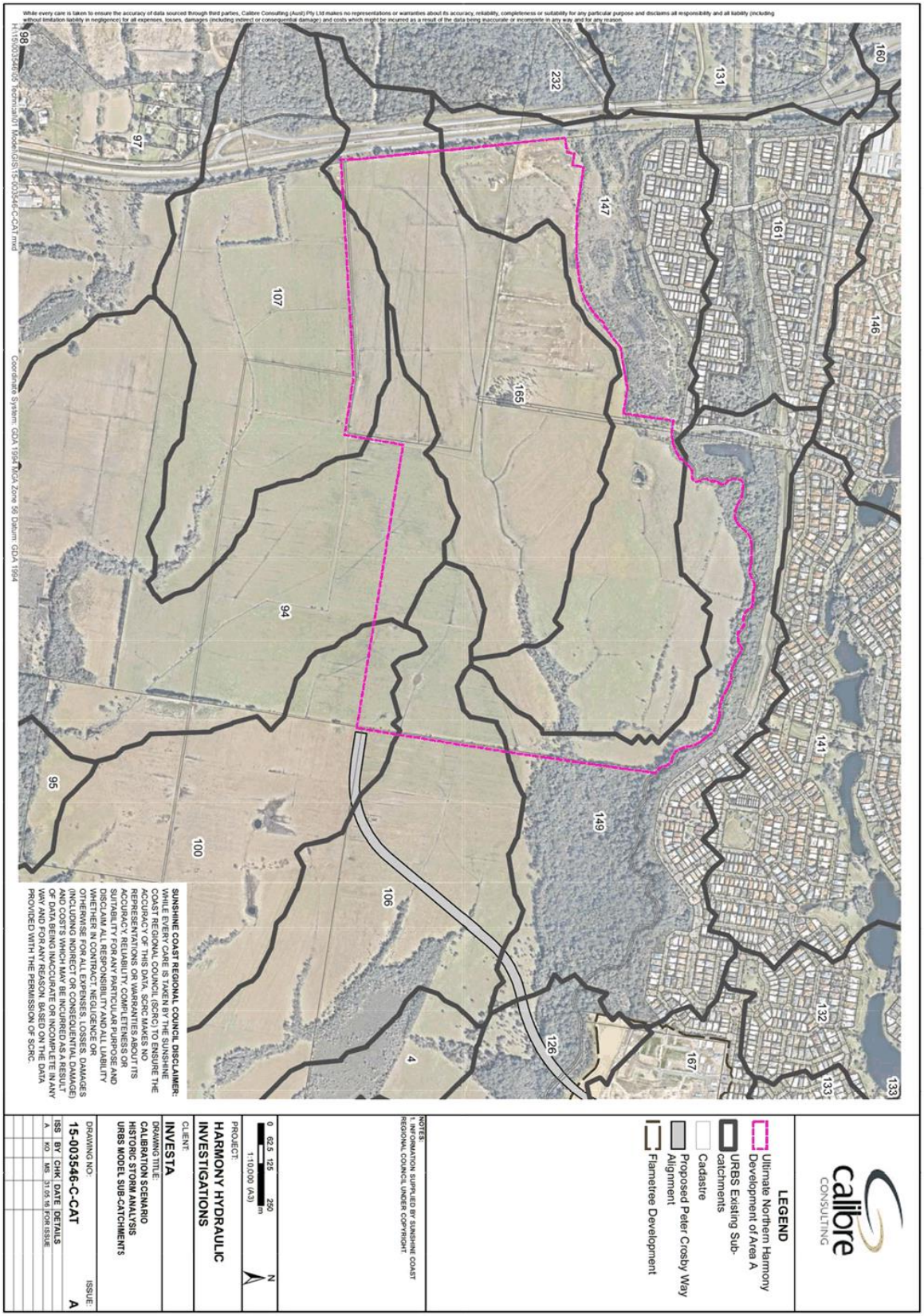
APPENDICES

APPENDIX A DEVELOPMENT LAYOUT DRAWINGS


DRAFT
RELEASE AREA TWO
RELEASE AREA ONE
DISPLAY VILLAGE ONE
Note:
All details are indicative only and subject to further detail design.
Legend
Site Boundary
Stage Boundary
Divide Release Boundary
Indicative Road Pavement
Indicative Laneway
Indicative Threshold
Indicative Access Driveway
Indicative Verge
Indicative Footpath
Open Space
Dedicated Park / Cycle Corridor
Note
Dimensions, Distances and Areas are approximate only, and are subject to survey and Council approval.
Plans should not be used for final detailed engineers design.
Source Information:
Cadastre: Survey
Adjoining Information: DCDB
Environmental Constraints: SDRC
Flood: SDRC
REVISION
CLIENT
INVESTA
PROJECT
harmony
CONCEPT LAYOUT
PHASE 1
OVERALL
Date 15 FEB 2016
Drawn By WNW
Checked By PK / PHE
Dwg No. 22470 - PHASE 1
Job Number 22470
Local Authority SUNSHINE COAST REGIONAL COUNCIL
Locality PALMVIEW
Scale 1 : 2000
Sheet A1
Plan Ref 22470 – 306
Rev
RPS

APPENDIX B CALIBRE CONSULTING DRAWINGS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SUNSHINE COAST REGIONAL COUNCIL DISCLAIMER:
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LEGEND
Ultimate Northern Harmony Development of Area A
URBS Existing Sub-catchments
Cadastre
Proposed Peter Crosby Way Alignment
Flametree Development
NOTES
1. INFORMATION SUPPLIED BY SUNSHINE COAST REGIONAL COUNCIL UNDER COPYRIGHT
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HARMONY HYDRAULIC INVESTIGATIONS
CLIENT:
INVESTA
DRAWING TITLE:
CALIBRATION SCENARIO HISTORIC STORM ANALYSIS URBS MODEL SUB-CATCHMENTS
DRAWING NO:
15-003546-C-CAT
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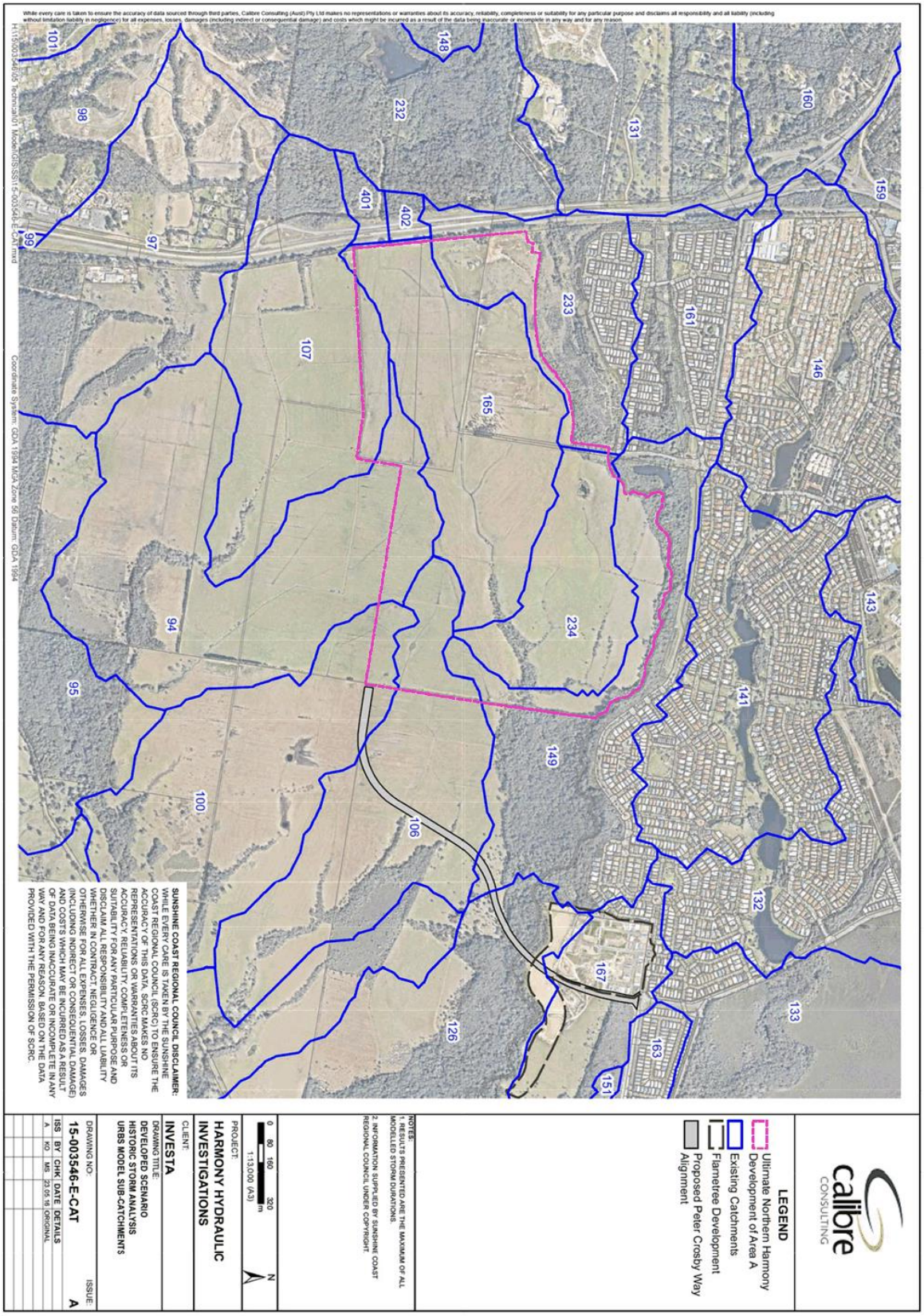
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Ultimate Northern Harmony Development of Area A
Existing Catchments
Flametree Development
Proposed Peter Crosby Way Alignment
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2. INFORMATION SUPPLIED BY SUNSHINE COAST REGIONAL COUNCIL UNDER COPYRIGHT
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DEVELOPED SCENARIO HISTORIC STORM ANALYSIS URBS MODEL SUB-CATCHMENTS
DRAWING NO:
15-003546-E-CAT
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A KO MS 23.05.16 ORIGINAL
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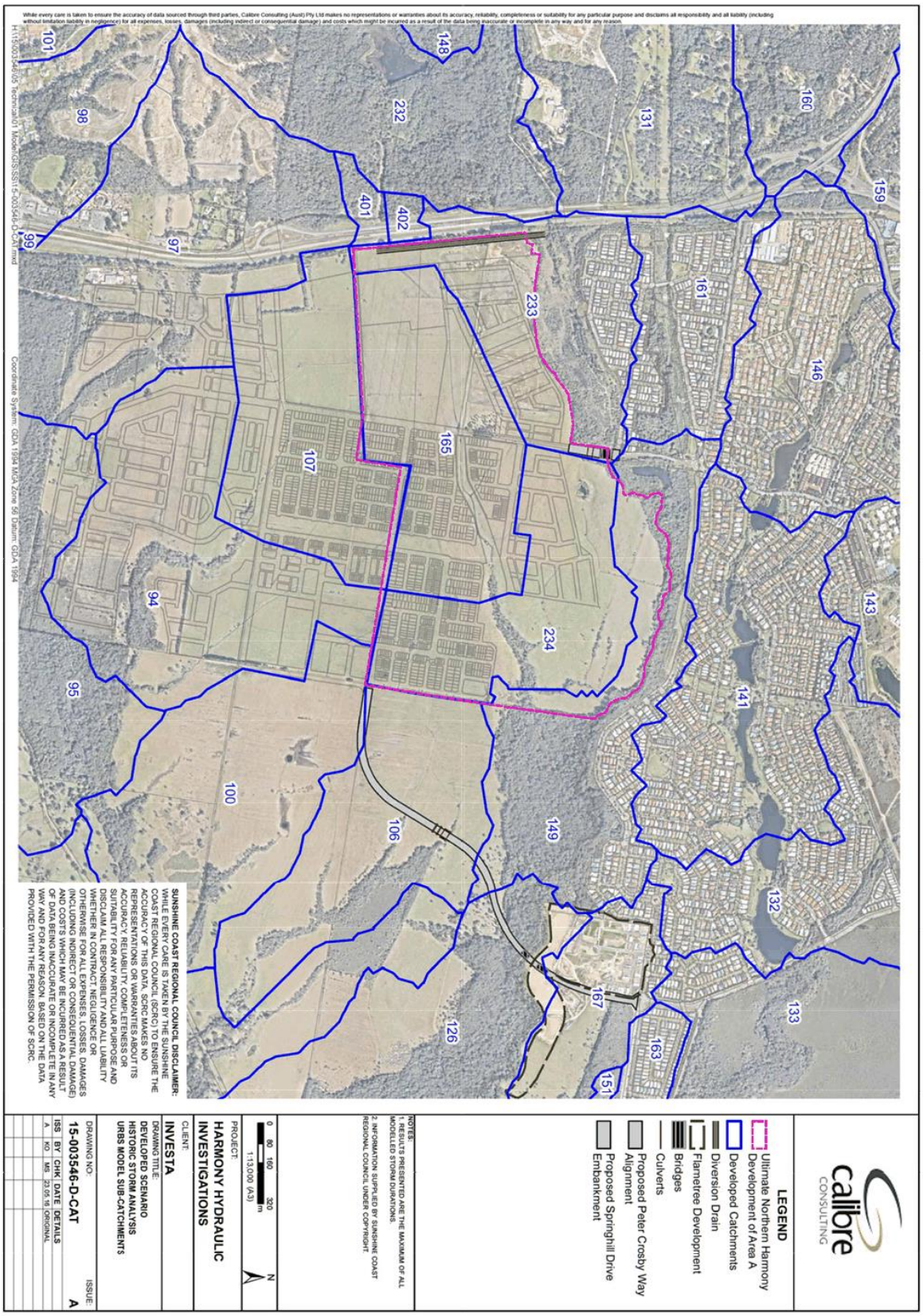
LEGEND
Ultimate Northern Harmony Development of Area A
Developed Catchments
Diversion Drain
Flametree Development
Bridges
Culverts
Proposed Peter Crosby Way Alignment
Proposed Springhill Drive Embankment
NOTES
1. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS
2. INFORMATION SUPPLIED BY SUNSHINE COAST REGIONAL COUNCIL UNDER COPYRIGHT
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1:3,000 (A3)
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PROJECT
HARMONY HYDRAULIC INVESTIGATIONS
CLIENT:
INVESTA
DRAWING TITLE:
DEVELOPED SCENARIO HISTORIC STORM ANALYSIS URBS MODEL SUB-CATCHMENTS
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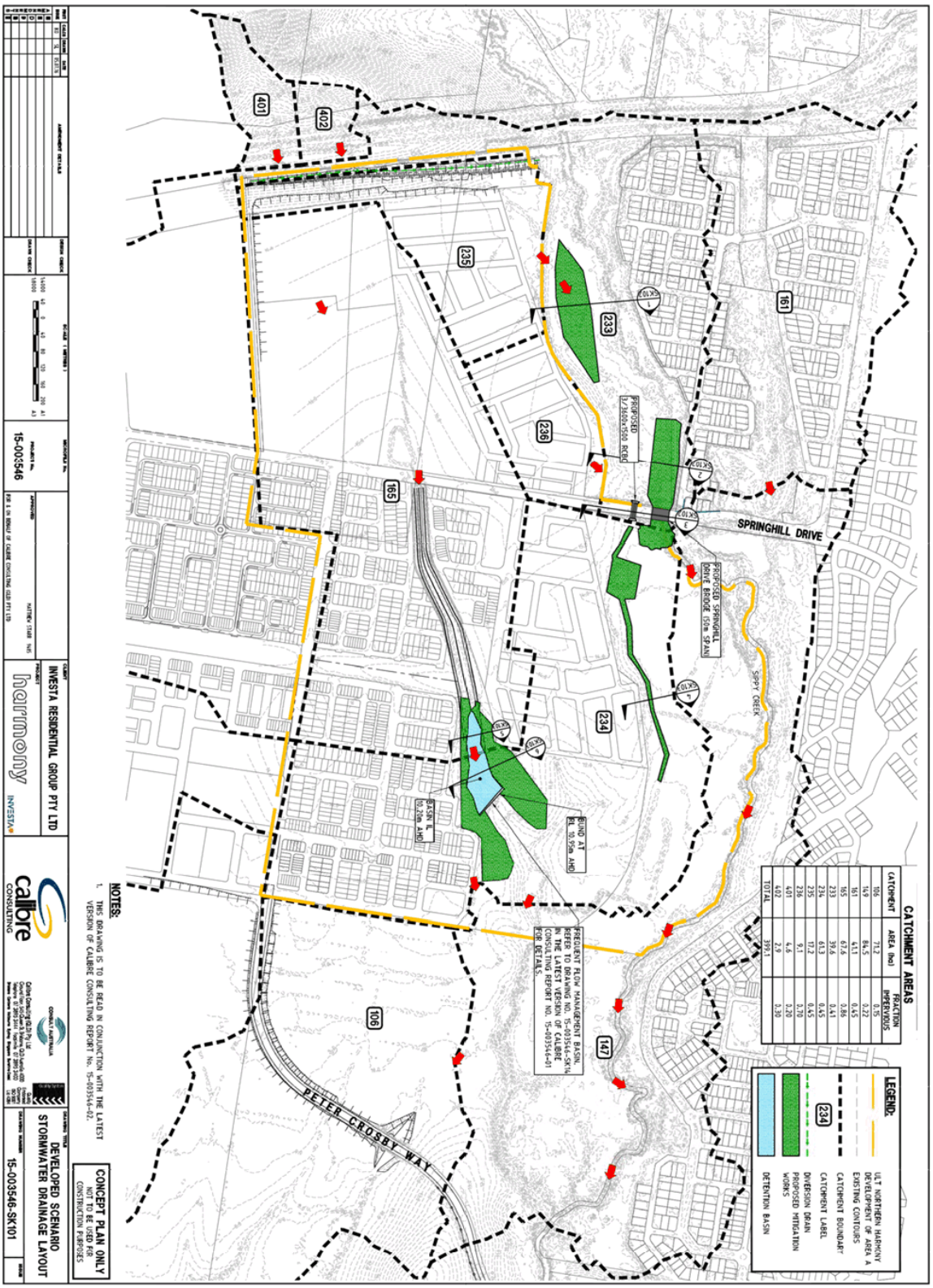
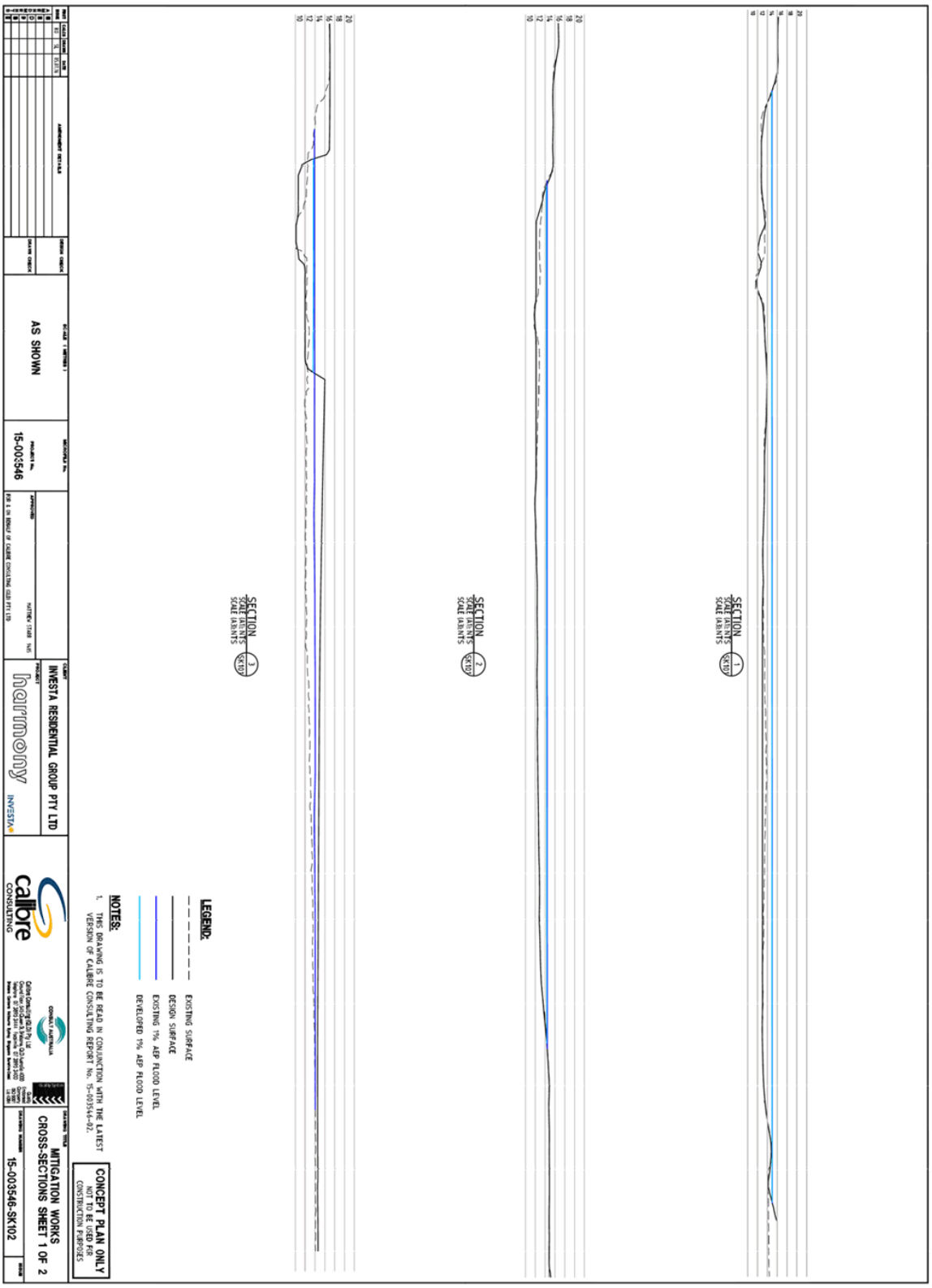
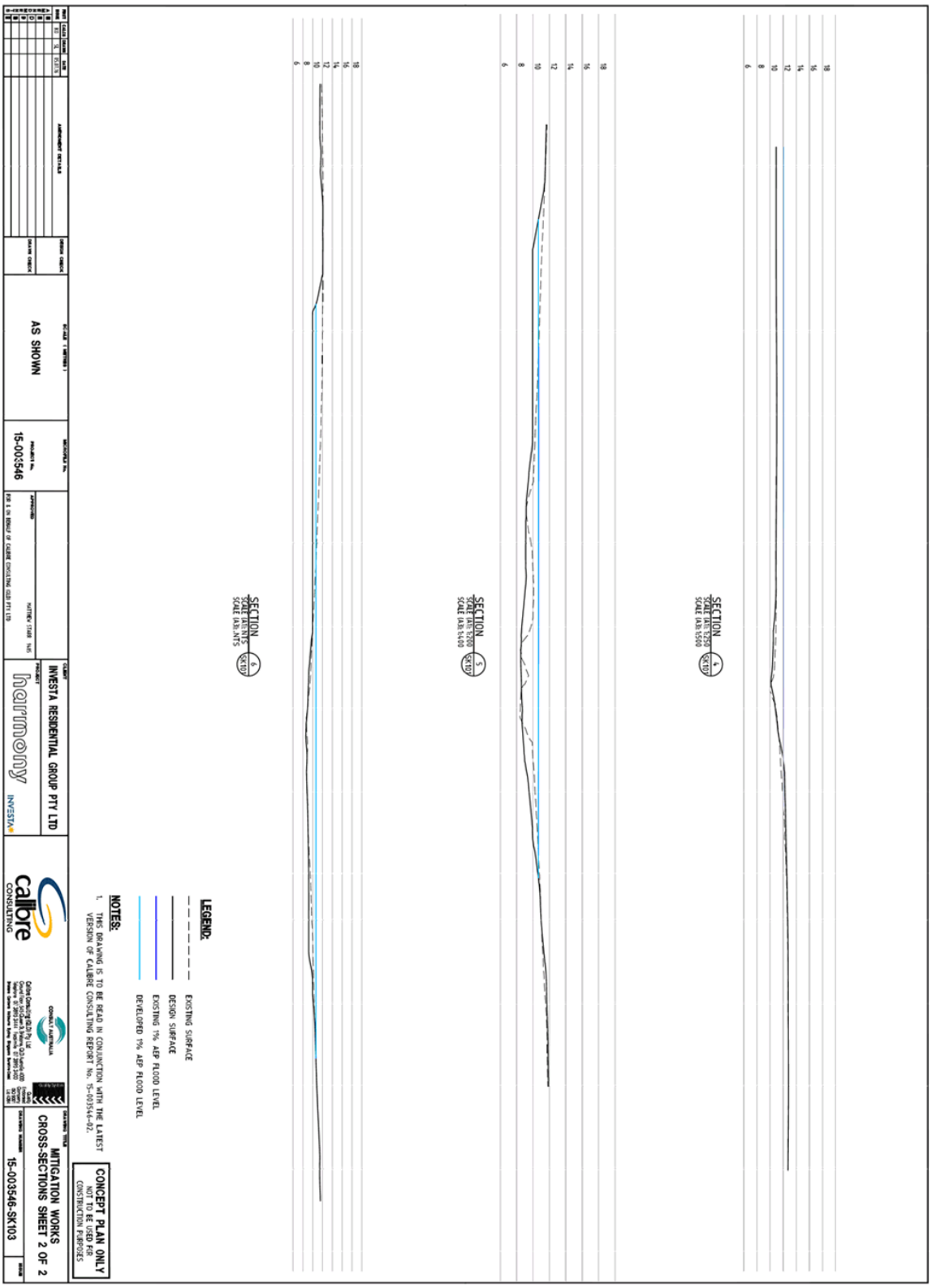
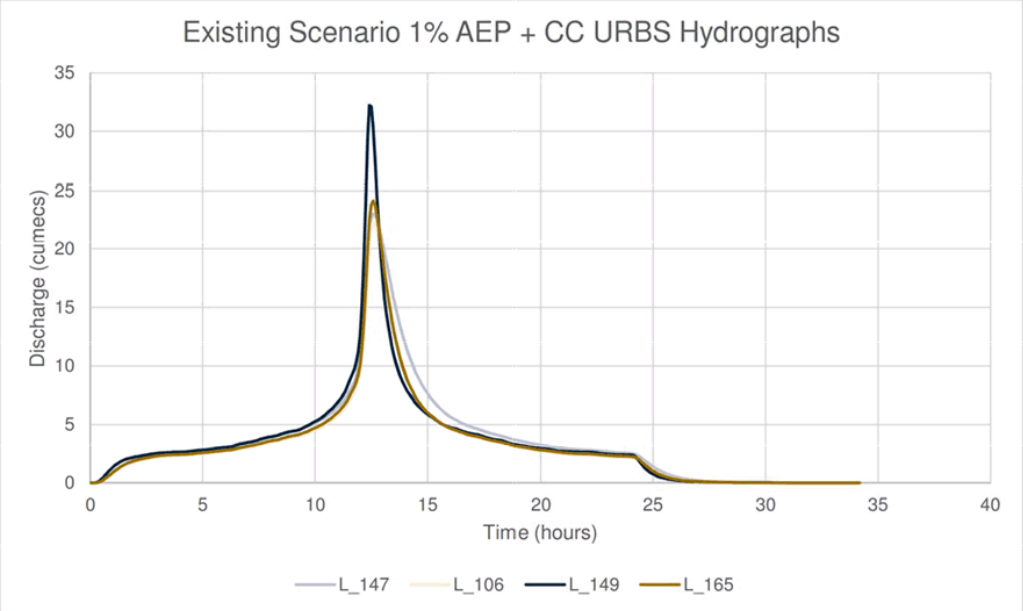
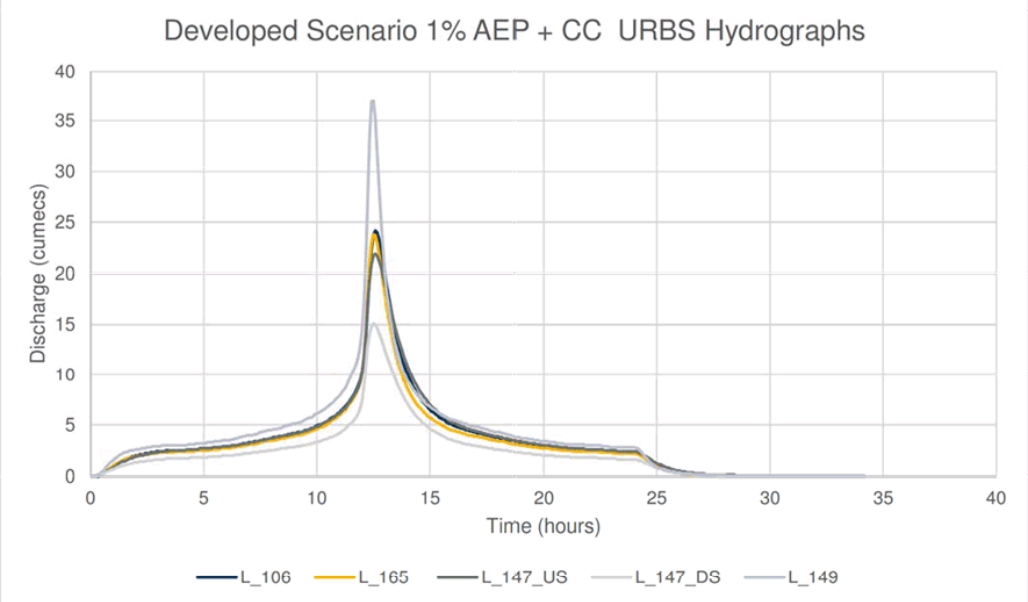

401
402
235
233
161
236
165
234
106
147
SPRINGHILL DRIVE
PROPOSED SPRINGHILL DRIVE BRIDGE 15m SPAN
PROPOSED 3.2400x550 RCBD
SIPPY CREEK
BASIN IL 10.22m AHD
BUND AT RL 10.95m AHD
FREQUENT FLOW MANAGEMENT BASIN, REFER TO DRAWING NO. 15-003546-SK14 IN THE LATEST VERSION OF CALIBRE CONSULTING REPORT NO. 15-003546-01 FOR DETAILS.
PETER CROSBY WAY
CATCHMENT AREAS
CATCHMENT | AREA (ha) | FRACTION IMPERVIOUS
106 | 71.2 | 0.15
149 | 84.5 | 0.22
161 | 41.1 | 0.45
165 | 67.6 | 0.86
233 | 39.6 | 0.41
234 | 61.3 | 0.45
235 | 17.2 | 0.45
236 | 9.1 | 0.70
401 | 2.6 | 0.30
402 | 2.6 | 0.30
TOTAL | 399.1 |
LEGEND:
ULT NORTHERN HARMONY DEVELOPMENT OF AREA A
EXISTING CONTOURS
CATCHMENT BOUNDARY
234 CATCHMENT LABEL
DIVERSION DRAIN
PROPOSED MITIGATION WORKS
DETENTION BASIN
NOTES:
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT No. 15-003546-02.
CONCEPT PLAN ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES
CLIENT
INVESTA RESIDENTIAL GROUP PTY LTD
PROJECT
harmony
INVESTA
calibre CONSULTING
DRAWING TITLE
DEVELOPED SCENARIO STORMWATER DRAINAGE LAYOUT
DRAWING NUMBER
15-003546-SK101
PROJECT No.
15-003546


SECTION
SCALE 1:400 AS SHOWN
SK101
1
SECTION
SCALE 1:400 AS SHOWN
SK101
2
SECTION
SCALE 1:400 AS SHOWN
SK101
3
LEGEND:
EXISTING SURFACE
DESIGN SURFACE
EXISTING 1% AEP FLOOD LEVEL
DEVELOPED 1% AEP FLOOD LEVEL
NOTES:
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT No. 15-003546-02.
CONCEPT PLAN ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES
INVESTA RESIDENTIAL GROUP PTY LTD
harmony
MITIGATION WORKS
CROSS-SECTIONS SHEET 1 OF 2
15-003546-SK102
AS SHOWN
15-003546

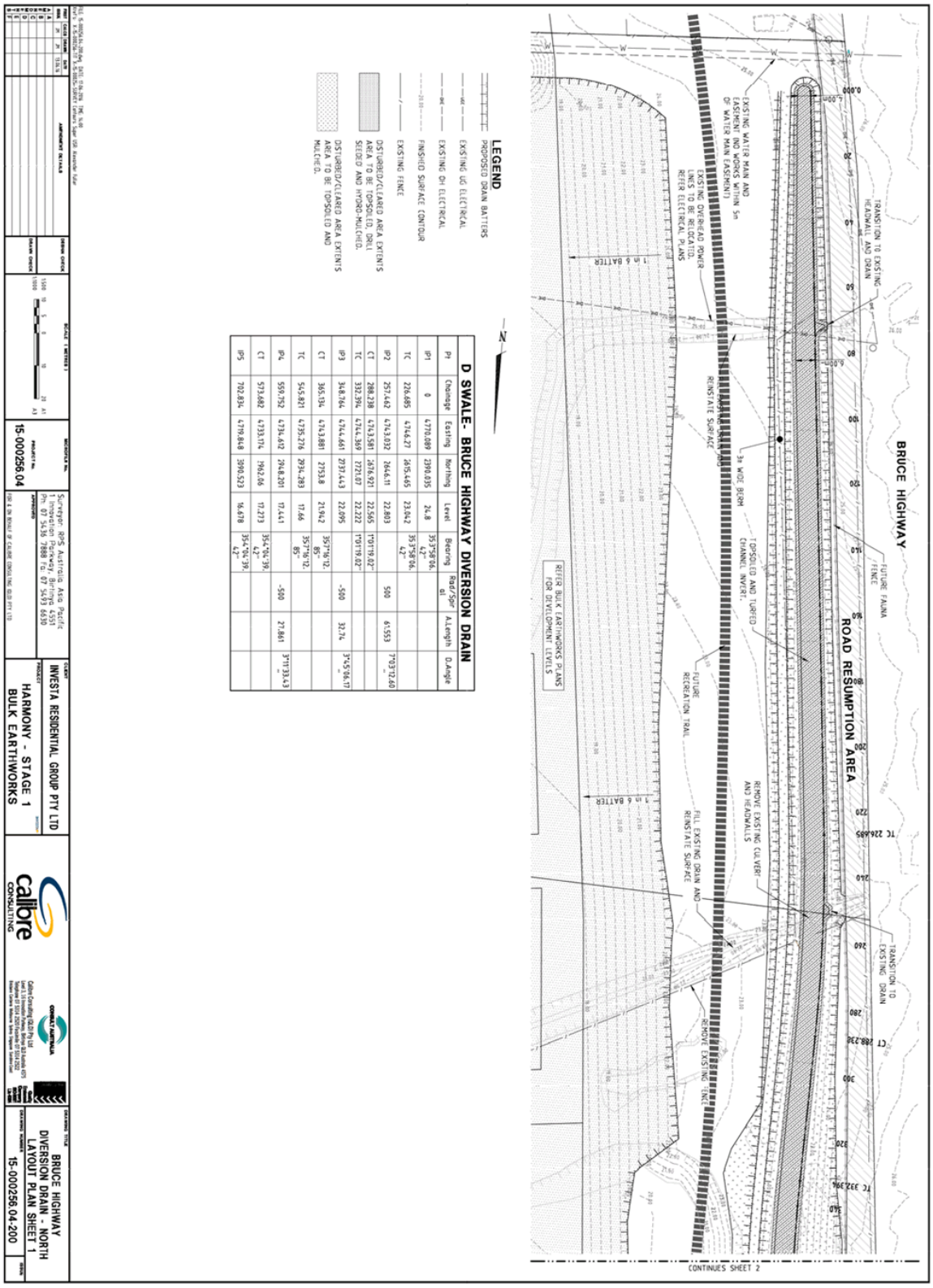

SECTION
SCALE H:1:200 V:1:100
SECTION
SCALE H:1:200 V:1:100
SECTION
SCALE H:1:200 V:1:100
LEGEND:
EXISTING SURFACE
DESIGN SURFACE
EXISTING 1% AEP FLOOD LEVEL
DEVELOPED 1% AEP FLOOD LEVEL
NOTES:
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT No. 15-003546-02.
CONCEPT PLAN ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES
CLIENT
INVESTA RESIDENTIAL GROUP PTY LTD
PROJECT
harmony
INVESTA
calibre CONSULTING
MITIGATION WORKS
CROSS-SECTIONS SHEET 2 OF 2
15-003546-SK103
AS SHOWN
15-003546

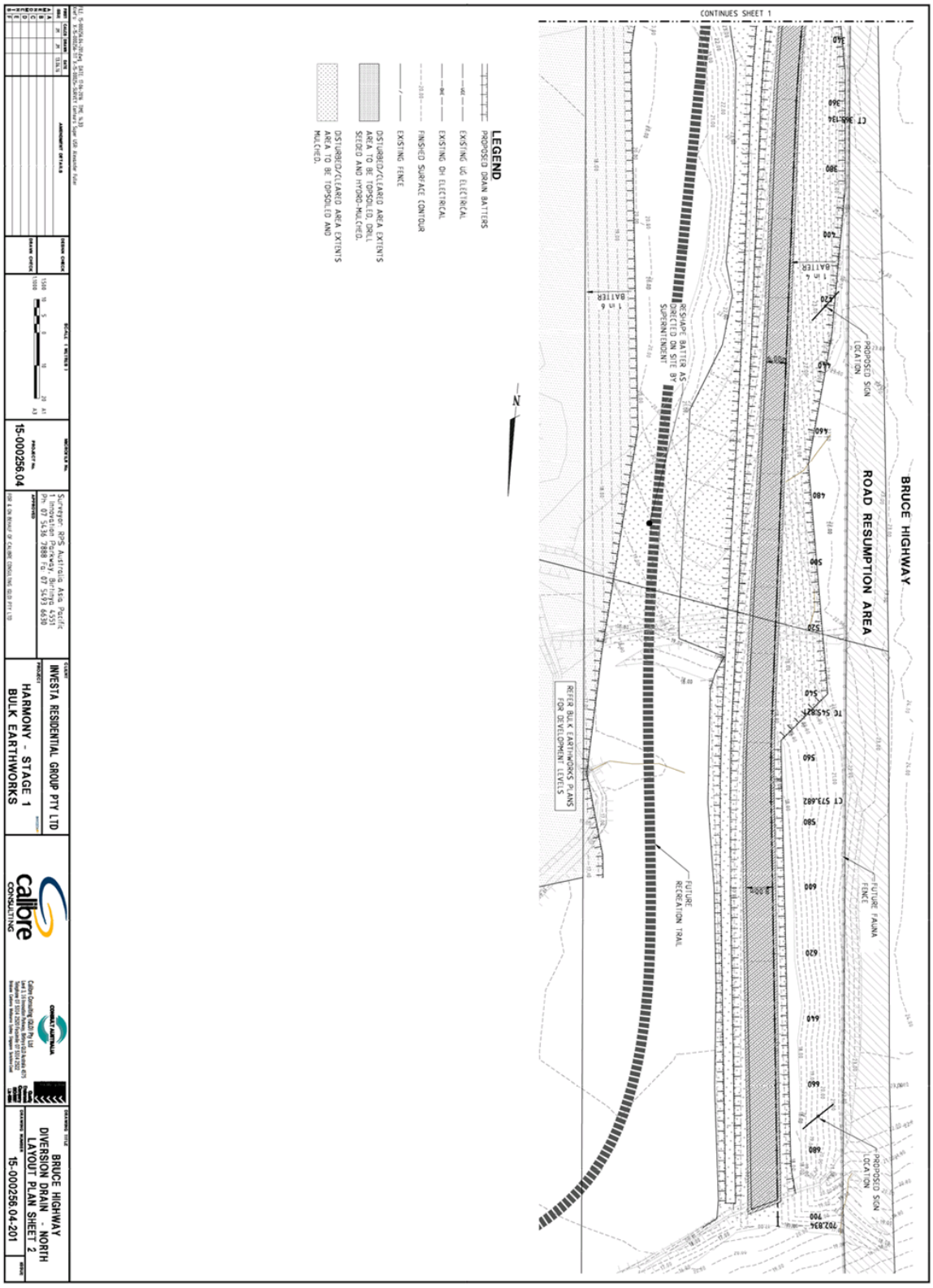
APPENDIX C URBS DIS HYDROGRAPHS

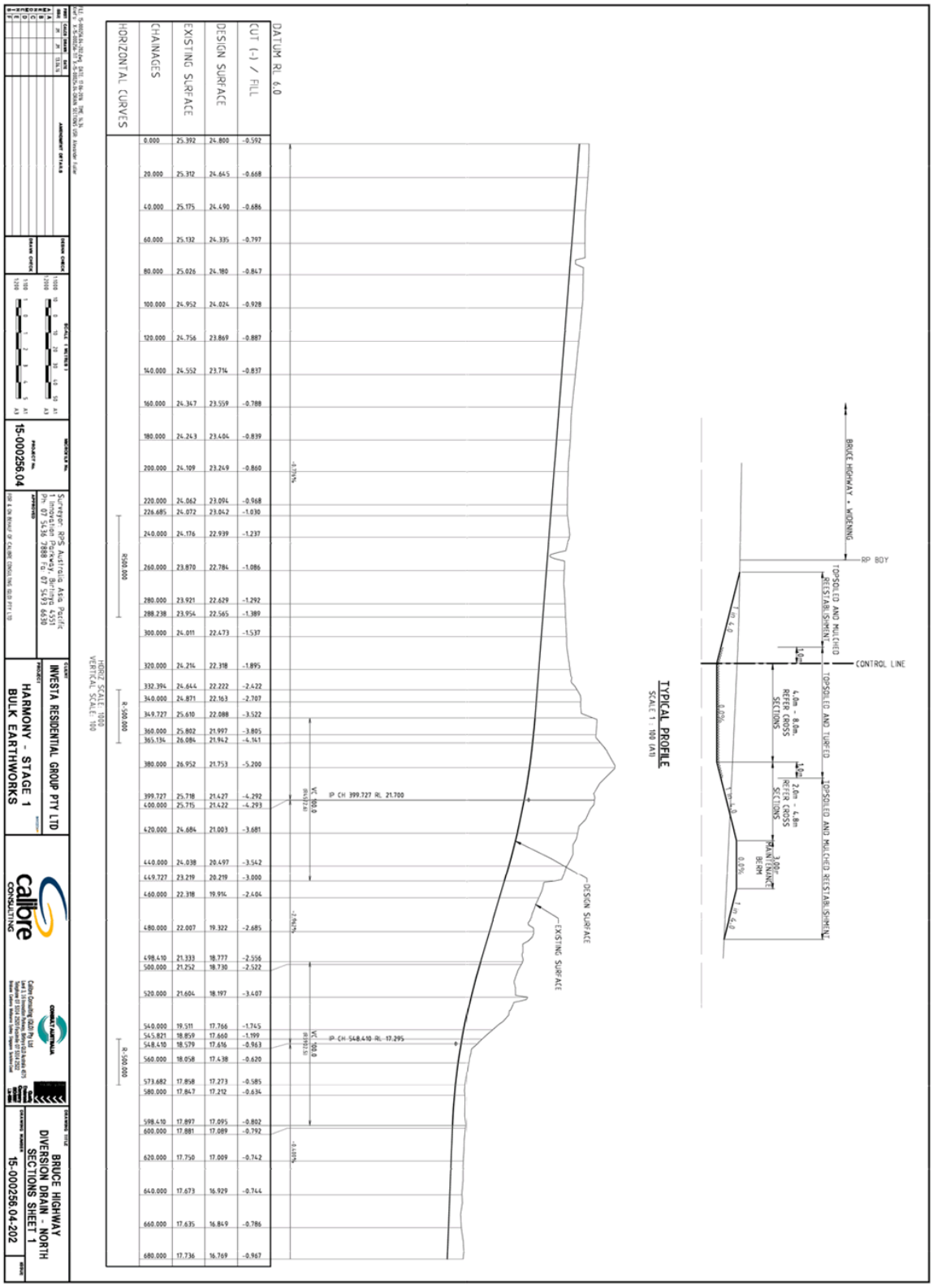




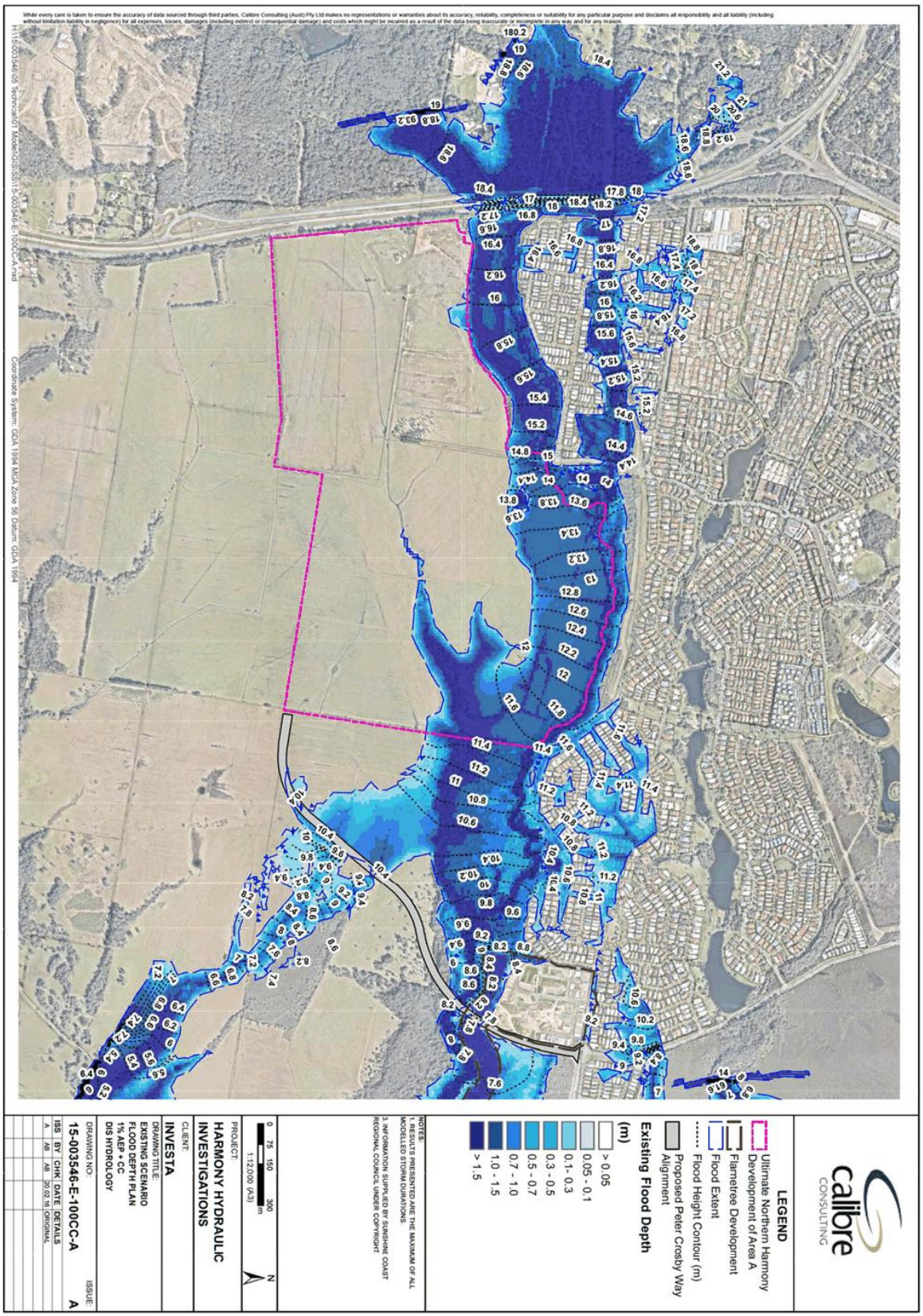
APPENDIX D DIVERSION DRAIN EARTHWORKS DESIGN EXTRACT


BRUCE HIGHWAY
ROAD RESUMPTION AREA
TRANSITION TO EXISTING HEADWALL AND DRAIN
FUTURE FAUNA FENCE
EXISTING WATER MAIN AND EASEMENT (NO WORKS WITHIN 5m OF WATER MAIN EASEMENT)
EXISTING OVERHEAD POWER LINES TO BE RELOCATED. REFER ELECTRICAL PLANS
REINSTATE SURFACE
3m WIDE BERM
TOPSOILED AND TURFED CHANNEL INVERT.
REFER BULK EARTHWORKS PLANS FOR DEVELOPMENT LEVELS
FUTURE RECREATION TRAIL
REMOVE EXISTING CULVERT AND HEADWALLS
FILL EXISTING DRAIN AND REINSTATE SURFACE
REMOVE EXISTING FENCE
TRANSITION TO EXISTING DRAIN
CONTINUES SHEET 2
LEGEND
PROPOSED DRAIN BATTERS
EXISTING UG ELECTRICAL
EXISTING OH ELECTRICAL
FINISHED SURFACE CONTOUR
EXISTING FENCE
DISTURBED/CLEARED AREA EXTENTS AREA TO BE TOPSOILED, SCALED, SEEDED AND HYDRO-MULCHED.
DISTURBED/CLEARED AREA EXTENTS AREA TO BE TOPSOILED AND MULCHED.
N
D SWALE- BRUCE HIGHWAY DIVERSION DRAIN
Pt | Chainage | Easting | Northing | Level | Bearing | Rad/Spiral | A.Length | D.Angle
IP1 | 0 | 4770.089 | 2390.035 | 24.8 | 35°58'04.42" | | | |
TC | 226.685 | 4746.27 | 2615.465 | 23.042 | 35°58'04.42" | | | |
IP2 | 257.462 | 4743.932 | 2646.11 | 22.803 | | 500 | 61.553 | 7°03'12.60
CT | 288.238 | 4743.581 | 2676.921 | 22.565 | 170°19.02" | | | |
TC | 332.394 | 4744.369 | 2721.07 | 22.222 | 170°19.02" | | | |
IP3 | 348.764 | 4744.661 | 2737.443 | 22.095 | | -500 | 32.74 | 3°45'04.17
CT | 365.134 | 4743.881 | 2753.8 | 21.942 | 354°16'12.85" | | | |
TC | 545.821 | 4735.276 | 2934.283 | 17.66 | 354°16'12.85" | | | |
IP4 | 559.752 | 4734.492 | 2948.201 | 17.441 | | -500 | 27.861 | 3°11'33.43
CT | 573.682 | 4733.174 | 2962.06 | 17.273 | 354°54'39.42" | | | |
IP5 | 702.834 | 4719.848 | 3090.523 | 16.678 | 354°54'39.42" | | | |
15-000256.04
HARMONY - STAGE 1 BULK EARTHWORKS
INVESTA RESIDENTIAL GROUP PTY LTD
BRUCE HIGHWAY DIVERSION DRAIN - NORTH LAYOUT PLAN SHEET 1
15-000256.04-200


BRUCE HIGHWAY
ROAD RESUMPTION AREA
CONTINUES SHEET 1
LEGEND
PROPOSED DRAIN BATTERS
EXISTING UG ELECTRICAL
EXISTING OH ELECTRICAL
FINISHED SURFACE CONTOUR
EXISTING FENCE
DISTURBED/CLEARED AREA EXISTING AREA TO BE TOPSOILED, SEEDED AND HYDRO-MULCHED.
DISTURBED/CLEARED AREA EXISTING AREA TO BE TOPSOILED AND MULCHED.
RESHAPE BATTER AS DIRECTED ON SITE BY SUPERINTENDENT
PROPOSED SIGN LOCATION
FUTURE FAUNA FENCE
FUTURE RECREATION TRAIL
REFER BULK EARTHWORKS PLANS FOR DEVELOPMENT LEVELS
BATTER 1 IN 6
BATTER 1 IN 4
CT 365,134
TC 545,827
CT 573,682
702,836
N
INVESTA RESIDENTIAL GROUP PTY LTD
HARMONY - STAGE 1
BULK EARTHWORKS
BRUCE HIGHWAY
DIVERSION DRAIN - NORTH
LAYOUT PLAN SHEET 2
15-000256.04-201
15-000256.04
calibre CONSULTING


DATUM RL 6.0
HORIZONTAL CURVES
CHAINAGES
EXISTING SURFACE
DESIGN SURFACE
CUT (-) / FILL
HORIZ SCALE 1000
VERTICAL SCALE 100
IP CH 399.727 RL 21.700
IP CH 548.410 RL 17.295
DESIGN SURFACE
EXISTING SURFACE
TYPICAL PROFILE
SCALE 1 : 100 (A1)
BRUCE HIGHWAY - WIDENING
RP BOY
TOPSOILED AND MULCHED REINSTATEMENT
CONTROL LINE
TOPSOILED AND TURFED
4.6m - 8.0m REFER CROSS SECTIONS
2.0m - 4.8m REFER CROSS SECTIONS
PLANTING BERM
1 on 6.0
0.5%
INVESTA RESIDENTIAL GROUP PTY LTD
HARMONY - STAGE 1
BULK EARTHWORKS
BRUCE HIGHWAY
DIVERSION DRAIN - NORTH
SECTIONS SHEET 1
15-000256.04-202
15-000256.04
Surveyors and Engineers Australia Asia Pacific
Calibre Consulting

APPENDIX E EXISTING DIS FLOOD MAPS


LEGEND
Ultimate Northern Harmony Development of Area A
Flametree Development
Flood Extent
Flood Height Contour (m)
Proposed Peter Crosby Way Alignment
Existing Flood Depth (m)
> 0.05
0.05 - 0.1
0.1 - 0.3
0.3 - 0.5
0.5 - 0.7
0.7 - 1.0
1.0 - 1.5
> 1.5
NOTES:
1. RESULTS PRESENTED ARE THE MAXIMUM OF ALL MODELLED STORM DURATIONS.
3. INFORMATION SUPPLIED BY SUNSHINE COAST REGIONAL COUNCIL UNDER COPYRIGHT
0 75 150 300 m
1:2000 (A3)
N
PROJECT:
HARMONY HYDRAULIC INVESTIGATIONS
CLIENT:
INVESTA
DRAWING TITLE:
EXISTING SCENARIO
FLOOD DEPTH PLAN
1% AEP + CC
DtS HYDROLOGY
DRAWING NO:
15-003546-E-100CC-A
ISSUE
A
ISS BY CHK DATE DETAILS
A AB 20.02.16 ORIGINAL
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H:\15\003546\05 Technical\01 Model\GIS\SS\15-003546-E-100CC-A.mxd
Coordinate System: GDA 1994 MGA Zone 56 Datum: GDA 1994