ENGINEERING SERVICES REPORT

DAVIDSON'S AT BELIVAH STAGES 3A, 3B, 3C & 3D

BELIVAH ROAD, BELIVAH

JBT CONSULTING PTY LTD

December 2022

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LIMITATIONS STATEMENT

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1.0 - INTRODUCTION

JBT Consulting was commissioned by Belivah Pty Ltd to prepare an Engineering Services Report for Stages 3A, 3B, 3C and 3D of the proposed multi-staged residential development located at Belivah Road, Belivah. The purpose of this report is to demonstrate at a conceptual level, how the development will achieve the performance criteria set out by Logan City Council's Planning Scheme.

2.0 - SITE LOCALITY

The subject site comprises part of a land parcel described as Lot 3 on SP 290608, the entirety of which is proposed for multi-staged residential development. The overall area of Lot 3 on SP 290608 is 6.81 ha and proposed Stages 3A, 3B, 3C and 3D comprise 6.81 ha of that overall site area. Survey plan SP 290608 is included in Attachment 1 of this report.

The Stage 3A, 3B, 3C and 3D site is bounded by existing residential dwellings and a drainage reserve to the north and south. To the west the site is bounded by a rural residential dwelling and grazing pastures. To the east to site is partly bounded by existing residential dwellings and lots and partly bounded by Beaudesert Beenleigh Road.

Currently the subject site is cleared of vegetation and it has been used for livestock grazing for decades. Recently, the land surrounding the site has been progressively developed for residential purposes. Over the past 4 years, Stages 1A – 1F and 2A – 2B of the Davidsons at Belivah Development have been developed on land located to the immediate east of the subject site. Figure 2.1 is a screen shot from Council's PD Online, showing the site locality plan and surrounding areas.

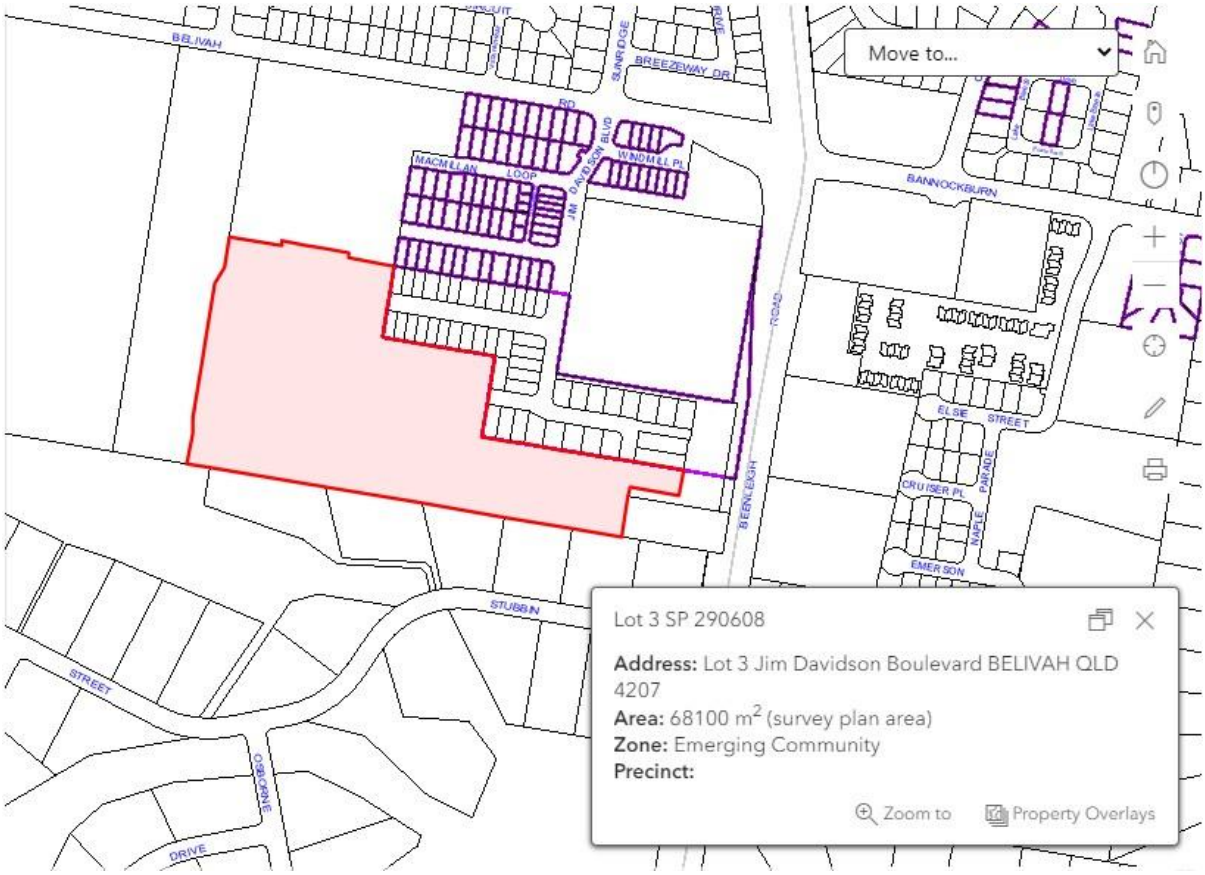


Figure 2.1 : Locality Plan

Figure 2.2 is a recent aerial photograph of the site, taken in Dec 2022 over the whole development. This photo also shows the completed Stages 1A-1F and majority completion of Stages 2A & 2B

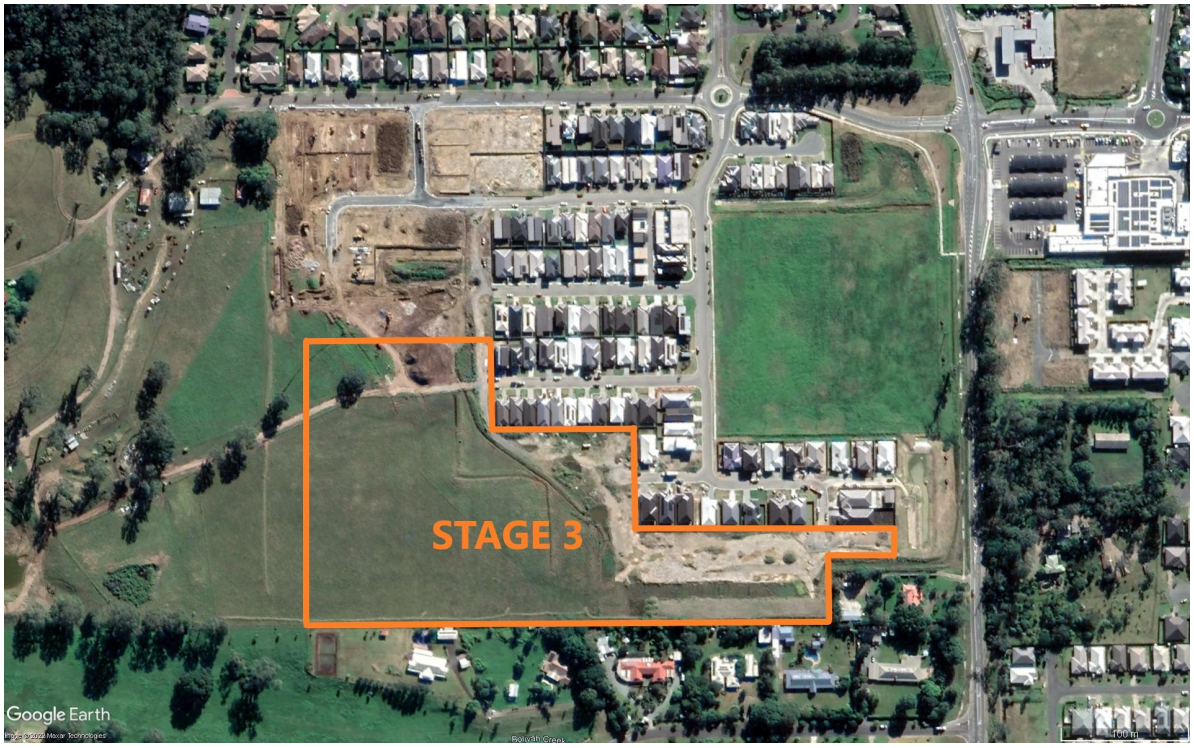


Figure 2.2 : Aerial Photograph (DEC 2022)

3.0 - SITE TOPOGRAPHY

Existing ground slopes vary from 2% over the eastern part of the site, to 6.0 % over the western part of the site. The lowest ground levels over the site are around RL 17 mAHD, located along the south eastern corner of Stage 3C, adjacent to Stage 1F and the existing water quality basin on the western side of Beaudesert Beenleigh Road. The highest ground levels over the site rise to a maximum of RL 27 mAHD in the rear north western corner of Stage 3A, adjacent to Stage 2B.

4.0 - PROPOSED DEVELOPMENT

Proposed Stages 3A, 3B, 3C and 3D contain 124 residential lots, as shown in Figure 4.1. The proposed plan of development for Stages 3A-3D is included in Attachment 2 of this report.

The stages are located to the immediate west of existing stages 1E, 1F and to the immediate south of stage 2B. These stages are intended to be accessed from Macmillan Loop, from Jim Davidson Boulevard, from Walker Avenue and from Learmonth Drive.

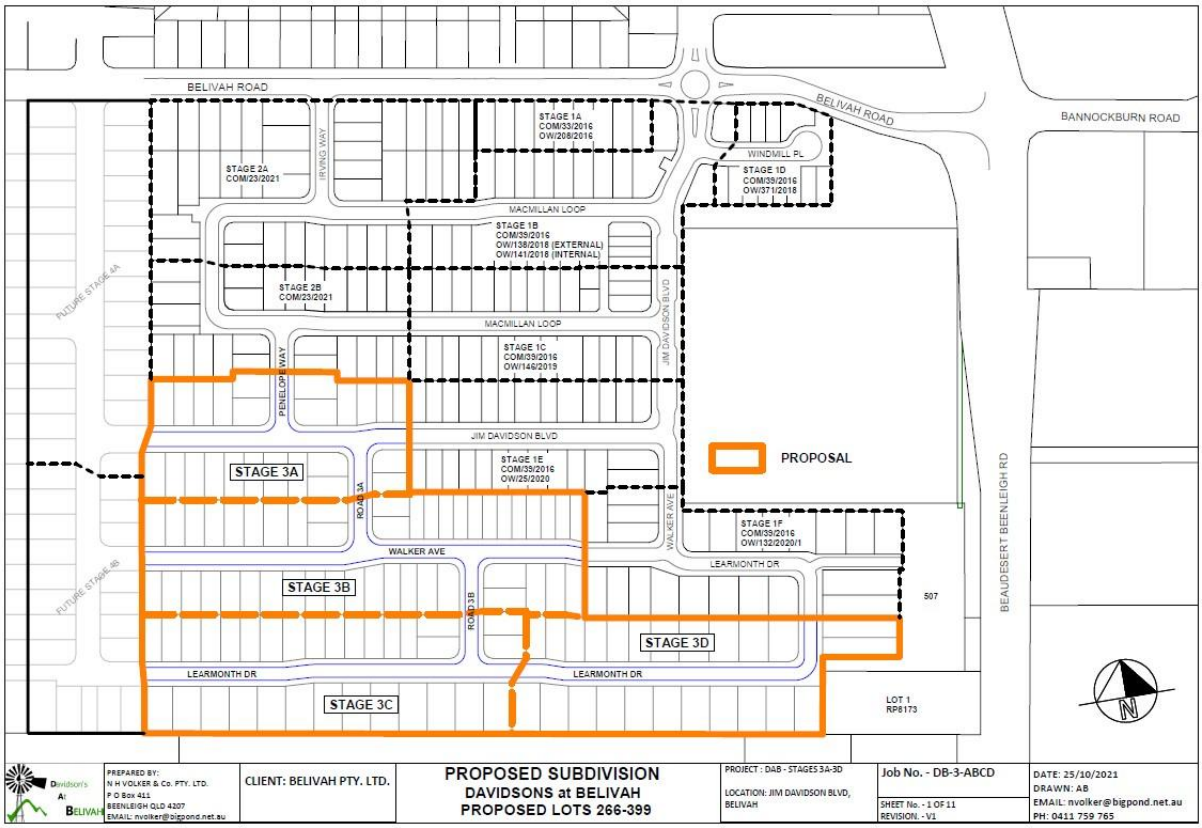


Figure 4.1 : Stages 3A, 3B, 3C & 3D Proposed Plan of Development

5.0 - BACKGROUND INFORMATION

In the preparation of this report, information about the site was gathered from the following sources:

- Logan City Council (For constructed services, hydrologic, and water quality parameters)
- Detailed Survey
- Dial Before You Dig
- Logan City Council Development Conditions MCUI/1/2014 MCU for Preliminary Approval
- JBT Consulting Pty Ltd – Preliminary Engineering Assessment Report JBT02-031_RP001G_Davidson_ENG_Report – July 2014
- ETS Engineering Pty Ltd – Engineering Services Report – Proposed Development at 31 Belivah Road, Belivah – Stage 1B to 1F, for Belivah Pty Ltd. – August 2016
- ETS Engineering Pty Ltd – Water Supply Report – Davidsons at Belivah - Belivah Road, Belivah, for Belivah Pty Ltd. – July 2016
- ETS Engineering Pty Ltd - Hydraulic Impact Assessment Proposed Farm Dam at Lot 297 on W3148, Belivah Road, Belivah - 13 July 2016.
- BMT WBM Pty Ltd – Stormwater Management Plan, Proposed Development at 31 Belivah Road, Belivah, Logan City, Qld – August 2017
- MORRISWATER Pty Ltd – Davidsons at Belivah Residential Development, Site Based Stormwater Management Plan, Prepared for Belivah Pty Ltd, August 2019
- Engeny Pty Ltd – Logan-Albert River – Flood Modelling and Mapping Study 2011, Volume 1, March 2011

6.0 - SERVICES FOR DEVELOPMENT

6.1 ROADWORKS

The layout of Stages 3A, 3B, 3C and 3D will require construction of new internal road networks which will extend and link up existing roads from previous stages.

The layout of Stage 3A will extend Jim Davidson Boulevard to the west and will also link Jim Davidson Boulevard to Macmillan Loop in the north and to Walker Avenue in the south.

The layout of Stage 3B will extend Walker Avenue to the west and will also link Walker Avenue to Jim Davidson Boulevard in the north and to Learmonth Drive in the south.

The layout of Stage 3C will link Learmonth Drive to Walker Avenue in the north and extend Learmonth Drive to the west

The layout of Stage 3D will extend Learmonth Drive to the south then turn west to join eastern end of Stage 3C

Refer to Figure 4.1 for typical details of the road layout.

6.2 EARTHWORKS

Earthworks will be necessary to facilitate the construction of Stages 3A, 3B, 3C and 3D. Low height retaining wall structures are currently proposed to enable the creation of suitable flat building platforms to the lots.

Refer to Attachment 3 for details of the bulk earthworks plans for Stages 2, 3 & 4 (currently submitted to Council for OW Approval under Council Application OW/73/2021).

6.3 STORMWATER

6.3.1 REGIONAL FLOODING

A review of regional flooding potentially impacting on the subjects, from the Albert River, from Belivah Creek and from Windaroo Creek was undertaken by JBT Consulting, as detailed in their report labelled JBT02-031_RP001E_Davidson_ENG_Report, dated January 2014. That report references the findings of the Logan-Albert River Flood Modelling and Mapping Study, prepared by Engeny Pty Ltd, for Council in March 2011.

From the Logan-Albert River Flood Modelling and Mapping Study, the closest model reporting point locations to the subject site are described as follows:

- Point ART19 Belivah Creek tributary upstream of Beaudesert Beenleigh Road
- Point ART20 Belivah Creek tributary downstream of Beaudesert Beenleigh Road
- Point ART21 Windaroo Creek tributary upstream of Beaudesert Beenleigh Road
- Point ART24 Windaroo Creek tributary downstream of Beaudesert Beenleigh Road
- Point AR41 Albert River at the junction with Belivah Creek tributary
- Point AR44 Albert River at the junction with Windaroo Creek tributary

The highest 1% AEP flood level applicable to the subject site is 13.78 mAHD, corresponding to model Reporting Point ART19. This reporting point is considered to be the most relevant to the subject site, as during a major flood event, flood waters from Belivah Creek tributary could potentially break the banks of the creek, spill over Stubbin Street and then inundate the subject site from the south east

corner. However, comparisons against existing ground levels have indicated that the 1% AEP flood level is well below the lowest existing ground level of the subject development site (20.7 mAHD). Therefore, the site is considered unaffected by regional flooding from either the Albert River, from Belivah Creek or from Windaroo Creek.

6.3.2 LOCAL FLOODING

In accordance with the Conditions of the Preliminary Approval, stormwater drainage infrastructure will be constructed within the development to ensure “no worsening” of existing stormwater runoff onto Beaudesert Beenleigh Road. It is proposed that all local stormwater runoff will be collected and conveyed through the site via new stormwater pipe infrastructure. This stormwater runoff will be directed to an existing northern biofilter basin and existing northern detention basin located in the in the north-eastern corner of the site. These basins will treat and attenuate the stormwater runoff from Stages 3A, 3B, 3C and 3D, prior to it being discharged to the existing stormwater drainage infrastructure under Beaudesert Beenleigh Road.

The new stormwater drainage pipework associated with Stage 3A will connect into the western end of existing stormwater drainage pipework, constructed as part of Stage 1E. Similarly, the new stormwater drainage pipework associated with Stage 2B will connect into the western end of existing stormwater drainage pipework, constructed as part of Stage 1F. The stormwater drainage pipework from Stages 1E and 1F already connect to the existing southern biofilter basin and existing southern detention basin.

The new stormwater drainage pipework associated with Stage 3D will connect into the western end of new stormwater drainage pipework associated with Stage 3C. Future Stage 4 stormwater drainage pipework will connect into the western end of stormwater drainage pipework associated with Stage 3D. The stormwater drainage pipework from Stage 3C will connect to the southern end of the existing southern biofilter basin and existing southern detention basin.

Details of the hydrologic and hydraulic performance of the local stormwater drainage system for the proposed Stages 3A, 3B, 3C and 3D are described in the MorrisWater Pty Ltd – Stormwater Management Plan, Davidsons at Belivah, Residential Development – August 2019. That SMP report included Stages 3A, 3B, 3C and 3D in the overall catchment layout, as part of the overall SMP design. Refer to Attachment 5 for details.

The external catchment west of the site has been re-directed as part of the construction of a farm dam on Lot 297 on W3148. Details of the assessment of this re-direction of flows is included in the ETS report “Hydraulic Impact Assessment Proposed Farm Dam at Lot 297 on W3148, Belivah Road, Belivah”, dated 13 July 2016.

In summary, the external upstream catchments will be directed around the future development site. Therefore, the stormwater drainage within the site will only have to manage the local site runoff. This will be achieved by construction of new stormwater infrastructure and cut/fill earthworks over the site to provide free gravity drainage towards road drainage networks.

6.3.3 WATER QUALITY

In accordance with the Conditions of the Preliminary Approval, stormwater drainage infrastructure will be constructed within the development to ensure “no worsening” of existing stormwater runoff quality onto Beaudesert Beenleigh Road. It is proposed that all local stormwater runoff will be collected and conveyed through the site via new stormwater pipe infrastructure. This stormwater runoff will be directed to an existing southern biofilter basin and existing southern detention basin located in the in the south-eastern corner of the development site. These basins will treat and attenuate the

stormwater runoff from Stages 3A, 3B, 3C and 3D, prior to it being discharged to the existing stormwater drainage infrastructure under Beaudesert Beenleigh Road.

Details of the water quality treatment performance of the existing stormwater treatment measures built as part of Stages 1E and 1F are described in the MorrisWater Pty Ltd – Stormwater Management Plan, Davidsons at Belivah, Residential Development – August 2019. That SMP report included Stages 3A, 3B, 3C and 3D in the overall catchment layout, as part of the overall SMP design. Refer to Attachment 7 for details.

It is noted that while both the biofilter basin and the detention basin built in Stages 1E and 1F have been constructed in accordance with the design documentation. The biobasin is yet to be transitioned to a fully operational biobasin, as the subsurface pipe system, filter media, transition layer and planting is yet to be undertaken. The biobasin has been functioning as a temporary sediment basin, while development and housing construction has taken place on the upstream stages. This aspect is discussed further in Section 6.3.4.

6.3.4 EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION

Erosion and sediment control over Stages 3A, 3B, 3C and 3D will be required during construction. As noted from the discussion on local stormwater drainage in Section 6.3.2 and 6.3.3, the stormwater drainage systems from Stages 3A, 3B will connect to existing stormwater drainage systems from Stages 1E and 1F and will drain to the existing southern biofilter basin and to the existing southern detention basin.

The new stormwater drainage pipework associated with Stage 3C will connect into the western end of new stormwater drainage pipework associated with Stage 3D. Future Stage 4 stormwater drainage pipework will connect into the western end of stormwater drainage pipework associated with Stage 3C. The stormwater drainage pipework from Stage 3D will connect to the southern end of the existing southern biofilter basin and existing southern detention basin.

The southern detention basin will temporarily be transitioned to a sediment basin to manage runoff from Stages 3A, 3B, 3C and 3D during the construction phase. The basin will transition to a Type A sediment basin, as per IECA 2018 guidelines. The spillway will be retained as per the current design. The outflow pipes will be retained as per the current design. Temporary changes will include the following:

- The base of the basin will be cleaned of sediment build-up and be trimmed to a floor level of RL 16.4 mAHD
- The base of the forebay area will be cleaned of sediment build-up to the current floor level of RL 16.4 mAHD
- Three decant arms will be added to the main outlet structure manhole to enable stored and treated water to be removed from the cleaner upper layers of the water column
- An automatic flocculent dosing system will be added to the basin layout to enable automatic dosing to inflows based on measured rainfalls

Once all construction works associated with Stage 3A, 3B, 3C and 3D are completed and 70% vegetal cover is achieved on the upstream catchment, the temporary works listed above can be removed from the southern detention basin. At that stage, the water quality treatment measures will become operational in accordance with the intent of the approved MorrisWater Pty Ltd – Stormwater Management Plan, Davidsons at Belivah, Residential Development – August 2019.

6.4 SEWER

Stage 3A sewer reticulation will connect into the existing 150mm dia uPVC sewer lines #2 and #3 that has been completed as part of Stage 1E. (Jim Davidson Boulevard).

Stage 3B sewer reticulation will connect into the existing 150mm dia uPVC sewer lines #3 and #4 that has been completed as part of Stage 1F. (Walker Avenue and LearMonth Drive).

Stages 3C and 3D sewer reticulation will connect into the existing 150mm dia uPVC sewer lines #2 and #3 that has been completed as part of Stage 1F. (LearMonth Drive).

Refer to Attachment 4 for preliminary sewer reticulation drawings.

6.5 WATER

Stage 3A water reticulation will connect into the existing 150mm dia uPVC water mains that has been completed as part of Stage 1E. (Jim Davidson Boulevard).

Stage 3B water reticulation will connect into the existing 150mm dia uPVC water mains that has been completed as part of Stage 1F. (Walker Avenue).

Stages 3C and 3D water reticulation will connect into the existing 150mm dia uPVC water mains that has been completed as part of Stage 1F. (LearMonth Drive).

Water demands from Stages 3A, 3B, 3C and 3D were already catered for in the water supply analysis undertaken by ETS Engineering Group, refer to report ETS Engineering Pty Ltd – Water Supply Report – Davidsons at Belivah - Belivah Road, Belivah, for Belivah Pty Ltd. – July 2016.

Refer to Attachment 5 for preliminary water reticulation drawings.

6.6 ELECTRICAL, TELLECOMMUNICATIONS AND GAS

Based on our review of background information sourced for the existing services, Telstra and Electricity supply infrastructure already exists along the Belivah Road site frontage for the site (Stages 1B and 2A). Additionally, Telstra and Electricity infrastructure already exists along Macmillan Loop (Stages 1B, 1C, 2A and 2B), Jim Davidson Boulevard (Stage 1E), Walker Avenue (Stage 1F) and Learmonth Drive. Electricity and telecommunications services will be designed in accordance with the appropriate service provider. Further information on these services will be provided during the operational works phase for the development.

7.0 - CONCLUSIONS

Based on our review of background information and on the finding of our preliminary investigations, it has been found that the proposed development can be adequately serviced in accordance with Logan City Council's Development Guidelines and Preliminary Approval conditions. All service and Infrastructure layouts are generally in accordance with Logan City Council Planning Scheme and other relevant planning and design documentation.

ATTACHMENT 1 – SURVEY PLANS (SP290608, SP290611, SP290612, SP290613 & SP290614)

Land Title Act 1994 ; Land Act 1994
Form 21 Version 4

SURVEY PLAN

Sheet 1 of 2

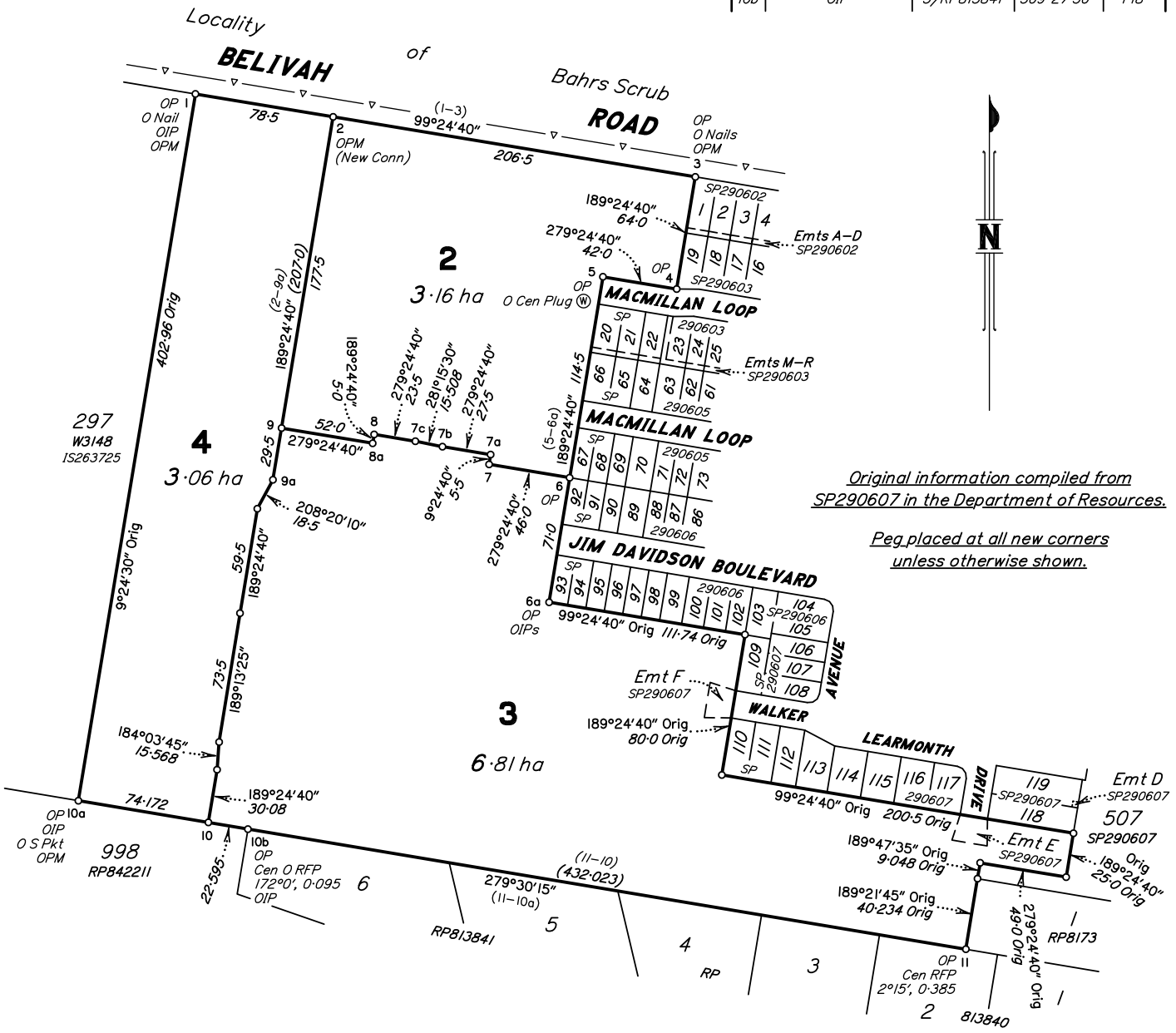
BD21002

PERMANENT MARKS

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2–OPM (New Conn)	10/IS263725	85°56'15"	59·862	177398	Mini Mark	
3–OPM	4/SP290602	284°47'05"	148·94	177398	Mini Mark	
10a–OPM	6/IS263725	241°04'45"	81·523	195998	Mini Mark	

REFERENCE MARKS

STN	TO	ORIGIN	BEARING	DIST
1	O Nail in conc	10/IS263725	9°05'50"	14·08
1	OIP	7/SP290601	328°01'50"	29·698
3	O Nail in kerb	4/SP290602	51°31'10"	4·995
3	O Nail in kerb	4/SP290602	68°58'40"	27·442
5	O Cen Plug	15/SP290603	189°11'55"	3·675
6a	OIP	10/SP290601	9°24'40"	1·0
6a	OIP	10/SP290601	99°24'40"	1·0
7b	Pin		279°24'40"	1·0
7c	Pin		99°24'40"	4·0
9	Pin		99°24'40"	1·0
10	Pin		9°24'40"	1·0
10a	OIP	14/RP813840	150°07'50"	0·62
10a	O S Pkt	14/RP813840	98°05'50"	21·77
10b	OIP	3/RP813841	309°27'50"	1·18



Original information compiled from SP290607 in the Department of Resources.

Peg placed at all new corners unless otherwise shown.

Metres 0 125m 250m 375m (50 mm / 100 mm / 150 mm)

State copyright reserved.

I, Neville Henry VOLKER hereby certify that the land comprised in this plan was surveyed by me personally and that the plan is accurate, that the said survey was performed in accordance with the Survey and Mapping Infrastructure Act 2003 and Surveyors Act 2003 and associated Regulations and Standards and that the said survey was completed on

.....
Cadastral Surveyor

Date .....

PLAN OF

Lots 2, 3 and 4

Cancelling Lot 2 on SP290607

LOCAL GOVERNMENT: LOGAN C.C.

LOCALITY: BELIVAH

Meridian: SP290607

Survey Records: NO

Scale: 1 : 2500

Format: STANDARD

SP290608

BLV_010

Land Title Act 1994 ; Land Act 1994
Form 21B Version 1

(Dealing No.)

WARNING : Folded or Mutilated Plans will not be accepted. Plans may be rolled. Information may not be placed in the outer margins.

Sheet 2 of 2

BD21002

5. Lodged by

(Include address, phone number, reference, and Lodger Code)

1. Certificate of Registered Owners or Lessees.

I/We PETER MCLEAN DAVIDSON
PENELOPE ROTHWELL ABELL
JAMES MCLEAN DAVIDSON
PERSONAL REPRESENTATIVE UNDER INSTRUMENT 717611386

(Names in full)

* as Registered Owners of this land agree to this plan and dedicate the Public Use Land as shown hereon in accordance with Section 50 of the Land Title Act 1994.

* ~~as Lessees of this land agree to this plan~~.

Signature of *Registered Owners *~~Lessees~~

* Rule out whichever is inapplicable

6.

Existing		Created		
Title Reference	Description	New Lots	Road	Secondary Interests
	Lot 2 on SP290607	2, 3 and 4	–	–

ENCUMBRANCE EASEMENT ALLOCATIONS

Easement	Lots to be Encumbered
(Emt E on SP290607)	3
(Emt F on SP290607)	3

REINSTATEMENT REPORT

Reinstatement agrees with marks and dimensions shown on IS263725, SP290602 and SP290607.

2. Planning Body Approval.

*
hereby approves this plan in accordance with the :
%

Dated this ..... day of .....

..... #

..... #

* Insert the name of the Planning Body.
# Insert designation of signatory or delegation
% Insert applicable approving legislation.

3. Plans with Community Management Statement :

CMS Number :

Name :

4. References :

Dept File :
Local Govt :
Surveyor : BLV_010

Lots	Orig
2, 3 and 4	Por 107

7. Orig Grant Allocation :

8. Passed & Endorsed :

By :
Date :
Signed :
Designation :

Date of Development Approval:

9. Building Format Plans only.

I certify that :
* As far as it is practical to determine, no part of the building shown on this plan encroaches onto adjoining lots or road;
* Part of the building shown on this plan encroaches onto adjoining * lots and road

....
Cadastral Surveyor/Director* Date
*delete words not required

10. Lodgement Fees :

Survey Deposit	$ .....
Lodgement	$ .....
.....New Titles	$ .....
Photocopy	$ .....
Postage	$ .....
TOTAL	$ .....

11. Insert Plan Number SP290608

Land Title Act 1994 ; Land Act 1994
Form 21 Version 4

SURVEY PLAN

Sheet 1 of 4

BD2/315

M.G.A. COORDINATES GDA–94

STATION	EASTING	NORTHING	ZONE	P.U.	LINEAGE	METHOD	REMARKS

PERMANENT MARKS

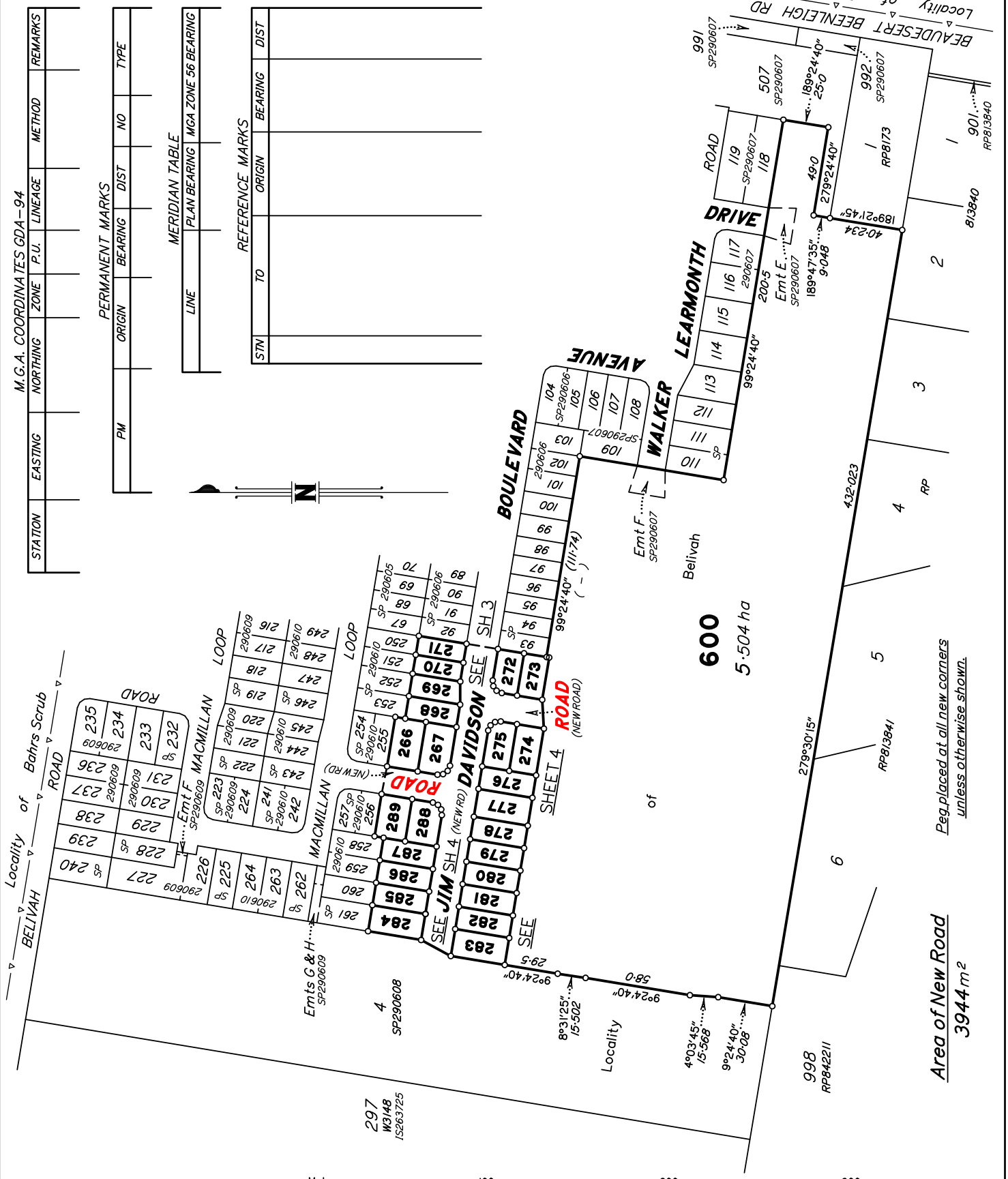
	ORIGIN	BEARING	DIST	NO	TYPE
PM					

MERIDIAN TABLE

LINE	PLAN BEARING	MGA ZONE 56 BEARING

REFERENCE MARKS

STN	TO	ORIGIN	BEARING	DIST



Metres 0 100m 50 mm 200m 100 mm 300m 150 mm

State copyright reserved.

I, Neville Henry VOLKER hereby certify that the land comprised in this plan was surveyed by me personally and that the plan is accurate, that the said survey was performed in accordance with the Survey and Mapping Infrastructure Act 2003 and Surveyors Act 2003 and associated Regulations and Standards and that the said survey was completed on

PRELIMINARY

.....
Cadastral Surveyor

Date .....

PLAN OF

Lots 266 to 289 and 600

Cancelling Lot 3 on SP290608

LOCAL GOVERNMENT: LOGAN C.C.

LOCALITY: BELIVAH

Meridian: SP290608

Survey Records: NO

Scale: 1 : 2000

Format: STANDARD

SP290611

BLV_013

Land Title Act 1994 ; Land Act 1994
Form 21B Version 2

(Dealing No.)

WARNING : Folded or Mutilated Plans will not be accepted. Plans may be rolled. Information may not be placed in the outer margins.

Sheet 2 of 4

BD21315

4. Lodged by

(Include address, phone number, reference, and Lodger Code)

1. Existing		Created		
Title Reference	Description	New Lots	Road	Secondary Interests
–	Lot 3 on SP290608	266 to 289 and 600	–	–

ENCUMBRANCE EASEMENT ALLOCATIONS

Easement	Lots to be Encumbered
(Emt E on SP290607)	600
(Emt F on SP290607)	600

REINSTATEMENT REPORT

Lots	Orig
265 to 290 and 600	Por 107

2. Orig Grant Allocation :

3. References :
Dept File :
Local Govt :
Surveyor : BLV_013

5. Passed & Endorsed :
By :
Date :
Signed :
Designation :

PRELIMINARY

Date of Development Approval:

6. Building Format Plans only.

I certify that :
* As far as it is practical to determine, no part of the building shown on this plan encroaches onto adjoining lots or road;
* Part of the building shown on this plan encroaches onto adjoining * lots and road

....
Cadastral Surveyor/Director* Date
*delete words not required

7. Lodgement Fees :

Survey Deposit	$ .....
Lodgement	$ .....
.....New Titles	$ .....
Photocopy	$ .....
Postage	$ .....
TOTAL	$ .....

8. Insert Plan Number SP290611

Land Title Act 1994 ; Land Act 1994
Form 21A Version 1

ADDITIONAL SHEET

Sheet 3 of 4

BD21315



Scale 1 : 400

Metres 0 20m 40m 60m
50 mm 100 mm 150 mm

State copyright reserved.

Insert Plan Number SP290611

BLV_013

Land Title Act 1994 ; Land Act 1994
Form 21A Version 1

ADDITIONAL SHEET

Sheet 4 of 4

BD2/315



Scale 1 : 400

Metres 0 20m 50 mm 40m 100 mm 60m 150 mm

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Insert Plan Number SP290611

BLV_013

Land Title Act 1994 ; Land Act 1994
Form 21 Version 4

SURVEY PLAN

Sheet 1 of 4

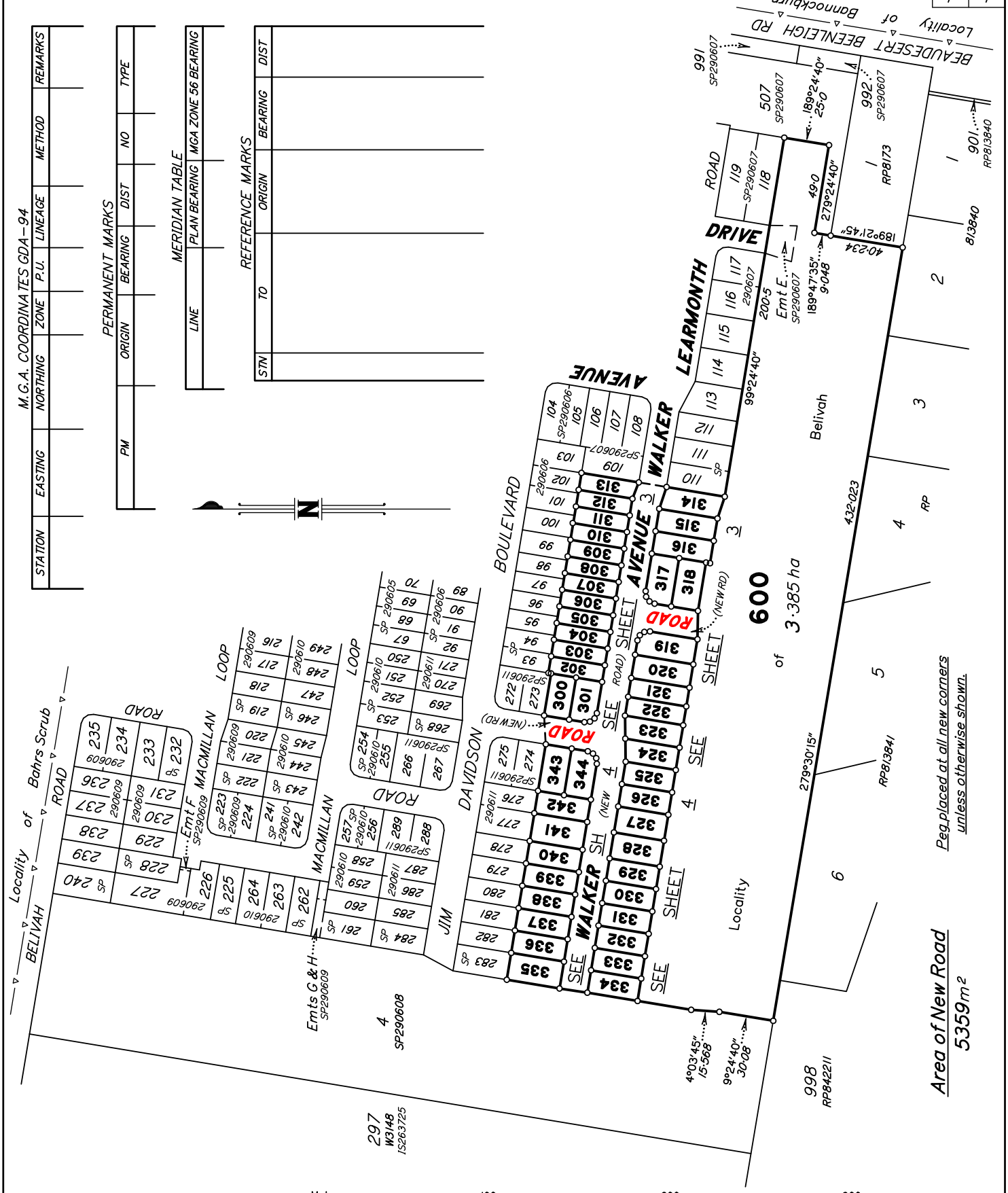
BD21322

M.G.A. COORDINATES GDA–94					
STATION	EASTING	NORTHING	ZONE	P.U.	LINEAGE	METHOD	REMARKS

PERMANENT MARKS					
	ORIGIN	BEARING	DIST	NO	TYPE
PM					

MERIDIAN TABLE		
LINE	PLAN BEARING	MGA ZONE 56 BEARING

REFERENCE MARKS			
	TO	ORIGIN	BEARING	DIST
STN				



Metres 0 | 100m 50 mm | 200m 100 mm | 300m 150 mm

State copyright reserved.

I, Neville Henry VOLKER hereby certify that the land comprised in this plan was surveyed by me personally and that the plan is accurate, that the said survey was performed in accordance with the Survey and Mapping Infrastructure Act 2003 and Surveyors Act 2003 and associated Regulations and Standards and that the said survey was completed on

PRELIMINARY

.....
Cadastral Surveyor

Date .....

PLAN OF

Lots 300 to 344 and 600

Cancelling Lot 600 on SP290611

LOCAL GOVERNMENT: LOGAN C.C.

LOCALITY: BELIVAH

Meridian: SP290611

Survey Records: NO

Scale: 1 : 2000

Format: STANDARD

SP290612

BLV_014

Land Title Act 1994 ; Land Act 1994
Form 21B Version 2

(Dealing No.)

WARNING : Folded or Mutilated Plans will not be accepted. Plans may be rolled. Information may not be placed in the outer margins.

Sheet 2 of 4

BD21322

4. Lodged by

(Include address, phone number, reference, and Lodger Code)

1. Existing		Created		
Title Reference	Description	New Lots	Road	Secondary Interests
–	Lot 600 on SP290611	300 to 344 and 600	–	–

Easement ..... (Emt F on SP290607) and Easement ..... (Emt X on SP290608) fully extinguished by New Road.

ENCUMBRANCE EASEMENT ALLOCATIONS

Easement	Lots to be Encumbered
(Emt E on SP290607)	600

REINSTATEMENT REPORT

Lots	Orig
300 to 344 and 600	Por 107

2. Orig Grant Allocation :

3. References :
Dept File :
Local Govt :
Surveyor : BLV_014

5. Passed & Endorsed :
By :
Date :
Signed :
Designation :

PRELIMINARY

Date of Development Approval:

6. Building Format Plans only.

I certify that :
* As far as it is practical to determine, no part of the building shown on this plan encroaches onto adjoining lots or road;
* Part of the building shown on this plan encroaches onto adjoining * lots and road

....
Cadastral Surveyor/Director* Date
*delete words not required

7. Lodgement Fees :

Survey Deposit	$ .....
Lodgement	$ .....
.....New Titles	$ .....
Photocopy	$ .....
Postage	$ .....
TOTAL	$ .....

8. Insert Plan Number SP290612

Land Title Act 1994 ; Land Act 1994
Form 21A Version 1

ADDITIONAL SHEET

Sheet 3 of 4

BD21322



Scale 1 : 500

Metres 0 25m 50 mm 50m 100 mm 75m 150 mm

State copyright reserved.

Insert Plan Number SP290612

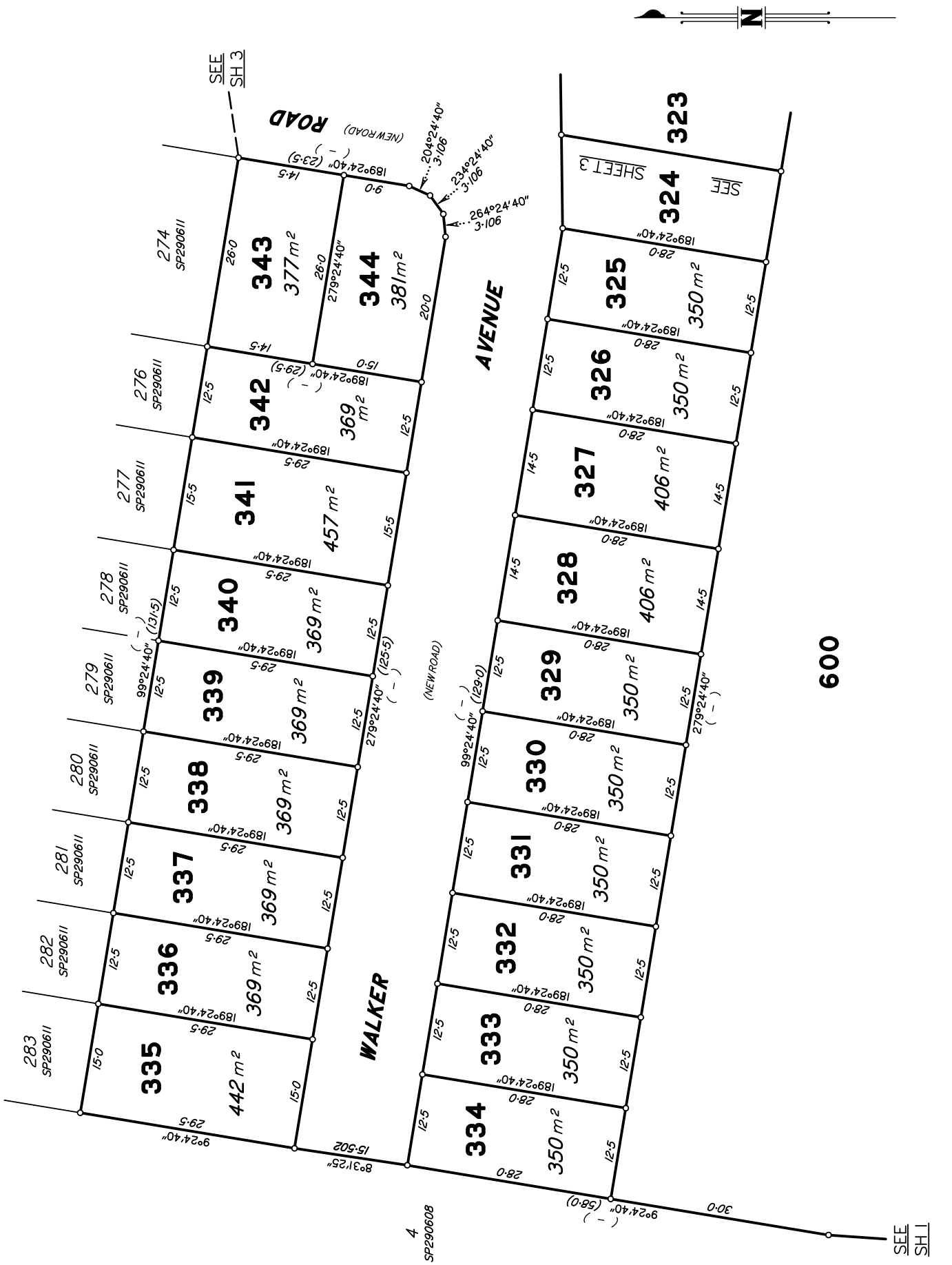
BLV_014

Land Title Act 1994 ; Land Act 1994
Form 21A Version 1

ADDITIONAL SHEET

Sheet 4 of 4

BD21322



Scale 1 : 500

Metres 0 25m 50 mm 50m 100 mm 75m 150 mm

State copyright reserved.

Insert Plan Number SP290612

BLV_014

Land Title Act 1994 ; Land Act 1994
Form 21 Version 4

SURVEY PLAN

Sheet 1 of 4

BD21346

M.G.A. COORDINATES GDA–2020

STATION	EASTING	NORTHING	ZONE	P.U.	LINEAGE	METHOD	REMARKS

PERMANENT MARKS

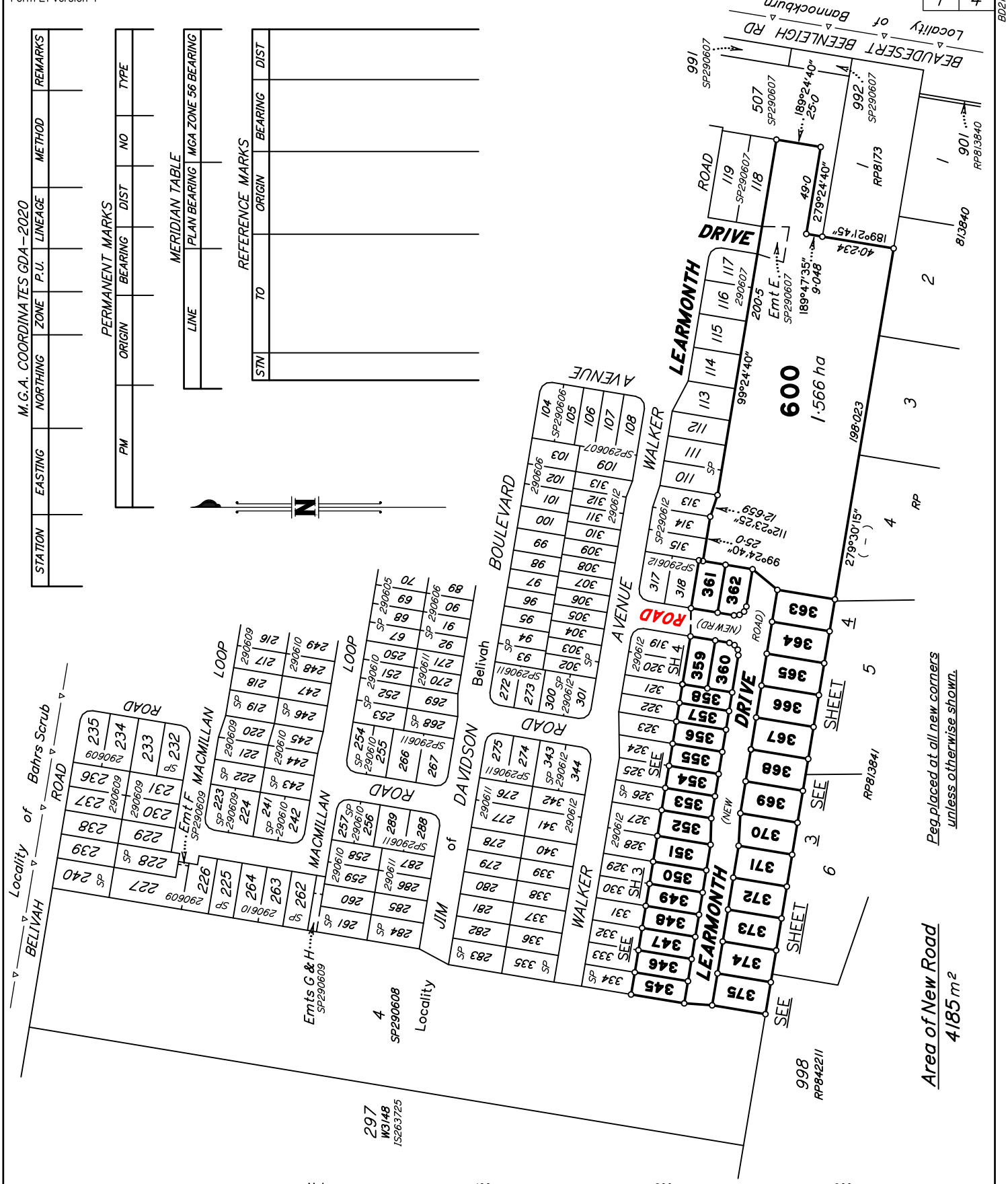
PM	ORIGIN	BEARING	DIST	NO	TYPE

MERIDIAN TABLE

LINE	PLAN BEARING	MGA ZONE 56 BEARING

REFERENCE MARKS

STN	TO	ORIGIN	BEARING	DIST



Metres 0 | 100m 50 mm | 200m 100 mm | 300m 150 mm

State copyright reserved.

I, Neville Henry VOLKER hereby certify that the land comprised in this plan was surveyed by me personally and that the plan is accurate, that the said survey was performed in accordance with the Survey and Mapping Infrastructure Act 2003 and Surveyors Act 2003 and associated Regulations and Standards and that the said survey was completed on

PRELIMINARY

.....
Cadastral Surveyor

Date .....

PLAN OF

Lots 345 to 375 and 600

Cancelling Lot 601 on SP290612

LOCAL GOVERNMENT: LOGAN C.C.

LOCALITY: BELIVAH

Meridian: SP290612

Survey Records: NO

Scale: 1 : 2000

Format: STANDARD

SP290613

BLV_015

Land Title Act 1994 ; Land Act 1994
Form 21B Version 2

(Dealing No.)

WARNING : Folded or Mutilated Plans will not be accepted. Plans may be rolled. Information may not be placed in the outer margins.

BD21346

4. Lodged by

(Include address, phone number, reference, and Lodger Code)

1. Existing		Created		
Title Reference	Description	New Lots	Road	Secondary Interests
–	Lot 600 on SP290612	345 to 375 and 600	New Road	–

ENCUMBRANCE EASEMENT ALLOCATIONS

Easement	Lots to be Encumbered
(Emt E on SP290607)	600

REINSTATEMENT REPORT

Lots	Orig
345 to 375 and 600	Por 107

2. Orig Grant Allocation :

3. References :
Dept File :
Local Govt :
Surveyor : BLV_015

5. Passed & Endorsed :
By :
Date :
Signed :
Designation :

PRELIMINARY

Date of Development Approval:

6. Building Format Plans only.

I certify that :
* As far as it is practical to determine, no part of the building shown on this plan encroaches onto adjoining lots or road;
* Part of the building shown on this plan encroaches onto adjoining * lots and road

....
Cadastral Surveyor/Director* Date
*delete words not required

7. Lodgement Fees :

Survey Deposit	$.....
Lodgement	$.....
.....New Titles	$.....
Photocopy	$.....
Postage	$.....
TOTAL	$.....

8. Insert Plan Number SP290613

Land Title Act 1994 ; Land Act 1994
Form 21A Version 1

ADDITIONAL SHEET

Sheet 3 of 4

BD21346



Scale 1 : 400

Metres 0 20m 40m 60m

50 mm 100 mm 150 mm

BLV_015

State copyright reserved.

Insert Plan Number SP290613

Land Title Act 1994 ; Land Act 1994
Form 21A Version 1

ADDITIONAL SHEET

Sheet 4 of 4

BD21346



Scale 1 : 500

Metres 0 25m 50 mm 50m 100 mm 75m 150 mm

State copyright reserved.

Insert Plan Number SP290613

BLV_015

Land Title Act 1994 ; Land Act 1994
Form 21 Version 4

SURVEY PLAN

Sheet 1 of 4

BD22504

M.G.A. COORDINATES GDA–2020

STATION	EASTING	NORTHING	ZONE	P.U.	LINEAGE	METHOD	REMARKS

PERMANENT MARKS

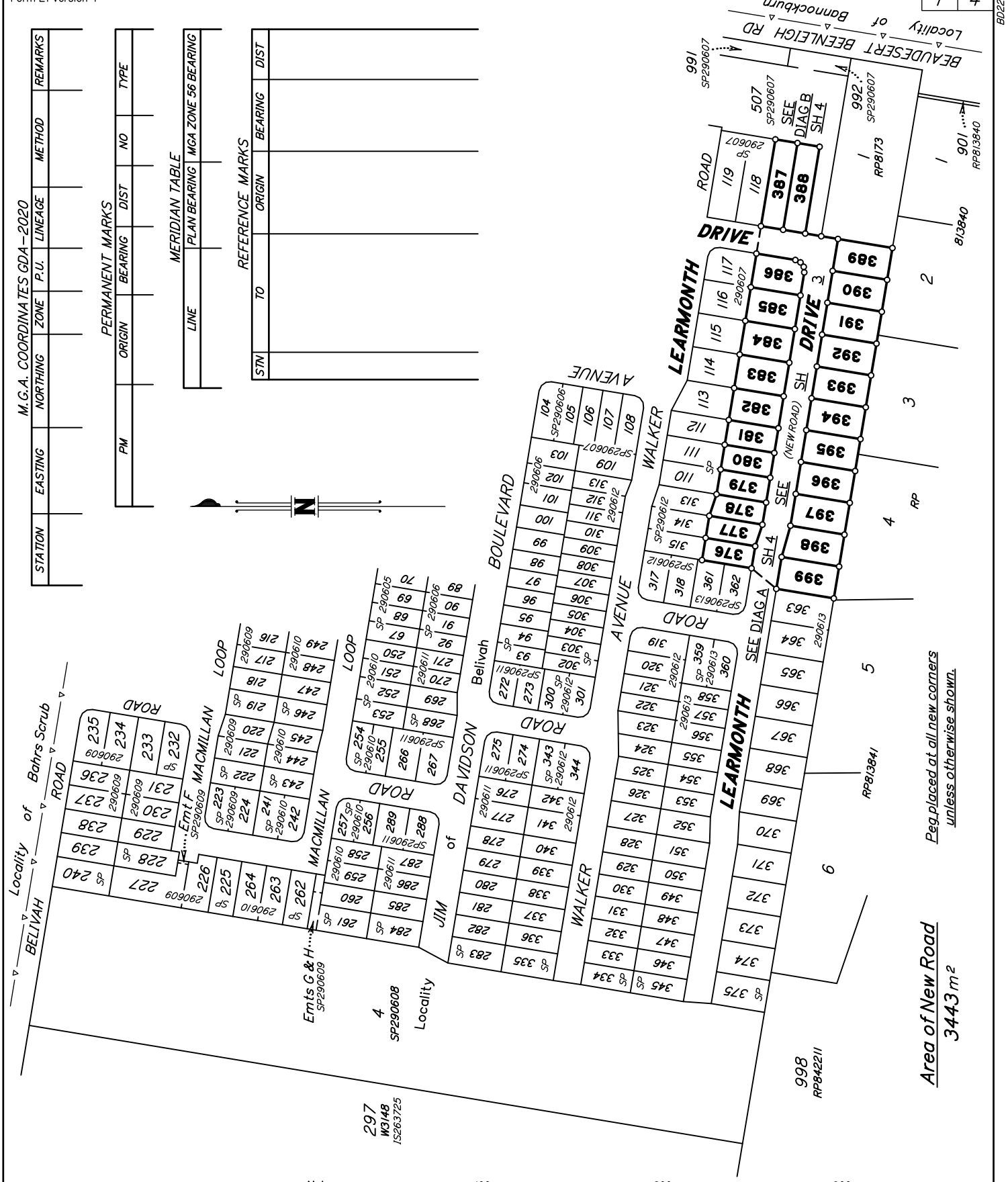
PM	ORIGIN	BEARING	DIST	NO	TYPE

MERIDIAN TABLE

LINE	PLAN BEARING	MGA ZONE 56 BEARING

REFERENCE MARKS

STN	TO	ORIGIN	BEARING	DIST



Metres 0 100m 50 mm 200m 100 mm 300m 150 mm

State copyright reserved.

I, Neville Henry VOLKER hereby certify that the land comprised in this plan was surveyed by me personally and that the plan is accurate, that the said survey was performed in accordance with the Survey and Mapping Infrastructure Act 2003 and Surveyors Act 2003 and associated Regulations and Standards and that the said survey was completed on

PRELIMINARY

Cadastral Surveyor

Date .....

PLAN OF

Lots 376 to 399

Cancelling Lot 600 on SP290613

LOCAL GOVERNMENT: LOGAN C.C.

LOCALITY: BELIVAH

Meridian: SP290613

Survey Records: NO

Scale: 1 : 2000

Format: STANDARD

SP290614

BLV_016

Land Title Act 1994 ; Land Act 1994
Form 21B Version 2

(Dealing No.)

WARNING : Folded or Mutilated Plans will not be accepted. Plans may be rolled. Information may not be placed in the outer margins.

Sheet 2 of 4

BD22504

4. Lodged by

(Include address, phone number, reference, and Lodger Code)

1. Existing		Created		
Title Reference	Description	New Lots	Road	Secondary Interests
–	Lot 600 on SP290613	376 to 399	New Road	–

Emt E on SP290607 ( ) fully absorbed by new road.

REINSTATEMENT REPORT

376 to 399	Por 107
Lots	Orig

2. Orig Grant Allocation :

3. References :
Dept File :
Local Govt :
Surveyor : BLV_016

5. Passed & Endorsed :
By :
Date :
Signed :
Designation :

PRELIMINARY

Date of Development Approval:

6. Building Format Plans only.

I certify that :
* As far as it is practical to determine, no part of the building shown on this plan encroaches onto adjoining lots or road;
* Part of the building shown on this plan encroaches onto adjoining * lots and road

....
Cadastral Surveyor/Director* Date
*delete words not required

7. Lodgement Fees :

Survey Deposit	$.....
Lodgement	$.....
.....New Titles	$.....
Photocopy	$.....
Postage	$.....
TOTAL	$.....

8. Insert Plan Number SP290614

Land Title Act 1994 ; Land Act 1994
Form 21A Version 1

ADDITIONAL SHEET

Sheet 3 of 4

BD22504



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Insert Plan Number SP290614

BLV_016

Land Title Act 1994 ; Land Act 1994
Form 21A Version 1

ADDITIONAL SHEET

Sheet 4 of 4

BD22504



DIAGRAM B

Scale 1:400

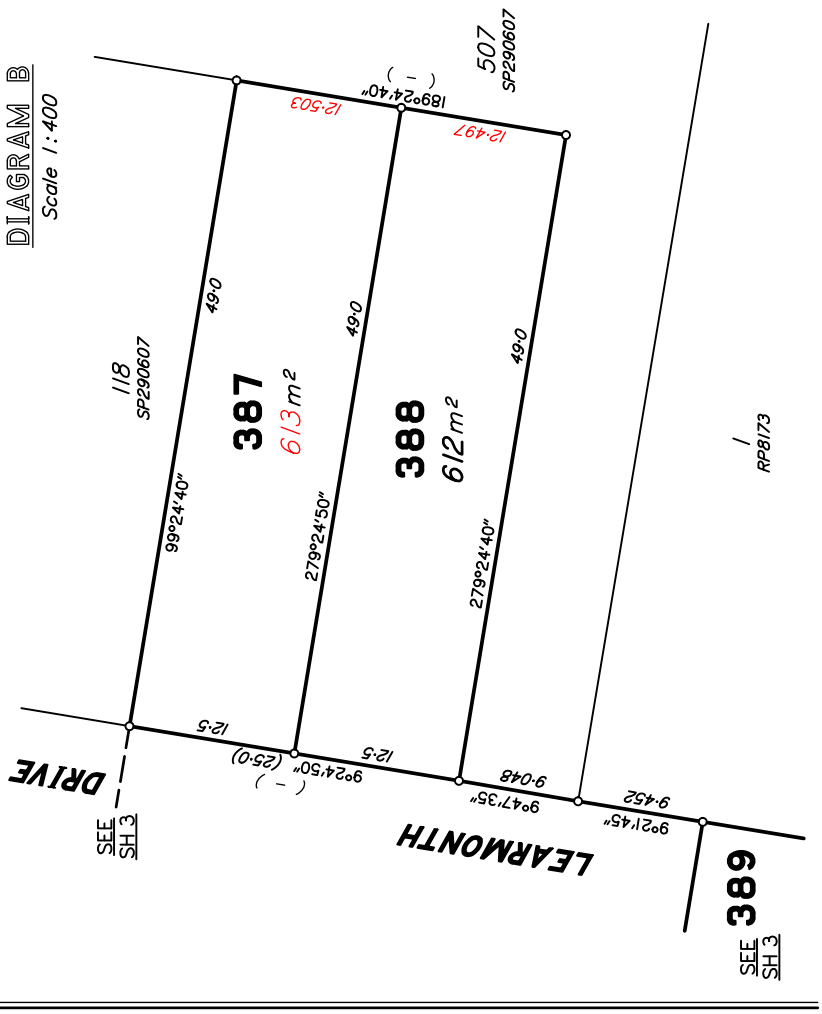
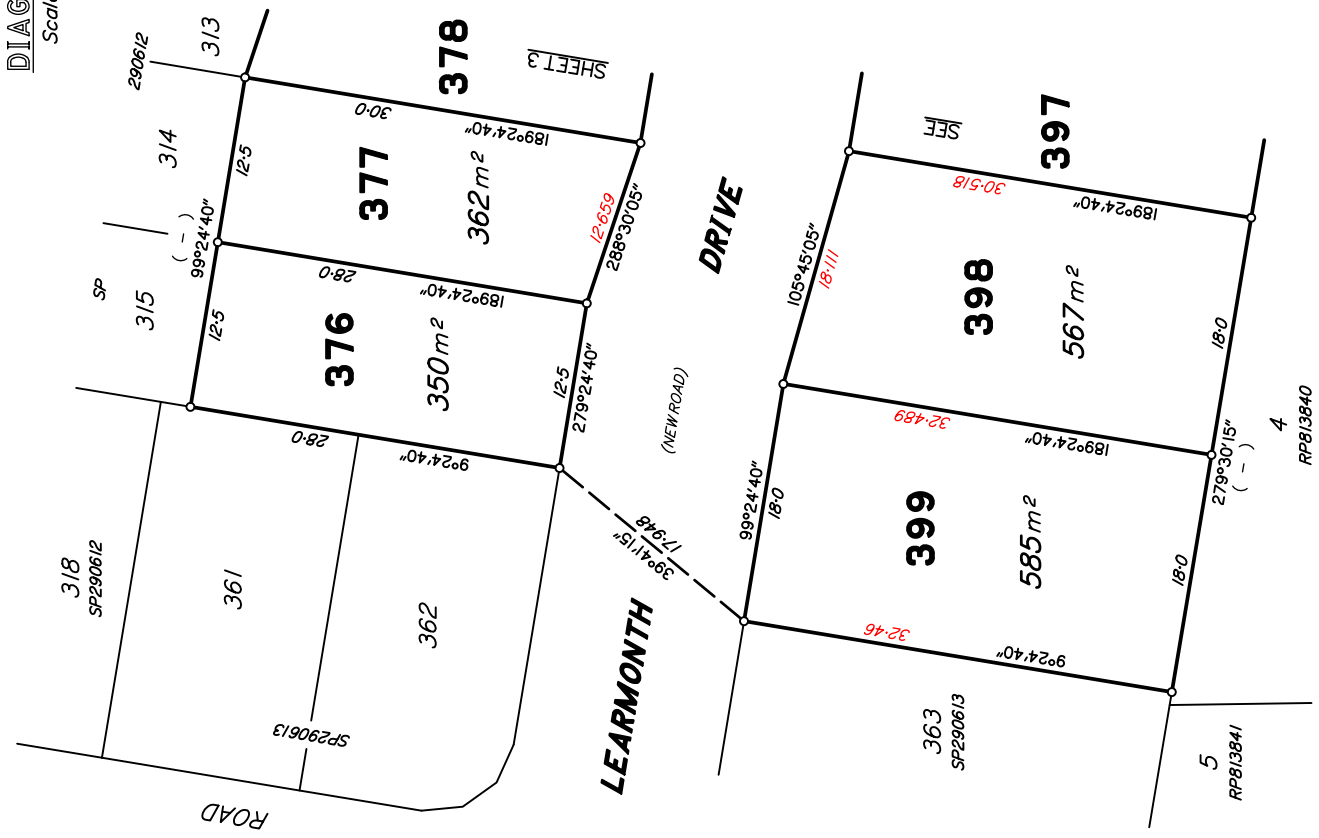


DIAGRAM A

Scale 1:400



Scale 1:400

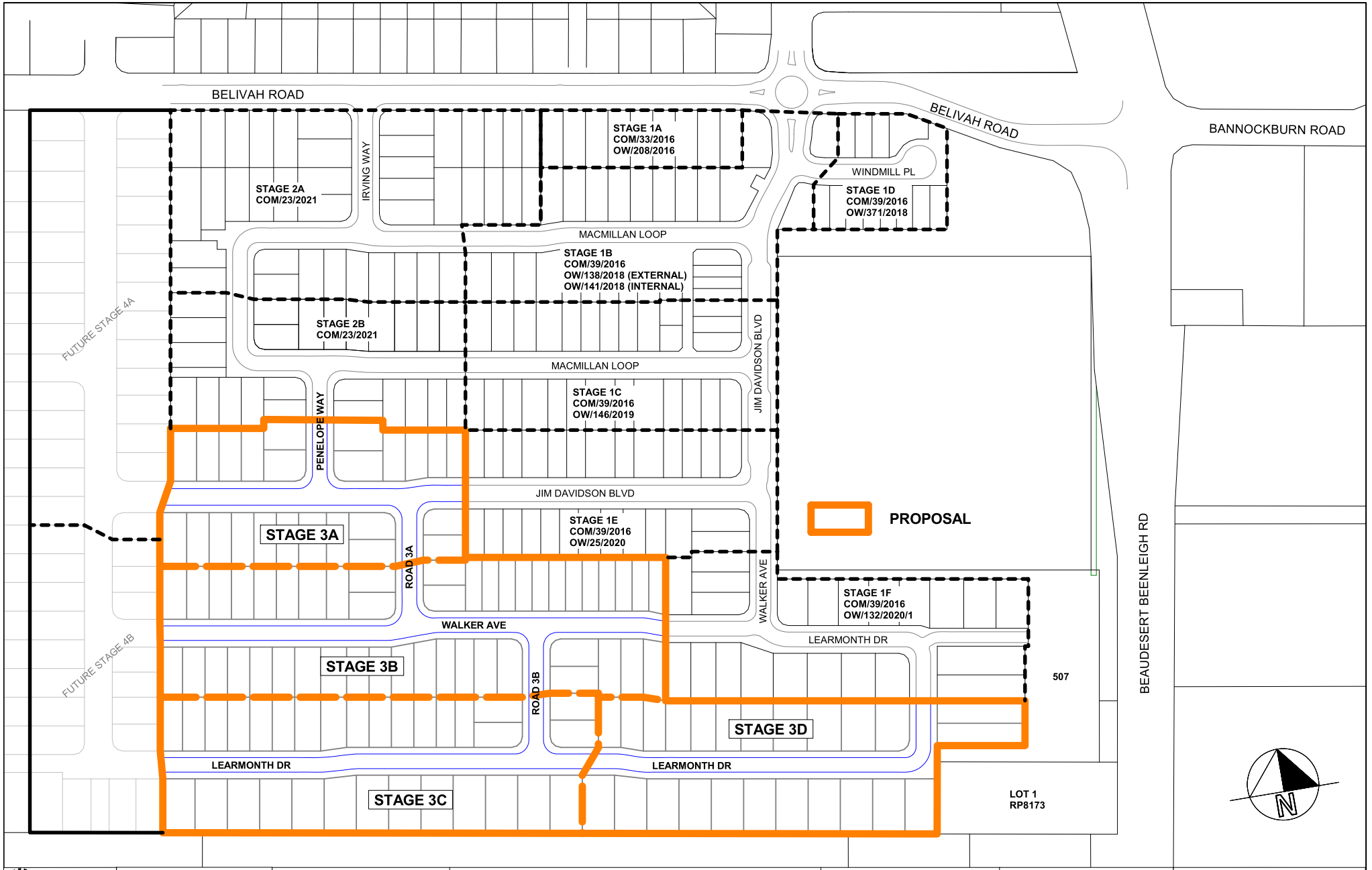
Metres 0 20m 40m 60m
50 mm 100 mm 150 mm

BLV_016

State copyright reserved.

Insert Plan Number SP290614

ATTACHMENT 2 – PLAN OF DEVELOPMENT (STAGES 3A-3D)



Davidson's At Belivah

PREPARED BY:
N H VOLKER & Co. PTY. LTD.
P O Box 411
BEENLEIGH QLD 4207
EMAIL: nvolker@bigpond.net.au

CLIENT: BELIVAH PTY. LTD.

PROPOSED SUBDIVISION
DAVIDSONS at BELIVAH
PROPOSED LOTS 266-399

PROJECT : DAB - STAGES 3A-3D

LOCATION: JIM DAVIDSON BLVD, BELIVAH

Job No. - DB-3-ABCD

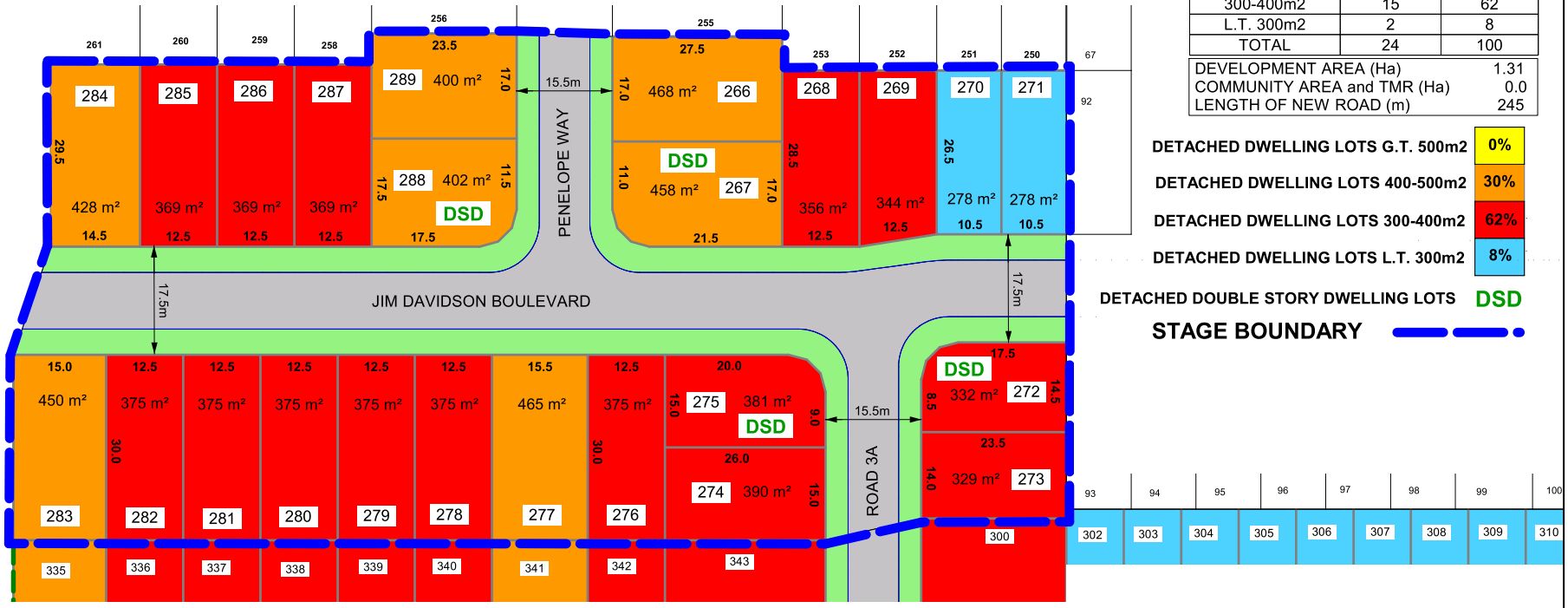
SHEET No. - 1 OF 11
REVISION. - V1

DATE: 25/10/2021
DRAWN: AB
EMAIL: nvolker@bigpond.net.au
PH: 0411 759 765

PROPOSAL PLAN

DAVIDSONS AT BELIVAH
STAGE 3A

SCALE: 1:750 @ A3



STAGE 3A STATISTICS

LOT SIZE	NO.	%
G.T. 500m2	0	0
400-500m2	7	30
300-400m2	15	62
L.T. 300m2	2	8
TOTAL	24	100

DEVELOPMENT AREA (Ha)	1.31
COMMUNITY AREA and TMR (Ha)	0.0
LENGTH OF NEW ROAD (m)	245

DETACHED DWELLING LOTS G.T. 500m2	0%
DETACHED DWELLING LOTS 400-500m2	30%
DETACHED DWELLING LOTS 300-400m2	62%
DETACHED DWELLING LOTS L.T. 300m2	8%
DETACHED DOUBLE STORY DWELLING LOTS	DSD
STAGE BOUNDARY	

Davidson's At Belivah

PREPARED BY:
N H VOLKER & Co. PTY. LTD.
P O Box 411
BEENLEIGH QLD 4207
EMAIL: nvolker@bigpond.net.au

CLIENT: BELIVAH PTY. LTD.

PROPOSED LOTS 266-288

PROJECT : DAB - STAGES 3A

LOCATION: JIM DAVIDSON BLVD, BELIVAH

Job No. - DB-3-ABCD

SHEET No. - 2 OF 11
REVISION. - V1

DATE: 25/10/2021
DRAWN: AB
EMAIL: nvolker@bigpond.net.au
PH: 0411 759 765

PROPOSAL PLAN

DAVIDSONS AT BELIVAH STAGE 3B

SCALE: 1:750 @ A3

STAGE 3B STATISTICS

LOT SIZE	NO.	%
G.T. 500m2	0	0
400-500m2	11	24
300-400m2	22	49
L.T. 300m2	12	27
TOTAL	45	100

DEVELOPMENT AREA (Ha)	2.12
COMMUNITY AREA and TMR (Ha)	0.0
LENGTH OF NEW ROAD (m)	357

DETACHED DWELLING LOTS G.T. 500m2 — 0%

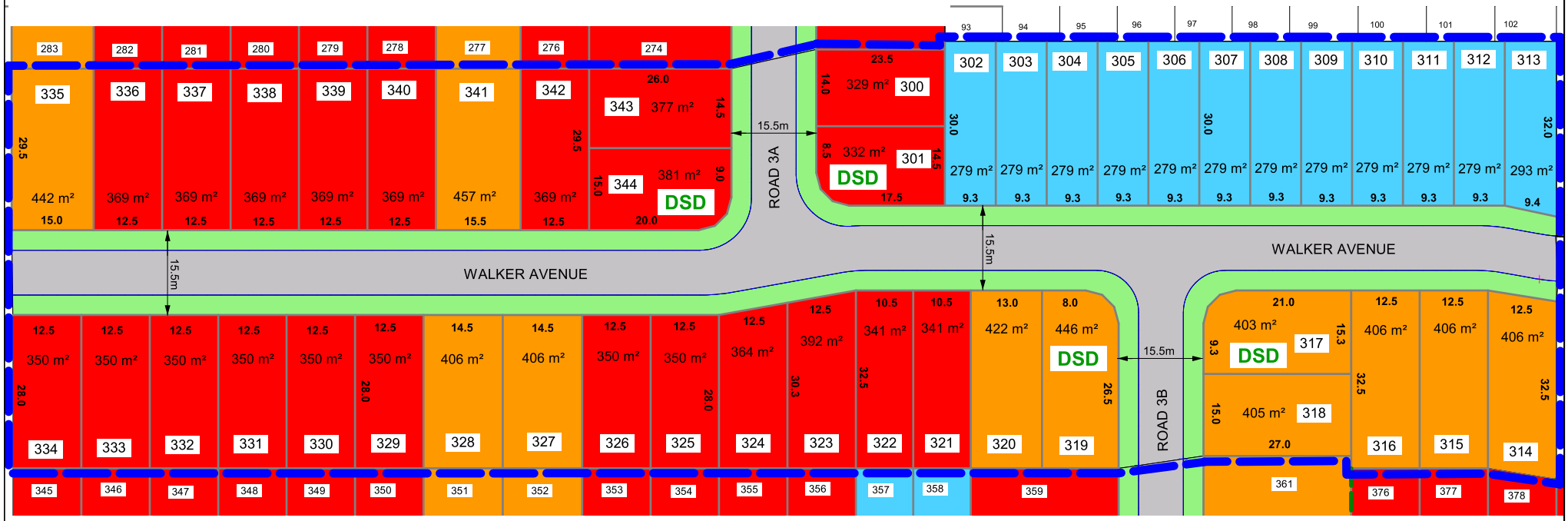
DETACHED DWELLING LOTS 400-500m2 — 24%

DETACHED DWELLING LOTS 300-400m2 — 49%

DETACHED DWELLING LOTS L.T. 300m2 — 27%

DETACHED DOUBLE STORY DWELLING LOTS — DSD

STAGE BOUNDARY



Davidson's At Belivah

PREPARED BY:
N H VOLKER & Co. PTY. LTD.
P O Box 411
BEENLEIGH QLD 4207
EMAIL: nvolker@bigpond.net.au

CLIENT: BELIVAH PTY. LTD.

PROPOSED LOTS 300-344

PROJECT : DAB - STAGES 3B

LOCATION: JIM DAVIDSON BLVD, BELIVAH

Job No. - DB-3-ABCD

SHEET No. - 3 OF 11
REVISION. - V1

DATE: 25/10/2021
DRAWN: AB
EMAIL: nvolker@bigpond.net.au
PH: 0411 759 765

PROPOSAL PLAN

DAVIDSONS AT BELIVAH STAGE 3C

SCALE: 1:750 @ A3

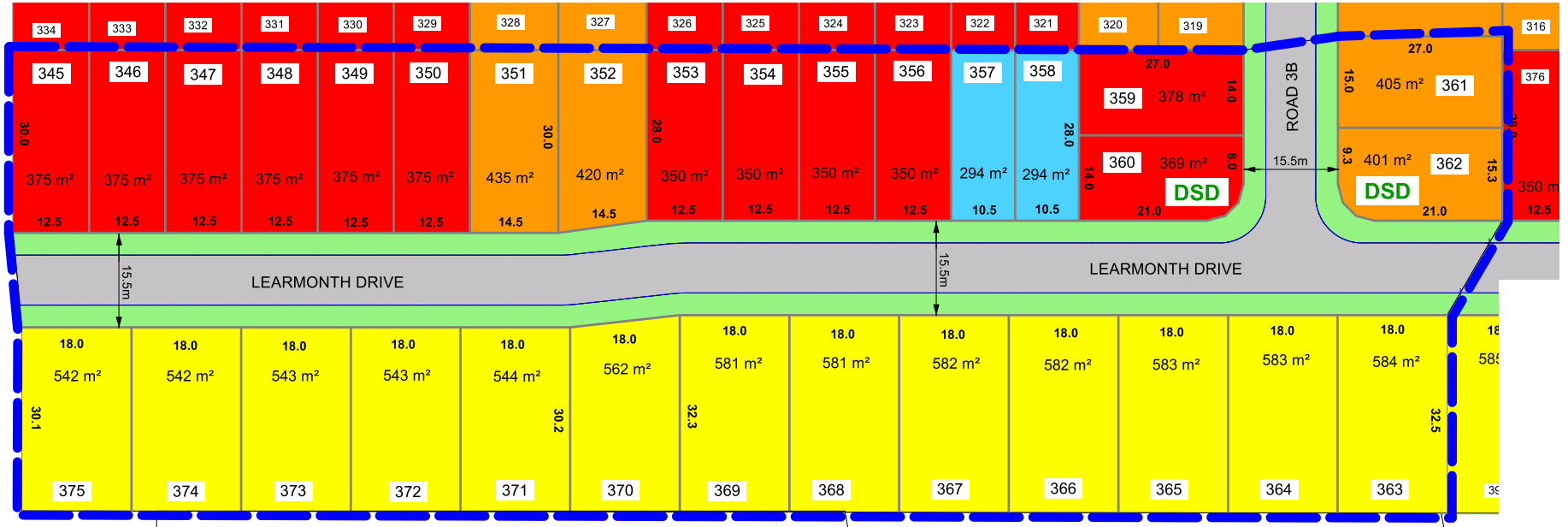
STAGE BOUNDARY

DETACHED DWELLING LOTS G.T. 500m2	41%
DETACHED DWELLING LOTS 400-500m2	13%
DETACHED DWELLING LOTS 300-400m2	39%
DETACHED DWELLING LOTS L.T. 300m2	7%
DETACHED DOUBLE STORY DWELLING LOTS	DSD

STAGE 3B STATISTICS

LOT SIZE	NO.	%
G.T. 500m2	13	41
400-500m2	4	13
300-400m2	12	39
L.T. 300m2	2	7
TOTAL	31	100

DEVELOPMENT AREA (Ha)	1.82
COMMUNITY AREA and TMR (Ha)	0.0
LENGTH OF NEW ROAD (m)	276



Davidson's At BELIVAH

PREPARED BY:
N H VOLKER & Co. PTY. LTD.
P O Box 411
BEENLEIGH QLD 4207
EMAIL: nvolker@bigpond.net.au

CLIENT: BELIVAH PTY. LTD.

PROPOSED LOTS 345-375

PROJECT : DAB - STAGES 3C

LOCATION: JIM DAVIDSON BLVD, BELIVAH

Job No. - DB-3-ABCD

SHEET No. - 4 OF 11
REVISION. - V1

DATE: 25/10/2021
DRAWN: AB
EMAIL: nvolker@bigpond.net.au
PH: 0411 759 765

PROPOSAL PLAN

DAVIDSONS AT BELIVAH
STAGE 3D

SCALE: 1:750 @ A3

DETACHED DWELLING LOTS G.T. 500m2	75%
DETACHED DWELLING LOTS 400-500m2	0%
DETACHED DWELLING LOTS 300-400m2	25%
DETACHED DWELLING LOTS L.T. 300m2	0%
DETACHED DOUBLE STORY DWELLING LOTS	DSD
STAGE BOUNDARY	

STAGE 3D STATISTICS

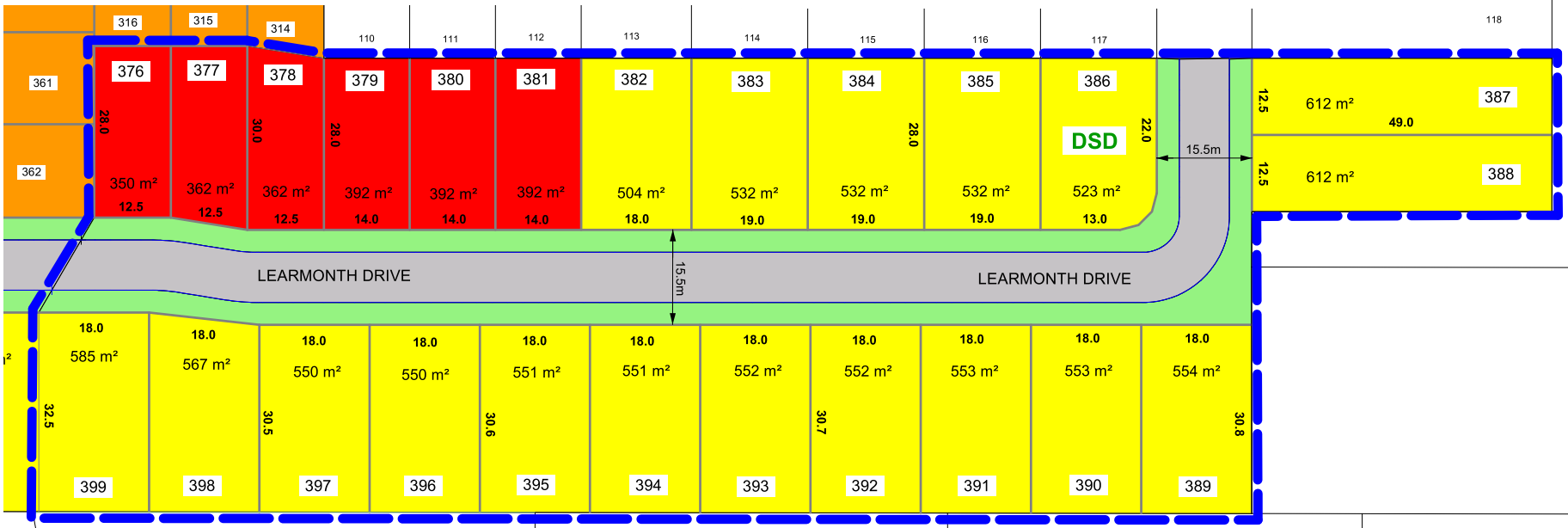
LOT SIZE	No.	%
G.T. 500m2	18	75
400-500m2	0	0
300-400m2	6	25
L.T. 300m2	0	0
TOTAL	24	100

DEVELOPMENT AREA (Ha)	1.57
COMMUNITY AREA and TMR (Ha)	0.0
LENGTH OF NEW ROAD (m)	217

STAGE 3A-3D STATISTICS

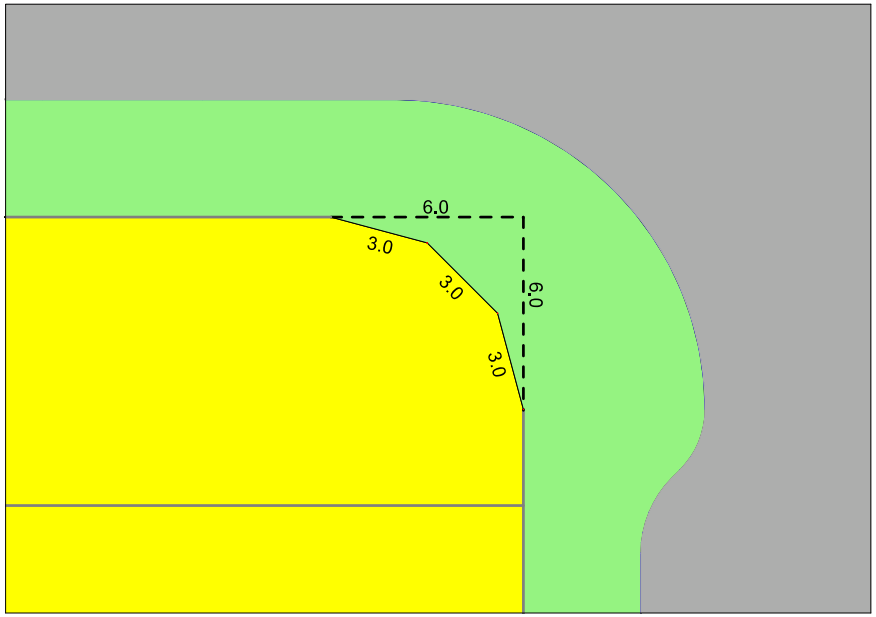
LOT SIZE	No.	%
G.T. 500m2	31	25
400-500m2	22	18
300-400m2	55	44
L.T. 300m2	16	13
TOTAL	124	100

DEVELOPMENT AREA (Ha)	6.82
COMMUNITY AREA and TMR (Ha)	0.0
LENGTH OF NEW ROAD (m)	1095



Davidson's At BELIVAH	PREPARED BY: N H VOLKER & Co. PTY. LTD. P O Box 411 BEENLEIGH QLD 4207 EMAIL: nvolker@bigpond.net.au	CLIENT: BELIVAH PTY. LTD.	PROPOSED LOTS 376-399	PROJECT : DAB - STAGES 3D LOCATION: JIM DAVIDSON BLVD, BELIVAH	Job No. - DB-3-ABCD SHEET No. - 5 OF 11 REVISION. - V1	DATE: 25/10/2021 DRAWN: AB EMAIL: nvolker@bigpond.net.au PH: 0411 759 765

DAVIDSONS AT BELIVAH



STANDARD 3 CHORD TRUNCATION



Davidson's At Belivah	PREPARED BY: N H VOLKER & Co. PTY. LTD. P O Box 411 BEENLEIGH QLD 4207 EMAIL: nvolker@bigpond.net.au	**CLIENT: BELIVAH PTY. LTD.**	**TRUNCATION DETAILS**	**PROJECT: STAGE 3A-D** **LOCATION: JIM DAVIDSON BOULEVARDE, BELIVAH**	**Job No. DB-3-ABCD** **SHEET No. 6 OF 11** **REVISION V1**	DATE: 25/10/2022 DRAWN: AB EMAIL: nvolker@bigpond.net.au PH: 0411 759 765

BUILDING ENVELOPE PLAN

DAVIDSONS AT BELIVAH STAGE 3A

SCALE: 1:750 @ A3

NOTES:
1. THIS SHEET MUST READ IN CONJUCTION WITH PLAN No. DB-1-CF SHEET 9 V1

2. AVAILABLE BUILD AREA MAY BE REDUCED BY EASEMENTS AND OTHER INFRASTRUCTURE

NO VEHICLE ACCESS

DEVELOPMENT ENVELOPE

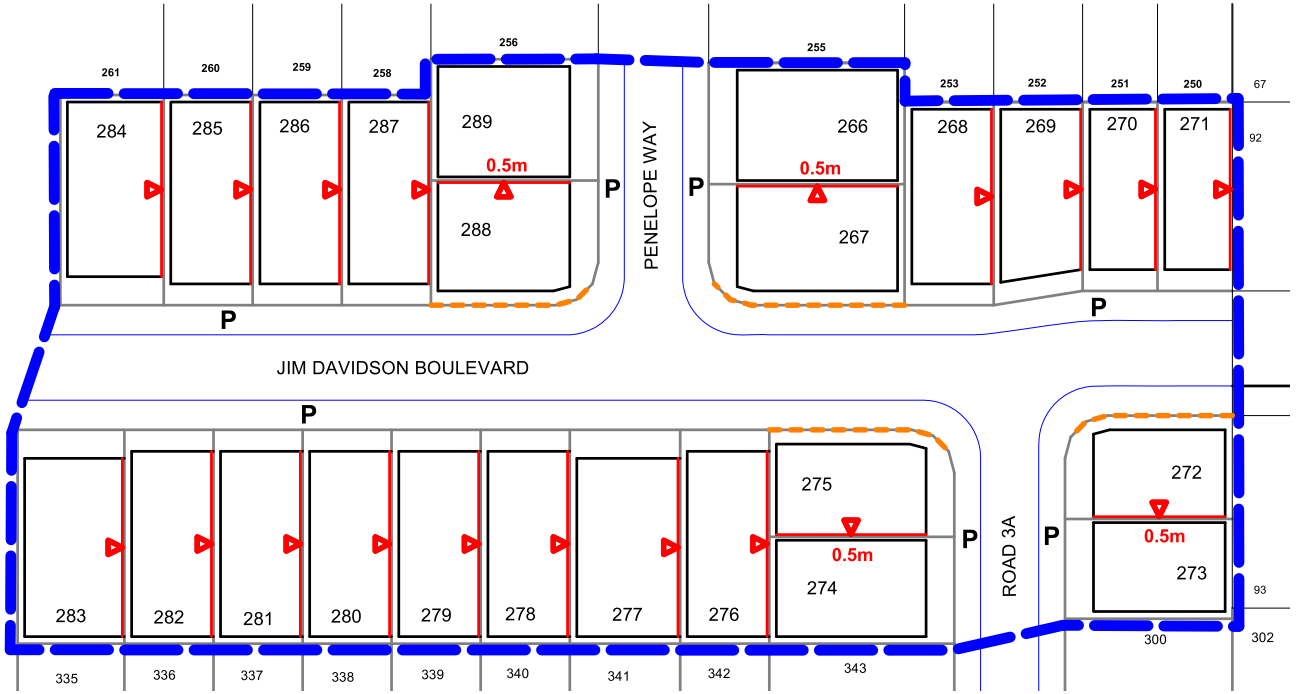
BUILD TO BOUNDARY

STAGE BOUNDARY

P PRIMARY STREET FRONTAGE

SETBACKS	(unless notified otherwise)				
STREET SETBACK	LOT WIDTH				
	< 14m	14m - 20m		> 20m	
	GROUND & UPPER	GROUND	UPPER	GROUND	UPPER
PRIMARY STREET	3m	4m	4m	4.5m	4.5m
SECONDARY STREET	2m	2m	2m	2m	2m
SIDE & REAR SETBACK	1m	1m	1.5m	1.5m	2m

NOTES:
1. SETBACKS ARE MEASURED TO THE BUILDING WALL.
2. FRONT SETBACK MAY BE REDUCED 1.5M FOR VERANDAH ENTRY TO PATIO.
3. SETBACKS TO ALL FRONTAGES ARE REDUCED BY 1.5m FOR A VERANDAH, PORCH, COVERED FIRST FLOOR BALCONY OR ENTRY PORTICO.
4. GARAGE DOORS ARE TO BE SETBACK 5m FROM THE STREET FRONTAGE



Davidson's At BELIVAH

PREPARED BY:
N H VOLKER & Co. PTY. LTD.
P O Box 411
BEENLEIGH QLD 4207
EMAIL: nvolker@bigpond.net.au

CLIENT: BELIVAH PTY. LTD.

PROPOSED LOTS 266-288

PROJECT : DAB - STAGES 3A

LOCATION: JIM DAVIDSON BLVD, BELIVAH

Job No. - DB-3-ABCD

SHEET No. - 7 OF 11

REVISION. - V1

DATE: 25/10/2021
DRAWN: AB
EMAIL: nvolker@bigpond.net.au
PH: 0411 759 765

BUILDING ENVELOPE PLAN

DAVIDSONS AT BELIVAH STAGE 3B

SCALE: 1:750 @ A3

NOTES:
1. THIS SHEET MUST READ IN CONJUCTION WITH PLAN No. DB-1-CF SHEET 9 V1

2. AVAILABLE BUILD AREA MAY BE REDUCED BY EASEMENTS AND OTHER INFRASTRUCTURE

NO VEHICLE ACCESS

DEVELOPMENT ENVELOPE

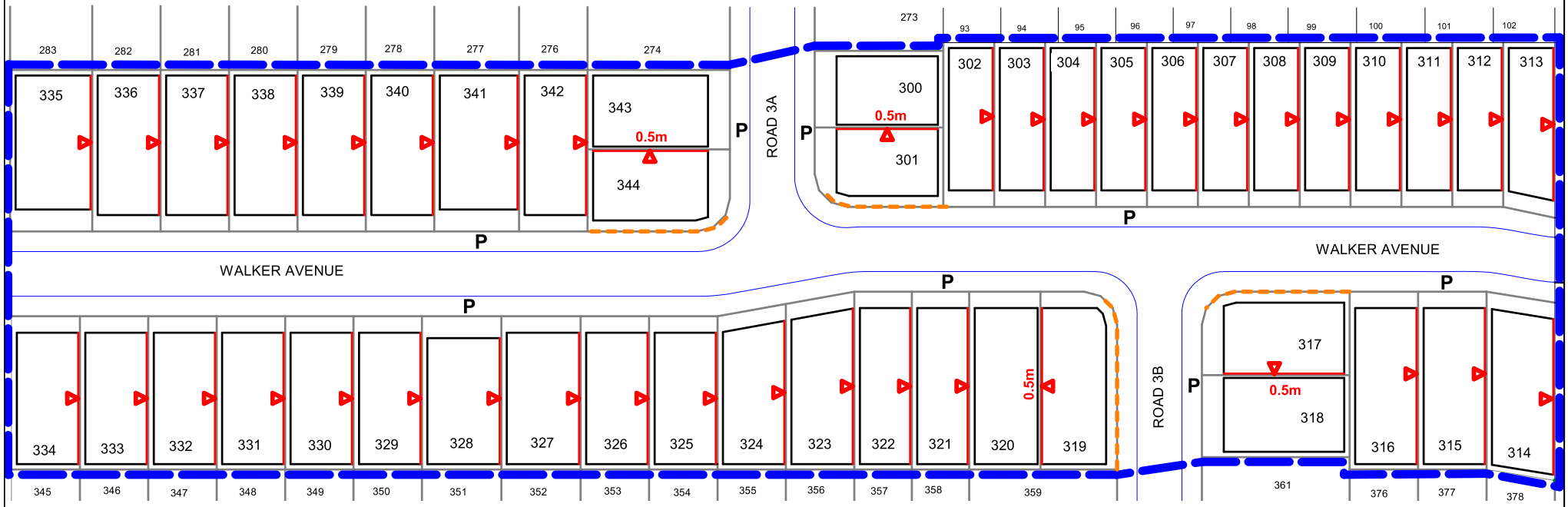
BUILD TO BOUNDARY

STAGE BOUNDARY

P PRIMARY STREET FRONTAGE

SETBACKS (unless notified otherwise)					
STREET SETBACK	LOT WIDTH				
	< 14m	14m - 20m		> 20m	
	GROUND & UPPER	GROUND	UPPER	GROUND	UPPER
PRIMARY STREET	3m	4m	4m	4.5m	4.5m
SECONDARY STREET	2m	2m	2m	2m	2m
SIDE & REAR SETBACK	1m	1m	1.5m	1.5m	2m

NOTES:
1. SETBACKS ARE MEASURED TO THE BUILDING WALL.
2. FRONT SETBACK MAY BE REDUCED 1.5M FOR VERANDAH ENTRY TO PATIO.
3. SETBACKS TO ALL FRONTAGES ARE REDUCED BY 1.5m FOR A VERANDAH, PORCH, COVERED FIRST FLOOR BALCONY OR ENTRY PORTICO.
4. GARAGE DOORS ARE TO BE SETBACK 5m FROM THE STREET FRONTAGE



Davidson's At BELIVAH

PREPARED BY:
N H VOLKER & Co. PTY. LTD.
P O Box 411
BEENLEIGH QLD 4207
EMAIL: nvolker@bigpond.net.au

CLIENT: BELIVAH PTY. LTD.

PROPOSED LOTS 300-344

PROJECT : DAB - STAGES 3B

LOCATION: JIM DAVIDSON BLVD, BELIVAH

Job No. - DB-3-ABCD

SHEET No. - 8 OF 11

REVISION. - V1

DATE: 25/10/2021
DRAWN: AB

EMAIL: nvolker@bigpond.net.au
PH: 0411 759 765

BUILDING ENVELOPE PLAN

DAVIDSONS AT BELIVAH STAGE 3C

SCALE: 1:750 @ A3

NOTES:
1. THIS SHEET MUST READ IN CONJUCTION WITH PLAN No. DB-1-CF SHEET 9 V1

2. AVAILABLE BUILD AREA MAY BE REDUCED BY EASEMENTS AND OTHER INFRASTRUCTURE

NO VEHICLE ACCESS

DEVELOPMENT ENVELOPE

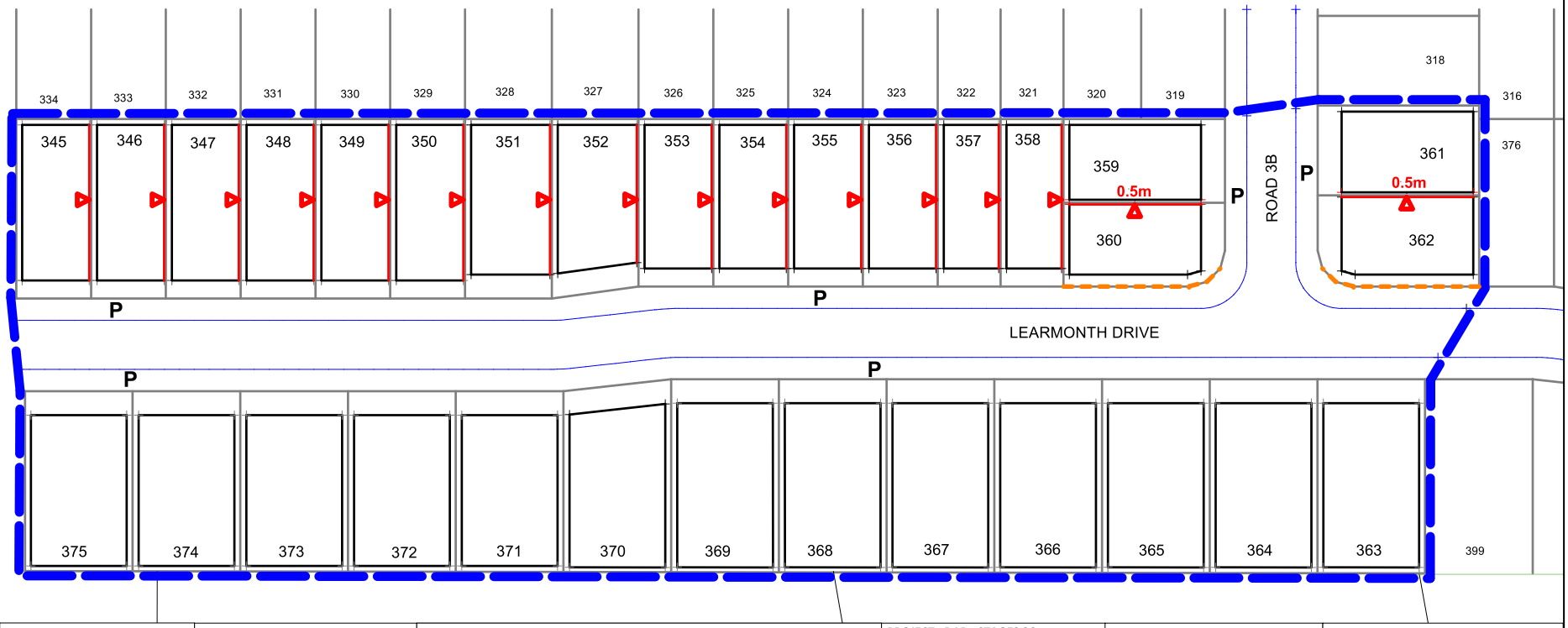
BUILD TO BOUNDARY

STAGE BOUNDARY

P PRIMARY STREET FRONTAGE

SETBACKS	(unless notified otherwise)				
STREET SETBACK	LOT WIDTH				
	< 14m	14m - 20m		> 20m	
	GROUND & UPPER	GROUND	UPPER	GROUND	UPPER
PRIMARY STREET	3m	4m	4m	4.5m	4.5m
SECONDARY STREET	2m	2m	2m	2m	2m
SIDE & REAR SETBACK	1m	1m	1.5m	1.5m	2m

NOTES:
1. SETBACKS ARE MEASURED TO THE BUILDING WALL.
2. FRONT SETBACK MAY BE REDUCED 1.5M FOR VERANDAH ENTRY TO PATIO.
3. SETBACKS TO ALL FRONTAGES ARE REDUCED BY 1.5m FOR A VERANDAH, PORCH, COVERED FIRST FLOOR BALCONY OR ENTRY PORTICO.
4. GARAGE DOORS ARE TO BE SETBACK 5m FROM THE STREET FRONTAGE



Davidson's At BELIVAH

PREPARED BY:
N H VOLKER & Co. PTY. LTD.
P O Box 411
BEENLEIGH QLD 4207
EMAIL: nvolker@bigpond.net.au

CLIENT: BELIVAH PTY. LTD.

PROPOSED LOTS 345-375

PROJECT : DAB - STAGES 3C

LOCATION: JIM DAVIDSON BLVD, BELIVAH

Job No. - DB-3-ABCD

SHEET No. - 9 OF 11
REVISION. - V1

DATE: 25/10/2021
DRAWN: AB

EMAIL: nvolker@bigpond.net.au
PH: 0411 759 765

BUILDING ENVELOPE PLAN

DAVIDSONS AT BELIVAH STAGE 3D

SCALE: 1:750 @ A3

NOTES:
1. THIS SHEET MUST READ IN CONJUCTION WITH PLAN No. DB-1-CF SHEET 9 V1

2. AVAILABLE BUILD AREA MAY BE REDUCED BY EASEMENTS AND OTHER INFRASTRUCTURE

NO VEHICLE ACCESS

DEVELOPMENT ENVELOPE

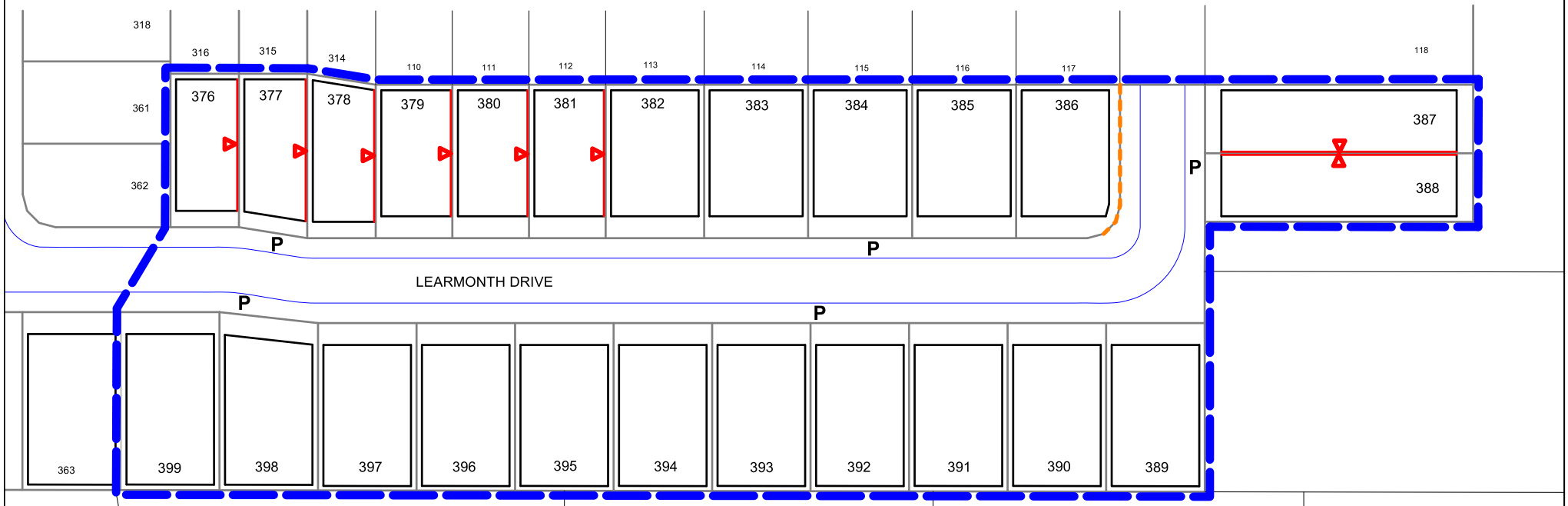
BUILD TO BOUNDARY

STAGE BOUNDARY

P PRIMARY STREET FRONTAGE

SETBACKS	(unless notified otherwise)				
STREET SETBACK	LOT WIDTH				
	< 14m	14m - 20m		> 20m	
	GROUND & UPPER	GROUND	UPPER	GROUND	UPPER
PRIMARY STREET	3m	4m	4m	4.5m	4.5m
SECONDARY STREET	2m	2m	2m	2m	2m
SIDE & REAR SETBACK	1m	1m	1.5m	1.5m	2m

NOTES:
1. SETBACKS ARE MEASURED TO THE BUILDING WALL.
2. FRONT SETBACK MAY BE REDUCED 1.5M FOR VERANDAH ENTRY TO PATIO.
3. SETBACKS TO ALL FRONTAGES ARE REDUCED BY 1.5m FOR A VERANDAH, PORCH, COVERED FIRST FLOOR BALCONY OR ENTRY PORTICO.
4. GARAGE DOORS ARE TO BE SETBACK 5m FROM THE STREET FRONTAGE



PREPARED BY:
N H VOLKER & Co. PTY. LTD.
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BEENLEIGH QLD 4207
EMAIL: nvolker@bigpond.net.au

CLIENT: BELIVAH PTY. LTD.

PROPOSED LOTS 376-399

PROJECT : DAB - STAGES 3D

LOCATION: JIM DAVIDSON BLVD, BELIVAH

Job No. - DB-3-ABCD

SHEET No. - 10 OF 11

REVISION. - V1

DATE: 25/10/2021
DRAWN: AB
EMAIL: nvolker@bigpond.net.au
PH: 0411 759 765

DAVIDSONS AT BELIVAH

STAGE 3A, 3B, 3C & 3D

DEVELOPMENT CRITERIA

1.0 BUILDING HEIGHT

1.1 Development has a maximum building height of 2 storeys

2.0 SITE COVER

2.1 Development does not exceed the site cover in Table 1 on this sheet.

3.0 SET BACKS

3.1 Development complies with the setbacks in Table 2A on each Stage Building Envelope Sheet and Figure 1 on this sheet.

4.0 BUILD TO BOUNDARY WALLS

4.1 Development ensures that built to boundary walls should not exceed the lesser of 25m or the length indicated in Table 2 and Figure 2 on this sheet.

5.0 DWELLING ENTRY

5.1 Development results in the entry to the dwelling house being covered, lit and visible from the street.

5.2 Development results in the dwelling house having windows to habitable rooms or balconies on the façades facing the street

6.0 CAR PARKING

6.1 Development provides a minimum number of on-site car parking spaces comprising:
(a) Each dwelling (3 or more bedrooms) must be provided with two car parks one of which must be under cover (e.g. carport or garage).
(b) One or two bedroom dwellings must be provided with one undercover car park; and
(c) 0.25 visitor spaces per dwelling for multiple dwellings (other than multiple dwellings comprising only three or four dwellings).

6.2 Dimensions are as per Australian Building Standards

6.3 Car parking spaces may be in tandem, provided one space is behind the road setback required

7.0 PRIVATE OPEN SPACE

7.1 Lots greater than 300m2 Development provides private open space which is:
- a minimum of 25 m2 and
- a minimum dimension of 4.0 m

7.2 Lots less than or equal to 300sqm2 Development provides private open space which is:
- a minimum of 6% of the area of the lot
- a minimum dimension of 3.0m

7.3 Private open space should have a maximum gradient not exceeding 1:10 and

7.4 May be provided by way of balconies where the living areas are on the first floor with a minimum area of 6 m2 and minimum dimension of 1.5m.

8.0 PRIVACY

8.1 Windows to habitable rooms of a dwelling house are separated a minimum of 2m at ground level or 9m above ground level to habitable rooms of another dwelling.

8.2 Where windows to habitable rooms of a dwelling are within 2m at ground level or 9m above ground level to habitable rooms of another dwelling, development incorporates windows that:
- Are offset from another window of a habitable room in an adjacent dwelling to minimise direct overlooking; or
- Have sill heights of 1.5m above floor level; or
- Are covered by fixed obscure glazing in any part of the window below 1.5m above floor level
- Have fixed external screens
- In the case of screening for a ground floor level, fencing to a height of 1.5m above ground floor level.

8.3 Development that results in a direct view from balconies, terraces decks or roof decks into windows of habitable rooms, balconies, terraces and decks in an adjacent dwelling, ensures that the view is screened from floor level to a height of 1.5m above floor level.

8.4 Where screening is used, it:
- is a solid translucent window or screen; or
- perforated or slated panels; or
- a fixed louvre, translucent window or screen which has a maximum 25% opening; and
- is permanently fixed, durable and designed to complement the development.

9.0 FENCING

9.1 Development ensures that the height of a new fence on a street frontage is a maximum of:
(i) 1.2m, where fence construction is solid or less than 50% transparent; or
(ii) 1.5m, where fence construction is at least 50% transparent; or
(iii) 1.5m and solid where it surrounds the dwelling's private open space area
(iv) 1.8m and solid, where the site is on an arterial road; or
(v) no fencing is provided or
(vi) fences or walls with less than 25% transparency do not exceed 10 metres in length without some articulation or detailing to provide visual interest

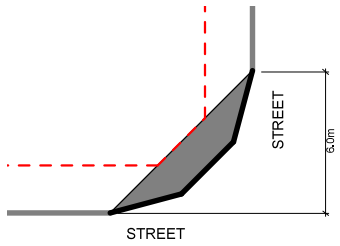
10.0 REFUSE STORAGE

10.1 One refuse bin store area with a minimum size of 1.7m X .9m and screened from the street is to be provided per lot.

TABLE 1 SITE COVER

SITE COVER (BY LOT SIZE)		
< 200m²	200 - < 300m²	300m² +
80%	160m² OR 70% OF THE SITE AREA, WHICHEVER IS THE GREATER	210m² OR 60% OF THE SITE AREA, WHICHEVER IS THE GREATER

FIGURE 1 SETBACK ON CORNERS



Setback line as per Table 2 & 3, no buildings allowed within shaded area

Davidson's At Belivah

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CLIENT: BELIVAH PTY. LTD.

PLAN OF DEVELOPMENT

PROJECT: STAGE 3A-D

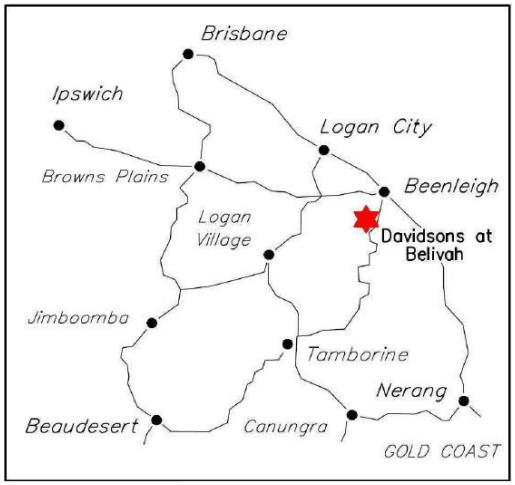
LOCATION: JIM DAVIDSON BOULEVARDE, BELIVAH

Job No. DB-3-ABCD

SHEET No. 11 OF 11
REVISION V1

DATE: 25/10/2022
DRAWN: AB
EMAIL: nvolker@bigpond.net.au
PH: 0411 759 765

ATTACHMENT 3 – BULK EARTHWORKS DRAWINGS (OW/73/2021)



LOCALITY PLAN
N.T.S.

PROPERTY DESCRIPTION

PART OF LOT 2 SP290601

DAVIDSONS at BELIVAH

BELIVAH ROAD, BELIVAH

LOGAN CITY COUNCIL

BELIVAH PTY LTD

PROPOSED BULK EARTHWORKS

STAGES 2, 3 & 4

LOGAN CITY COUNCIL
APPROVED PLAN OF DEVELOPMENT
This is the approved plan of development for Development Application
OW/73/2021

NOTES:-

1. Topsoil shall be stripped to a depth of 75mm for all cut and fill areas and shall be stockpiled in a suitable location as agreed by the Superintendent, and respread to have a minimum of 75mm compacted thickness to all disturbed areas including batters and in accordance with Council's current Earthworks Standard Specification.
2. Proposed Contours represent finished surface inclusive of topsoil.
3. All fill placed on site shall comprise of natural earth and rock and is to be free of contaminants, noxious, hazardous, deleterious and organic materials.
   Suitable fill material is deemed to comply with the requirements of clause 4.3, AS 3798, Guideleines on Earthworks for Commercial and Residential Developments.
4. Compaction testing shall be performed by an approved N.A.T.A. testing authority in accordance with the Local Authority testing requirements.
5. Site earthworks shall be completed with Level Two supervision in accordance with AS 3798-2007.
6. The use of vibratory compaction equipment (other than hand held devices) within 100m of any building or structure is strictly prohibited.
7. Notwithstanding the extent of works shown on the drawings, the Contractor is not permitted to carry out works outside the extent of the site without first obtaining the permission of the owner.
8. Provision shall be made for site to be maintained in a clean and tidy state at all times. Satisfactory arrangements shall be made for the collection, storage and disposal of all waste materials.
9. The Contractor is responsible for organising As Constructed survey. As Constructed plans shall be prepared by a Registered Surveyor in accordance with Council requirements and be forwarded to the Superintendent.
10. The Contractor is responsible for maintaining Council's construction tolerances. Any works deemed non-acceptable shall be rectified at the Contractors cost.
11. Upon the completion of the eathworks and the respreading on the topsoil, the distubance area is to be seeded in accordance with Council's standard specifications.

DRAWING LIST

DRAWING No.	DRAWING TITLE
DAB-ST-234-BW-01	COVER SHEET, LOCALITY PLAN AND NOTES
DAB-ST-234-BW-02	PROPOSED BULK EARTWORKS PLAN - STAGE PLAN
DAB-ST-234-BW-03	BULK EARTHWORKS PLAN - LAYOUT
DAB-ST-234-BW-04	EAST WEST CROSS SECTIONS SHEET 1 OF 2
DAB-ST-234-BW-05	EAST WEST CROSS SECTIONS SHEET 2 OF 2
DAB-ST-234-BW-06	NORTH SOUTH CROSS SECTIONS SHEET 1 OF 2
DAB-ST-234-BW-07	NORTH SOUTH CROSS SECTIONS SHEET 2 OF 2
DAB-ST-234-BW-08	SEDIMENT AND EROSION CONTROL PLAN
DAB-ST-234-BW-09	SEDIMENT BASIN DESIGN AND MAIN DRAIN LONGITUDINAL SECTION
DAB-ST-234-BW-10	SEDIMENT AND EROSION CONTROL NOTES
DAB-ST-234-BW-11	SEDIMENT AND EROSION DETAILS AND NOTES

JBT - CONSULTING - BRAD TITE
PO BOX 1350
SPRINGWOOD QLD 4150
Phone 07 3207 3399 RPEQ 2673
Mbl Phone: 0408 712 538 Email: btite@jbtconsulting.com.au

ASSOCIATED CONSULTANT
N H VOLKER & Co. PTY. LTD.
P O Box 411
BEENLEIGH QLD 4207
EMAIL: nvolker@bigpond.net.au

CLIENT: BELIVAH PTY. LTD.
PO BOX 411
BEENLEIGH QLD 4207
EMAIL: nvolker@bigpond.net.au

DESIGNED: AB
DRAWN: AB
CHECKED BT
DATE: 24/05/2021

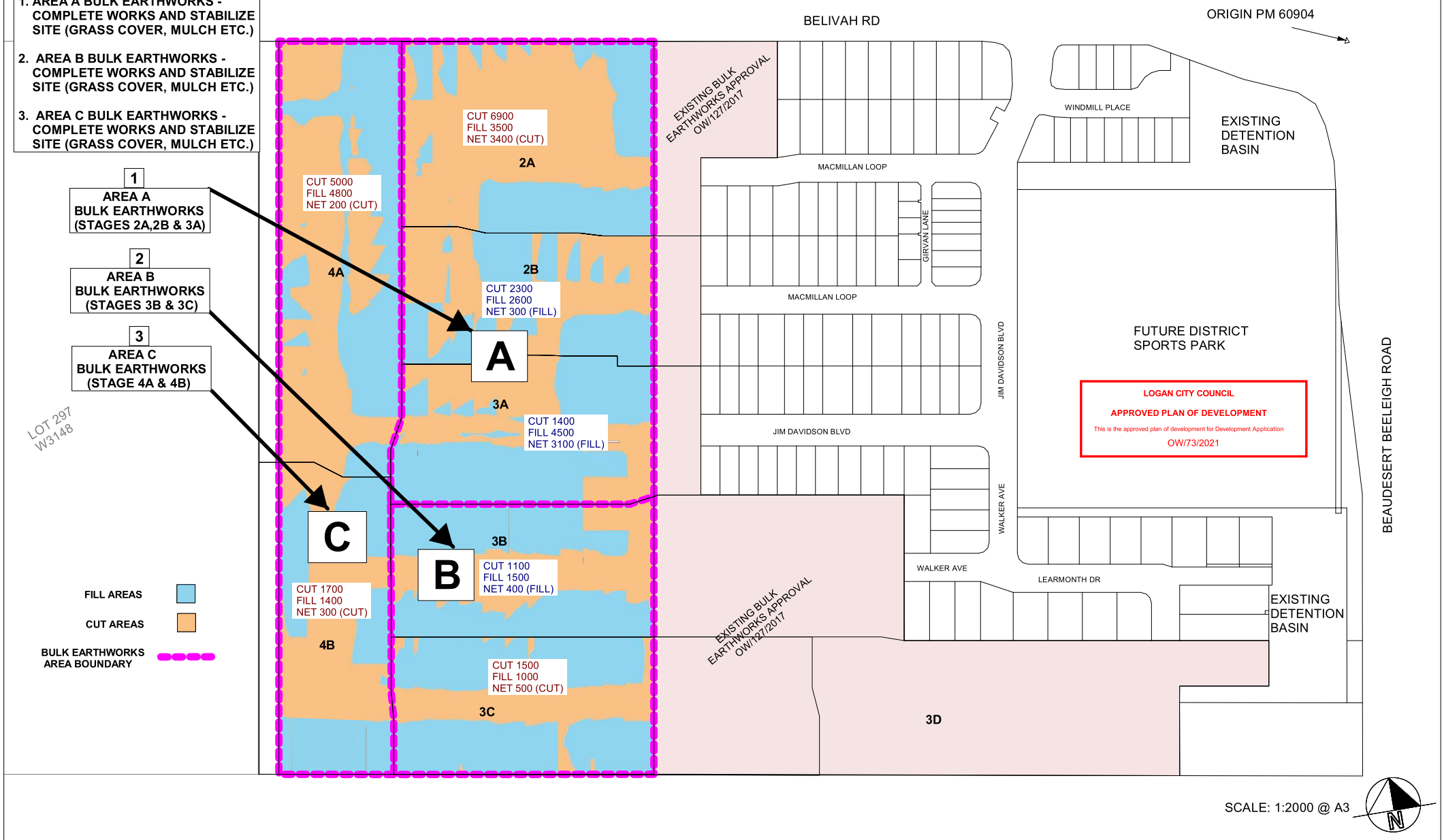
APPROVED:
DATE: 24/05/2021
BRAD TITE - RPEQ 2673

PROJECT : DAVIDSONS AT BELIVAH - BULK EARTHWORKS - STAGES 1, 2 & 3
LOCATION: BELIVAH ROAD, BELIVAH
SHEET TITLE: BULK EARTHWORKS LAYOUT - COVER

DRAWING NO. DAB-ST-234-BW-01
REV A
DATE: 12/03/2021
DRAWN: AB
EMAIL: nvolker@bigpond.net.au
PH: 0411 759 765

SCHEDULE OF WORKS

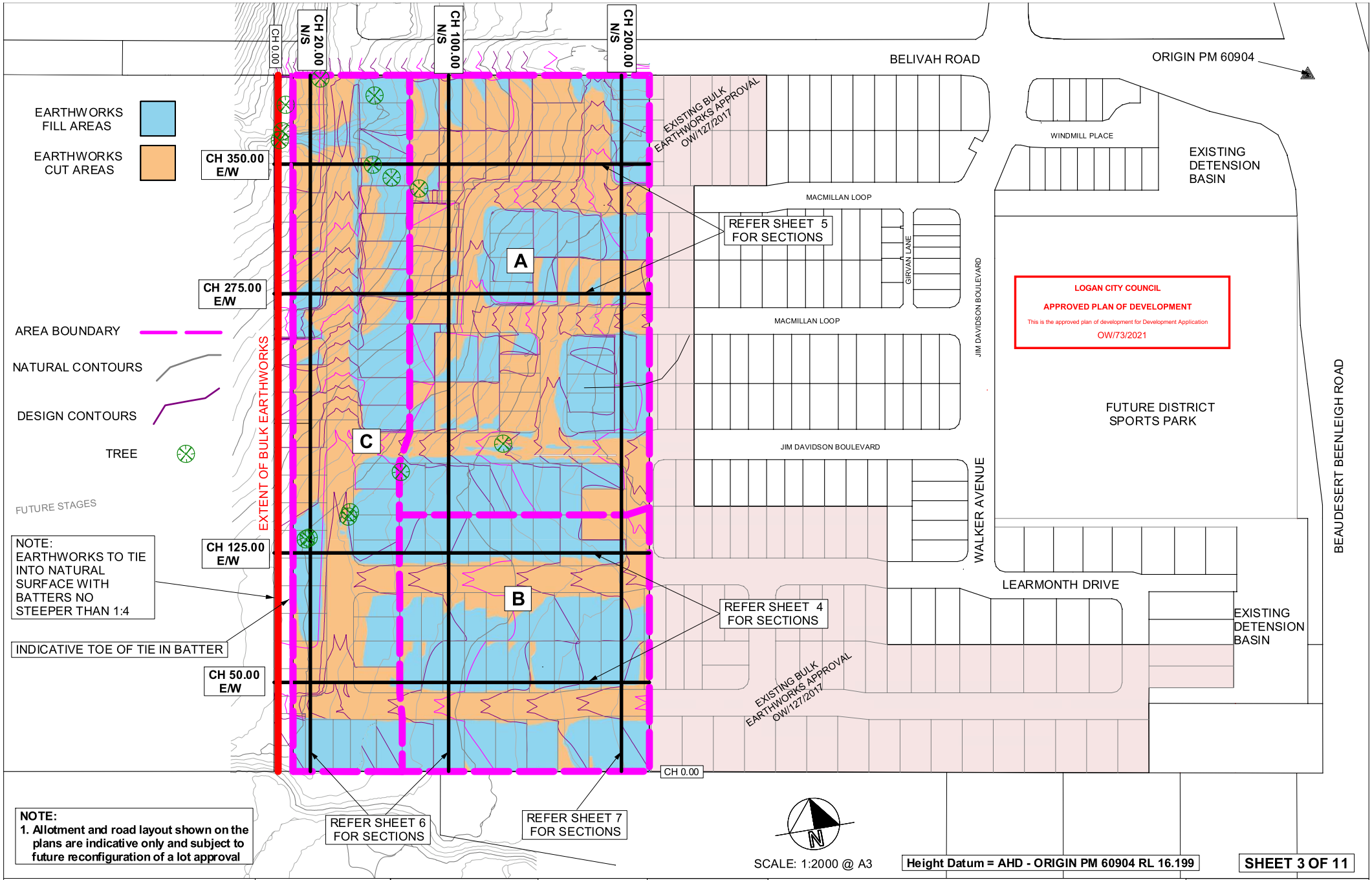
1. AREA A BULK EARTHWORKS - COMPLETE WORKS AND STABILIZE SITE (GRASS COVER, MULCH ETC.)
2. AREA B BULK EARTHWORKS - COMPLETE WORKS AND STABILIZE SITE (GRASS COVER, MULCH ETC.)
3. AREA C BULK EARTHWORKS - COMPLETE WORKS AND STABILIZE SITE (GRASS COVER, MULCH ETC.)



Height Datum = AHD origin PM 60904 RL 16.199

SHEET 2 OF 11

JBT - CONSULTING - BRAD TITE PO BOX 1350 SPRINGWOOD QLD 4150 Phone 07 3207 3399 RPEQ 2673 Mbl Phone: 0408 712 538 Email: btite@jbtconsulting.com.au	ASSOCIATED CONSULTANT N H VOLKER & Co. PTY. LTD. P O Box 411 BEENLEIGH QLD 4207 EMAIL: nvolker@bigpond.net.au	CLIENT: BELIVAH PTY. LTD. PO BOX 411 BEENLEIGH QLD 4207 EMAIL: nvolker@bigpond.net.au	DESIGNED: AB DRAWN: AB CHECKED BT DATE: 24/05/2021	APPROVED: DATE: 24/05/2021 BRAD TITE - RPEQ 2673	PROJECT : DAVIDSONS AT BELIVAH - BULK EARTHWORKS - STAGES 2, 3 & 4 LOCATION: BELIVAH ROAD, BELIVAH SHEET TITLE: BULK EARTHWORKS STAGE PLAN	DRAWING NO. DAB-ST-234-BW-02 REV A DATE: 19/05/2021 DRAWN: AB EMAIL: nvolker@bigpond.net.au PH: 0411 759 765



JBT - CONSULTING - BRAD TITE
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CLIENT: BELIVAH PTY. LTD.
PO BOX 411
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EMAIL: nvolker@bigpond.net.au

DESIGNED: AB
DRAWN: AB
CHECKED BT
DATE: 24/05/2021

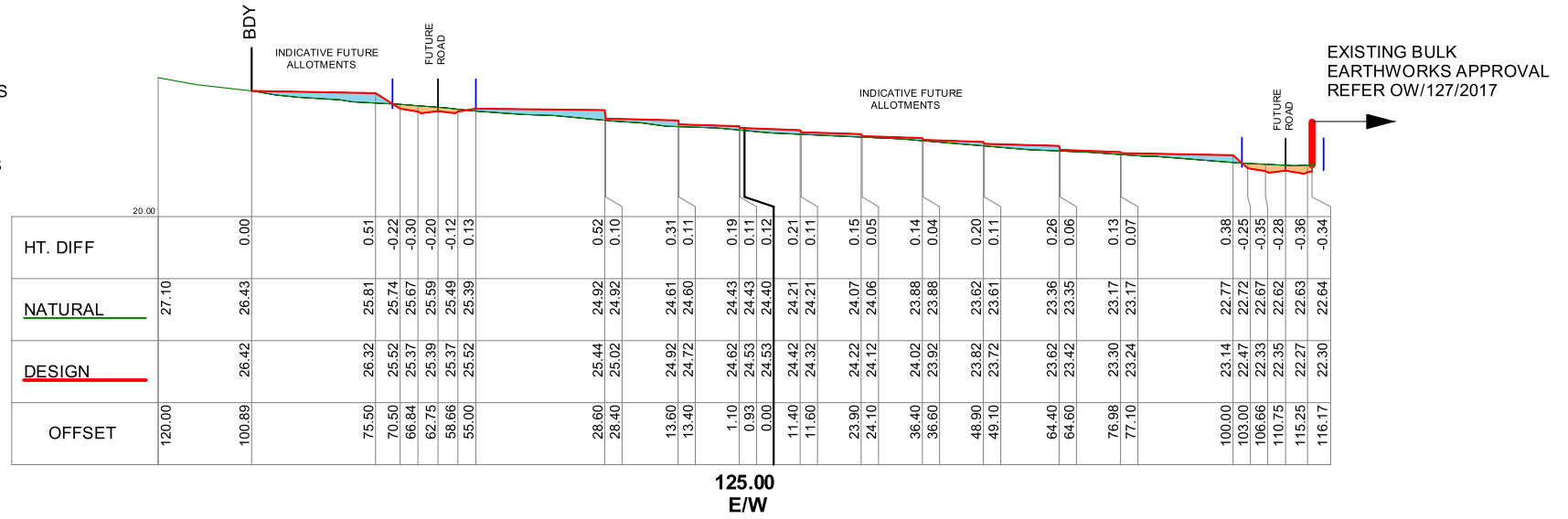
APPROVED:
DATE: 24/05/2021
BRAD TITE - RPEQ 2673

PROJECT : DAVIDSONS AT BELIVAH - BULK EARTHWORKS - STAGES 2, 3 & 4
LOCATION: BELIVAH ROAD, BELIVAH
SHEET TITLE: PROPOSED BULK EARTHWORKS LAYOUT PLAN

DRAWING NO. DAB-ST-234-BW-03
REV A
DATE: 20/05/2021
DRAWN: AB
EMAIL: nvolker@bigpond.net.au
PH: 0411 759 765

EARTHWORKS CUT AREAS

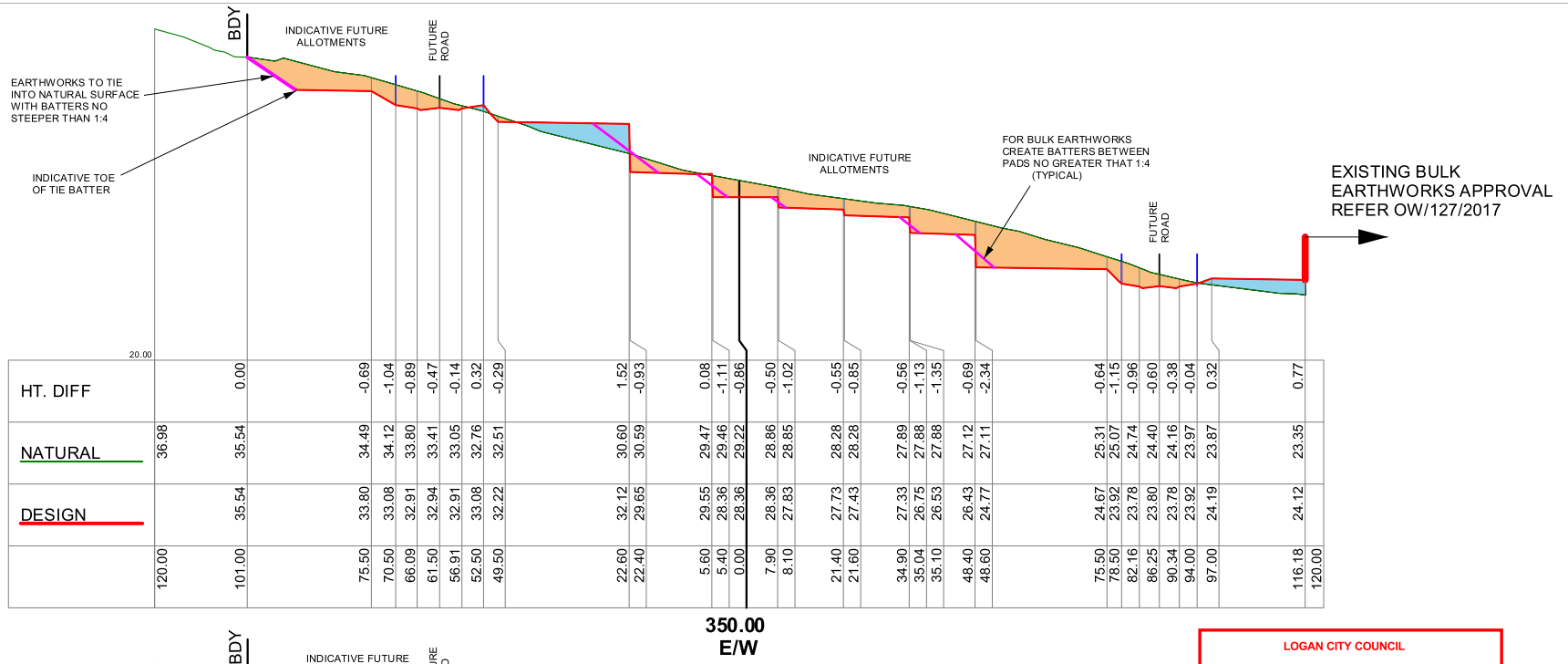
EARTHWORKS FILL AREAS



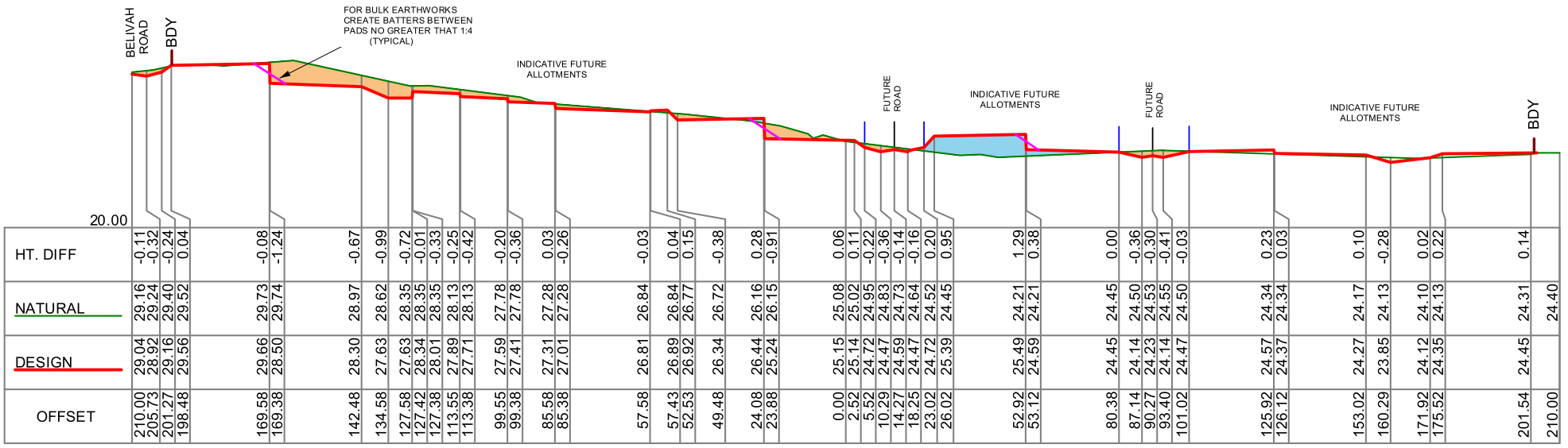
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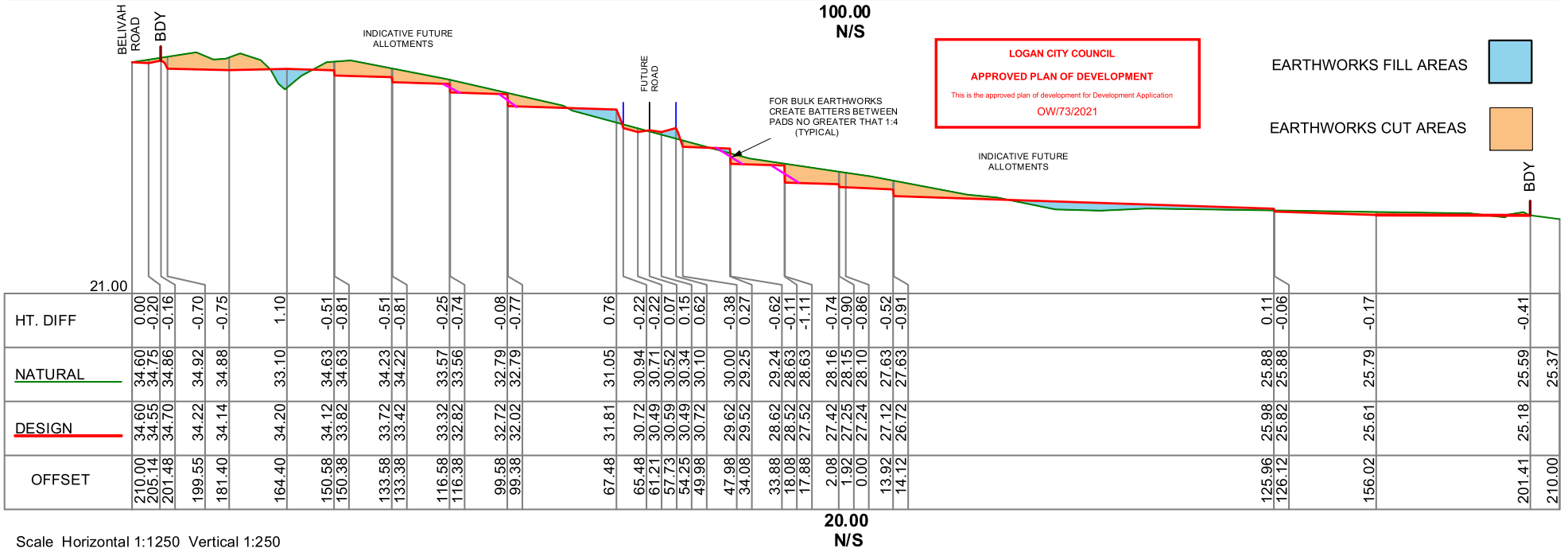
EARTHWORKS CUT AREAS

EARTHWORKS FILL AREAS



| | | |





LOGAN CITY COUNCIL
APPROVED PLAN OF DEVELOPMENT
This is the approved plan of development for Development Application
OW/73/2021

EARTHWORKS FILL AREAS

EARTHWORKS CUT AREAS

Scale Horizontal 1:1250 Vertical 1:250

SHEET 6 OF 11

JBT - CONSULTING - BRAD TITE PO BOX 1350 SPRINGWOOD QLD 4150 Phone 07 3207 3399 RPEQ 2673 Mbl Phone: 0408 712 538 Email: btite@jbtconsulting.com.au	ASSOCIATED CONSULTANT N H VOLKER & Co. PTY. LTD. P O Box 411 BEENLEIGH QLD 4207 EMAIL: nvolker@bigpond.net.au	CLIENT: BELIVAH PTY. LTD. PO BOX 411 BEENLEIGH QLD 4207 EMAIL: nvolker@bigpond.net.au	DESIGNED: AB DRAWN: AB CHECKED BT DATE:24/05/2021	APPROVED: DATE:24/05/2021 BRAD TITE - RPEQ 2673	**PROJECT :** DAVIDSONS AT BELIVAH - BULK EARTHWORKS - STAGES 2, 3 & 4 **LOCATION:** BELIVAH ROAD, BELIVAH **SHEET TITLE:** SITE CROSS SECTIONS (NORTH/SOUTH) 1 OF 2	DRAWING NO. DAB-ST-234-BW-06 REV A DATE: 19/05/2021 DRAWN: AB EMAIL: nvolker@bigpond.net.au PH: 0411 759 765

LOGAN CITY COUNCIL

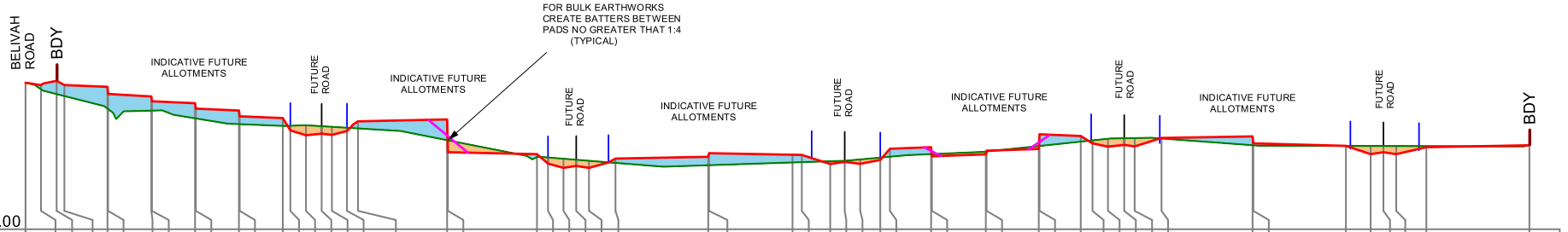
APPROVED PLAN OF DEVELOPMENT

This is the approved plan of development for Development Application

OW/73/2021

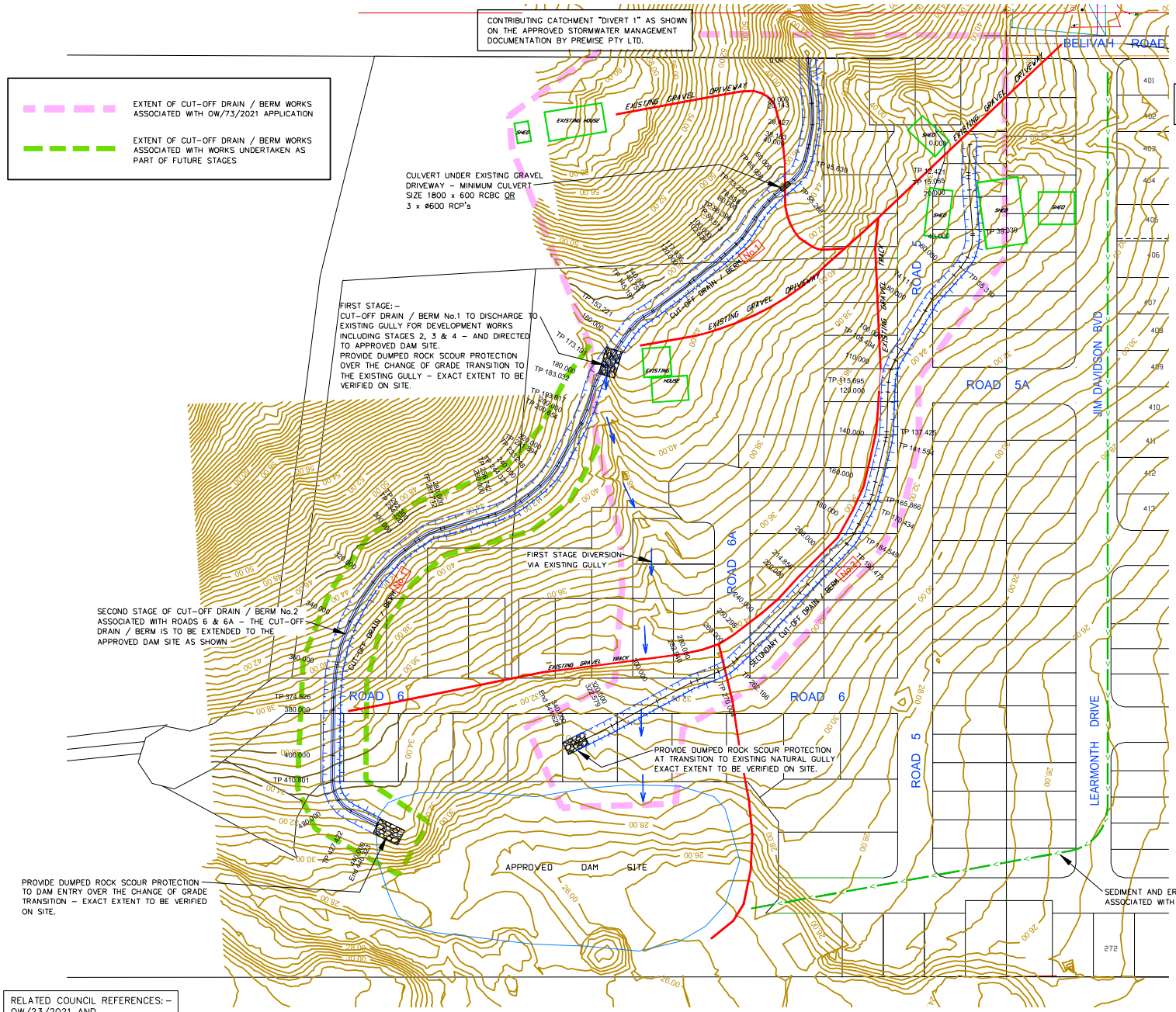
EARTHWORKS FILL AREAS

EARTHWORKS CUT AREAS



18.00

| | | |



LAYOUT PLAN N.T.S.

DIAL BEFORE YOU DIG www.1100.com.au

NOTES:
1. MAINTAIN EXISTING GRAVEL DRIVEWAYS.
2. PROPOSED CUT-OFF DRAIN / BERM CONSTRUCTION IS NOT TO ADVERSELY AFFECT THE EXISTING GRAVEL DRIVEWAY FORMATION.
3. SEDIMENT AND EROSION CONTROL MEASURES ARE TO BE IMPLEMENTED DURING THE CUT-OFF DRAIN / BERM CONSTRUCTION UTILISING BEST PRACTICE METHODS.
4. BERM CONSTRUCTION COMPACTION TO COMPLY WITH MINIMUM STANDARDS.
5. ALL DISTURBED AREAS AND CONSTRUCTED BERM ARE TO BE TOP SOILED AND SEEDED IMMEDIATELY FOLLOWING FINAL PROFILING.

NOTE:
THIS DRAWING SHOWS THE "PROPOSED" HORIZONTAL ALIGNMENTS FOR THE CUT-OFF DRAIN/ BERMS AS DETERMINED ON SITE. THE FINAL / AS CONSTRUCTED ALIGNMENTS MAY BE ALTERED DURING CONSTRUCTION TO BETTER SUIT THE NATURAL TERRAIN.

ALIGNMENTS ARE TO BE VERIFIED BY THE SUPERVISOR PRIOR TO THE COMMENCEMENT OF WORKS

FINAL ALINMENTS ARE TO BE CLARIFIED WITH THE AS CONSTRUCTED INFORMATION AT THE COMPLETION OF THE WORKS.

NOTE:
THIS LAYOUT PLAN AND THE ASSOCIATED LONGITUDINAL SECTIONS AND CROSS SECTIONS (DWG's DB-ST2-DD02 TO DD04) HAVE BEEN PREPARED TO SHOW THE PROPOSED DIVERSION AND CONVEYANCE OF CATCHMENTS "DIVERT1" AND "DIVERT2" AS PER THE APPROVED STORMWATER MANAGEMENT DOCUMENTATION BY PREMISE PTY. LTD.

RELATED COUNCIL REFERENCES:–
OW/23/2021 AND
OW/73/2021

LOGAN CITY COUNCIL

APPROVED PLAN OF DEVELOPMENT

This is the approved plan of development for Development Application

OW/73/2021

NOTE:
FOR CONTRIBUTING CATCHMENT AND DESIGN DETAILS REFER TO DRAWING DB-ST2-DD05

REFER TO DRAWINGS DB-ST2-DD02 TO DD04 FOR CUT-OFF DRAIN / BERM LONGITUDINAL AND CROSS SECTIONS

RELATED COUNCIL REFERENCES:–
OW/23/2021 AND
OW/73/2021

ISSUE FOR APPROVAL

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Associated Consultant
N H Volker & Co. Pty Ltd
P O Box 411
BEENLEIGH QLD 4207
Email - nvolker@bigpond.net.au

REVISION		DATE
C	WORK EXTENTS ADDED AT COUNCIL'S REQUEST	08/21
B	AMENDS FOR FINAL APPROVAL	08/21
A	ORIGINAL ISSUE FOR APPROVAL	07/21

CLIENT Belivah Pty Ltd

PROJECT
DAVIDSONS at BELIVAH
Belivah Road, BELIVAH
STAGE 2A / 2B

DRAWING
CUT-OFF DRAIN / BERM
LAYOUT PLAN

DRAWN RMM DATE 07/21
APPROVED BRAD TITE - RPEQ 2673 DATE 05/08/21
DWG. NO. DB-ST2-DD01 REVISION C

FILE E:\DDATA\Jamie Davidson\Design Folder\Stage 2 2021\External Catchments\LAYOUT 27072021.dwg

PLOT DATE: 24 August, 2021 - 7:32am

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COMPLETED AS PART OF OW/73/2021
EXTENT OF FIRST STAGE
SECOND STAGE - FUTURE WORKS
CUT-OFF DRAIN / BERM CONSTRUCTION
CUT-OFF DRAIN / BERM CONSTRUCTION

PROP BDY

CH 60.0 - INDICATIVE LOCATION OF DRIVEWAY CULVERTS

PROVIDE DUMPED ROCK SCOUR PROTECTION OVER THE CHANGE OF GRADE TRANSITION TO THE EXISTING GULLY - EXACT EXTENT TO BE VERIFIED ON SITE.

DRAIN INVERT LINE

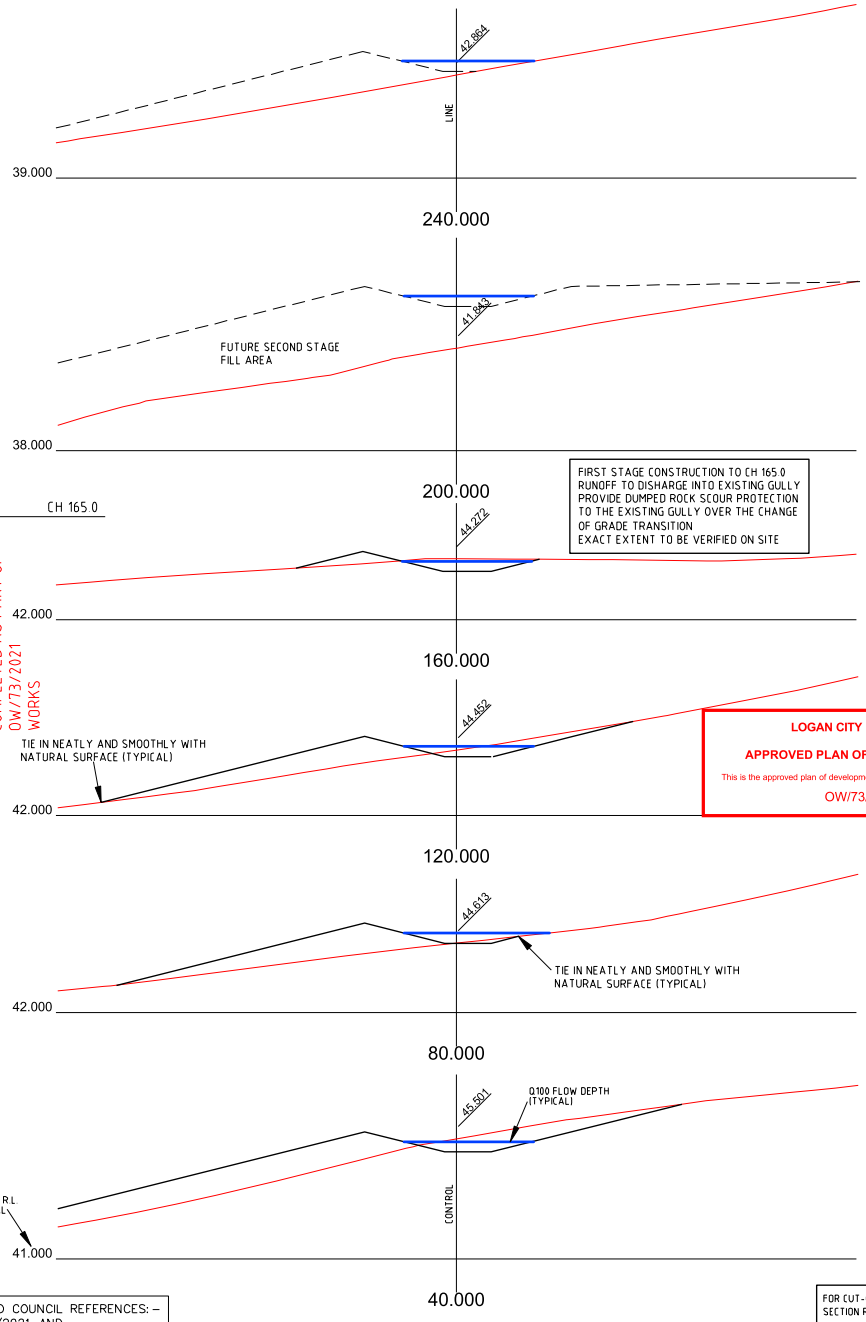
REFER TO DRAWING DB-ST2-DD03 FOR CUT-OFF DRAIN / BERM CROSS SECTIONS

Natural Surface Line

APPROVED DAM SITE

I.P. 45.400 | -1.000% | I.P. 42.140 | 15.000 | -10.710% | I.P. 36.943 | -8.399% | 10.000 | -1.008% | I.P. 32.500 | I.P. 32.370

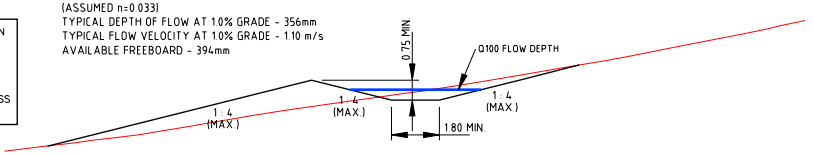
| | | |



FIRST STAGE CONSTRUCTION TO CH 165.0 RUNOFF TO DISHARGE INTO EXISTING GULLY PROVIDE DUMPED ROCK SCOUR PROTECTION TO THE EXISTING GULLY OVER THE CHANGE OF GRADE TRANSITION EXACT EXTENT TO BE VERIFIED ON SITE

ALL DISTURBED GROUND RESULTING FROM THE CONSTRUCTION OF THE CUT-OFF DRAIN / BERMS ARE TO BE STABILISED USING A COMBINATION OF TURF STRIPS AT 3.0m SPACINGS WITH ALL AREAS IN BETWEEN STRIPS BEING SEEDED. ALL TURF STRIPS AND SEEDED AREAS ARE TO REGULARLY WATERED IN THE INITIAL STAGES TO ENSURE ADEQUATE GRASS STRIKE AND ESTABLISHMENT OF THE REVEGITATION.

DESIGN DISCHARGE - 0.945 cumecs
(ASSUMED n=0.033)
TYPICAL DEPTH OF FLOW AT 1.0% GRADE - 356mm
TYPICAL FLOW VELOCITY AT 1.0% GRADE - 1.10 m/s
AVAILABLE FREEBOARD - 394mm



DIVERT 1 (CUT-OFF DRAIN / BERM No. 1)
CONTRIBUTING CATCHMENT AREA - 9.1 Ha.
C_{10} - 0.27
FREQUENCY FACTOR - 1.2
C_Y - 0.32
T'c - 20 mins.
FROM "PCDrain" - 1% AEP (Q100) DISCHARGE - 1.424 cumecs
CUT-OFF DRAIN / BERM PROFILE: -
n = 0.033, S = 1.0%
RESULTANT DEPTH OF FLOW - 366 mm
RESULTANT FLOW VELOCITY - 1.195 m/s
AVAILABLE FREEBOARD - 384 mm

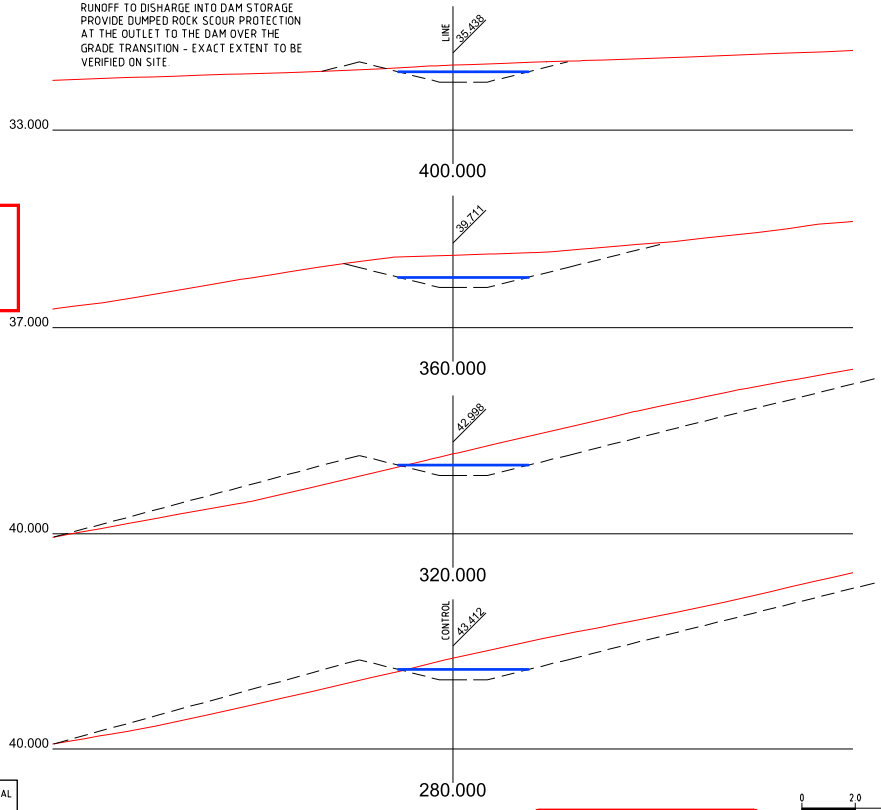
TYPICAL CUT-OFF DRAIN / BERM No.1 SECTION

NOTE:
THIS DRAWING SHOWS THE "PROPOSED" VERTICAL ALIGNMENTS FOR THE CUT-OFF DRAIN/ BERMS AS DETERMINED ON SITE. THE FINAL / AS CONSTRUCTED ALIGNMENTS MAY BE ALTERED DURING CONSTRUCTION TO BETTER SUIT THE NATURAL TERRAIN.

ALIGNMENTS ARE TO BE VERIFIED BY THE SUPERVISOR PRIOR TO THE COMMENCEMENT OF WORKS

FINAL ALIGNMENTS ARE TO BE CLARIFIED WITH THE AS CONSTRUCTED INFORMATION AT THE COMPLETION OF THE WORKS.

FUTURE SECOND STAGE CONSTRUCTION RUNOFF TO DISHARGE INTO DAM STORAGE PROVIDE DUMPED ROCK SCOUR PROTECTION AT THE OUTLET TO THE DAM OVER THE GRADE TRANSITION - EXACT EXTENT TO BE VERIFIED ON SITE.



LOGAN CITY COUNCIL
APPROVED PLAN OF DEVELOPMENT
This is the approved plan of development for Development Application
OW/73/2021

RELATED COUNCIL REFERENCES: -
OW/23/2021 AND
OW/73/2021

FOR CUT-OFF DRAIN / BERM LONGITUDINAL SECTION REFER TO DWG. DB-ST2-DD02

ISSUE FOR APPROVAL

0 2.0 4.0 6.0 8.0
SCALE - VERT. 1:200 (A3 SIZE)

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Mbl. Phone: 0408 712 538 Email: btite@jbtconsulting.com.au

Associated Consultant
N H Volker & Co. Pty Ltd
P O Box 411
BEENLEIGH QLD 4207
Email - nvolker@bigpond.net.au

REVISION		DATE
C	EXTENT OF WORKS NOTE UPDATED, STABILISATION NOTE ADDED	08/21
B	DETAILS ADDED FOR FINAL APPROVAL	08/21
A	ORIGINAL ISSUE FOR APPROVAL	07/21

CLIENT Belivah Pty Ltd
PROJECT
DAVIDSONS at BELIVAH
Belivah Road, BELIVAH
STAGE 2A / 2B

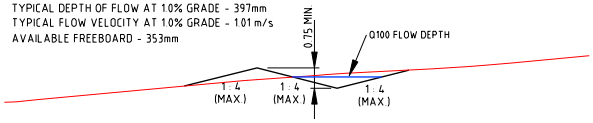
DRAWING
CROSS SECTIONS
CUT-OFF DRAIN / BERM No. 1

DRAWN RMM DATE 07/21
APPROVED BRAD TITE - RPEQ 2673 DATE 05/08/21
DWG. NO. DB-ST2-DD03 REVISION C

FILE E:\DDATA\Jamie Davidson\Design Folder\Stage 2 2021\External Catchments\CHANNEL BERM XS.dwg
PLOT DATE: 24 August, 2021 - 8:20am

DIVERT 2 (CUT-OFF DRAIN / BERM No. 2)
CONTRIBUTING CATCHMENT AREA – 4.6 Ha.
C10 – 0.27
FREQUENCY FACTOR – 1.2
CY – 0.32
T'c – 20 mins.
FROM "PCDrain" – 1% AEP (Q100) DISCHARGE – 0.72 cumecs
CUT-OFF DRAIN / BERM PROFILE: –
n = 0.033, S = 1.0%
RESULTANT DEPTH OF FLOW – 416 mm
RESULTANT FLOW VELOCITY – 1.042 m/s
AVAILABLE FREEBOARD – 334 mm

DESIGN DISCHARGE - 0.63 cumecs
(ASSUMED n = 0.033)
TYPICAL DEPTH OF FLOW AT 1.0% GRADE - 397mm
TYPICAL FLOW VELOCITY AT 1.0% GRADE - 1.01 m/s
AVAILABLE FREEBOARD - 353mm



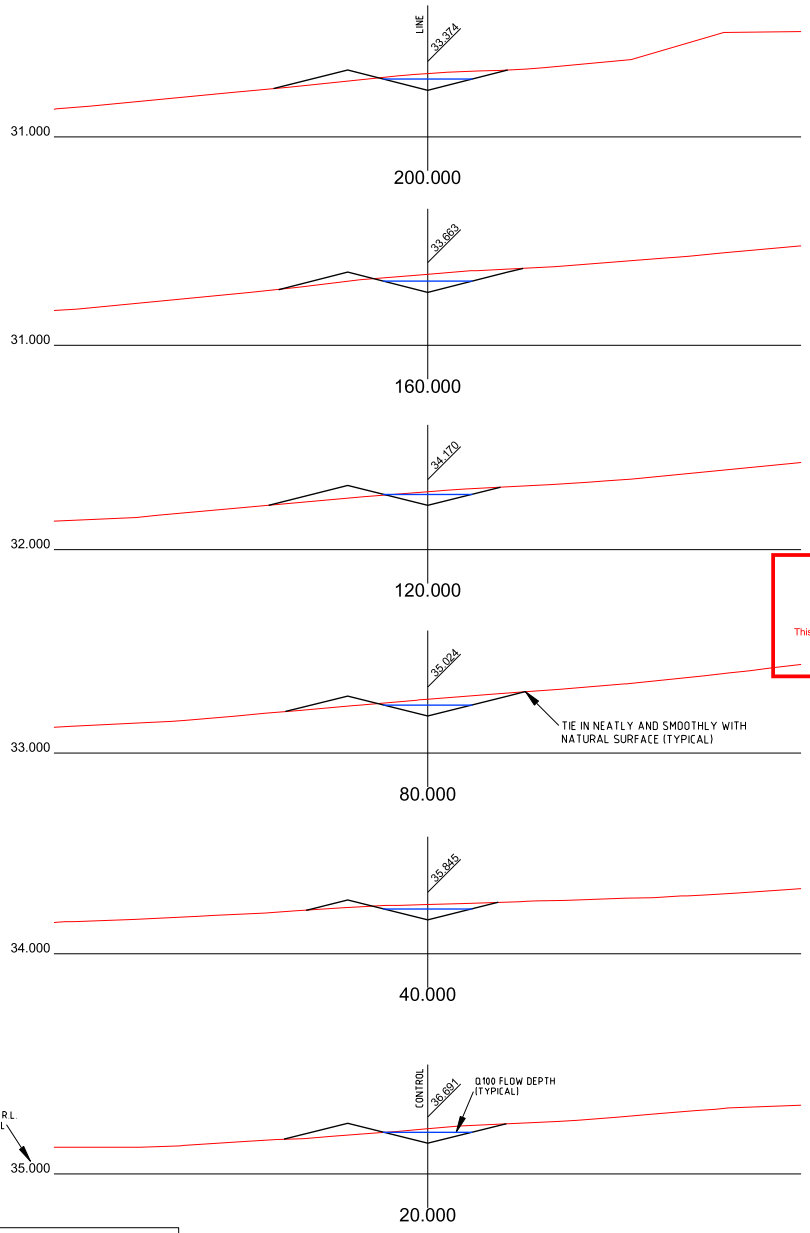
TYPICAL CUT-OFF DRAIN / BERM No.2 SECTION

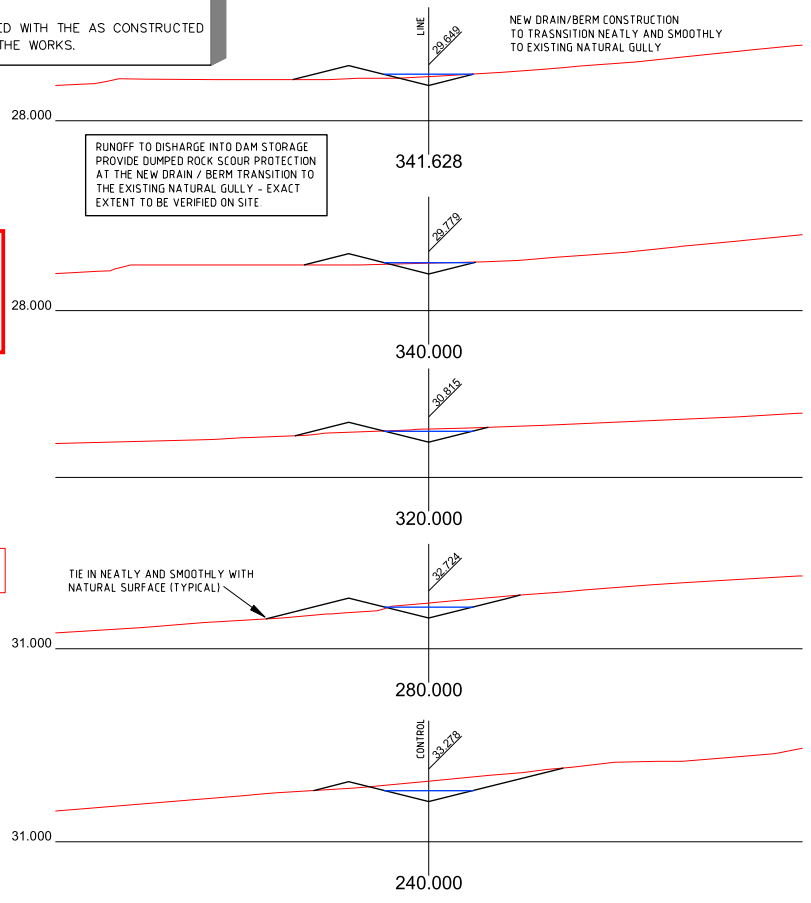
NOTE:
THIS DRAWING SHOWS THE "PROPOSED" VERTICAL ALIGNMENTS FOR THE CUT-OFF DRAIN/ BERMS AS DETERMINED ON SITE. THE FINAL / AS CONSTRUCTED ALIGNMENTS MAY BE ALTERED DURING CONSTRUCTION TO BETTER SUIT THE NATURAL TERRAIN.

ALIGNMENTS ARE TO BE VERIFIED BY THE SUPERVISOR PRIOR TO THE COMMENCEMENT OF WORKS

FINAL ALIGNMENTS ARE TO BE CLARIFIED WITH THE AS CONSTRUCTED INFORMATION AT THE COMPLETION OF THE WORKS.

ALL DISTURBED GROUND RESULTING FROM THE CONSTRUCTION OF THE CUT-OFF DRAIN / BERMS ARE TO BE STABILISED USING A COMBINATION OF TURF STRIPS AT 3.0m SPACINGS WITH ALL AREAS IN BETWEEN STRIPS BEING SEEDED. ALL TURF STRIPS AND SEEDED AREAS ARE TO REGULARLY WATERED IN THE INITIAL STAGES TO ENSURE ADEQUATE GRASS STRIKE AND ESTABLISHMENT OF THE REVEGITATION.





RUNOFF TO DISHARGE INTO DAM STORAGE PROVIDE DUMPED ROCK SCOUR PROTECTION AT THE NEW DRAIN / BERM TRANSITION TO THE EXISTING NATURAL GULLY - EXACT EXTENT TO BE VERIFIED ON SITE.

LOGAN CITY COUNCIL

APPROVED PLAN OF DEVELOPMENT

This is the approved plan of development for Development Application

OW/73/2021

CUT-OFF DRAIN / BERM No. 2 WORKS TO BE COMPLETED AS PART OF OW/73/2021

ALL DISTURBED AREAS AND BERM ARE TO BE TOPSOILED AND SEEDED IMMEDIATELY FOLLOWING FINAL TRIMMING

RELATED COUNCIL REFERENCES: –
OW/23/2021 AND
OW/73/2021

FOR CUT-OFF DRAIN / BERM LONGITUDINAL SECTION REFER TO DWG DB-ST2-DD02

ISSUE FOR APPROVAL

SCALE - VERT. 1:200 (A3 SIZE)

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REVISION		DATE
C	WORK EXTENT AND STABILISATION NOTES ADDED	08/21
B	DETAILS ADDED FOR FINAL APPROVAL	08/21
A	ORIGINAL ISSUE FOR APPROVAL	07/21

CLIENT Belivah Pty Ltd
PROJECT
DAVIDSONS at BELIVAH
Belivah Road, BELIVAH
STAGE 2A / 2B

DRAWING
CROSS SECTIONS
CUT-OFF DRAIN / BERM No. 2

DRAWN RMM DATE 07/21
APPROVED BRAD TITE - RPEQ 2673 DATE 05/08/21
DWG. NO. DB-ST2-DD04 REVISION C

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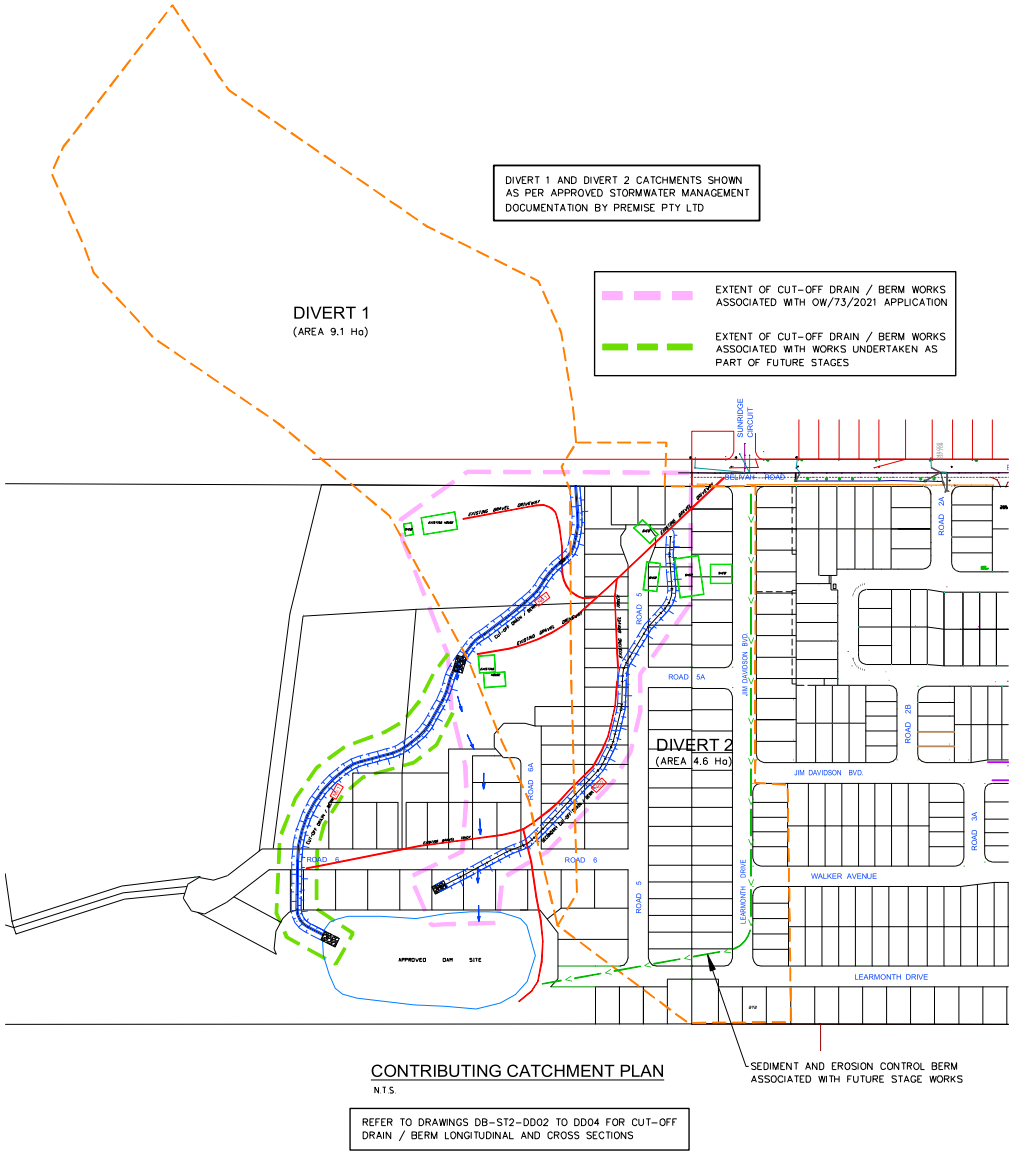
PLOT DATE: 24 August, 2021 - 8:25am

DIAL BEFORE YOU DIG www.1100.com.au

DIVERT 1 AND DIVERT 2 CATCHMENTS SHOWN AS PER APPROVED STORMWATER MANAGEMENT DOCUMENTATION BY PREMISE PTY LTD

EXTENT OF CUT-OFF DRAIN / BERM WORKS ASSOCIATED WITH OW/73/2021 APPLICATION

EXTENT OF CUT-OFF DRAIN / BERM WORKS ASSOCIATED WITH WORKS UNDERTAKEN AS PART OF FUTURE STAGES



CONTRIBUTING CATCHMENT PLAN
N.T.S.

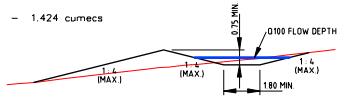
SEDIMENT AND EROSION CONTROL BERM ASSOCIATED WITH FUTURE STAGE WORKS

REFER TO DRAWINGS DB-ST2-DD02 TO DD04 FOR CUT-OFF DRAIN / BERM LONGITUDINAL AND CROSS SECTIONS

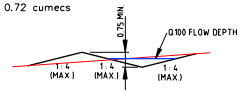
RELATED COUNCIL REFERENCES: – OW/23/2021 AND OW/73/2021

CATCHMENT DETAILS:

DIVERT 1 (CUT-OFF DRAIN / BERM No. 1)
CONTRIBUTING CATCHMENT AREA – 9.1 Ha.
C10 – 0.27
FREQUENCY FACTOR – 1.2
Cv – 0.32
Tc – 20 mins.
FROM "PCDrain" – 1% AEP (Q100) DISCHARGE – 1.424 cumecs
CUT-OFF DRAIN / BERM PROFILE: –
n = 0.033, S = 1.0%
RESULTANT DEPTH OF FLOW – 444 mm
RESULTANT FLOW VELOCITY – 1.258 m/s
AVAILABLE FREEBOARD – 300 mm



DIVERT 2 (CUT-OFF DRAIN / BERM No. 2)
CONTRIBUTING CATCHMENT AREA – 4.6 Ha.
C10 – 0.27
FREQUENCY FACTOR – 1.2
Cv – 0.32
Tc – 20 mins.
FROM "PCDrain" – 1% AEP (Q100) DISCHARGE – 0.72 cumecs
CUT-OFF DRAIN / BERM PROFILE: –
n = 0.033, S = 1.0%
RESULTANT DEPTH OF FLOW – 416 mm
RESULTANT FLOW VELOCITY – 1.042 m/s
AVAILABLE FREEBOARD – 300 mm



ASSOCIATED NOTES:

1. SEDIMENT AND EROSION CONTROL MEASURES ARE TO IMPLIMENTED AS OUTLINED IN THE ORIGINALLY SUBMITTED DOCUMENTATION AND USING APPROPRIATE GOOD PRACTICES SO AS TO MINIMISE THE EFFECTS ON DOWNSTREAM LANDUSE AREAS.

2. ALL DISTURBED GROUND RESULTING FROM THE CONSTRUCTION OF THE CUT-OFF DRAIN / BERMS ARE TO BE STABILISED USING A COMBINATION OF TURF STRIPS AT 3.0m SPACINGS WITH ALL AREAS BETWEEN STRIPS BEING SEEDED.
ALL TURF STRIPS AND SEEDED AREAS ARE TO REGULARLY WATERED IN THE INITIAL STAGES TO ENSURE ADEQUATE GRASS STRIKE AND ESTABLISHMENT OF THE REVEGITATION.

3. AS THE CUT-OOF DRAIN / BERM FLOW VELOCITIES FOR THE TWO CASES ARE RELATIVE LOW (1.258 m/s AND 1.042 m/s), FURTHER EROSION CONTROL MEASURES ARE GENERALLY NOT REQUIRED.
THE IMPLEMENTATION OF INTERMITTENT CHECK DAMS IS TO VERIFIED ON SITE DURING THE WORKS.
WHERE RUNOFF IN THE OW/73/2021 PHASE OF DIVERSION DRAIN No. 1 IS CONVEYED TO THE EXISTING NATURAL GULLY LINE WHICH IS SOUNDLY VEGETATED, CHECK DAMS MAY BE UTILISED TO DISIPATE THE FLOWS PRIOR TO ENTERING THE STORAGE DAM AREA WHERE DIRECTED.

4. THE DETAILS ON THESE DRAWINGS AND THE DETAILS PROVIDED IN THE ORIGINAL SUBMISSION DOCUMENTATION WILL ENSURE THAT THE WORKS WILL RESULT IN: –
   4.1 NO INCREASE IN PEAK FLOW RATES DOWNSTREAM FROM THE SITE;
   4.2 NO INCREASE IN FLOOD LEVELS EXTERNAL TO THE SITE;
   4.3 NO INCREASE IN DURATION OF INUNDATION EXTERNAL TO THE SITE THAT COULD CAUSE LOSS OR DAMAGE.

LOGAN CITY COUNCIL
APPROVED PLAN OF DEVELOPMENT
This is the approved plan of development for Development Application
OW/73/2021

ISSUE FOR APPROVAL

JBT Consulting - Brad Tite
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N H Volker & Co. Pty Ltd
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Email - nvolker@bigpond.net.au

REVISION		DATE
B	WORKS EXTENTS AND NOTES ADDED FOR APPROVAL	08/21
A	ORIGINAL ISSUE FOR APPROVAL	08/21

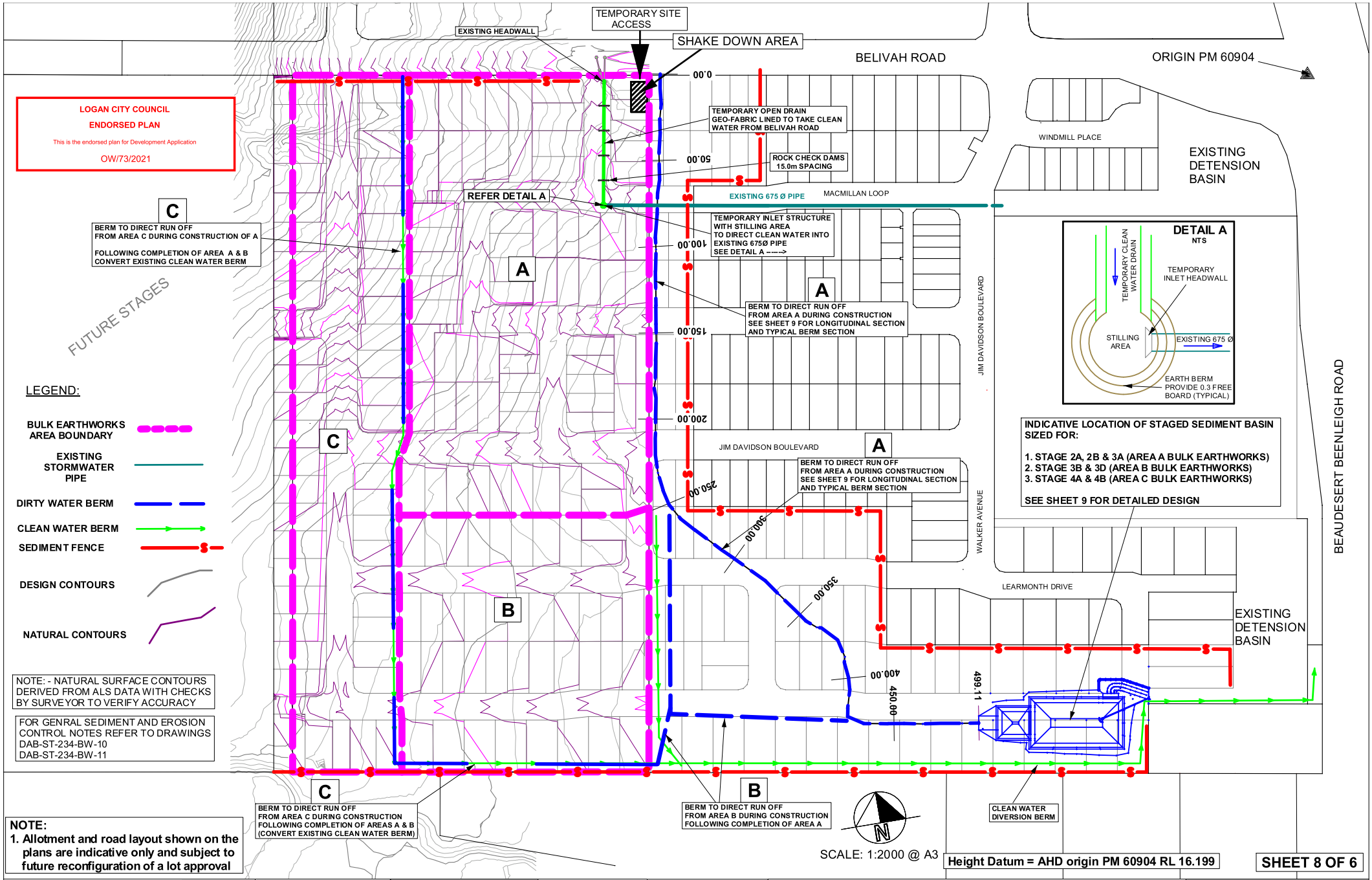
CLIENT Belivah Pty Ltd
PROJECT
DAVIDSONS at BELIVAH
Belivah Road, BELIVAH
STAGE 2A / 2B

DRAWING
CUT-OFF DRAIN / BERM CATCHMENT PLAN

DRAWN RMM DATE 08/21
APPROVED BRAD TITE - RPEQ 2673 DATE 16/08/21
DWG. NO. DB-ST2-DD05 REVISION B

FILE E:\DDATA\Jamie Davidson\Design Folder\Stage 2 2021\External Catchments\LAYOUT 27072021.dwg

PLOT DATE: 24 August, 2021 - 8:10am



JBT - CONSULTING - BRAD TITE
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ASSOCIATED CONSULTANT
N H VOLKER & Co. PTY. LTD.
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EMAIL: nvolker@bigpond.net.au

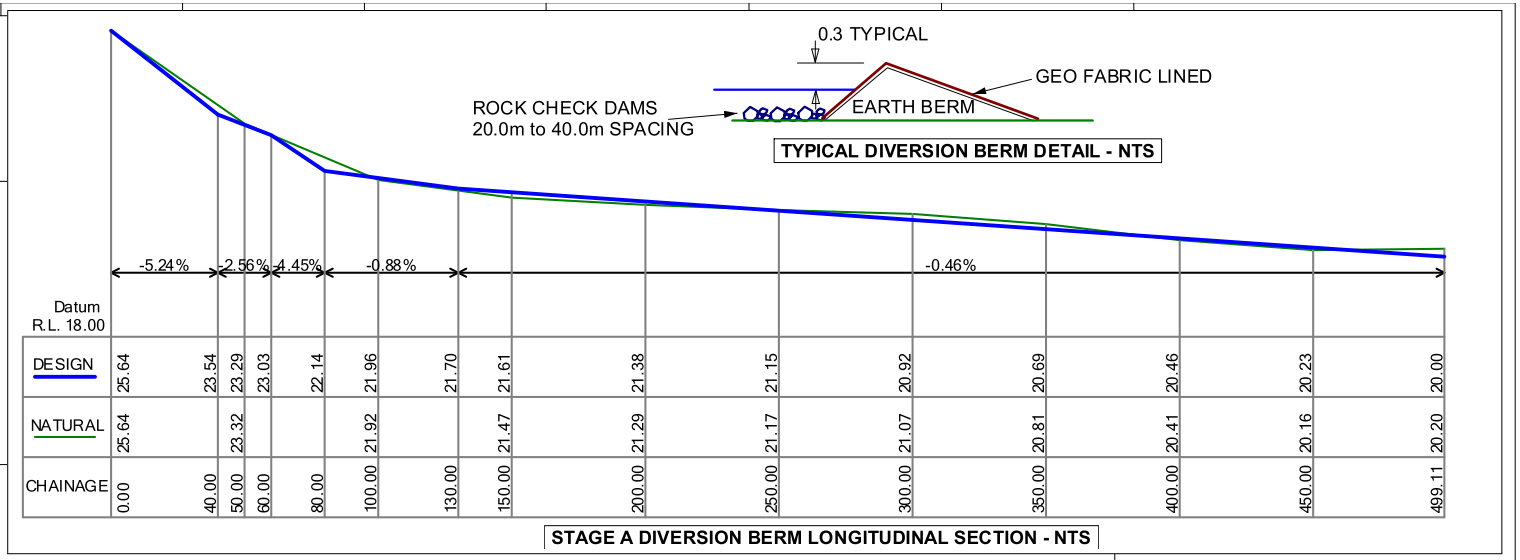
CLIENT: BELIVAH PTY. LTD.
PO BOX 411
BEENLEIGH QLD 4207
EMAIL: nvolker@bigpond.net.au

DESIGNED: AB
DRAWN: AB
CHECKED BT
DATE: 24/05/2021

APPROVED:
DATE: 24/05/2021
BRAD TITE - RPEQ 2673

PROJECT : DAVIDSONS AT BELIVAH - BULK EARTHWORKS - STAGES 2, 3 & 4
LOCATION: BELIVAH ROAD, BELIVAH
SHEET TITLE: SEDIMENT AND EROSION CONTROL PLAN

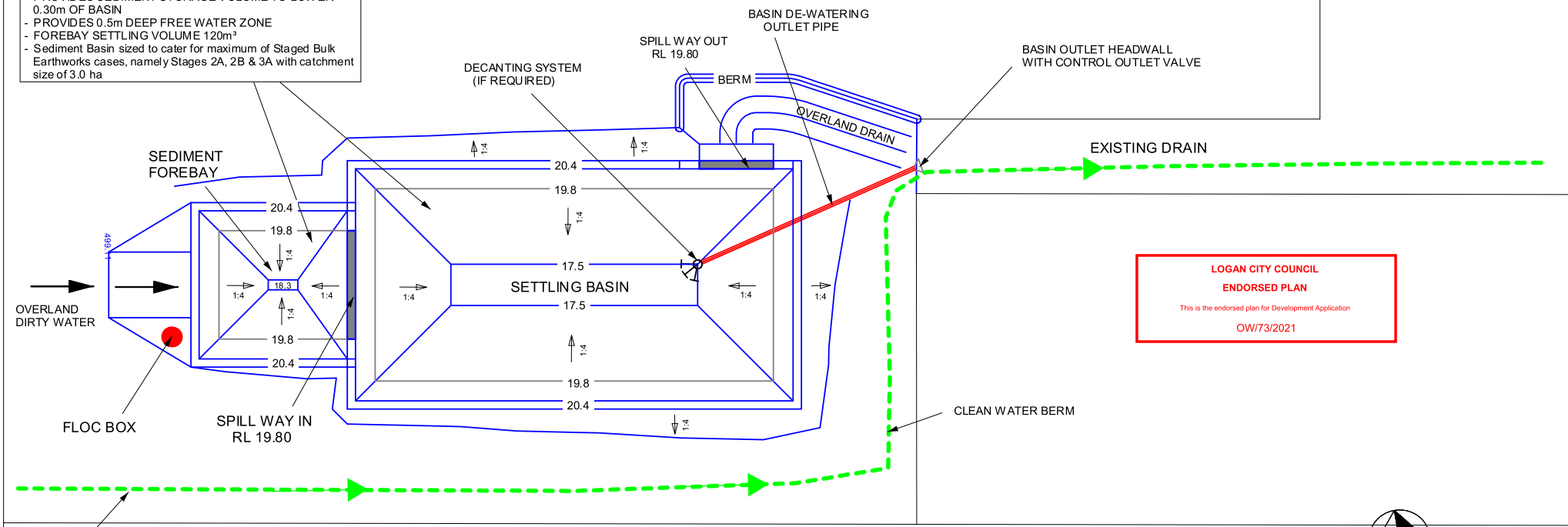
DRAWING NO. DAB-ST-234-BW-08
REV A
DATE: 19/05/2021
DRAWN: AB
EMAIL: nvolker@bigpond.net.au
PH: 0411 759 765



TYPICAL DIVERSION BERM DETAIL - NTS

STAGE A DIVERSION BERM LONGITUDINAL SECTION - NTS

SEDIMENT BASIN - TYPE A (SIZED IN ACCORDANCE WITH ICEA 2018 GUIDELINES)
FLOOR LEVEL AT 17.5m AHD:-
- PROVIDES 1200m³ SETTLING VOLUME TO SPILLWAY CREST AT RL 19.8 AHD.
- PROVIDES SEDIMENT STORAGE VOLUME TO LOWER 0.30m OF BASIN
- PROVIDES 0.5m DEEP FREE WATER ZONE
- FOREBAY SETTLING VOLUME 120m³
- Sediment Basin sized to cater for maximum of Staged Bulk Earthworks cases, namely Stages 2A, 2B & 3A with catchment size of 3.0 ha



LOGAN CITY COUNCIL
ENDORSED PLAN
This is the endorsed plan for Development Application
OW/73/2021

Height Datum = AHD origin PM 60904 RL 16.199

SCALE: 1:500 @ A3

SHEET 9 OF 11

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BEENLEIGH QLD 4207
EMAIL: nvolker@bigpond.net.au

CLIENT: BELIVAH PTY. LTD.
PO BOX 411
BEENLEIGH QLD 4207
EMAIL: nvolker@bigpond.net.au

DESIGNED: AB
DRAWN: AB
CHECKED BT
DATE: 24/05/2021

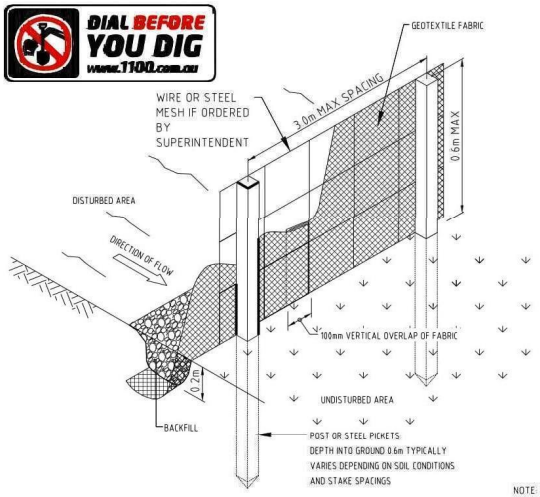
APPROVED:
DATE: 24/05/2021
BRAD TITE - RPEQ 2673

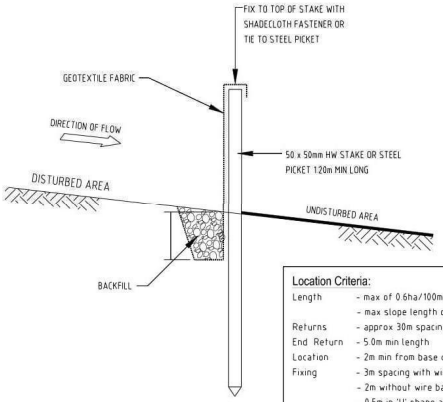
PROJECT : DAVIDSONS AT BELIVAH - BULK EARTHWORKS - STAGES 2, 3 & 4

LOCATION: BELIVAH ROAD, BELIVAH

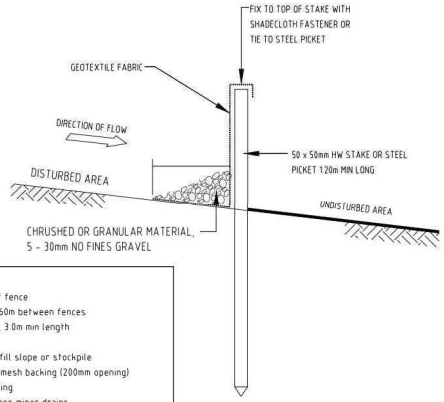
SHEET TITLE: SEDIMENT BASIN DESIGN AND BERM ~~LONGITUDINAL~~ Longitudinal SECTION

DRAWING NO. DAB-ST-234-BW-09
REV A
DATE: 12/03/2021
DRAWN: AB
EMAIL: nvolker@bigpond.net.au
PH: 0411 759 765





ALTERNATIVE 1



ALTERNATIVE 2

Location Criteria:

Length	- max of 0.6ha/100m of fence - max slope length of 60m between fences
Returns	- approx 30m spacings, 3.0m min length
End Return	- 5.0m min length
Location	- 2m min from base of fill slope or stockpile
Fixing	- 3m spacing with wire mesh backing (200mm opening) - 2m without wire backing - 0.5m in 'U' shape across minor drains

300mm high spill through weir provided at low points and 20m spacings for fences installed along contours to control overflow, unless directed otherwise by superintendent

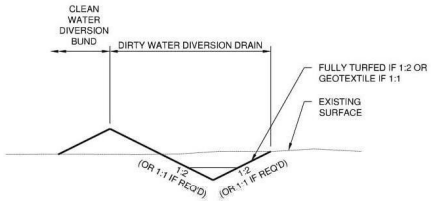
NOTE: 300MM HIGH SPILL THROUGH WEIR PROVIDED AT 20M SPACINGS FOR FENCES INSTALLED ALONG CONTOURS TO CONTROL OVERFLOW

GEOTEXTILE SEDIMENT FENCE

SCALE N.T.S.

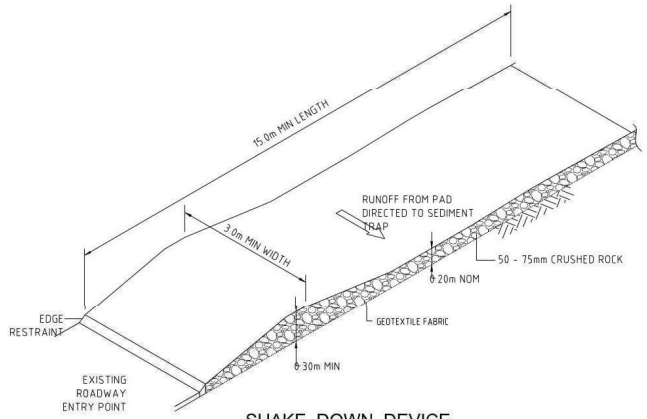
Reference Document: IECA 2008, Best Practice Erosion and Sediment Control. International Erosion Control Association (Australasia), Picton, NSW.

NOTE:
Variations/Alternatives (eg IPWEA standards) may be used with the Superintendent's permission.



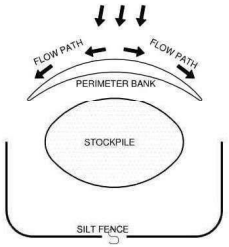
TEMPORARY DIVERSION DRAIN

SCALE N.T.S.



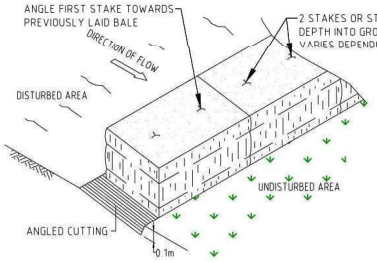
SHAKE DOWN DEVICE

SCALE N.T.S.



STOCKPILE EROSION PREVENTION DETAIL

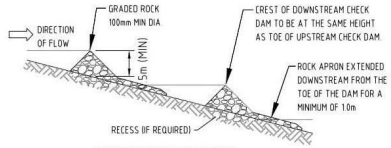
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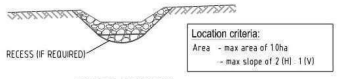
Location criteria:
Area - max area of 0.4ha
- max slope of 1(V) : 2 (h)
Note: In the event of imminent rainfall, straw bales may be temporarily used to direct flows around excavated areas, slopes & trenches.

STRAW BALE FILTER

SCALE N.T.S.



LONGITUDINAL SECTION



CROSS SECTION

NOTES
1. Where slope of channels exceeds 5%, provide rock check dams at 3m spacing.
- >500mm deep use sand/gravel filled bags
- >500mm deep use rock check dams
- for slopes >1:10 use recessed rock check dams

CHECK DAM

SCALE N.T.S.

LOGAN CITY COUNCIL
ENDORSED PLAN
This is the endorsed plan for Development Application
OW/73/2021

SHEET 10 OF 11

JBT - CONSULTING - BRAD TITE PO BOX 1350 SPRINGWOOD QLD 4150 Phone 07 3207 3399 RPEQ 2673 Mbl Phone: 0408 712 538 Email: btite@jbtconsulting.com.au	ASSOCIATED CONSULTANT N H VOLKER & Co. PTY. LTD. P O Box 411 BEENLEIGH QLD 4207 EMAIL: nvolker@bigpond.net.au	CLIENT: BELIVAH PTY. LTD. PO BOX 411 BEENLEIGH QLD 4207 EMAIL: nvolker@bigpond.net.au	DESIGNED: AB DRAWN: AB CHECKED BT DATE: 24/05/2021	APPROVED: DATE: 24/05/2021 BRAD TITE - RPEQ 2673	**PROJECT :** DAVIDSONS AT BELIVAH - BULK EARTHWORKS - STAGES 2, 3 & 4 **LOCATION:** BELIVAH ROAD, BELIVAH **SHEET TITLE:** SEDIMENT AND EROSION CONTROL DETAILS NOTES	DRAWING NO. DAB-ST-234-BW-10 REV A DATE: 12/03/2021 DRAWN: AB EMAIL: nvolker@bigpond.net.au PH: 0411 759 765

ESC GENERAL IMPLEMENTATION SEQUENCE

1. OBTAIN ALL NECESSARY PERMITS AND APPROVALS BEFORE SITE ESTABLISHMENT.
2. IF REQUIRED, HOLD A "PRE-START" MEETING WITH THE SUPERINTENDENT AND COUNCIL REPRESENTATIVES PRIOR TO COMMENCEMENT OF WORKS
3. THE CONTRACTOR SHALL OBTAIN APPROVAL FROM THE LOCAL AUTHORITY AND SUPERINTENDENT IF IT WISHES TO AMEND THE APPROVED ESC PLAN TO SUIT THEIR CONSTRUCTION METHODOLOGY. IN THESE CIRCUMSTANCES THE CONTRACTOR SHALL PREPARE A SUPPLEMENTARY ESC PLAN AND OBTAIN APPROVAL FROM THE LOCAL AUTHORITY AND THE SUPERINTENDENT.
4. IF NOT SPECIFICALLY NOMINATED ON PLANS, STAGING OF EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE CONFIRMED WITH SUPERINTENDENT PRIOR TO CONSTRUCTION.
5. STABILISE AND DELINEATE CONSTRUCTION ACCESS ROUTES AND ENTRY / EXIT POINTS
6. INSTALL OTHER VEGETATION PROTECTION MEASURES
7. ESTABLISH TEMPORARY DRAINAGE MEASURES INCLUDING DIVERSION DRAINS, BUNDS, AND ENERGY DISSIPATERS TO DIVERT CLEAN WATER AROUND DISTURBED AREAS
8. UNDERTAKE MINIMUM CLEARING REQUIRED TO ALLOW ESTABLISHMENT OF ESC MEASURES
9. GRADE THE SITE AND CONSTRUCT DEVELOPMENT WORKS
10. SITE CLEARING, ESC MEASURES, REVEGETATION AND OTHER ASSOCIATED LANDSCAPE WORKS. DISTURBED AREAS SHOULD BE STABILISED AS SOON AS POSSIBLE.
11. UNDERTAKE ONGOING MAINTENANCE, REPAIR AND MODIFICATIONS TO ESC AND TEMPORARY DRAINAGE MEASURES AS REQUIRED DURING THE PERIOD OF SITE WORKS AND DISTURBANCE.
12. ALL TEMPORARY ESC MEASURES ARE TO BE MAINTAINED UNTIL SATISFACTORY STABILISATION OF SITE OR COMPLETION OF AN "OFF MAINTENANCE" INSPECTION BY COUNCIL AND PRIOR TO FORMAL ACCEPTANCE "OFF MAINTENANCE" BY COUNCIL IF REQUIRED.

ESC GENERAL NOTES

1. IMMEDIATELY FOLLOWING SETTING OUT OF THE WORKS, BUT PRIOR TO COMMENCEMENT OF ANY CLEARING OR EARTHWORKS, THE CONTRACTOR AND SITE SUPERINTENDENT SHALL WALK THE SITE TO NOMINATE THE LOCATIONS AND TYPES OF SEDIMENT AND EROSION CONTROL MEASURES TO BE ADOPTED. THESE MEASURES SHALL BE IMPLEMENTED PRIOR TO ANY CLEARING OR EARTHWORKS AND MAINTAINED UNTIL THE WORKS ARE COMPLETED AND NO LONGER POSE AN EROSION HAZARD, UNLESS OTHERWISE APPROVED BY THE SUPERINTENDENT.
2. IMMEDIATELY FOLLOWING SETTING OUT OF THE WORKS, BUT PRIOR TO COMMENCEMENT OF ANY CLEARING OR EARTHWORKS, THE CONTRACTOR AND SITE SUPERINTENDENT SHALL WALK THE SITE TO IDENTIFY AND MARK TREES WHICH ARE TO BE PRESERVED. NOT WITHSTANDING THE ABOVE,THE CONTRACTOR SHALL TAKE ALL REASONABLE PRECAUTIONS TO MINIMISE DISTURBANCE TO EXISTING VEGETATION AND GROUND COVER OUTSIDE THE MINIMUM AREAS REQUIRED TO COMPLETE THE WORKS AND SHALL BE RESPONSIBLE FOR RECTIFICATION, AT ITS OWN COST, OF ANY DISTURBANCE BEYOND THOSE AREAS.
3. PROVIDE ROCK CHECK DAMS AT 3m (MAXIMUM) DOWNSTREAM OF ALL OUTLETS AND AT 20m (MAXIMUM) CENTRES ALONG OPEN CHANNELS AND AROUND FIELD INLETS.
4. PROVIDE GULLY GRATE INLET SEDIMENT TRAPS AT ALL GULLY PITS.
5. PROVIDE SILT FENCING ALONG DOWNSTREAM PROPERTY LINE AS DIRECTED BY SUPERINTENDENT.
6. ADDITIONAL CONTROL DEVICES TO BE PLACED WHERE DIRECTED BY THE SITE SUPERINTENDENT .
7. ALTERNATIVE DESIGNS TO BE APPROVED BY SUPERINTENDENT PRIOR TO CONSTRUCTION.
8. WASH DOWN/RUMBLE AREA TO BE CONSTRUCTED WITH PROVISIONS RESTRICTING ALL SILT AND TRAFFICKED DEBRIS FROM ENTERING THE STORMWATER SYSTEM.
9. NO WORK OR STOCKPILING OF MATERIALS TO BE PLACED OUTSIDE SITE OF WORK BOUNDARY.
10. APPROPRIATE EROSION AND SEDIMENT CONTROLS TO BE USED TO PROTECT STOCKPILES AND MAINTAINED THROUGH OUT CONSTRUCTION.
11. IT IS THE CONTRACTORS RESPONSIBILITY TO TAKE DUE CARE OF NATURAL VEGETATION. NO CLEARING IS TO BE UNDERTAKEN WITHOUT PRIOR APPROVAL FROM THE SUPERINTENDENT.
12. TO AVOID DISTURBANCE TO EXISTING TREES, EARTHWORKS WILL BE MODIFIED AS DIRECTED ON-SITE BY THE SUPERINTENDENT.
13. THE LOCATION OF EROSION AND SEDIMENTATION CONTROLS WILL BE DETERMINED ON SITE BY THE SUPERINTENDENT.
14. ACCESS TRACKS THROUGH THE SITE WILL BE LIMITED TO THOSE DETERMINED BY THE SUPERINTENDENT AND THE CONTRACTOR PRIOR TO ANY WORK COMMENCING.
15. THE CONTRACTOR SHALL AT ALL TIMES WITHIN ALLOTMENTS AND PARKLANDS MINIMISE THE DISTURBANCE OF THE EXISTING VEGETATION INCLUDING GRASS COVER, AND IF REQUESTED SHALL ROPE OFF OR SIMILARLY PROTECT ANY AREAS DIRECTED BY THE SUPERINTENDENT.
16. PLANS ARE MINIMUM REQUIREMENTS AND ARE TO BE USED AS A GUIDE ONLY. EXACT MEASURES USED SHALL BE DETERMINED ON SITE IN CONJUNCTION WITH PROGRAM OF CONTRACTORS WORKS etc.
17. DUST CONTROL MEASURES ARE TO INCLUDE SPRAYING WATER ON UNPAVED ROADS, ACCESS TRACKS AND STOCKPILES AT A SUFFICIENT LEVEL TO SUPPRESS DUST GENERATION. ADDITIONALLY CONTRACTORS ARE TO COVER OR ENCLOSE STOCKPILES WHERE REASONABLY PRACTICAL TO RESTRICT DUST MOVEMENT.

BCC WATER TESTING AND TREATMENT:

- TESTING: IMPLEMENT WATER TESTING AND MONITORING PROGRAMS COMPLIANT WITH THE BRISBANE CITY COUNCIL'S EROSION AND SEDIMENT CONTROL STANDARD (VERSION 9 OR LATER VERSION) AND ASSOCIATED DOCUMENTS INCLUDING:- COUNCIL'S EROSION HAZARD ASSESMENT FORM AND SUPPORTING TECHNICAL NOTES (JUNE 2006) AND COUNCIL'S SOIL SAMPLING AND TESTING GUIDELINE FOR EROSION POTENTIAL (2001)
- TREATMENT: DESIGN AND IMPLEMENT ONSITE WATER TREATMENT PROGRAMS TO BE CAPABLE OF BEING OPERATED AND MAINTAINED TO ACHIEVE THE STORMWATER RELEASE LIMIT ("THE WATER QUALITY OBJECTIVES") FROM THE SITE DURING A DESIGN RAINFALL EVENT:
  - A) 50 MG/L TSS (TOTAL SUSPENDED SOLIDS)
  - B) 75 NTUS (NEPHELOMETRIC TURBIDITY UNITS)
  - C) PH BETWEEN 6.5 AND 8.5 AT ALL TIMES.

NOTE:

IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO DEVELOP AND IMPLEMENT A SUITABLE EROSION AND SEDIMENT CONTROL PROGRAM IN ACCORDANCE WITH THE CURRENT INTERNATIONAL EROSION CONTROL ASSOCIATION (IECA) GUIDELINES AND STANDARD DETAILS AND TO ENSURE THEY HAVE AN ADEQUATE SET OF EROSION AND SEDIMENT CONTROL PLANS ONSITE AT ALL TIMES DURING CONSTRUCTION.

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SEDIMENT & EROSION CONTROL NOTES:

PRIOR TO THE COMMENCEMENT OF CONSTRUCTION

- AVOID STRIPPING & EXCAVATING UNTIL NECESSARY.
- CONSTRUCTION OF AN ENTRY/EXIT POINT TO THE SITE SHOULD BE MANAGED SO THAT SEDIMENT IS NOT TRACKED OFF THE SITE.

BULK EARTHWORKS

- TOPSOIL SHOULD BE STOCKPILED ON SITE FOR LATER USE.
- WHERE PRACTICABLE MAINTAIN VEGETATION IN A HEALTHY STATE DURING THE CONSTRUCTION PROCESS.
- WHEN UP SLOPE WATER IS DIVERTED AROUND A WORK SITE IT IDEALLY SHOULD BE DISCHARGED AS SHEET FLOW THROUGH AN UNDISTURBED AREA.

CONSTRUCTION OPERATIONS

- THIS PLAN SUGGESTS MINIMUM SEDIMENT & EROSION PROTECTION. THE CONTRACTOR SHALL TAKE ANY OTHER MEASURES AS NECESSARY IN CONSULTATION WITH THE SUPERVISING ENGINEER.
- ADHERE TO STORMWATER INLET PROTECTION DIAGRAM ON I.P.W.E.A.Q STD DWG D-0041.
- PLACE 12mm THICK PLATE OVER MANHOLES UNTIL CI FRAMES & LID ARRIVE. THIS IS TO KEEP SEDIMENT OUT OF DRAINAGE SYSTEM.
- SAND BAGS ARE TO BE PLACED AT 45° TO THE ROAD AS SPECIFIED:
  - (a) ROAD GRADE (0.5% TO 5%) - 25m MAX. CENTRES
  - (b) ROAD GRADE (5% TO 10%) - 15m MAX. CENTRES
  - (c) ROAD GRADE (10 TO 15%) - 10m MAX. CENTRES
  - (d) ROAD GRADE (15 TO 20%) - 5m MAX. CENTRES
- ERODIBLE MATERIAL MISTAKENLY PLACED WITHIN THE ROAD RESERVE (INCLUDING ACCIDENTAL SPILLAGE & TRACKING OF SUCH MATERIALS ONTO THE ROAD) THAT CANNOT BE PREVENTED THROUGH REASONABLE MEANS, MUST BE:
  - (a) REMOVED IMMEDIATELY IF RAINFALL IS IMMINENT OR OCCURRING
  - (b) REMOVED PRIOR TO THE END OF THE DAY'S WORK IF RAINFALL IS NOT EXPECTED.
- SAND BAGS ARE TO BE PLACED AT 45° TO THE ROAD AS SPECIFIED.
- MATERIALS SHOULD BE SWEPT FROM THE ROAD. NOT WASHED DOWN THE GUTTER.
- ALL SOLID WASTE SHOULD BE STORED ON SITE IN SUCH A MANNER THAT IT IS PREVENTED FROM LEAVING THE SITE EITHER BY THE ACTION OF WIND OR WATER. SMALLER MATERIALS, SUCH AS LITTER, SHOULD BE CONTAINED IN COVERED BINS.

STOCKPILES

- STOCKPILES ARE NOT TO BE STORED ON THE FOOTPATH OR THE ROAD RESERVE, UNLESS APPROVED BY COUNCIL.
- ALL STOCKPILES & BUILDING MATERIAL SHOULD BE LOCATED WITHIN THE SEDIMENT CONTROL ZONE.
- TO MINIMISE EROSION & THE LOSS OF SAND & SOIL, STOCKPILES SHOULD NOT BE LOCATED WITHIN AN OVERLAND FLOW PATH.
- INSTALL DIVERSION CATCH DRAINS UPSTREAM OF, AND SILT FENCE DOWNSTREAM OF STOCKPILES.
- STOCKPILES ARE TO BE LOCATED AWAY FROM EROSION HAZARD AREAS SUCH AS DRAINAGE LINES AND STEEP SLOPES.
- STOCKPILES ARE TO BE PROTECTED FROM EROSION BY THE WIND, PROTECTION MEASURES ARE TO BE AGREED WITH THE SUPERINTENDENT PRIOR TO FORMATION OF ANY STOCKPILE.

SEDIMENT FENCE

- INSTALL SEDIMENT FENCE(S) ALONG THE LOW SIDE OF THE SITE & IDEALLY ALONG A LINE OF CONSTANT LAND LEVEL TO PREVENT THE CONCENTRATION OF STORMWATER RUNOFF. IN AREAS WHERE IT IS EITHER UNDESIRABLE OR IMPRACTICAL TO BURY THE LOWER EDGE OF THE SEDIMENT FENCE, THE LOWER 200MM (MIN) PORTION OF THE FABRIC SHOULD BE PLACED ON THE GROUND UP SLOPE OF THE FENCE & BURIED UNDER A 100MM (MIN) LAYER OF AGGREGATE REFER I.P.W.E.A.Q. STD DWG D-0040.

FIELD INLET GULLIES

- SEDIMENT CONTROLS FOR STORMWATER INLETS LOCATED WITHIN THE PROPERTY BOUNDARIES MAY CONSIST OF GEOTEXTILE FABRIC PLACED EITHER DIRECTLY OVER THE GRATED INLET OR AROUND THE INLET SUPPORT BY A TIMBER FRAME. FIELD INLET PROTECTION IS NECESSARY WHERE INLETS DRAIN AREAS OF BARE & UNPROTECTED SOIL. DURING STORMS, PONDING SHOULD BE ALLOWED TO OCCUR AROUND THE STORMWATER INLET TO ASSIST IN THE SETTLING OUT OF SEDIMENTS. REFER I.P.W.E.A.Q D-0041.

PAVEMENT INLET GULLY

- A ROADSIDE INLET BARRIER IS TO BE INSTALLED, SO THAT IT SHOULD NOT BE ALLOWED TO FULLY BLOCK THE INLET STRUCTURE. ON A HILLSIDE, SEDIMENT BARRIERS MAY CONSIST OF A TEMPORARY DAM CONSTRUCTED FROM SAND & GRAVEL BAGS AT LEAST 4 METERS UP SLOPE FROM THE GULLY INLET.

TURFING

- ALL DISTURBED AREAS ARE TO BE TURFED, AS SPECIFIED, WITHIN SEVEN DAYS OF FINAL TRIMMING. BATTER SLOPES STEEPER THAN 1in4 ARE TO BE HYDROMULCHED.
- AFTER FINAL TRIMMING OF FOOTPATHS PROVIDE TWO STRIPS OF TURF 0.8m WIDE TO BACK OF KERB & CHANNEL AS SPECIFIED.

MAINTENANCE

- SEDIMENT FENCES SHOULD BE REPLACED IF THE FABRIC IS RIPPED OR OTHERWISE DAMAGED. THE MAINTENANCE OF THE SEDIMENT FENCES INCLUDING THE REMOVAL OF SEDIMENT DEPOSITED UP SLOPE OF THE FENCE & RETRENCHING THE FABRIC WHEN THE FENCE IS 25% FULL.
- FOLLOWING STORM EVENTS, THE ROAD RESERVE & ALL SEDIMENT BARRIERS SHOULD BE INSPECTED & ANY EXCESSIVE SEDIMENT RESIDUE SHOULD BE APPROPRIATELY REMOVED.
- THE CONTRACTOR SHALL MAINTAIN ALL SEDIMENT CONTROL DEVICES FOR THE FULL EXTENT OF THE DEFECTS LIABILITY PERIOD.

VEGETATION MANAGEMENT

1. VEGETATION PROTECTION ORDERS ON THE SITE SHALL BE OBSERVED AT ALL TIMES.
2. ALL REASONABLE AND PRACTICABLE EFFORTS MUST BE TAKEN TO MINIMISE THE REMOVAL OR DISTURBANCE OF TREES, SHRUBS AND PARTICULARLY GROUND COVER ON THE SITE PRIOR TO, AND DURING LAND-DISTURBING DEVELOPMENT.
3. WHERE SOME CLEARING IS INEVITABLE, IT SHOULD BE DELAYED AS LONG AS PRACTICABLE AND STAGED WHERE POSSIBLE TO MINIMISE THE EROSION POTENTIAL.
4. NO CLEARING SHALL BE UNDERTAKEN UNLESS PRECEDED OR ACCOMPANIED BY INSTALLATION OF ADEQUATE RUN-OFF AND SEDIMENT CONTROL MEASURES.
5. CONSIDERATION SHOULD BE GIVEN TO THE FENCING-OFF, OR OTHERWISE CLEAR MARKING OF VEGETATION THAT IS NOT TO BE DISTURBED AT ANY GIVEN STAGE OF THE PROPOSED WORKS (INCLUDING ALONG ACCESS/ENTRY TRACKS)
6. WHERE REHABILITATION OF VEGETATION IS REQUIRED, SIMILAR INDIGENOUS SPECIES SHALL BE USED WHERE POSSIBLE.

ESC QUALITY ASSURANCE

1. THIS PROGRAM SHALL BE READ IN CONJUNCTION WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS.
2. THE EROSION AND SEDIMENT CONTROL WORKS SHALL COMPLY WITH THE REQUIREMENTS OF THE LOCAL AUTHORITIES EROSION AND SEDIMENT CONTROL STANDARDS AND THE "SOIL EROSION AND SEDIMENT CONTROL - ENGINEERING GUIDELINES FOR QUEENSLAND (CURRENT EDITIONS)".
3. THE CONTRACTOR SHALL TAKE ALL REASONABLE AND PRACTICABLE MEASURES TO:
   - ALLOW STORMWATER TO PASS THROUGH THE SITE IN A CONTROLLED MANNER AND AT NON EROSIVE FLOW VELOCITIES;
   - MINIMISE SOIL EROSION FROM WATER AND WIND;
   - MINIMISE ADVERSE EFFECTS OF SEDIMENT RUN-OFF;
   - MINIMISE OR PREVENT ENVIRONMENTAL HARM ASSOCIATED WITH DISCHARGES FROM THE SITE (EG. THE EFFECTS OF SEDIMENTATION ON THE ENVIRONMENTAL VALUES OF RECEIVING WATERS); AND
   - ENSURE THAT THE VALUE AND USE OF RESIDENTIAL PROPERTIES ADJACENT TO THE DEVELOPMENT (SUCH AS DRAINAGE AND ROADS) ARE NOT DIMINISHED AS A RESULT OF THE MIGRATION OF SEDIMENT FROM THE DEVELOPMENT.
4. THE CONTRACTOR SHALL APPOINT AN APPROPRIATELY EXPERIENCED PERSON TO BE MADE RESPONSIBLE FOR IMPLEMENTATION OF THE ESC.
5. ALL ESC MEASURES SHALL BE INSPECTED:
   - AT LEAST DAILY (WHEN WORK IS OCCURRING ON SITE)
   - AT LEAST WEEKLY (WHEN WORK IS NOT OCCURRING ON SITE)
   - WITHIN 24 HOURS OF EXPECTED RAINFALL
   - WITHIN 12 HOURS OF RAINFALL OCCURRING
6. MAINTENANCE OF ESC MEASURES SHALL OCCUR IN ACCORDANCE WITH THE FOLLOWING SCHEDULE:
   - OTHER ESC MEASURES ARE TO BE IMPLEMENTED WHEN SETTLED SEDIMENT VOLUME EXCEEDS 25% OF THE CAPACITY OF THE ESC MEASURE. MEASURES ARE TO BE IN PLACE BY THE END OF EACH DAY AND PRIOR TO ANY RAIN EVENT.
7. ADEQUATE SUPPLIES OF EMERGENCY MAINTENANCE MATERIALS, INCLUDING (BUT NOT LIMITED TO) TIE WIRE, STAKES, FILTER CLOTH, WIRE MESH AND CLEAN GRAVEL SHOULD BE AVAILABLE ON-SITE, DURING THE FULL DURATION OF CONSTRUCTION.
8. DISTURBED AREAS ARE TO BE SEEDED WITHIN 3 DAYS OF COMPLETION OF WORKS. TURFING OF SWALES AND CHANNELS IS REQUIRED WITHIN 3 DAYS OF COMPLETION OF TRIMMING. GRASS SEEDING & HYDROMULCHING IS REQUIRED TO ACHIEVE 80% COVER WITHIN 30 DAYS OF THE COMPLETION OF EARTHWORKS.
9. SUPPLEMENTARY ESC MEASURES IF REQUIRED, ARE TO BE IMPLEMENTED AS DIRECTED BY THE SUPERINTENDENT.

SEDIMENT BASIN MAINTENANCE PROGRAM

1. FOLLOWING STORM EVENTS WATER SHOULD BE ALLOWED TO SETTLE, FOR THE TIME REQUIRED FOR SUSPENDED SILT TO SETTLE INTO THE SEDIMENT STORAGE ZONE IN THE BASIN.
2. IN LARGER STORM EVENTS WATER SHALL STILL BE DIRECTED INTO THE BASIN SO COURSE SEDIMENT CAN BE REMOVED.
3. IF REQUIRED WATER QUALITY SAMPLES MUST BE TAKEN AND ANALYSED BY A NATA CERTIFIED LABORATORY PRIOR TO THE RELEASE OF ANY WATER FROM THE SEDIMENT BASINS. WATER QUALITY MUST SATISFY THE FOLLOWING CRITERIA: TSS<50mg/L, pH BETWEEN 6.5 AND 8.5 AT ALL TIMES
4. ALL WATER QUALITY DATA INCLUDING DATES OF RAINFALL, DATES OF TESTING AND WATER RELEASE, MUST BE MAINTAINED IN AN ON-SITE REGISTER. THIS REGISTER IS TO BE MAINTAINED FOR THE DURATION OF THE APPROVED WORKS, AND BE AVAILABLE ON-SITE FOR INSPECTION BY COUNCIL OFFICERS ON REQUEST.
5. A MARKER PEG SHALL BE INSTALLED FIRMLY INTO THE BASE OF THE BASIN WITH THE TOP OF THE PEG 380mm ABOVE THE BASIN INVERT. ONCE STORED SEDIMENT REACHES THIS MAXIMUM LEVEL THE SEDIMENT IS TO BE REMOVED.
6. AFTER REMOVAL THIS SEDIMENT CAN BE DRIED IN AN APPROVED MANNER UPSTREAM OF THE BASIN/PONDED AREAS AND THEN REMOVED FROM SITE OR MIXED WITH ON-SITE SOILS (IN A MANNER THAT WILL NOT CAUSE EROSION) AND BURIED.
7. PORTABLE DECANT PUMPS ARE TO BE USED TO DRAIN CLEAR WATER FROM THE BASIN/PONDED AREAS. WHEN PUMPING ENSURE SUSPENDED SEDIMENT IS NOT ALLOWED TO BE PUMPED OUT OF THE BASIN.

LOGAN CITY COUNCIL

ENDORSED PLAN

This is the endorsed plan for Development Application

OW/73/2021

SHEET 11 OF 11

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NT = NATIVE TREE

NHT = NATIVE HABITAT TREE

PLEASE CIRCLE --------->

INSPECTION BY - Arbo Operations

INSPECTION DATE - 8.6.2021

LOT	TYPE	COMMENTS
227 -	(NT) or NHT	SMALL LEAF MORETON BAY FIG
283 -	NT or (NHT)	FOREST RED GUM
288 -	(NT) or NHT	SMALL LEAF FIG
401 -	(NT) or NHT	SMALL LEAF FIG
404 N -	(NT) or NHT	SHE-OAK
404 S -	(NT) or NHT	MORETON BAY FIG
425 -	NT or (NHT)	FOREST RED GUM
426 N -	NT or (NHT)	FOREST RED GUM
426 S -	NT or (NHT)	FOREST RED GUM

LOT	TYPE	COMMENTS
427 -	(NT) or NHT	SMALL LEAF FIG
428 -	NT or (NHT)	FOREST RED GUM
429 -	NT or (NHT)	FOREST RED GUM
437 E -	NT or (NHT)	WATTLE
437 W -	NT or (NHT)	FOREST RED GUM
438 E -	NT or (NHT)	FOREST RED GUM
438 W -	NT or (NHT)	FOREST RED GUM
444 E -	NT or (NHT)	FOREST RED GUM
444 W -	NT or (NHT)	FOREST RED GUM



LOGAN CITY COUNCIL
APPROVED PLAN OF DEVELOPMENT
This is the approved plan of development for Development Application
OW/73/2021

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DAVIDSON AT BELIVAH - STAGE 234 BULK EARTHWORKS
EXISTING TREE INDENDIFICATION PLAN
LCC REF - OW/73/2021

DRAWING No. - DAB-ST-234-BW-TREE01

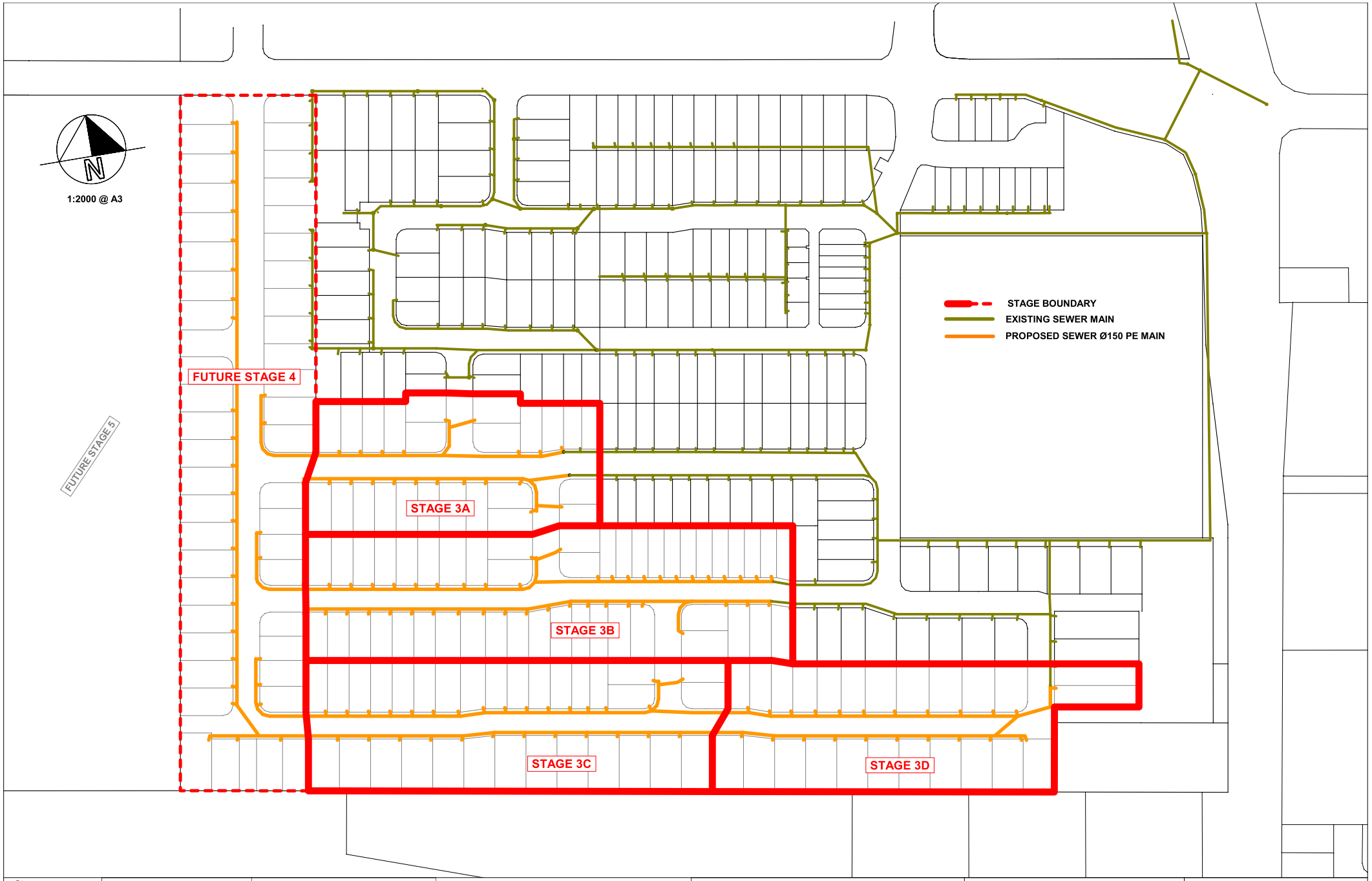
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DATE: 02/06/2021
DRAWN: AB

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ATTACHMENT 4 – PRELIMINARY SEWER RETICULATION PLAN



Davidson's At BELIVAH

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DAVIDSONS AT BELIVAH

PRELIMINARY SEWER RETICULATION

STAGE 3A-3D & FUTURE STAGES 4

PROJECT : STAGE 3A-3D AND FUTURE STAGE 4

LOCATION: JIM DAVIDSON BOULEVARD, BELIVAH

SHEET TITLE: PRELIM SEWER RETIC PLAN

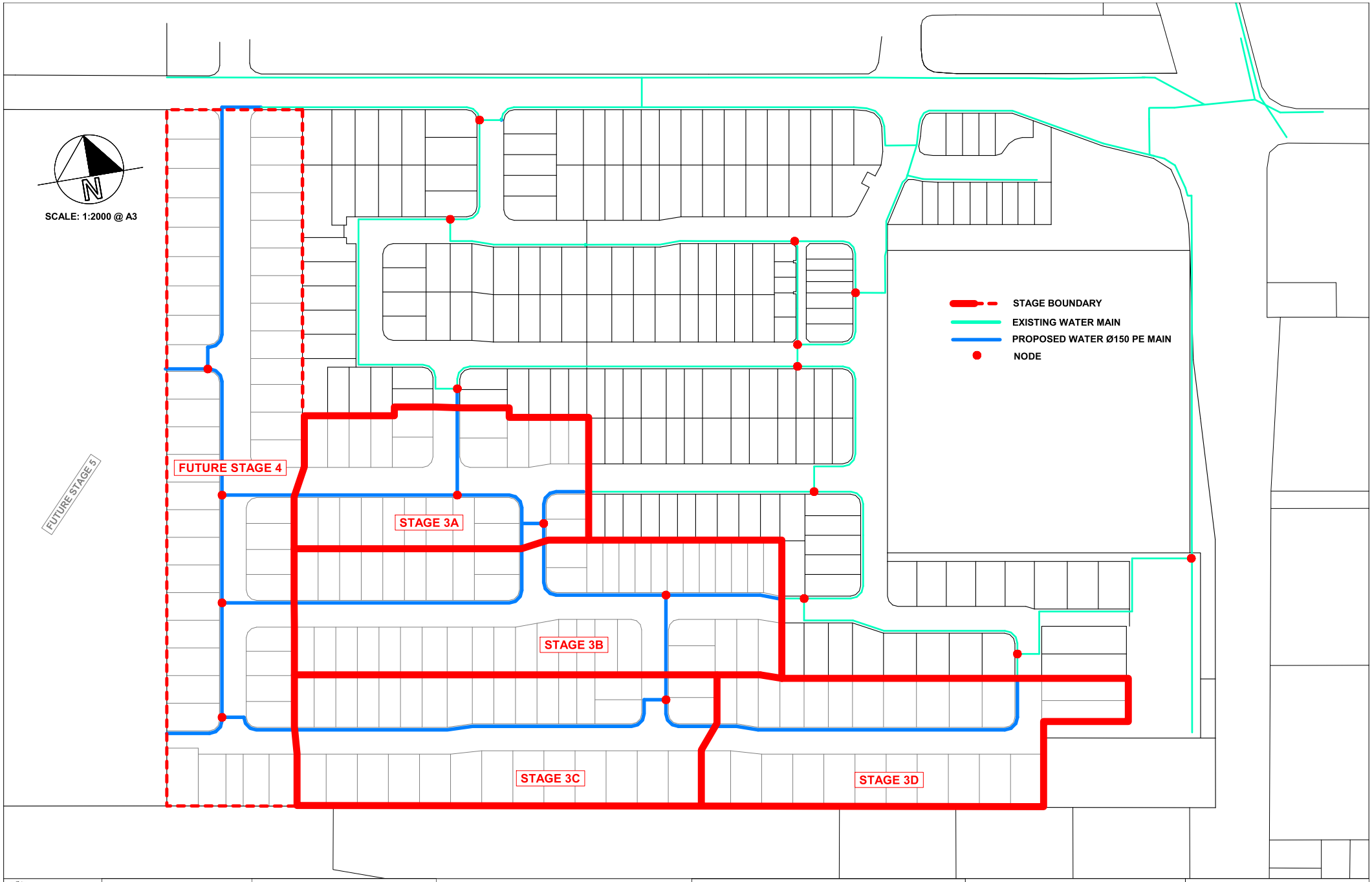
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ATTACHMENT 5 – PRELIMINARY WATER RETICULATION PLAN



Davidson's At BELIVAH

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DAVIDSONS AT BELIVAH

PRELIMINARY WATER RETICULATION
STAGE3A-3D & FUTURE STAGE 4

PROJECT : STAGE 3A-3D AND FUTURE STAGE 4

LOCATION: JIM DAVIDSON BOULEVARD, BELIVAH

SHEET TITLE: PRELIM WATER RETIC PLAN

DRAWING No. - 091222-34-WAT-01

SHEET No. - 1 OF 1

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ATTACHMENT 6 – ETS WATER SUPPLY REPORT



WATER SUPPLY REPORT

DAVIDSONS AT BELIVAH

Belivah Road, Belivah

FOR

Belivah Pty Ltd

We know engineering

Exceeding expectations

Trusted advisors

Proactive and engaging

High quality work

ETS Engineering Pty Ltd
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CLIENT	**BELIVAH PTY LTD**
DOCUMENT TITLE	**WATER SUPPLY REPORT DAVIDSONS AT BELIVAH**

STATUS	Preliminary		Final	X

Author	**Scott Averkoff**	**Reviewer**	**Keith Howells**
Date	***29th July 2016***	***Date***	***29th July 2016***

Engineer's Certification:

Name: Keith Howells (RPEQ 7295)

Signature		***Date***	***29 July 2016***

Document Control

Version	Date	Author Name	Initials	Reviewer Name	Initials
A	29-07-2016	Scott Averkoff	SA	Keith Howells	KPH

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1. INTRODUCTION

ETS Engineering was commissioned by Belivah Pty Ltd to undertake an analysis of the existing and proposed water network to accommodate the water supply for the proposed residential development in accordance with the requirements of Logan City Council and the SEQ WS&S D&C Code – Design Criteria July 2013. The proposed development is located at 31 Belivah Road, Belivah.

The findings of this report have been produced from information obtained from the other consultants and Logan City Council.

Information obtained included: -

- Water boundary conditions;
- Survey data for the site; and
- DA Town Planning Report;

2. EXISTING INFRASTRUCTURE

These models have been set up using the provided water boundary conditions were supplied by Logan City Council. A temporary connection to the existing 150mm diameter water main along Belivah Road will service Stage 1A until other works are constructed to provide the ultimate connection to the existing 225mm diameter main on Beaudesert – Beenleigh Road.

3. DESIGN REQUIREMENTS

Stage 1A of the development is proposed to be supplied from a temporary connection to the existing 150mm diameter water main along Belivah Road until other works are constructed to provide the ultimate connection to the existing 225mm diameter main on Beaudesert – Beenleigh Road. The internal pipe network within the proposed development has been modeled as part of this report. Refer to plan in Appendix A with the proposed layout plan. Further to the demand flows calculated below an additional demand for 73 lots has been allowed for the future adjoining development to the west of the proposed development site.

3.1 Demand Flows – Standard Network

Proposed Residential Lots

The proposed development will provide a total of 400 residential lots. Based on SEQ requirements for water supply, average daily demand of 230 L/EP/day has been adopted with 2.8 EP/lot.

The following demand calculations have been calculated: -

- Average daily Demand = 2.98 L/s
- Mean Day Max Month = 1.5 x 2.98 = 4.47L/s
- Peak Hour = 4 x 2.98 = 11.92 L/s

Non-Revenue Water (NRW)

Based on SEQ requirements for water supply, the estimated NRW demand of 30 L/EP/day has been adopted.

The following demand calculations have been calculated: -

- Average daily Demand = 0.39 L/s.

Combined Demand

Based on the above calculations, the combined demand flows would be: -

- Average daily Demand = 2.98 + 0.39 = 3.37 L/s
- Mean Day Max Month = 4.47 + 0.39 = 4.86 L/s
- Peak Hour = 11.92 + 0.39 = 12.31 L/s

3.2 Standards of Service

The analysis has been based on the following water service requirements as outlined in the SEQ WS&S D&C Code – Design Criteria July 2013:

- Minimum residual pressure is specified as 22m (55m Maximum).
- Average Day Demand 230 L/EP/d.
- Estimated Non-Revenue Water (NRW) 30L/EP/d
- The minimum pressure during firefighting events is specified as 12m at the flowing hydrant and 6m elsewhere.
- Minimum 15L/s (for 2 hours) urban firefighting capacity.

3.3 Friction Losses

The analysis was undertaken utilizing EPANET, a computer software package that performs a simulation of the hydraulic behaviour within a pressurised pipe network. EPANET calculates the hydraulic head lost by water flowing in a pipe due to the friction with the pipe walls, using the Hazen Williams formula:

$$HL = Aq^B$$

Where H_L = headloss, q = flow rate, A = resistance coefficient, and B = flow exponent.

The resistance coefficient utilized by EPANET is:

$$A = 10.67\ C^{-1.852} d^{-4.871} L$$

Where C = Hazen-Williams roughness coefficient, d = pipe diameter (mm), L = Length (m).

The roughness coefficient used for the network analysis has been adopted as 100 <=DN150 pipes and 110 for >DN150 to DN300mm pipes.

3.4 Minor Losses

EPANET accounts for minor head losses caused by the added turbulence occurring at bends and fittings by assigning the pipe a minor loss coefficient. The minor head loss is the product of this coefficient and the velocity head of the pipe:

$$H_L = K\ (v^2/2g)$$

Where K = minor loss coefficient, v = flow velocity, g = acceleration of gravity

Minor loss coefficients outlined by EPANET include:

	Loss Coeff. K
Globe valve, fully open	10
Angle valve, fully open	5
Swing check valve, fully open	2.5
Grate valve, fully open	0.2
Short-radius elbow	0.9
Medium-radius elbow	0.8
Long-radius elbow	0.6
45 degree elbow	0.4
Closed return bend	2.2
Standard tee – flow through run	0.6
Standard tee – flow through branch	1.8
Exit	1

4. METHODOLOGY

The proposed water reticulation network analysis was performed by producing “Epanet” model’s based on the water supply demands of the proposed development site. The EPANET models were set up to suit the projected demands and losses caused by the development of the proposed community to accurately determine the water supply pressures within the area. The demands for service were entered at supply nodes within the proposed network to mimic actual demands for the development and external constraints. Refer to plan in Appendix A for node locations and total demand (ET’s) applied at each node.

The EPANET analysis was performed for a full 24-hour period, using the peaking factors specified for LCC in the SEQ Code Table 4.1, with the maximum hour demand occurring at 6pm.

A residential fire-fighting scenario was run using the identical networks and adding the firefighting demand of 15L/s (for 2 hours) into the system at various nodes. The fire-fighting pattern used was the residential firefighting pattern from the models supplied.

All EPANET models have been run with an average day demand for the proposed site at 230 L/EP/d. The following lists summarises the EPANET models that have been run and have results included in the appendices of this report:

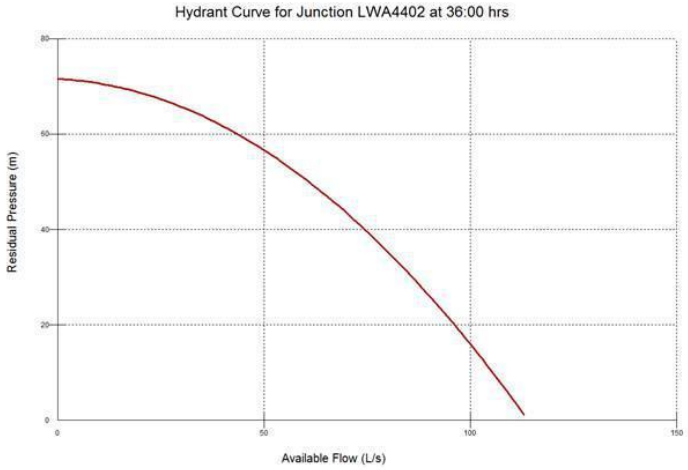
- Entire development – AD 230 L/EP/d
- Entire development (Residential Fire Fighting) – 15L/s (for 2 hours), AD 230 L/EP/d

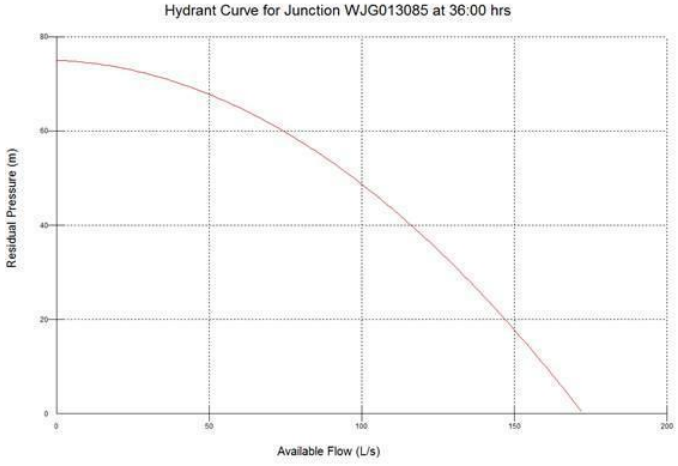
5. BOUNDARY CONDITIONS

Logan Water provided the following site boundary conditions to be used in the analysis.

- 150mm main at Belivah Road (LWA 4402)
- 225mm main at Beaudesert Beenleigh Road(WJG013085).







6. WATER MODEL RESULTS

6.1 Pressure Results

The results indicate for the proposed development all nodes will have sufficient residual pressures within the network. However, some nodes exceed the maximum pressure head of 55m as required by SEQ WS&S D&C Code – Design Criteria July 2013. Therefore, a pressure reducing valve may be required by Logan City Council. Refer to the tables in the Appendix B for all results for the ultimate design.

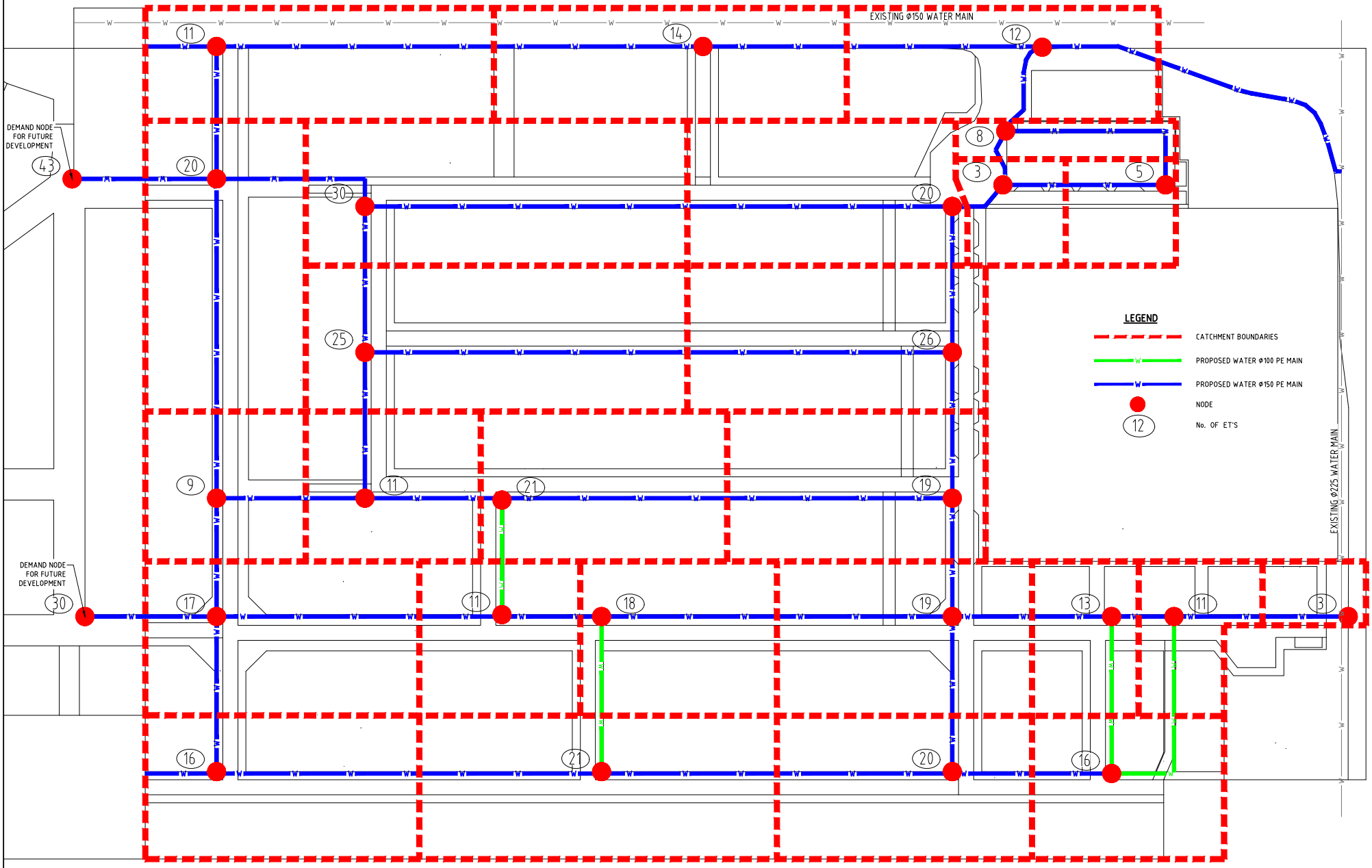
6.2 Fire Fighting Results

The results indicate for the proposed development all nodes will have sufficient residual pressures within the network to accommodate 15l/s (for 2 hours) firefighting. However, the nodes exceed the maximum pressure head of 55m as required by SEQ WS&S D&C Code – Design Criteria July 2013. Therefore, a pressure reducing valve may be required by Logan City Council. Refer to the tables in the Appendix C for all fire fighting results for the ultimate design.

7. CONCLUSION

The existing infrastructure can accommodate the demands of the proposed development including firefighting (15L/s for 2 hours) and will meet the requirements the SEQ WS&S D&C Code – Design Criteria July 2013. However, the nodes exceed the maximum residual pressure of 55m as required by SEQ WS&S D&C Code – Design Criteria July 2013. Therefore, a pressure reducing valve may be required by Logan City Council.

APPENDIX A – Proposed Layout Plan



REVISIONS				
DATE	REV	DESCRIPTION		APPROVED
	A	ORIGINAL ISSUE		

BRISBANE OFFICE
LEVEL 1, 100 BRUNSWICK STREET
PO BOX 361
FORTITUDE VALLEY, QLD 4006
PH: (07) 3253 2222

ets engineering
part of the DZ Group

DESIGNED
DRAWN
CHECKED DATE
DATE

APPROVED DATE
K. Howells
KEITH HOWELLS RPEQ 7295

SCALE
0 10 20 30m
SCALE 1:500 (A1)

CLIENT

PROJECT PROPOSED RESIDENTIAL SUBDIVISION
LOCATION 59 BELIVAH ROAD, BELIVAH
SHEET TITLE PRELIMINARY WATER

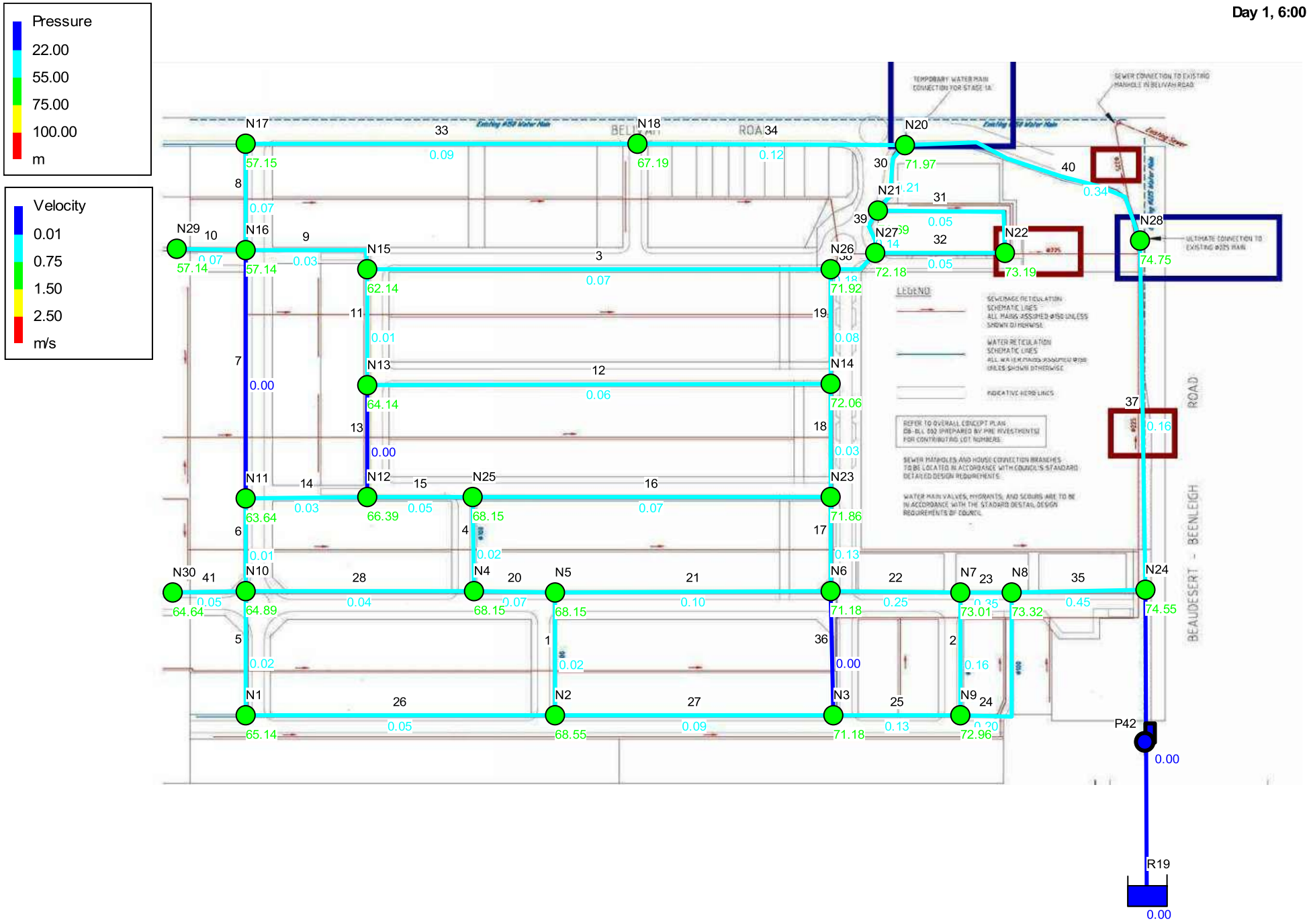
JOB CODE: EAGSBE
SHEET NUMBER: SK06
REV: A

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FORM E027 10 AUG 2006

APPENDIX B – EPANET Results – Proposed Network

Ultimate Development - Residential Demand + NRW

Day 1, 6:00 PM



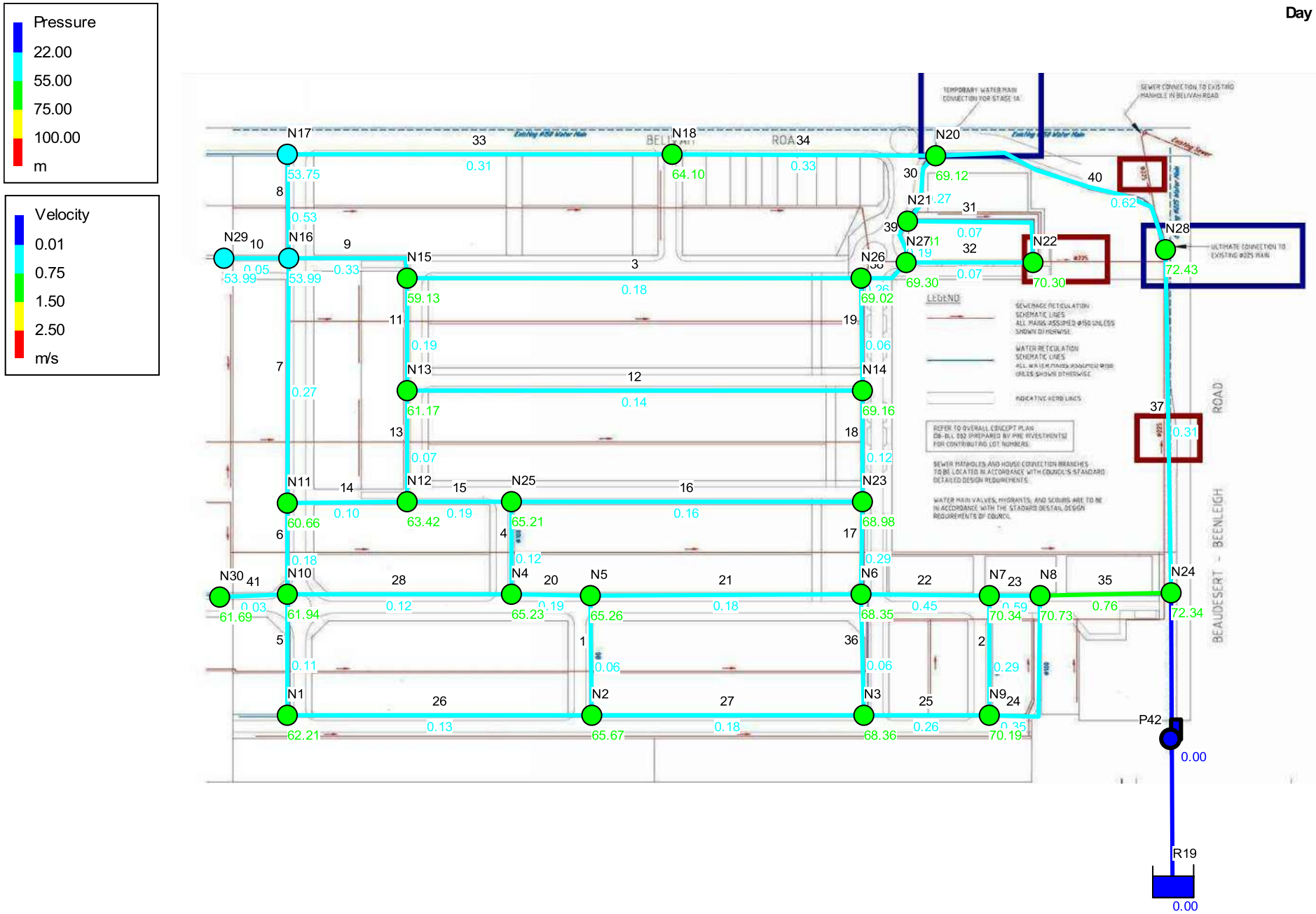
Davidsons at Belivah - Ultimate					
Network Table - Nodes at 18:00 Hrs					
Node ID	Elevation m	Base Demand LPS	Demand LPS	Head m	Pressure m
Junc N1	25.5	16	0.48	90.64	65.14
Junc N2	22.1	21	0.63	90.65	68.55
Junc N3	19.5	20	0.6	90.68	71.18
Junc N4	22.5	11	0.33	90.65	68.15
Junc N5	22.5	18	0.54	90.65	68.15
Junc N6	19.5	19	0.57	90.68	71.18
Junc N7	17.75	13	0.39	90.76	73.01
Junc N8	17.5	11	0.33	90.82	73.32
Junc N9	17.75	16	0.48	90.71	72.96
Junc N10	25.75	17	0.51	90.64	64.89
Junc N11	27	9	0.27	90.64	63.64
Junc N12	24.25	11	0.33	90.64	66.39
Junc N13	26.5	25	0.75	90.64	64.14
Junc N14	18.6	26	0.78	90.66	72.06
Junc N15	28.5	30	0.9	90.64	62.14
Junc N16	33.5	20	0.6	90.64	57.14
Junc N17	33.5	11	0.33	90.65	57.15
Junc N18	23.5	14	0.42	90.69	67.19
Junc N21	19	8	0.24	90.69	71.69
Junc N22	17.5	5	0.15	90.69	73.19
Junc N23	18.8	19	0.57	90.66	71.86
Junc N24	16.5	3	0.09	91.05	74.55
Junc N25	22.5	21	0.63	90.65	68.15
Junc N26	18.75	20	0.6	90.67	71.92
Junc N27	18.5	3	0.09	90.68	72.18
Junc N20	18.75	12	0.36	90.72	71.97
Junc N28	16.25	0.46	0.46	91	74.75
Junc N29	33.5	43	1.29	90.64	57.14
Junc N30	26	30	0.9	90.64	64.64
Resvr R19	17	#N/A	-14.62	17	0

Davidsons at Belivah - Ultimate								
Network Table - Links at 18:00 Hrs								
Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Unit Headloss m/km	Friction Factor	Status
Pipe 1	75	100	100	0.12	0.02	0.01	0.071	Open
Pipe 2	75	100	100	-1.26	0.16	0.74	0.056	Open
Pipe 4	58	100	100	0.19	0.02	0.02	0.067	Open
Pipe 5	75	150	100	0.44	0.02	0.01	0.071	Open
Pipe 6	58	150	100	-0.22	0.01	0	0.069	Open
Pipe 7	150	150	100	0.07	0	0	0.086	Open
Pipe 8	62	150	100	-1.32	0.07	0.1	0.053	Open
Pipe 9	85	150	100	-0.5	0.03	0.02	0.062	Open
Pipe 11	61	150	100	-0.2	0.01	0	0.071	Open
Pipe 12	286	150	100	-1.02	0.06	0.07	0.057	Open
Pipe 13	61	150	100	0.07	0	0	0.102	Open
Pipe 14	75	150	100	-0.55	0.03	0.02	0.061	Open
Pipe 15	61	150	100	-0.81	0.05	0.04	0.057	Open
Pipe 16	177	150	100	-1.25	0.07	0.1	0.057	Open
Pipe 17	58	150	100	2.28	0.13	0.32	0.057	Open
Pipe 18	61	150	100	0.46	0.03	0.01	0.063	Open
Pipe 19	61	150	100	-1.34	0.08	0.1	0.053	Open
Pipe 20	51	150	100	-1.27	0.07	0.11	0.06	Open
Pipe 21	177	150	100	-1.69	0.1	0.17	0.053	Open
Pipe 22	82	150	100	-4.49	0.25	0.98	0.044	Open
Pipe 23	31	150	100	-6.14	0.35	1.74	0.042	Open
Pipe 24	105.4	100	100	-1.54	0.2	1.04	0.053	Open
Pipe 25	79	150	100	2.32	0.13	0.31	0.053	Open
Pipe 26	194	150	100	-0.92	0.05	0.05	0.058	Open
Pipe 27	177	150	100	-1.67	0.09	0.16	0.053	Open
Pipe 28	143	150	100	-0.76	0.04	0.04	0.06	Open
Pipe 31	92	150	100	0.97	0.05	0.06	0.056	Open
Pipe 32	82	150	100	-0.82	0.05	0.04	0.057	Open
Pipe 33	238	150	100	-1.65	0.09	0.15	0.052	Open
Pipe 35	82	150	100	-8.01	0.45	2.85	0.041	Open
Pipe 36	75	150	100	0.05	0	0	0.085	Open
Pipe 30	50	150	100	-3.62	0.21	0.66	0.046	Open
Pipe 34	170	150	100	-2.07	0.12	0.23	0.05	Open
Pipe 38	28	150	100	-3.14	0.18	0.5	0.047	Open
Pipe 39	28	150	100	-2.42	0.14	0.31	0.049	Open
Pipe 3	286	150	100	-1.2	0.07	0.09	0.056	Open
Pipe 37	221	225	110	6.52	0.16	0.24	0.04	Open
Pipe 40	160	150	100	6.06	0.34	1.7	0.043	Open
Pipe 10	20	150	100	1.29	0.07	0.13	0.071	Open
Pipe 41	20	150	100	0.9	0.05	0.07	0.074	Open
Pump P42	#N/A	#N/A	#N/A	14.62	0	-74.05	0	Open

APPENDIX C – EPANET Results (Fire Fighting – Residential Only)

Ultimate Development - Fire Fighting Flow + 2/3 Background Residential Demand

Day 1, 6:00 PM

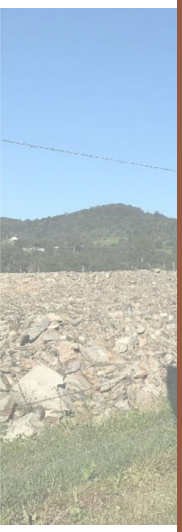


Davidsons at Belivah - Ultimate FF					
Network Table - Nodes at 18:00 Hrs					
Node ID	Elevation m	Base Demand LPS	Demand LPS	Head m	Pressure m
Junc N1	25.5	16	0.32	87.71	62.21
Junc N2	22.1	21	0.42	87.77	65.67
Junc N3	19.5	20	0.4	87.86	68.36
Junc N4	22.5	11	0.22	87.73	65.23
Junc N5	22.5	18	0.36	87.76	65.26
Junc N6	19.5	19	0.57	87.85	68.35
Junc N7	17.75	13	0.26	88.09	70.34
Junc N8	17.5	11	0.22	88.23	70.73
Junc N9	17.75	16	0.32	87.94	70.19
Junc N10	25.75	17	0.34	87.69	61.94
Junc N11	27	9	0.18	87.66	60.66
Junc N12	24.25	11	0.22	87.67	63.42
Junc N13	26.5	25	0.5	87.67	61.17
Junc N14	18.6	26	0.52	87.76	69.16
Junc N15	28.5	30	0.6	87.63	59.13
Junc N16	33.5	20	0.4	87.49	53.99
Junc N17	33.5	15	15	87.25	53.75
Junc N18	23.5	14	0.28	87.6	64.1
Junc N21	19	8	0.16	87.81	68.81
Junc N22	17.5	5	0.1	87.8	70.3
Junc N23	18.8	19	0.38	87.78	68.98
Junc N24	16.5	3	0.06	88.84	72.34
Junc N25	22.5	21	0.42	87.71	65.21
Junc N26	18.75	20	0.4	87.77	69.02
Junc N27	18.5	3	0.06	87.8	69.3
Junc N20	18.75	12	0.24	87.87	69.12
Junc N28	16.25	1.39	1.39	88.68	72.43
Junc N29	33.5	43	0.86	87.49	53.99
Junc N30	26	30	0.6	87.69	61.69
Resvr R19	17	#N/A	-25.8	17	0

Davidsons at Belivah - Ultimate - FF								
Network Table - Links at 18:00 Hrs								
Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Unit Headloss m/km	Friction Factor	Status
Pipe 1	75	100	100	0.45	0.06	0.1	0.059	Open
Pipe 2	75	100	100	-2.24	0.29	1.95	0.047	Open
Pipe 4	58	100	100	0.93	0.12	0.38	0.053	Open
Pipe 5	75	150	100	2.02	0.11	0.22	0.05	Open
Pipe 6	58	150	100	3.27	0.18	0.54	0.047	Open
Pipe 7	150	150	100	4.84	0.27	1.12	0.044	Open
Pipe 8	62	150	100	9.44	0.53	3.86	0.04	Open
Pipe 9	85	150	100	-5.86	0.33	1.6	0.043	Open
Pipe 11	68	150	100	-3.37	0.19	0.57	0.046	Open
Pipe 12	286	150	100	-2.54	0.14	0.34	0.048	Open
Pipe 13	61	150	100	-1.32	0.07	0.1	0.053	Open
Pipe 14	75	150	100	-1.75	0.1	0.17	0.051	Open
Pipe 15	61	150	100	-3.29	0.19	0.55	0.047	Open
Pipe 16	177	150	100	-2.79	0.16	0.4	0.048	Open
Pipe 17	58	150	100	5.2	0.29	1.28	0.044	Open
Pipe 18	61	150	100	2.04	0.12	0.23	0.05	Open
Pipe 19	61	150	100	-1.02	0.06	0.06	0.055	Open
Pipe 20	51	150	100	-3.34	0.19	0.56	0.046	Open
Pipe 21	177	150	100	-3.25	0.18	0.54	0.047	Open
Pipe 22	82	150	100	-7.99	0.45	2.84	0.041	Open
Pipe 23	31	150	100	-10.5	0.59	4.7	0.039	Open
Pipe 24	105.4	100	100	-2.71	0.35	2.77	0.045	Open
Pipe 25	79	150	100	4.64	0.26	1.04	0.044	Open
Pipe 26	194	150	100	-2.34	0.13	0.29	0.049	Open
Pipe 27	177	150	100	-3.2	0.18	0.52	0.047	Open
Pipe 28	143	150	100	-2.19	0.12	0.26	0.049	Open
Pipe 31	92	150	100	1.3	0.07	0.1	0.053	Open
Pipe 32	82	150	100	-1.2	0.07	0.09	0.054	Open
Pipe 33	238	150	100	-5.56	0.31	1.45	0.043	Open
Pipe 35	82	150	100	-13.43	0.76	7.42	0.038	Open
Pipe 36	75	150	100	1.03	0.06	0.06	0.055	Open
Pipe 30	50	150	100	-4.84	0.27	1.12	0.044	Open
Pipe 34	170	150	100	-5.84	0.33	1.59	0.043	Open
Pipe 38	28	150	100	-4.52	0.26	0.99	0.044	Open
Pipe 39	28	150	100	-3.37	0.19	0.57	0.046	Open
Pipe 3	286	150	100	-3.09	0.18	0.49	0.047	Open
Pipe 37	221	225	110	12.31	0.31	0.73	0.034	Open
Pipe 40	160	150	100	10.92	0.62	5.06	0.039	Open
Pipe 10	20	150	100	0.86	0.05	0.06	0.075	Open
Pipe 41	20	150	100	0.6	0.03	0.03	0.077	Open
Pump P42	#N/A	#N/A	#N/A	25.8	0	-71.84	0	Open

ATTACHMENT 7 – MORRISWATER STORMWATER MANAGEMENT PLAN

Davidsons at Belivah
Residential Development







SITE BASED STORMWATER MANAGEMENT PLAN

Prepared for Belivah Pty Ltd

MORRISWATER

COMMERCIAL IN CONFIDENCE

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Morris Water Pty Ltd
ABN: 84 625 420 135

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MORRIS WATER PROJECT NUMBER: **VOLK01**

Version	Date	Issue Details
1	16/07/2018	For Approval
2	22/07/2018	Minor Amendments

EXECUTIVE SUMMARY

It is proposed to develop a 13.3 ha site at Belivah Road, Belivah, with a residential subdivision containing 175 lots. Morris Water Pty Ltd has prepared this report to outline the conceptual stormwater management strategies to comply with the relevant Logan City Council Planning Scheme Policies.

The analyses included hydrology calculations, hydraulic modelling, water quality modelling and a preliminary risk assessment.

Hydrology calculations were undertaken generally in accordance with Australian Rainfall and Runoff (ARR, 2016). Catchment areas were kept constant between the pre-developed and post-developed scenarios. The xprafts rainfall-runoff model produced a reasonable representation of the catchments being modelled.

Hydraulic analyses were undertaken using xpstorm. The proposed minor drainage system and overland flow paths were represented using 1D elements. The piped drainage network was designed to convey the 39% AEP design storm discharge. Overland flow paths such as the proposed 7.5 m wide road cross sections were verified to convey the design 1% AEP design storm discharge with appropriate levels of freeboard.

Water quality modelling was undertaken using MUSIC. Analyses were undertaken generally in accordance with the Water By Design MUSIC Modelling Guidelines. Bioretention filter medium properties were modified based on detailed technical specifications provided by the product manufacturer.

A combined bioretention/detention device with sediment forebays is proposed. The device will have an overall footprint of approximately 2,000 m^2. The sediment forebays have been sized to remove at least 80% of total suspended solids (TSS). The bioretention basin has been sized to deliver Total Phosphorus (TP) and Total Nitrogen (TN) pollutant reductions in accordance with the design water quality objectives. The detention area, combined with extended detention storage available within the bioretention and sediment forebay areas, will ensure that peak discharges leaving the site are not worsened as a result of the proposed development.

Based on the analyses undertaken, the proposed development is provided with adequate flood immunity and will not adversely affect the surrounding development, existing residential areas or the adjacent Council reserve. The proposed development will not worsen the flood immunity at Beaudesert Beenleigh Road.

A preliminary Risk Assessment Report was prepared to define a safety risk rating for the proposed detention basin and identify possible safety mitigation measures such as inlet screens where practicable.

It is recommended that Logan City Council approve the conceptual design and stormwater management strategies presented in this report, and that detailed engineering design be completed to incorporate these stormwater management strategies whilst maintaining the design objectives.

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1 INTRODUCTION

Morris Water Pty Ltd was commissioned by Belivah Pty Ltd to prepare a Site Based Stormwater Management Plan for a proposed residential development containing 175 lots at Belivah Road, Belivah.

The site layout is included in Appendix A. For clarity and consistency, the proposed development as shown within Appendix A, will herein be referred to as 'the site'.

This report investigates and addresses the management of stormwater quantity, flooding and stormwater quality requirements for the development in accordance with relevant Local and State Government standards. It provides a stormwater quantity strategy for managing peak flows discharging from the site to demonstrate that the development will not cause actionable nuisance to neighbouring properties.

The report also provides a strategy for managing the quality of runoff before leaving the site. The stormwater quality management strategy was developed in accordance with Logan City Council (LCC)'s 2015 *Planning Scheme Policy 5 – Infrastructure* and the *State Planning Policy* (*SPP* 2014).

1.1 SCOPE

Morris Water was commissioned to provide flood impact and stormwater quality assessments in support of the proposed development. This report includes the following:

- **Hydrology Analysis.** The analysis was undertaken using xpstorm to determine existing peak flows and developed mitigated peak flows, to demonstrate no adverse impacts from the development.
- **Hydraulic Analysis.** Local flood investigations were undertaken using xpstorm. The existing flood immunity at Beaudesert Beenleigh Rd is low with runoff overtopping the road from the existing site at relatively low Annual Exceedance Probabilities (AEP). The design goal was to ensure that the flood levels and velocities were not worsened as a result of the proposed development.
- **Water Quality Analysis.** Conceptual stormwater quality modelling was undertaken using MUSIC to demonstrate that the water quality objectives will be met.
- **Risk Assessment.** A Risk Assessment Report has been prepared as per Section 12.2 of the Queensland Urban Drainage Manual (QUDM) Fourth Edition (2016).

2 SITE CHARACTERISTICS

2.1 LOCATION

The site is located within the Queensland suburb of Belivah in the Logan City Council area. The proposed development is on real property descriptions, 500 SP290602 and 2 SP290601. The proposed development partially covers the site and has a total area of approximately 13.3 ha.

The site is bounded by Beaudesert Beenleigh Rd to the east, Belivah Rd to the north, existing rural residential development to the south and vacant land to the west. The site location is notionally shown on Figures 2-1 and 2-2.

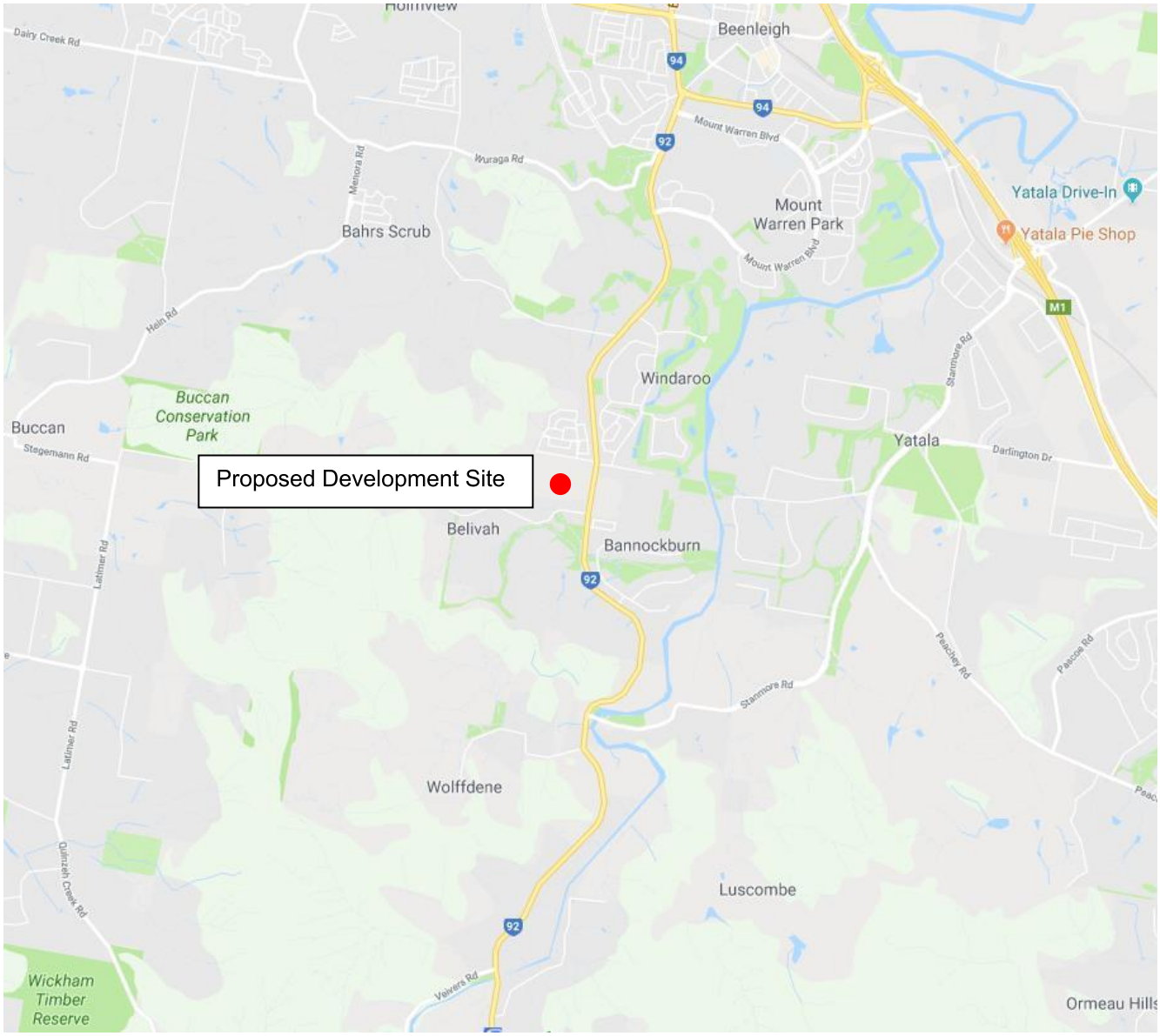


Figure 2-1: Locality Plan (Regional Scale)



Figure 2-2: Locality Plan (Local Scale)

The proposed development site location is shown indicatively on Figures 2-1 and 2-2.

2.2 EXISTING TOPOGRAPHY AND EARTHWORKS

The existing surface levels grade gently to the east. Existing surface elevations across the site range between approximately RL 16 m AHD adjacent to Beaudesert Beenleigh Rd and RL 37 m AHD in the north-western corner. The grades are typically in the order of 2 to 3%.

Some minor localised earthworks construction is proposed. Levels will be modified to provide favourable conditions for residential development. Following construction of the proposed minor drainage and overland flow paths, runoff will discharge to the proposed detention basin in the south-eastern corner.

3 HYDROLOGY ANALYSIS

3.1 RAINFALL PARAMETERS

3.1.1 Location

The requested coordinate was -27.756 Latitude,153.185 Longitude. The nearest grid cell was -27.7625 Latitude, 153.1875 Longitude. This location is approximately 800 m to the south of the proposed development site.

3.1.2 Areal Reduction Factors

The following Long Duration Areal Reduction Factor Coefficients were used as outlined in Table 3-1.

Table 3-1: Existing and Proposed Sub-catchment Parameters

a	b	c	d	e	f	g	h	i
0.327	0.241	0.448	0.360	0.00096	0.480	-0.21	0.012	-0.0013

It is noted that these are the default ARR values. The total catchment area of 0.126 km^2 was used.

3.1.3 Raw Data

The ARR data files are included in Appendix C.

3.2 CATCHMENT PARAMETERS

3.2.1 Catchment Areas

The pre-development catchment boundaries were determined based on existing surface contours. Post-developed sub-catchment boundaries were determined based on design surface levels, taking into account the impacts of built features such as roads and buildings. The same sub-catchment areas were used for both the pre and post-developed cases.

The pre-developed (existing) and post-developed (proposed) sub-catchments are shown on the sketch drawings in Appendix B.

The existing and proposed sub-catchment parameters are outlined in Table 3-2.

Table 3-2: Existing and Proposed Sub-catchment Parameters

Catchment ID	Catchment Area, ha	Existing Fraction Impervious	Proposed Fraction Impervious
Cat-01	0.512	0	0.7
Cat-02	0.969	0	0.7
Cat-03	0.826	0	0.7
Cat-04	1.045	0	0.7
Cat-05	0.781	0	0.7
Cat-06	0.593	0	0.7
Cat-07	1.039	0	0.7
Cat-08	0.784	0	0.7
Cat-09	1.066	0	0.7
Cat-10	0.787	0	0.7
Cat-11	0.061	0	0.7
Cat-12	0.724	0	0.7
Cat-13	0.754	0	0.7
Cat-14	1.060	0	0.7
Cat-15	1.132	0	0.7
Cat-16	1.126	0	0.7
Ext-01	0.700	0	0
Total	13.959 ha		

Catchments were modelled with constant slopes of 2% for both pre-developed and post-developed cases.

3.2.2 Manning's n and Infiltration Parameters

The following global values were used as outlined in Table 3-3.

Table 3-3: Manning's n and Infiltration Parameters

Parameter	Pre-developed	Post-developed	Comment
Initial Loss	0 mm	0 mm	ARR default values of 25 mm were not adopted, catchment saturated at start of storm burst.
Continuing Loss	2.3 mm/hr	2.3 mm/hr	
Pervious Area Manning's n	0.3	0.08	Long grass/rural area (pre) versus maintained lawns (post)
Impervious Area Manning's n	n/a	0.02	Pre-developed 0% impervious, post-developed Manning's n accounting for roads, obstacles etc.
Routing Method	Laurenson	Laurenson	'Calculate B' option was used.

The Laurenson routing method was used including the 'Calculate B' option.

3.3 VERIFICATION

It is considered that the hydrology model delivered a reasonable representation of the catchments being modelled. A manual check was undertaken using the Rational Method as outlined in Table 3-4.

Table 3-4: Hydrology Model Peak Discharge Verification

Model	Hydrology Model	Rational Method
Single Sub-catchment		
Major Storm (1% AEP)		
Pre-development	0.43	0.45
Post-development (unmitigated)	0.56	0.57
% increase	29%	25%
Minor Storm (63% AEP)		
Pre-development	0.13	0.12
Post-development (unmitigated)	0.20	0.14
% increase	49%	25%
Whole Catchment		
Major Storm (1% AEP)		
Pre-development	7.06	5.99
Post-development (unmitigated)	7.88	7.49
% increase	12%	25%
Minor Storm (63% AEP)		
Pre-development	2.08	1.52
Post-development (unmitigated)	2.50	1.90
% increase	20%	25%

The hydrology model was adopted. The percentage increases in peak discharges were reasonable compared with the Rational Method with an estimated time of concentration of 15 minutes.

4 HYDRAULIC ANALYSIS

4.1 MODEL SET UP

4.1.1 Minor Drainage System

A 1D network model was used to represent the proposed minor drainage system. A global Manning's n value of 0.013 was used for pipe roughness. Losses through manholes were approximated using k values of 0.2 (entrance) and 0.5 (exit). Pipe diameters were adjusted until the minor drainage system adequately conveyed the 39% AEP (2 year ARI) and inundation depths were reasonable during a major storm event. Minimum longitudinal grades were used as outlined in QUDM Table 7.12.1.

The minor drainage system is proposed with two outlets to the proposed bioretention area. Each outlet will be provided with sediment forebays to provide preliminary treatment prior to entering the basin.

The proposed minor drainage system is shown on the sketch drawings in Appendix B.

4.1.2 Overland Flow Paths

The 1D network model also included overland flow paths. Road cross sections were used as extracted from the design DTM. Indicatively, the road cross section width was 7.5 m. The total with of the road verge was notionally 20 m. Manning's n value of 0.02 was used for roads. Road elevations were extracted from the design DTM.

An overland flow path is proposed adjacent to the Council park area to convey flows into the proposed detention basin. The total channel width will not exceed 5 m. The channel was modelled with a low flow 'v' drain to the southern side and an overbank at a depth of approximately 0.4 m. The overall channel depth was 0.8 m, which provides 300 mm freeboard.

The proposed drainage network including cross section representations is shown on the sketch drawings in Appendix B.

4.1.3 Proposed Bioretention / Detention Basin

It is proposed to treat water quality and quantity in a combined bioretention/detention basin. The water quality requirements have been designed based on MUSIC modelling as outlined in Section 5.

Sediment Forebay

The minor drainage outlets will discharge to a proposed sediment forebay. The sediment forebay treats the entire subdivision and has a minimum surface area of 78 m^2. The surface area was determined using Equations 3, 4 and 5 of the Water By Design Bioretention Technical Design Guidelines (October 2014). A clean out frequency of 2 years was adopted. The design invert level is RL 17.2 m AHD and the design crest level is RL 17.4 m AHD.

Bioretention Area

Based on MUSIC modelling, a minimum design bioretention surface area of 780 m^2 is required. The design invert level is RL 16.9 m AHD and the design crest level is RL 17.2 m AHD. This has been designed as an additional water quality measure so that the water elevations, when flowing over the spill crest, will not backfill the sediment forebays. The design filter depth is 400 mm and the base of the bioretention basin is RL 16.2 m AHD. The bioretention basin will be free draining.

Detention Area

Based on xpstorm modelling, an average design detention surface area of 500 m^2 is required. The design invert level ranges from RL 16.2 to 16.4 m AHD with a notional grade of 1 in 100 towards the outlet. The outlet includes 5 by 375 mm pipes/headwall and a 15 m long overflow weir with crest level of 17.4 m AHD. Both will discharge to the existing spoon drain running parallel to Beaudesert Beenleigh Rd.

An overview of the proposed bioretention/detention basin is included in Appendix B. The overall device footprint including batter slopes will be approximately 2,000 m^2.

4.1.4 Model Overview

An xpstorm model screenshot is shown on Figure 4-1.

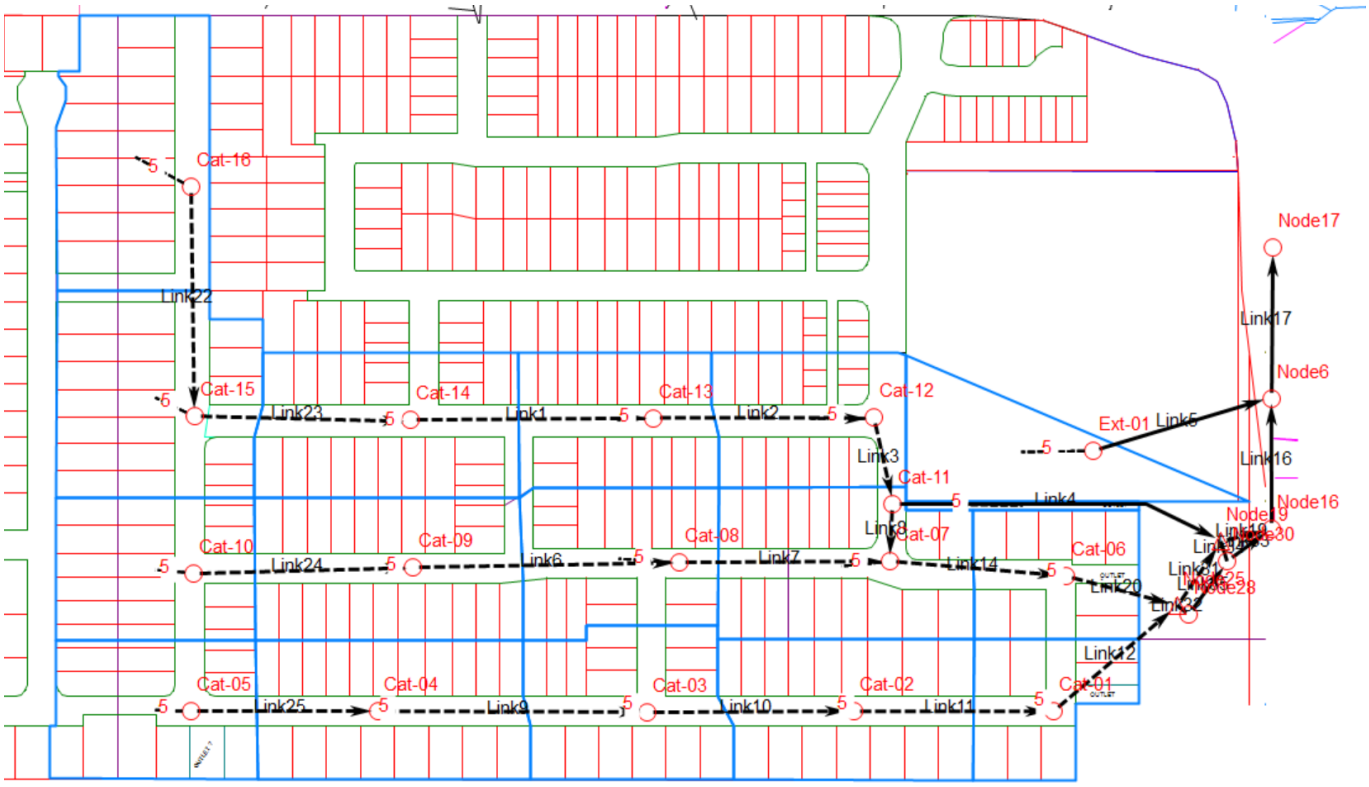


Figure 4-1: Xpstorm Model Screenshot

4.2 HYDRAULIC MODELLING RESULTS

Hydraulic analyses were undertaken using xpstorm to determine the flood conditions during a local flood event. The analyses were undertaken to demonstrate no adverse impacts upstream and downstream of the site and to ensure that the development has appropriate flood immunity.

The following investigations were undertaken:

- **Existing Scenario** to determine the existing peak discharges crossing Beaudesert Beenleigh Rd.
- **Developed Scenario** to demonstrate that the proposed development will not result in significant adverse impacts at Beaudesert Beenleigh Rd, the Council reserve or neighbouring properties, and that appropriate flood immunity has been achieved for the development

4.2.1 Peak Discharges

The peak discharges are not worsened as a result of the proposed development. Based on hydraulic modelling the peak discharge at Beaudesert Beenleigh Rd is not increased compared with the pre-development case. An overview of the modelling results are outlined in Table 4-1.

Table 4-1: Comparison of Pre and Post-Development Peak Discharges (Major Storm Events)

Storm Event	Pre-development Peak Discharge, m^3/s	Post-development Peak Discharge, m^3/s	Comparison
1% AEP (100 year ARI)			
10 min	6.45	4.17	-2.28
15 min	7.41	5.67	-1.74
30 min	6.18	5.28	-0.90
45 min	**7.06**	**6.43**	**-0.64**
1 hr	6.47	6.18	-0.29
1.5 hr	4.34	4.03	-0.32
2 hr	4.48	4.06	-0.42
3 hr	3.96	3.68	-0.28
2% AEP (50 year ARI)			
10 min	5.65	3.40	-2.25
15 min	6.61	4.84	-1.76
30 min	5.45	4.66	-0.78
45 min	**6.24**	**5.44**	**-0.80**
1 hr	5.68	5.31	-0.38
1.5 hr	3.81	3.50	-0.31
2 hr	3.86	3.47	-0.40
3 hr	3.39	3.17	-0.23

Table 4-2: Comparison of Pre and Post-Development Peak Discharges (Moderate Storm Events)

Storm Event	Pre-development Peak Discharge, m^3/s	Post-development Peak Discharge, m^3/s	Comparison
5% AEP (20 year ARI)			
10 min	4.60	2.54	-2.07
15 min	4.89	3.53	-1.36
30 min	4.63	3.63	-0.99
45 min	**4.97**	**4.00**	**-0.97**
1 hr	4.17	3.70	-0.46
1.5 hr	3.66	3.32	-0.35
2 hr	3.02	2.86	-0.16
3 hr	3.43	3.18	-0.25
10% AEP (10 year ARI)			
10 min	3.76	1.88	-1.88
15 min	4.15	2.75	-1.40
30 min	3.86	3.00	-0.87
45 min	**4.16**	**3.30**	**-0.87**
1 hr	3.53	3.04	-0.49
1.5 hr	3.03	2.71	-0.31
2 hr	2.52	2.38	-0.14
3 hr	2.82	2.60	-0.22

Table 4-3: Comparison of Pre and Post-Development Peak Discharges (Minor Storm Events)

Storm Event	Pre-development Peak Discharge, m^3/s	Post-development Peak Discharge, m^3/s	Comparison
18% AEP (5 year ARI)			
10 min	3.00	1.28	-1.71
15 min	3.31	1.97	-1.34
30 min	**3.67**	**2.73**	**-0.94**
45 min	3.25	2.30	-0.94
1 hr	3.13	2.26	-0.87
1.5 hr	2.63	1.84	-0.79
2 hr	2.21	1.49	-0.72
3 hr	2.48	2.16	-0.32
39% AEP (2 year ARI)			
10 min	2.00	1.08	-0.92
15 min	2.25	1.17	-1.08
30 min	**2.48**	**1.40**	**-1.08**
45 min	2.17	1.27	-0.90
1 hr	2.06	1.28	-0.77
1.5 hr	1.71	1.12	-0.59
2 hr	1.44	1.05	-0.39
3 hr	1.64	1.18	-0.46
63% AEP (1 year ARI)			
10 min	1.69	0.99	-0.70
15 min	1.93	1.10	-0.83
30 min	**2.08**	**1.18**	**-0.90**
45 min	1.86	1.14	-0.72
1 hr	1.77	1.10	-0.68
1.5 hr	1.45	1.03	-0.42
2 hr	1.24	0.95	-0.30
3 hr	1.40	1.09	-0.31

As outlined in Tables 4-1, 4-2 and 4-3, the peak discharges are not increased as a result of the proposed development.

4.2.2 Water Surface Elevations in Basin

The water surface elevations in the proposed detention basin are outlined in Table 4-4.

Table 4-4: Depths and Water Surface Elevations in Proposed Detention Basin

Storm Event	Water Surface Elevation, m AHD	Average Depth, m
1% AEP (100 year ARI)	17.76	1.52
2% AEP (50 year ARI)	17.72	1.47
5% AEP (20 year ARI)	17.62	1.40
10% AEP (10 year ARI)	17.58	1.32
18% AEP (5 year ARI)	17.52	1.29
39% AEP (2 year ARI)	17.46	1.18
63% AEP (1 year ARI)	17.40	1.14

The values in Table 4-4 correspond to the worst case storm duration between 10 minutes and 3 hours. The proposed top of basin level is RL 18.1 m AHD, maintaining a minimum freeboard of 300 mm during the 1% AEP event. It is considered that the design water surface elevations are acceptable.

4.2.3 Hydrographs

Typical hydrographs are shown on Figure 4-2 (1% AEP, 60 min duration storm event) and Figure 4-3 (63% AEP, 30 min duration storm event).

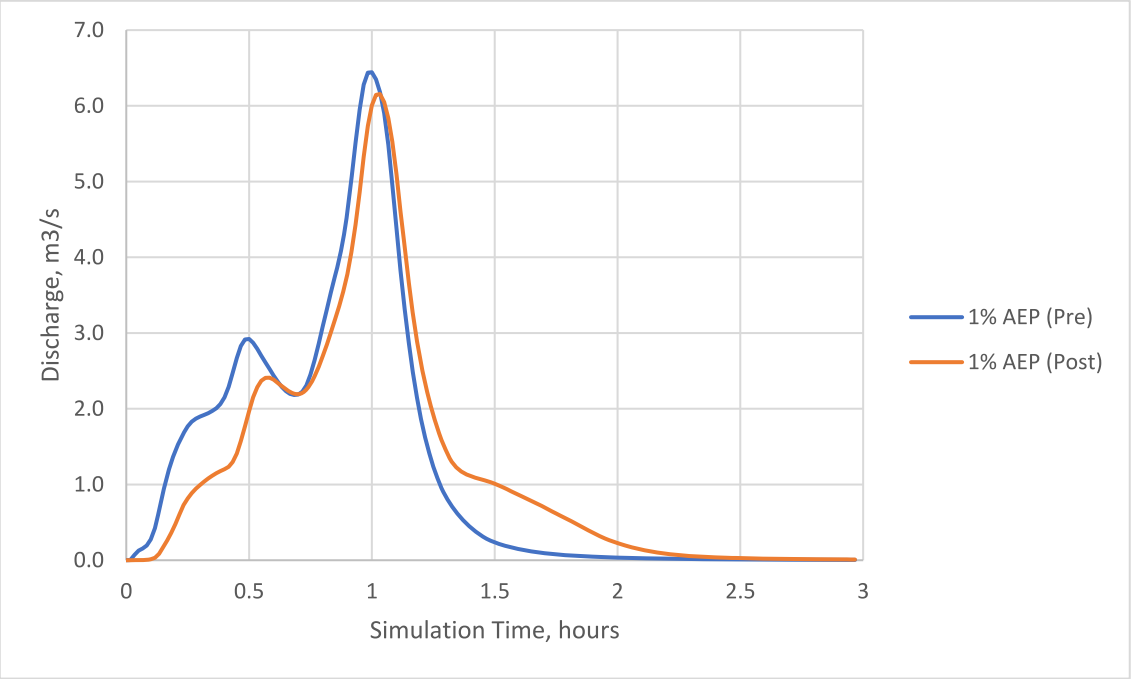


Figure 4-2: Typical Hydrograph Comparison (Major Storm Event)

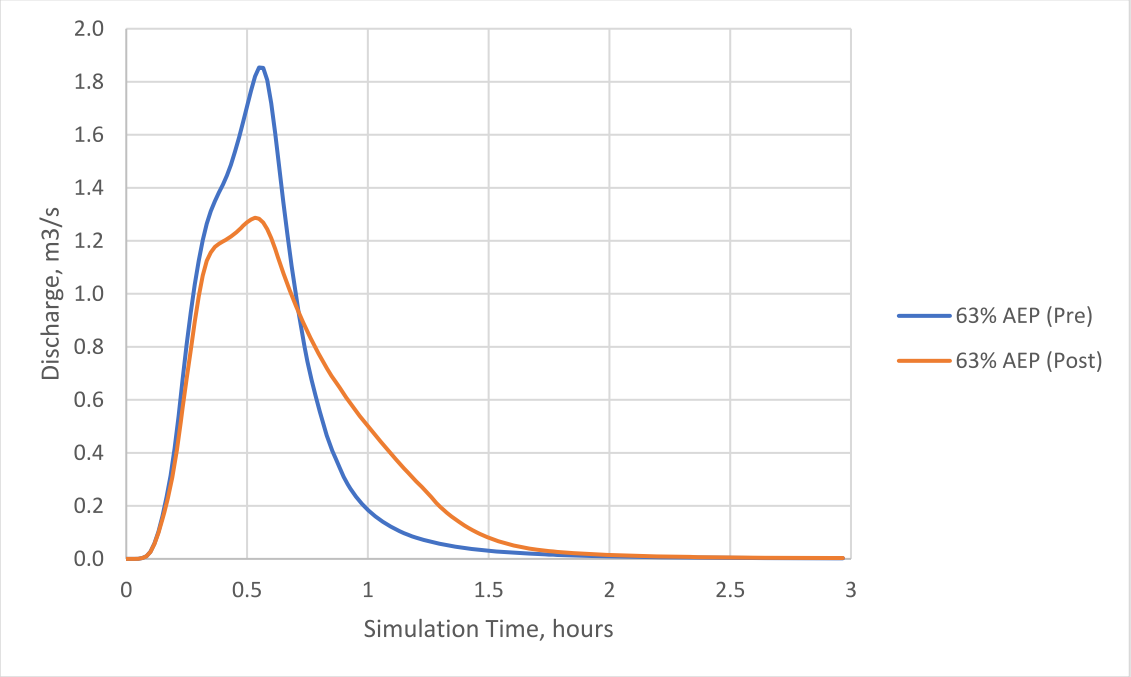


Figure 4-3: Typical Hydrograph Comparison (Minor Storm Event)

Based on the hydraulic modelling, as outlined on Figures 4-2 and 4-3, the proposed development does not significantly alter the shape of the flow hydrographs, particularly the timing of peak discharges.

4.2.4 Proposed Development Drainage Infrastructure

The proposed piped drainage network within the subdivision has been designed in accordance with the Queensland Urban Drainage Manual (QUDM). Pipes have been sized to comply with the roadway flow limits and capacities, including flow depths and freeboards, as per QUDM Section 7.4. Pipe grade limits are as per QUDM Table 7.12.

The proposed minor drainage network is shown on the sketch drawings in Appendix B. The final pipe and storage configurations will be confirmed prior to the finalisation of detailed engineering design.

5 WATER QUALITY ANALYSIS

5.1 MODEL SET UP

The MUSIC model was set up generally as outlined in the Water By Design MUSIC Modelling Guidelines (MUSIC Guidelines, 2010). Default values were used unless otherwise noted.

5.1.1 Meteorological Data

The 10 year rainfall series and Mean PET for Shailer Park was used with 6 minute timestep as per the MUSIC Guidelines Table 3.1.

Table 5-1: MUSIC Mean PET

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
195	153	149	107	74	61	63	80	110	148	173	199

The Mean Annual Rainfall over the period was 1,119 mm/year.

5.1.2 Catchment Parameters

The proposed development is contained within a catchment covering 14 ha, containing approximately 200 lots, that is including 25 external lots. Typical surface type splits were adopted as per the MUSIC Guidelines Table 3.3 for the 'Residential 15 du/ha' development type.

Table 5-2: Breakdown of Surface Types and Fractions Impervious

Catchment Parameter	Road	Roof	Ground Level
Breakdown of Surface Types, %	25	32.5	42.5
Surface Type Impervious Fraction, %	60	100	20

Typical surface type splits and impervious fractions were adopted as per the MUSIC Guidelines Table 3.3 and 3.5 for the 'Residential 15 du/ha' development type.

5.1.3 Rainfall-Runoff and Pollutant Export Parameters

Rainfall-runoff parameters were adopted as per the MUSIC Guidelines Table 3.7 for the 'Urban Residential' land use type. The following values were adopted as outlined in Table 5-3.

Table 5-3: Breakdown of Surface Types

Parameter	Land Use (Urban Residential)
Rainfall threshold, mm	1
Soil storage capacity, mm	500
Initial storage, % capacity	10
Field capacity, mm	200
Infiltration capacity coefficient a / b	211 / 5.0
Initial depth, mm	50
Daily recharge rate, %	28
Daily baseflow rate, %	27
Daily deep seepage rate, %	0

The values in Table 5-3 were considered to be appropriate for the proposed development.

Pollutant export parameters were adopted as per the MUSIC Guidelines Table 3.8 for the 'Urban Residential' land use type. The following values were adopted as outlined in Table 5-4.

Table 5-4: Pollutant Export Parameters

Flow Type	Surface Type	TSS Log_{10} Values		TSS Log_{10} Values		TSS Log_{10} Values	
		Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
Baseflow	Roof	n/a	n/a	n/a	n/a	n/a	n/a
	Roads	1.00	0.34	-0.97	0.31	0.20	0.20
	Ground Level	1.00	0.34	-0.97	0.31	0.20	0.20
Stormflow	Roof	1.30	0.39	-0.89	0.31	0.26	0.23
	Roads	2.43	0.39	-0.30	0.31	0.26	0.23
	Ground Level	2.18	0.39	-0.47	0.31	0.26	0.23

The values outlined in Tables 5.3 and 5.4 were not changed from the default values.

5.1.4 Bioretention Filter Media Specifications

The default parameters used by MUSIC in bioretention basins for 'TN Content of Filer Media' and 'Orthophosphate Content of Filter Media' are considered to be overly conservative. More representative values of 600 mg/kg and 20 mg/kg, respectively, were adopted. Detailed filter media technical specifications are included in Appendix D which support these values. This material is readily available and is proposed for use on this project.

5.1.5 Model Overview

A MUSIC model screenshot is shown on Figure 5-1.

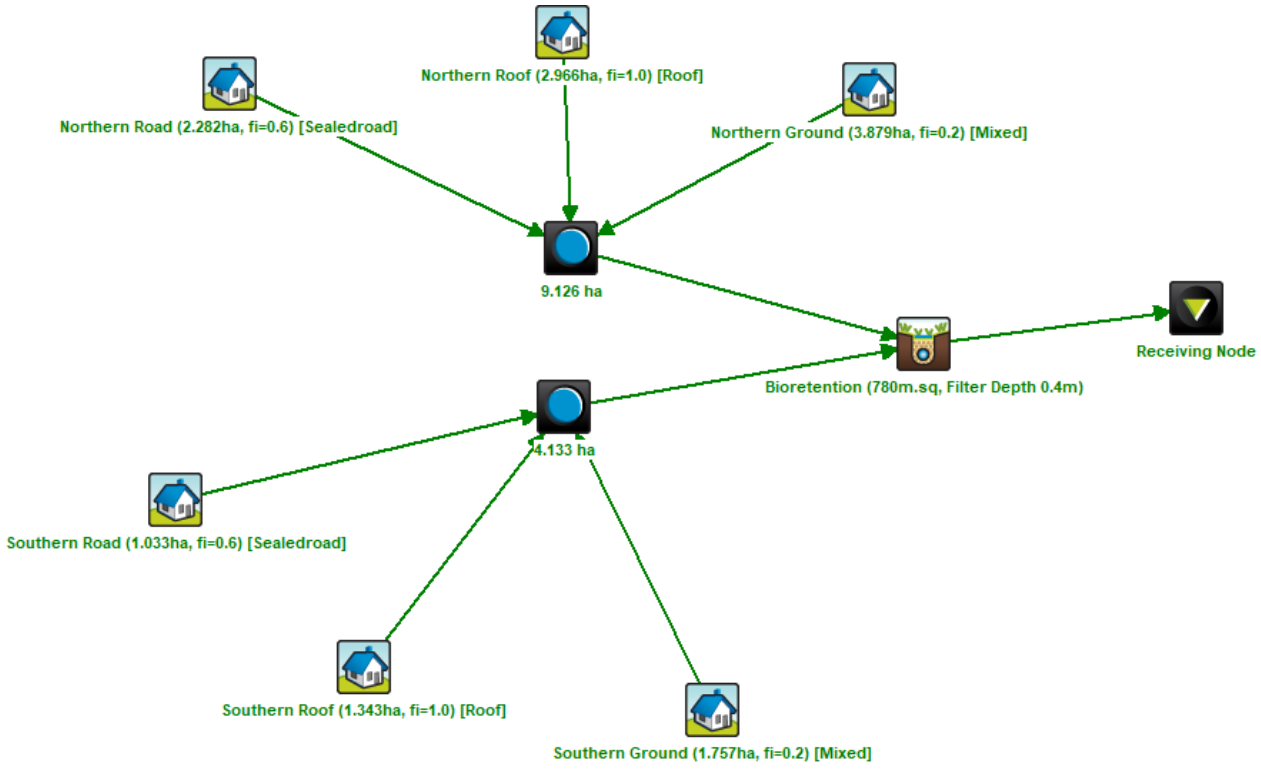


Figure 5-1: MUSIC Model Screenshot

5.2 PROPOSED STORMWATER QUALITY IMPROVEMENT DEVICES

5.2.1 Sediment Forebay

The proposed sediment forebay was designed in accordance with Equations 3, 4 and 5 of the Water By Design Bioretention Technical Design Guidelines (October 2014):

Equation 3

$V_s = A_c \times R \times L_o \times F_c$

Where: V_s = volume of forebay sediment storage required (m^3)

A_c = contributing catchment area (ha)

R = capture efficiency (0.8 recommended)

L_o = sediment loading rate (m^3/ha/year)

F_c = desired cleanout frequency (years)

Equation 4

$$R = 1 - \left[1 + \frac{1}{n} \times \frac{v_s}{Q/A_f}\right]^{-n}$$

Where: R = fraction of target sediment removed (0.8 recommended)

v_s = settling velocity of target sediment (0.1 m/s for 1 mm particle)

Q = 3-month ARI flow rate (m^3/s)

A_f = minimum forebay area for sediment capture (m^2)

n = turbulence or short-circuiting parameter (0.5 recommended)

Equation 5

$$D_s = \frac{V_s}{A_f}$$

Where: V_s = minimum forebay volume for sediment storage (m^3) from Equation 3

A_f = minimum forebay area for sediment capture (m^2)

D_s = forebay depth (≤ 0.3 m)

The sediment forebay services 13.3 ha. From Eq. 3, using a sediment loading rate of 0.6 m^3/ha/year and a desired cleanout frequency of 2 years, a storage volume of 12.7 m^3 is required. The 3 month ARI flow rate was estimated based on the hydraulic model. From Eq. 4, the minimum forebay area for sediment capture was 78 m^2. From Eq. 5, the minimum forebay depth was 0.17 m.

Based on these calculations, the following was adopted:

- Forebay Area: 100 m^2
- Forebay Depth: 0.2 m
- Invert Level: RL 17.2 m AHD
- Crest Level: RL 17.4 m AHD

The sediment forebay will provide preliminary treatment prior to stormwater entering the bioretention area and provide some pollutant reductions towards the design water quality objectives, particularly TSS. Specifically, the sediment forebays will by design remove at least 80% of TSS.

5.2.2 Bioretention Area

The proposed bioretention basin was sized to deliver pollutant reductions towards the design water quality objectives for TN and TP as well as further reducing TSS. The MUSIC model was iteratively run until the desired TN and TP pollutant reductions were achieved. Based on the MUSIC modelling, the following was adopted:

- Filter Area / Surface Area: 780 m^2
- Filter Depth: 0.4 m
- Extended Detention Depth: 0.3 m

The bioretention basin was modelled with the following properties: Unlined filter media 14 m, vegetated with effective nutrient removal plants, total nitrogen content 600 mg/kg, orthophosphate content 20 mg/kg, saturated hydraulic conductivity 200 mm/hr, zero exfiltration, underdrain present.

The levels were designed to reduce the frequency of backfilling the upstream sediment forebays. The design invert level is RL 16.9 m AHD and the crest level is RL 17.2 m AHD, providing 0.3 m of extended detention depth below the invert of the sediment forebays. The design base level is RL 16.2 m AHD, allowing for 400 mm filter depth and 300 mm gravel layer. This will also ensure that the bioretention basin is free draining to the detention basin outlet.

5.3 WATER QUALITY MODELLING RESULTS

Based on the MUSIC modelling and design calculations outlined in the Water By Design technical publications, the proposed development will meet the target water quality objectives, as outlined in Table 5-5.

Table 5-5: Pollutant Reductions

Pollutant Type	Source Load, kg/year	Mitigated Pollutant Discharges, kg/year	Pollutant Reduction Target, %	Pollutant Reduction Achieved, %
Total Suspended Solids (TSS)	10,400	< 8,320	80 %	> 80 %
Total Phosphorus (TP)	24.7	8.21	60 %	66.7 %
Total Nitrogen (TN)	182	100	45 %	45.1 %

As outlined in Table 5-5, the proposed development complies with the design water quality objectives. The proposed treatment train is effective in complying with the relevant Logan City Council Planning Scheme Policies. The final water quality treatment configurations will be confirmed prior to the finalisation of detailed engineering design.

6 RISK ASSESSMENT REPORT

6.1 SAFETY RISK RANKING (DETENTION BASIN)

A Risk Ranking was used to describe the proposed pipe outlets which discharge into the proposed detention basin, as outlined in Table 6-1.7

Table 6-1: Detention Basin Risk Ranking

Element	Description / Ranking	Justification
Contact Classification	Class B2	Within 100 m of a future urban residential area, access to potentially dangerous waters is unlikely
Safety risks associated with a conduit flowing full	Low (1)	A person is unlikely to become trapped in the 300 mm diameter outlet pipes so low risk.
Safety risks associated with lengths of conduit	Medium (3)	Conduit lengths typically between 30 and 60 m
Safety risks associated with flow conditions within conduit	Medium (3)	Change of direction junction pit proposed
Safety risks associated with flow conditions at outlet of conduit	Low (1)	Sediment forebay provides favourable conditions for rescue
Risk Ranking	**14 out of 20**	1 being highest risk and 20 being lowest risk

The proposed detention basin has a Risk Ranking of 14 out of 20.

6.2 PROPOSED SAFETY MITIGATION MEASURES

Case 5 mitigation measures are proposed as outlined in QUDM Section 12. Case 5 mitigation measures may include:

- Appropriate screens on inlets with openings exceeding 300 mm, wherever practical
- Exclusion fencing for areas with depth by velocity product greater than 0.6 m^2/s
- Use of vegetation or other measures to restrict access if exclusion fencing not suitable
- Warning signs to be erected / placed around inside of the bank

It is proposed that the detention basin will not be fenced. The device will be clearly visible while in flood and in conjunction with adequate warning signs, it is considered that the proposed detention basin will be a reasonably foreseeable danger, meaning a parent or guardian of a child could reasonably be expected to be aware that dangers exist.

Safety in Design measures may include the provision of gentle grassed slopes, minimising potential for a person to fall into dangerous waters or fall more than 1 m on to a hard surface, reducing potentially hidden obstacles, etc.

7 CONCLUSIONS

Morris Water Pty Ltd has prepared this conceptual Site Based Stormwater Management Plan to support the development application for the proposed development at Belivah Road, Belivah.

The following analyses were undertaken:

- Catchment hydrology analysis to generate discharge hydrographs for existing and developed case scenarios.
- Hydraulic analysis using xpstorm to determine existing peak flows and developed mitigated peak flows, to demonstrate no adverse impacts as a result of the development.
- Water quality analysis including MUSIC modelling to evaluate the performance of the proposed treatment train.
- Preliminary risk assessment including proposed mitigation measures.

The following conclusions have been drawn based on the above investigations:

- Peak flow mitigation is achieved via the proposed detention storage in the south-eastern corner of the site.
- Appropriate flood immunity has been provided within the proposed development.
- The proposed development has no adverse impact on neighbouring properties including the adjacent Council reserve.
- The proposed stormwater quality management strategy will meet the target water quality objectives.
- Final configurations of proposed water quality and quantity infrastructure will be confirmed and may be amended generally in accordance with and delivering the same overall objectives of this report, prior to the finalisation of detailed engineering design.
- Conceptual design drawings are included in Appendix B.

8 RECOMMENDATIONS

The following is recommended based on the above conclusions:

- That Council approve the conceptual design and stormwater management strategies presented in this report.
- That the stormwater management strategies be incorporated into the detailed engineering design.
- Detailed design may require minor changes to the stormwater management strategies whilst maintaining the design objectives outlined in this report.

APPENDICES

APPENDIX A

PROPOSED DEVELOPMENT LAYOUT PLAN



NOTES:

1. DRAWING PREPARED FOR DISCUSSION PURPOSES ONLY.
2. CONFIRM LOCATION OF AND MAINTAIN CLEARANCE TO EXISTING UTILITY SERVICES.

GENERAL LAYOUT PLAN

1:1000

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ABN: 84 625 420 135

MORRISWATER

FOR N.H. VOLKER & CO. PTY. LTD.

Design Project Officer	A. Morris
Designed/Drawn	A. Morris
Certified when signed:	Anthony Morris RPEQ No. 13639
Project Name	DAVIDSONS AT BELIVAH
Project Identifier	N/A
Project Number	VOLK01

Issue	Description	Name	Date
B	MINOR AMENDMENTS	A.MORRIS	22/07/18
A	FOR APPROVAL	A.MORRIS	16/07/18

Bar Scales: 1:1000 0 10 20 30 40m

Do not scale, use figured dimensions only

Client Details: N.H. VOLKER & CO PTY LTD, PO BOX 411, BEENLEIGH 4207

DAVIDSONS AT BELIVAH
BELIVAH ROAD, BELIVAH

PROPOSED DEVELOPMENT LAYOUT CONTEXT PLAN

Drawing Number: **VOLK01-02**

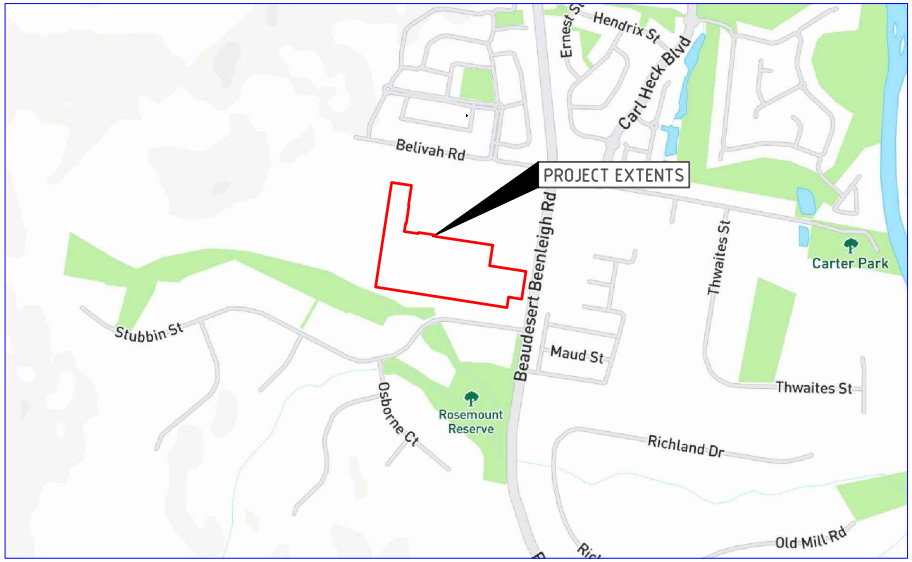
Date: **22/07/2018** Issue: **B**

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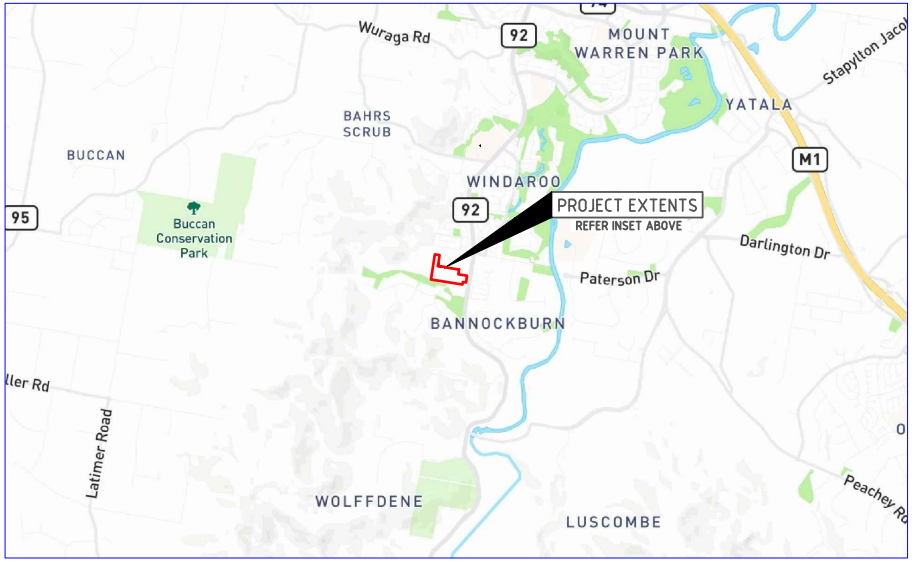
APPENDIX B

ENGINEERING SKETCH PLANS

DAVIDSONS AT BELIVAH, RESIDENTIAL SUBDIVISION
STORMWATER MANAGEMENT PLAN



LOCALITY PLAN
N.T.S.



REGION PLAN
N.T.S.

DRAWING SCHEDULE		
DRAWING NUMBER	REVISION	DRAWING TITLE
VOLK01-01	B	LOCALITY PLAN AND DRAWING SCHEDULES
VOLK01-02	B	PROPOSED DEVELOPMENT LAYOUT
VOLK01-03	B	EXISTING SITE CONDITIONS
VOLK01-04	B	PROPOSED DRAINAGE INFRASTRUCTURE
VOLK01-05	B	PROPOSED DETENTION BASIN DETAIL
VOLK01-06	B	CONCEPTUAL WATER AND SEWERAGE SERVICES PLAN

LEGEND

- STORMWATER (PROPOSED)
- STORMWATER (EXISTING)
- WATER MAIN (PROPOSED)
- WATER MAIN (EXISTING)
- SEWER MAIN (PROPOSED)
- SEWER MAIN (EXISTING)
- TELECOMMUNICATIONS
- ELECTRICITY POWER POLE
- PROPERTY BOUNDARY
- STAGE BOUNDARY
- CATCHMENT BOUNDARY













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WARNING

EXISTING FEATURES PLOTTED FROM RECORDS. EXISTING FEATURES TO BE PHYSICALLY LOCATED AND CONFIRMED PRIOR TO CONSTRUCTION.

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Designed/Drawn: A. Morris
Certified when signed: Anthony Morris RPEQ No. 13639
Project Name: DAVIDSONS AT BELIVAH
Project Identifier: N/A
Project Number: VOLK01

Issue	Description	Name	Date
B	MINOR AMENDMENTS	A.MORRIS	22/07/18
A	FOR APPROVAL	A.MORRIS	16/07/18

Bar Scales: Do not scale, use figured dimensions only

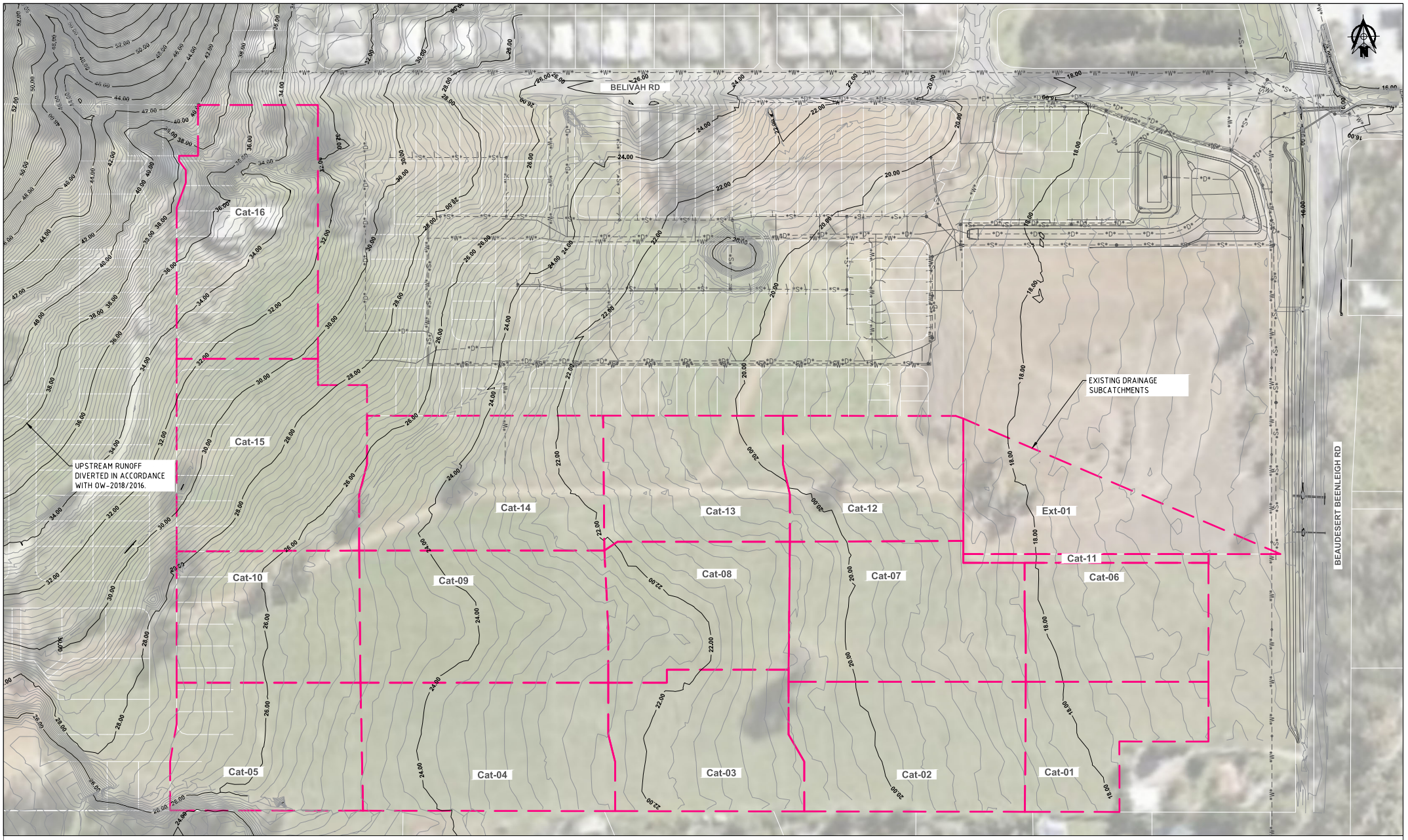
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DAVIDSONS AT BELIVAH
BELIVAH ROAD, BELIVAH

PRELIMINARY DRAINAGE PLAN

Drawing Number: VOLK01-01
Date: 22/07/2018
Issue: B

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GENERAL LAYOUT PLAN

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Certified when signed:	Anthony Morris RPEQ No. 13639
Project Name	DAVIDSONS AT BELIVAH
Project Identifier	N/A
Project Number	VOLK01

Issue	Description	Name	Date
B	MINOR AMENDMENTS	A.MORRIS	22/07/18
A	FOR APPROVAL	A.MORRIS	16/07/18

Bar Scales: 1:1000 0 10 20 30 40m

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DAVIDSONS AT BELIVAH
BELIVAH ROAD, BELIVAH

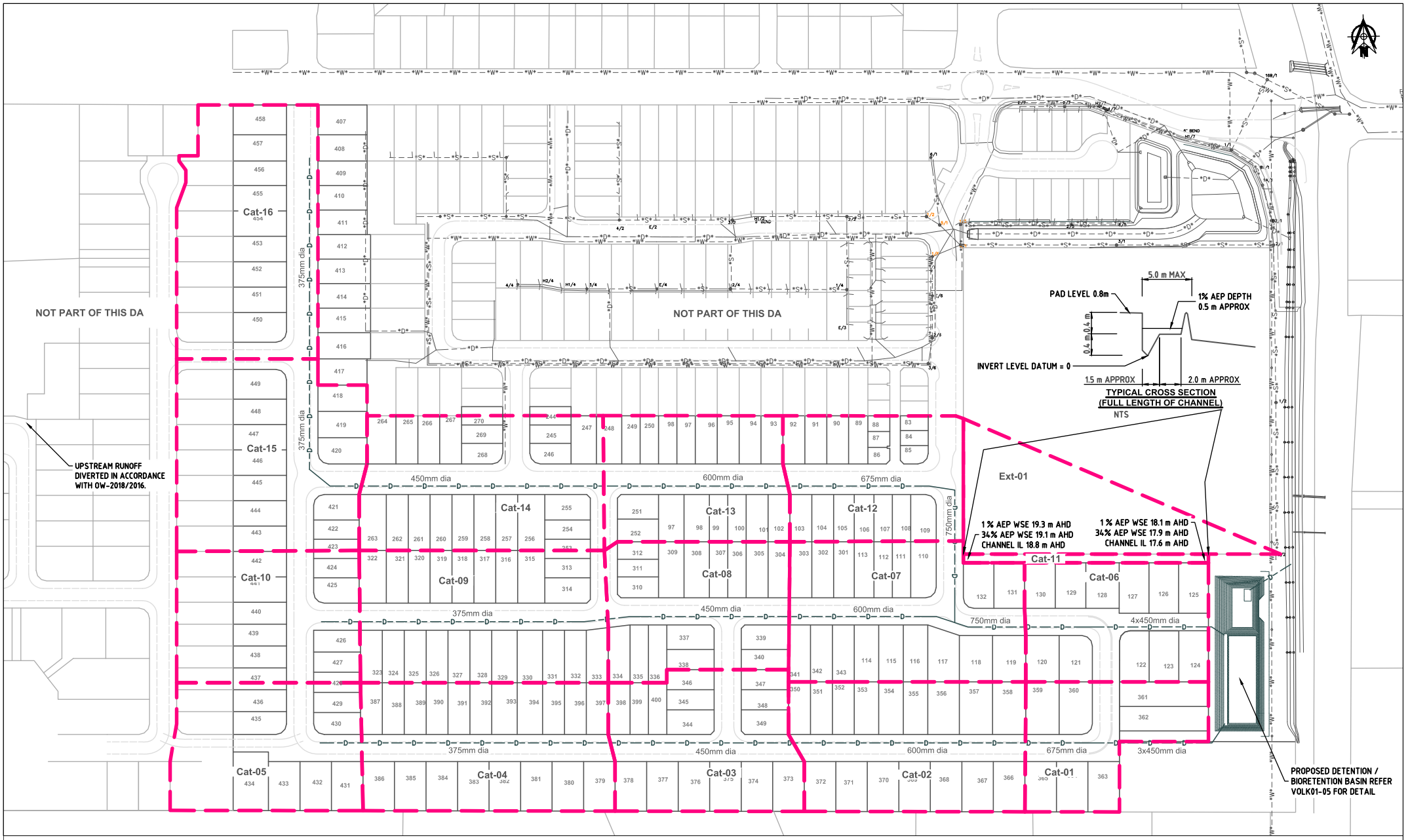
EXISTING SITE FEATURES

Drawing Number: VOLK01-03

Date: 22/07/2018

Issue: B

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GENERAL LAYOUT PLAN

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NOTE: PIPE DIAMETERS AND GULLY PIT LOCATIONS TO BE CONFIRMED PRIOR TO FINALISING DETAILED DESIGN.

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Designed/Drawn	A. Morris
Certified when signed:	Anthony Morris RPEQ No. 13639
Project Name	DAVIDSONS AT BELIVAH
Project Identifier	N/A
Project Number	VOLK01

Issue	Description	Name	Date
B	MINOR AMENDMENTS	A.MORRIS	22/07/18
A	FOR APPROVAL	A.MORRIS	16/07/18

Bar Scales: 1:1000 0 10 20 30 40m

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Client Details: N.H. VOLKER & CO PTY LTD, PO BOX 411, BEENLEIGH 4207

DAVIDSONS AT BELIVAH
BELIVAH ROAD, BELIVAH

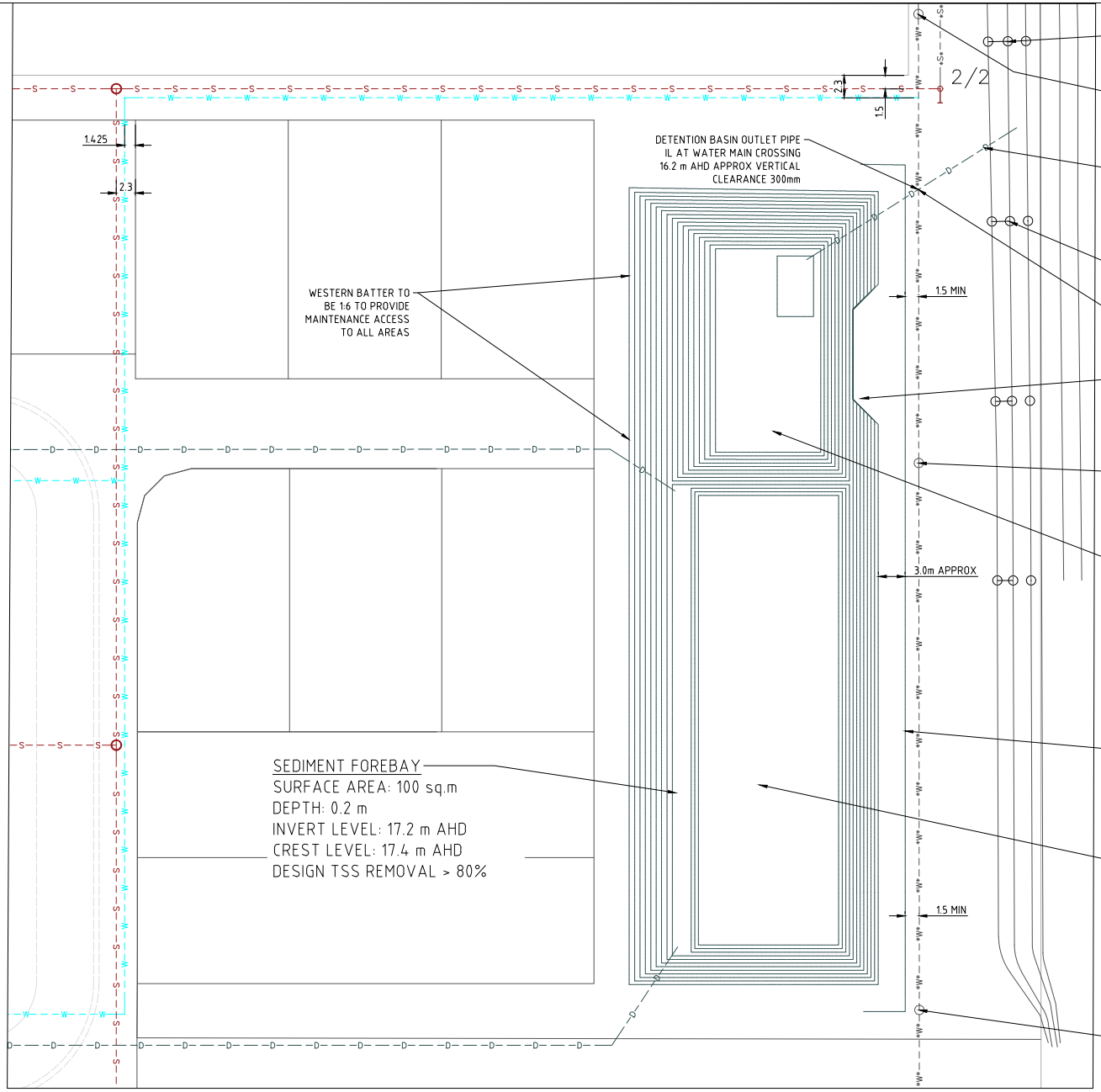
PROPOSED DRAINAGE NETWORK

Drawing Number: VOLK01-04

Date: 22/07/2018

Issue: B

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DETAILED LAYOUT PLAN

1:250

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Design Project Officer	A. Morris
Designed/Drawn	A. Morris
Certified when signed:	Anthony Morris RPEQ No. 13639
Project Name	DAVIDSONS AT BELIVAH
Project Identifier	N/A
Project Number	VOLK01

Issue	Description	Name	Date
B	MINOR AMENDMENTS	A.MORRIS	22/07/18
A	FOR APPROVAL	A.MORRIS	16/07/18

Bar Scales: 1:250 0 2 4 6 8 10m

Do not scale, use figured dimensions only

Client Details: N.H. VOLKER & CO PTY LTD, PO BOX 411, BEENLEIGH 4207

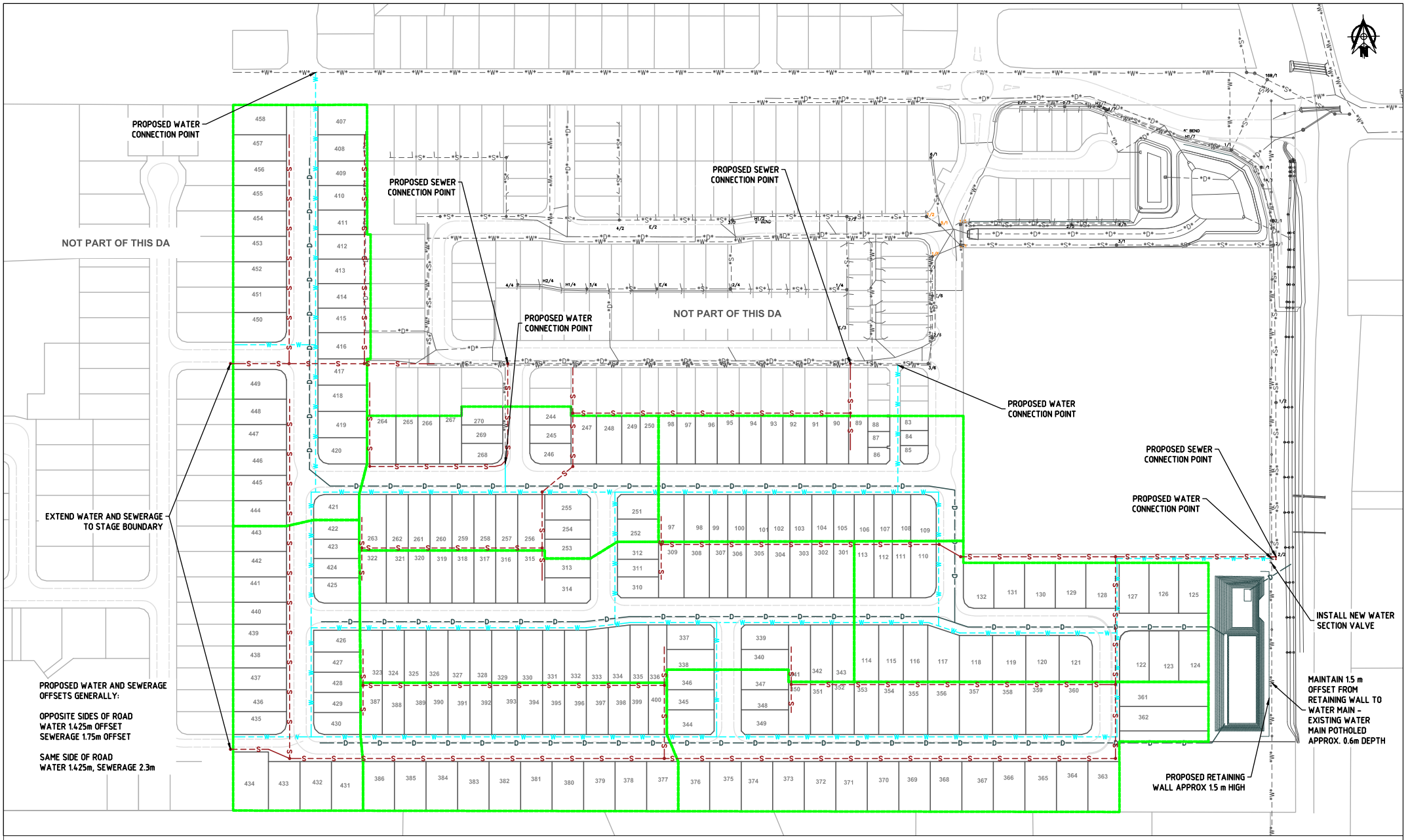
DAVIDSONS AT BELIVAH
BELIVAH ROAD, BELIVAH

PRELIMINARY DETENTION BASIN DETAILS

Drawing Number: **VOLK01-05**

Date: **22/07/2018** Issue: **B**

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2. CONFIRM LOCATION OF AND MAINTAIN CLEARANCE TO EXISTING UTILITY SERVICES.
3. CONNECTIONS TO EXISTING WATER AND SEWERAGE INFRASTRUCTURE TO BE PRIVATE WORKS - DEVELOPER DELIVERED LIVE CONNECTION.

GENERAL LAYOUT PLAN

1:1000

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Designed/Drawn	A. Morris
Certified when signed:	Anthony Morris RPEQ No. 13639
Project Name	DAVIDSONS AT BELIVAH
Project Identifier	N/A
Project Number	VOLK01

Issue	Description	Name	Date
B	MINOR AMENDMENTS	A.MORRIS	22/07/18
A	FOR APPROVAL	A.MORRIS	16/07/18

Bar Scales: 1:1000 0 10 20 30 40m

Do not scale, use figured dimensions only

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DAVIDSONS AT BELIVAH
BELIVAH ROAD, BELIVAH

CONCEPTUAL WATER AND SEWERAGE SERVICES PLAN

Drawing Number: VOLK01-06

Date: 22/07/2018

Issue: B

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APPENDIX C

ARR RAW DATA FILES

```
Results - ARR Data Hub
[STARTTXT]

Input Data Information
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Latitude,-27.756
Longitude,153.172
[END_INPUTDATA]

River Region
[RIVREG]
division,North East Coast
rivregnum,45
River Region,Logan-Albert Rivers
[RIVREG_META]
Time Accessed,16 April 2018 07:46AM
Version,2016_v1
[END_RIVREG]

ARF Parameters
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Zone,East Coast North
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b,0.241
c,0.448
d,0.36
e,0.00096
f,0.48
g,-0.21
h,0.012
i,-0.0013
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Time Accessed,16 April 2018 07:46AM
Version,2016_v1
[END_LONGARF]

Storm Losses
[LOSSES]
Storm Initial Losses (mm),25.0
Storm Continuing Losses (mm/h),2.3
[LOSSES_META]
Time Accessed,16 April 2018 07:46AM
Version,2016_v1
[END_LOSSES]

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Label,East Coast North
[TP_META]
Time Accessed,16 April 2018 07:46AM
Version,2016_v2
[END_TP]

Areal Temporal Patterns
[ATP]
code,ECnorth
arealabel,East Coast North
[ATP_META]
Time Accessed,16 April 2018 07:46AM
Version,2016_v2
[END_ATP]

BOM IFD Depths
[BOMIFD]
[BOMIFD_META]
```

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Time Accessed,16 April 2018 07:46AM
Version,2016_v2
[END_BOMIFD]

Median Preburst Depths and Ratios
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min (h)\AEP(%),50,20,10,5,2,1,
60 (1.0),3.0 (0.082),5.5 (0.108),7.2 (0.118),8.8 (0.123),10.0 (0.118),10.8 (0.114),
90 (1.5),4.0 (0.094),12.8 (0.218),18.7 (0.264),24.3 (0.294),16.2 (0.163),10.1 (0.09),
120 (2.0),2.0 (0.043),9.2 (0.142),14.0 (0.179),18.6 (0.202),20.9 (0.187),22.6 (0.178),
180 (3.0),3.8 (0.071),14.9 (0.198),22.2 (0.244),29.3 (0.272),37.3 (0.285),43.3 (0.289),
360 (6.0),7.4 (0.108),24.7 (0.253),36.2 (0.302),47.2 (0.331),73.5 (0.421),93.1 (0.463),
720 (12.0),13.4 (0.148),25.6 (0.194),33.7 (0.207),41.4 (0.214),63.0 (0.265),79.1 (0.29),
1080 (18.0),13.2 (0.122),22.3 (0.141),28.3 (0.145),34.1 (0.146),51.2 (0.179),63.9
(0.195),
1440 (24.0),2.9 (0.023),14.1 (0.078),21.6 (0.097),28.7 (0.108),54.8 (0.168),74.3 (0.199),
2160 (36.0),0.4 (0.003),7.4 (0.035),12.1 (0.046),16.5 (0.052),39.4 (0.102),56.5 (0.127),
2880 (48.0),0.0 (0.0),8.0 (0.034),13.3 (0.045),18.4 (0.052),30.1 (0.069),38.9 (0.078),
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[PREBURST_META]
Time Accessed,16 April 2018 07:46AM
Version,2016_v2
[END_PREBURST]

10% Preburst Depths
[PREBURST10]
min (h)\AEP(%),50,20,10,5,2,1,
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180 (3.0),0.0 (0.0),0.0 (0.0),0.0 (0.0),0.0 (0.0),0.0 (0.0),0.0 (0.0),0.0 (0.0),
360 (6.0),0.0 (0.0),0.0 (0.0),0.0 (0.0),0.0 (0.0),0.0 (0.0),0.0 (0.0),0.0 (0.0),
720 (12.0),0.0 (0.0),0.0 (0.0),0.0 (0.0),0.0 (0.0),1.4 (0.006),2.5 (0.009),
1080 (18.0),0.0 (0.0),0.1 (0.001),0.2 (0.001),0.2 (0.001),0.3 (0.001),0.3 (0.001),
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[PREBURST10_META]
Time Accessed,16 April 2018 07:46AM
Version,2016_v2
[END_PREBURST10]

25% Preburst Depths
[PREBURST25]
min (h)\AEP(%),50,20,10,5,2,1,
60 (1.0),0.0 (0.0),0.1 (0.003),0.2 (0.004),0.3 (0.005),0.3 (0.004),0.3 (0.004),
90 (1.5),0.0 (0.0),0.8 (0.014),1.4 (0.019),1.9 (0.023),0.9 (0.009),0.2 (0.002),
120 (2.0),0.0 (0.0),1.1 (0.017),1.9 (0.024),2.6 (0.028),1.6 (0.014),0.9 (0.007),
180 (3.0),0.0 (0.0),1.3 (0.017),2.2 (0.024),3.0 (0.028),4.1 (0.031),4.9 (0.033),
360 (6.0),0.0 (0.0),2.7 (0.027),4.4 (0.037),6.1 (0.043),6.7 (0.038),7.1 (0.035),
720 (12.0),0.0 (0.0),4.4 (0.033),7.3 (0.045),10.0 (0.052),20.4 (0.086),28.1 (0.103),
1080 (18.0),0.0 (0.0),3.9 (0.025),6.5 (0.033),8.9 (0.038),10.7 (0.038),12.1 (0.037),
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2880 (48.0),0.0 (0.0),0.0 (0.0),0.0 (0.0),0.0 (0.0),2.2 (0.005),3.8 (0.008),
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Time Accessed,16 April 2018 07:46AM
Version,2016_v2
[END_PREBURST25]

75% Preburst Depths
[PREBURST75]
min (h)\AEP(%),50,20,10,5,2,1,
60 (1.0),32.6 (0.879),43.3 (0.845),50.4 (0.824),57.2 (0.805),49.4 (0.585),43.6 (0.459),
```

```
90 (1.5),30.8 (0.728),49.7 (0.844),62.3 (0.88),74.3 (0.898),85.2 (0.857),93.3 (0.829),
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720 (12.0),70.9 (0.778),86.9 (0.658),97.5 (0.601),107.7 (0.555),183.3 (0.772),240.0 (0.879),
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Time Accessed,16 April 2018 07:46AM
Version,2016_v2
[END_PREBURST75]

90% Preburst Depths
[PREBURST90]
min (h)\AEP(%),50,20,10,5,2,1,
60 (1.0),115.7 (3.115),135.4 (2.639),148.4 (2.427),160.9 (2.266),192.9 (2.285),216.9 (2.285),
90 (1.5),134.5 (3.181),160.4 (2.723),177.5 (2.51),193.9 (2.345),240.5 (2.42),275.4 (2.445),
120 (2.0),76.6 (1.653),131.5 (2.024),167.8 (2.141),202.7 (2.2),256.9 (2.307),297.6 (2.346),
180 (3.0),136.0 (2.565),187.5 (2.502),221.7 (2.437),254.5 (2.367),308.6 (2.357),349.2 (2.327),
360 (6.0),96.7 (1.415),155.0 (1.582),193.6 (1.616),230.6 (1.617),286.8 (1.642),328.8 (1.635),
720 (12.0),137.5 (1.51),180.2 (1.363),208.4 (1.284),235.5 (1.215),300.2 (1.264),348.7 (1.276),
1080 (18.0),111.0 (1.023),143.4 (0.904),164.9 (0.844),185.4 (0.794),238.2 (0.834),277.8 (0.847),
1440 (24.0),80.5 (0.656),121.1 (0.672),148.0 (0.666),173.8 (0.653),256.0 (0.787),317.7 (0.852),
2160 (36.0),60.0 (0.415),102.5 (0.479),130.6 (0.494),157.6 (0.497),218.9 (0.565),264.9 (0.596),
2880 (48.0),54.6 (0.34),84.5 (0.355),104.3 (0.353),123.3 (0.347),172.5 (0.397),209.3 (0.42),
4320 (72.0),35.2 (0.194),53.8 (0.199),66.2 (0.197),78.0 (0.192),114.6 (0.23),142.1 (0.249),
[PREBURST90_META]
Time Accessed,16 April 2018 07:46AM
Version,2016_v2
[END_PREBURST90]

Interim Climate Change Factors
[CCF]
2030,0.892 (4.5%),0.775 (3.9%),0.979 (4.9%),
2040,1.121 (5.6%),1.002 (5.0%),1.351 (6.8%),
2050,1.334 (6.7%),1.28 (6.4%),1.765 (8.8%),
2060,1.522 (7.6%),1.527 (7.6%),2.23 (11.2%),
2070,1.659 (8.3%),1.745 (8.7%),2.741 (13.7%),
2080,1.78 (8.9%),1.999 (10.0%),3.249 (16.2%),
2090,1.825 (9.1%),2.271 (11.4%),3.727 (18.6%),
[CCF_META]
Time Accessed,16 April 2018 07:46AM
Version,2016_v1
Note,ARR recommends the use of RCP4.5 and RCP 8.5 values
[END_CCF]
```

APPENDIX D

FILTER MEDIA TECHNICAL SPECIFICATIONS

RIVER SANDS PTY LTD
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PRODUCT DATA SHEET

This is a typical analysis of material produced and does not constitute as a Product Certification for material supply

Product:

River Sands Cert BioMedia (V1)

BioRetention Filter Media

Manufactured to Meet:

- **The Facility for Advance Water Biofiltration Guidelines (V 3.01 June 2009)**
- **The Healthy Waterways / Water By Design Specifications (V1, October 2012)**

Main Applications:

BioRetention Filter Media for BioRetention Systems to be used with BioRetention Transition Layer and Drainage Layer to assist in removing pollutants and supporting vegetation.

Indicative Grade Analysis:

Sieve Standards: ASTM C136, AS1141.11.1
Sampling Methods: ASTM D75, AS1141.3.1

Note:

Indicative grading only. Grading analysis will vary over time due to changes in raw feed.

Technical Properties:

Analysis	FAWB Specification	Result
Organic Matter (%)	>3-10 (Ideally 5-10)	6.8 %
Saturated Hydraulic Conductivity (Ksat) (mm/hr)	100-600mm	150 – 300 mm/hr
Electrical Conductivity (1:5) (dS/m)	<1.2	0.30 dS/m
pH (1:5) in H2O (pH units)	5.5-7.5	6.2
Total Nitrogen (mg/kg)	< 1000 mg/kg	600.0 mg / kg
Phosphate as PO4 (mg/kg)	<80 mg / kg	3.0 mg / kg

Grading Properties:

The below attached Particle Size Distribution (PSD) is a recommended range and is of secondary importance compared with saturated hydraulic conductivity.

Size (mm)	FAWB Indicative PSD	Result
<0.05	2-6%	3.3%
0.05-0.15	5-30%	8.7%
0.15-0.25	10-30%	32.1%
0.25-1.0	40-60%	55.5%
1.0-2.0	7-10%	0.3%
2.0-3.35	<3.0%	0.1%
>3.35		0.1%
D85 (Filter Media Layer)	AS 1141.11.1	0.8mm
5 x D85 (Filter Media Layer)	AS 1141.11.1	4.0mm
Fines <0.002mm	< 2 %	✓

To meet 'bridging criteria' the smallest 15% of the sand particles in the transition layer should bridge with the largest 15% of the filter media layer. As per section 4.3.2. Transition Layer (Where using alternate materials please check bridging criteria before use.)

D15 (Transition Layer)</= 5 x D85 (Filter Media Layer)	0.26-0.41mm (D15 River Sands BioTrans 1mm & BioTrans) </= 4.0mm (5 x D85 River Sands BioMedia)	✓

River Sands operates and maintains a Quality Certified system in accordance with AS/NZS ISO 9001:2008.
The Quality system is third party certified by BSI/NCSI. Registration # 6898
River Sands also maintains a registered NATA laboratory. Registration # 10470

Testing results achieved at time of manufacture 28.06.13:3AHS,13/26751

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PRODUCT DATA SHEET

This is a typical analysis of material produced and does not constitute as a Product Certification for material supply

Product:

River Sands BioDrain (V1)

BioRetention Drainage Layer (N)

Manufactured to Meet:

- **The Facility for Advance Water Biofiltration Guidelines (V 3.01 June 2009)**
- **The Healthy Waterways / Water By Design Specifications (V1, October 2012)**

Main Applications:

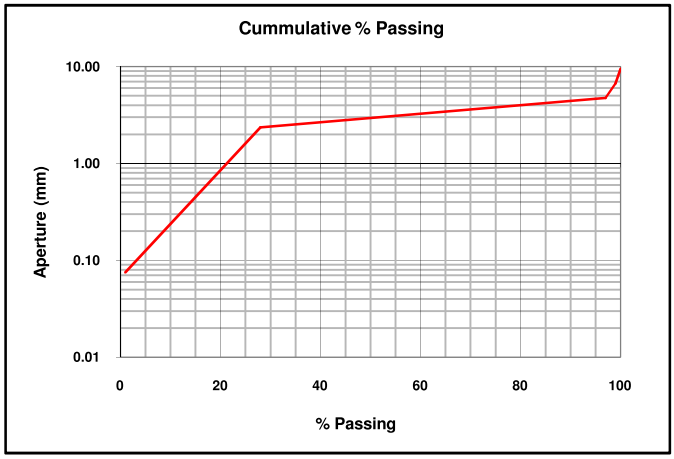
Drainage Layer for BioRetention Systems to be used with BioRetention Filter Media and Transition Layer to convey infiltrated flows horizontally across the base of the system into the slotted underdrainage pipes.

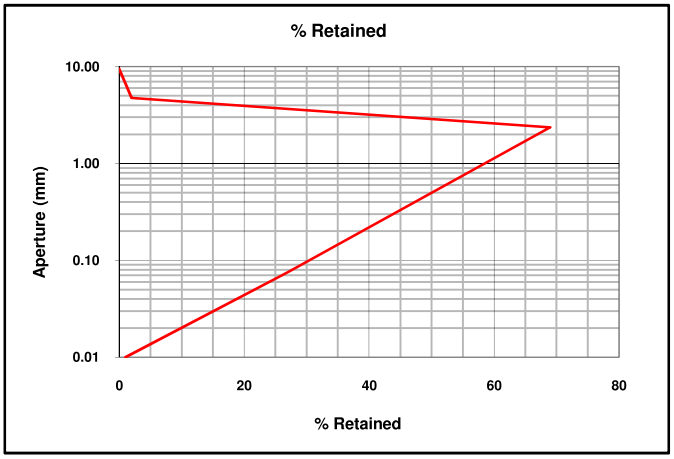
Indicative Grade Analysis:

Sieve Standards: ASTM C136, AS1141.11.1
Sampling Methods: ASTM D75, AS1141.3.1

Note:

Indicative grading only. Grading analysis will vary over time due to changes in raw feed.





Other Properties:		
Analysis	**Test Method / FAWB Specification**	**Result**
D15 (DrainageLayer)	AS 1141.11.1	1.7mm
Fines <0.002mm	< 2 %	✓
Hydraulic Conductivity	➢ 4000mm / hr - ASTM F1815	4500mm/hr
To meet 'bridging criteria' the smallest 15% of the sand particles in the drainage layer should bridge with the largest 15% of the transition layer. As per section 4.3.3. Drainage Layer(Where using alternate materials please check bridging criteria before use.)		
D15 (Drainage Layer) </= 5 x D85 (Transition Layer)	1.7-3.2mm (D15 River Sands BioDrain) </= 8.8-9.6mm (5 x D85 River Sands BioTrans)	✓
D15 (Drainage Layer) </= 5 x D85 (Transition Layer)	1.7-3.2mm (D15 River Sands BioDrain) </= 3.35mm (5 x D85 River Sands BioTrans 1mm)	✓

River Sands operates and maintains a Quality Certified system in accordance with AS/NZS ISO 9001:2008.
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River Sands also maintains a registered NATA laboratory. Registration # 10470

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PRODUCT DATA SHEET

This is a typical analysis of material produced and does not constitute as a Product Certification for material supply

Product:

River Sand BioTrans 1mm (V1)

BioRetention Transition Layer

Manufactured to Meet:

- **The Facility for Advance Water Biofiltration Guidelines (V 3.01 June 2009)**
- **The Healthy Waterways / Water By Design Specifications (V1, October 2012)**

Main Applications:

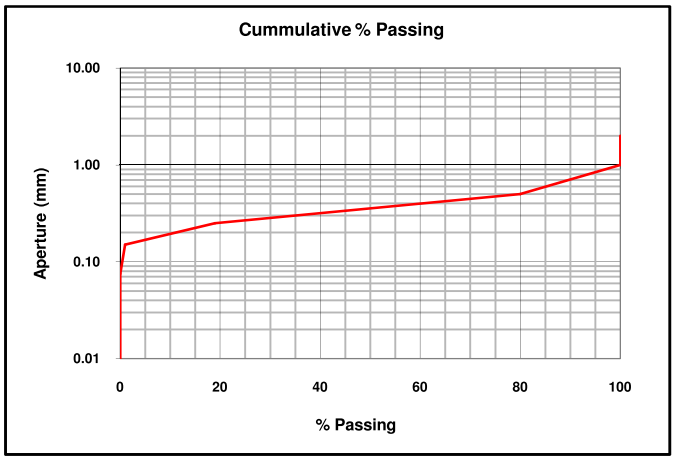
Transition Layer for BioRetention Systems to be used for bridging between BioRetention Filter Media and Drainage Layer0

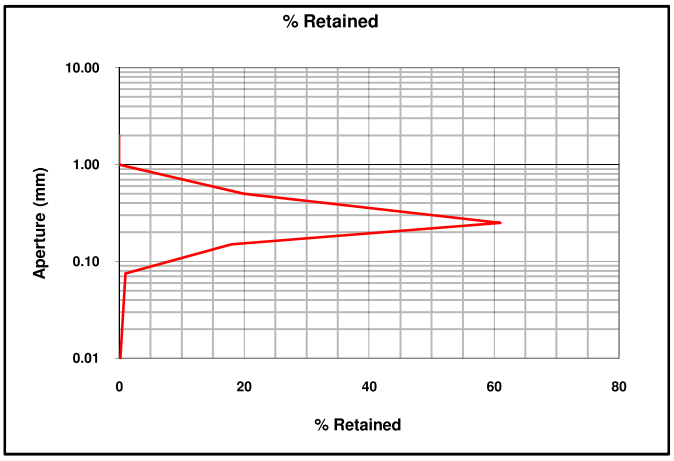
Indicative Grade Analysis:

Sieve Standards: ASTM C136, AS1141.11.1
Sampling Methods: ASTM D75, AS1141.3.1

Note:

Indicative grading only. Grading analysis will vary over time due to changes in raw feed.





Other Properties:		
Analysis	**Test Method / FAWB Specification**	**Result**
D15 (Transition Layer)	AS 1141.11.1	0.26mm
D85 (Transition Layer)	AS 1141.11.1	0.67mm
5 x D85 (Transition Layer)	AS 1141.11.1	3.35mm
Fines <0.002mm	< 2 %	✓
To meet 'bridging criteria' the smallest 15% of the sand particles in the transition layer should bridge with the largest 15% of the filter media layer. As per section 4.3.2. Transition Layer (Where using alternate materials please check bridging criteria before use.)		
D15 (Transition Layer)</= 5 x D85 (Filter Media Layer)	0.26mm (D15 River Sands BioTrans 1mm) </= 4.0mm (5 x D85 River Sands BioMedia)	✓
To meet 'bridging criteria' the smallest 15% of the sand particles in the drainage layer should bridge with the largest 15% of the transition layer. As per section 4.3.3. Drainage Layer(Where using alternate materials please check bridging criteria before use.)		
D15 (Drainage Layer) </= 5 x D85 (Transition Layer)	1.7-3.2mm (D15 River Sands BioDrain) </= 3.35 (5 x D85 River Sands BioTrans 1mm)	✓

River Sands operates and maintains a Quality Certified system in accordance with AS/NZS ISO 9001:2008.
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