870 Westernport Rd
Yannathan
100B\PP2969
Parish of Lang Lang
910 Westernport Rd
Yannathan
39B\PP2969
Parish of Lang Lang
Legend
Depth Limit
0
100
200
300 m

REGISTER SEARCH STATEMENT (Title Search) Transfer of Land Act 1958

VOLUME 11017 FOLIO 205

Security no : 124111304534P
Produced 14/12/2023 03:34 PM

LAND DESCRIPTION

Crown Allotment 100B Parish of Lang Lang East.
PARENT TITLE Volume 05859 Folio 720
Created by instrument AF167697G 29/06/2007

REGISTERED PROPRIETOR

Estate Fee Simple
Sole Proprietor
HANSON CONSTRUCTION MATERIALS PTY LTD of 601 DONCASTER ROAD DONCASTER VIC 3108
AC674741E 17/02/2004

ENCUMBRANCES, CAVEATS AND NOTICES

For details of any other encumbrances see the plan or imaged folio set out under DIAGRAM LOCATION below.

AGREEMENT Section 173 Planning and Environment Act 1987
AD414146Q 04/02/2005

DIAGRAM LOCATION

SEE TP406858H FOR FURTHER DETAILS AND BOUNDARIES

ACTIVITY IN THE LAST 125 DAYS

NIL

------------------------END OF REGISTER SEARCH STATEMENT------------------------

Additional information: (not part of the Register Search Statement)

Street Address: 870 WESTERNPORT ROAD YANNATHAN VIC 3981

DOCUMENT END

Imaged Document Cover Sheet

The document following this cover sheet is an imaged document supplied by LANDATA®, Secure Electronic Registries Victoria.

Document Type	**Instrument**
Document Identification	**AF167697G**
Number of Pages (excluding this cover sheet)	**1**
Document Assembled	**14/12/2023 15:34**

Application for a new folio of the Register
Section 32 Transfer of Land Act 1958

OFFICE OF TITLES
M.S.
VICTORIA

AF167697G
29/06/2007 $120.70 32-2

Lodged by:
Name: HANSON CONSTRUCTION MATERIALS PTY. LTD ABN. 90 009 679 734 (FORMERLY PIONEER CONSTRUCTION MATERIALS PTY. LTD.
Phone: (03) 9 274 3757 MS S. LANGHORNE
Address: 601 DONCASTER ROAD, DONCASTER. 3108.
Ref: S. LANGHORNE
Customer Code: ....

The applicant applies for the creation of a new folio of the Register for the land.

Land: *(volume and folio reference(s))*

VOLUME 05859 FOLIO 720
VOLUME 02897 FOLIO 251

Applicant: *(full name(s) and address(es) including postcode to be set out on the new certificate(s) of title)*

HANSON CONSTRUCTION MATERIALS PTY. LTD. OF
601 DONCASTER ROAD, DONCASTER. 3108

Reason for request: *(tick the appropriate box)*

☑ Change of name
(complete the accompanying statutory declaration)

☐ Change manner of holding

☐ Consolidation of interest(s)

☐ Damaged certificate of title

☐ Separate certificate(s) of title for the following interest(s)
(specify number of certificates of title requested and the respective interest(s))

Manner of holding : *(if unchanged leave blank)*

Date: 23 / 4 / 07

Signed in accordance with s127 of the Corporations Act by Hanson Construction Materials Pty Ltd:

Signed: LESLIE CADZOW
Level 6, 35 Clarence St Sydney
DIRECTOR

VICTORIA VINCENT
Level 6, 35 Clarence St Sydney
Victoria Vincent
DIRECTOR

The Common Seal of
ACN 009 679 734

Applicant
HANSON CONSTRUCTION MATERIALS PTY. LTD.
601 DONCASTER ROAD
DONCASTER. 3108.

or

Current Practitioner under the *Legal Practice Act 1996* for applicant ....

THE BACK OF THIS FORM MUST NOT BE USED

AP32

Land Registry, 570 Bourke Street, Melbourne, 3000, Phone 8636-2010

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Document Type	**Instrument**
Document Identification	**AC674741E**
Number of Pages (excluding this cover sheet)	**6**
Document Assembled	**14/12/2023 15:35**

TRANSFER OF LAND

Section 45 Transfer of Land Act 1958

C.J.

AC674741E

T1 ce

Lodged by:
Name: **MINTER ELLISON**
Phone: 525 COLLINS STREET
Address: Melbourne 3000
Ref: OFC: 20-4380483
Customer Code: 781-Q

MADE AVAILABLE/CHANGE CONTROL

Land Titles Office Use Only

The transferor at the direction of the directing party (if any) transfers to the transferee the estate and interest specified in the land described for the consideration expressed and subject to the encumbrances affecting the land including any created by dealings lodged for registration before the lodging of this transfer.

Land: *(volume and folio reference)*

See annexure pages 2 and 3

CAVEAT

Estate and Interest: *(e.g. "all my estate in fee simple")*

all its estate in fee simple

NOTICE SENT
11 MAR 2004
G 325500
RE CAVEAT

Consideration:

Entitlement in equity

Transferor: *(full name)*

Pioneer Concrete (Vic) Pty Ltd ACN 004 375 302

Transferee: *(full name and address including postcode)*

Pioneer Construction Materials Pty Ltd ACN 009 679 734 of 601 Doncaster Road, Doncaster 3108

Directing Party: *(full name)*

Dated: 3 February 2004

Execution and attestation

See annexure page 4

see annexure pgs. 2-4

Approval No. 476022A

ORDER TO REGISTER

Please register and issue title to

Signed

Cust. Code

Not Chargeable Pursuant To
Section 250
Trn:1402277 06-FEB-2004
SRO Victoria Duty, LXP1

T1

eae 4/3/04

LJE 17/2/04

THE BACK OF THIS FORM MUST NOT BE USED

MEL4_853578_1 (W97)

ANNEXURE PAGE

Approved Form A1

Transfer of Land Act 1958

Victorian Land Titles Office

This is page 2 of **Transfer of Land** dated between Pioneer Concrete (Vic) Pty Ltd ACN 004 375 302 and Pioneer Construction Materials Pty Ltd ACN 009 679 734

Signature of parties

Victoria Vincent

Pioneer Concrete (Vic) Pty Ltd

Pioneer Construction Materials Pty Ltd

Panel Heading

Land:

1. Certificate of Title Volume 9738 Folio 981
2. Certificate of Title Volume 8272 Folio 785
3. Certificate of Title Volume 8321 Folio 774
4. Certificate of Title Volume 8289 Folio 481
5. Certificate of Title Volume 8548 Folio 208
6. Certificate of Title Volume 8548 Folio 209
7. Certificate of Title Volume 8548 Folio 214
8. Certificate of Title Volume 8548 Folio 211
9. Certificate of Title Volume 8548 Folio 210
10. Certificate of Title Volume 9022 Folio 620
11. Certificate of Title Volume 9346 Folio 757
12. Certificate of Title Volume 9595 Folio 974
13. Certificate of Title Volume 9432 Folio 893
14. Certificate of Title Volume 1119 Folio 792
15. Certificate of Title Volume 7422 Folio 201
16. Certificate of Title Volume 8708 Folio 431
17. Certificate of Title Volume 9306 Folio 259
18. Certificate of Title Volume 9350 Folio 734
19. Certificate of Title Volume 9861 Folio 905
20. Certificate of Title Volume 4695 Folio 817
21. Certificate of Title Volume 7652 Folio 026
22. Certificate of Title Volume 8539 Folio 653
23. Certificate of Title Volume 9260 Folio 879
24. Certificate of Title Volume 10736 Folio 509
25. Certificate of Title Volume 10164 Folio 157
26. Certificate of Title Volume 8392 Folio 788
27. Certificate of Title Volume 8479 Folio 871
28. Certificate of Title Volume 8536 Folio 006
29. Certificate of Title Volume 8536 Folio 007
30. Certificate of Title Volume 8565 Folio 592
31. Certificate of Title Volume 8686 Folio 156

Approval No. 476022A

A1

AC674741E
17/02/2004 $90 45

1. If there is insufficient space to accommodate the required inf ed Form insert the words "See Annexure Page 2" (or as the case ma n on the Annexure Page under the appropriate heading. **THE BACK O OT TO BE USED.**
2. If multiple copies of a mortgage are lodged, original Annexure P
3. The Annexure Pages must be properly identified and signed by t to which it is annexed.
4. All pages must be attached together by being stapled in the top left corner.

MEL4_853578_1 (W97)

ANNEXURE PAGE

Transfer of Land Act 1958

Approved Form A1

Victorian Land Titles Office

This is page 3 of **Transfer of Land** dated between Pioneer Concrete (Vic) Pty Ltd ACN 004 375 302 and Pioneer Construction Materials Pty Ltd ACN 009 679 734

Signature of parties

Victoria Vincent

Pioneer Concrete (Vic) Pty Ltd Pioneer Construction Materials Pty Ltd

Panel Heading

Land:

32. Certificate of Title Volume 8942 Folio 750
33. Certificate of Title Volume 9082 Folio 872
34. Certificate of Title Volume 9237 Folio 643
35. Certificate of Title Volume 8836 Folio 814
36. Certificate of Title Volume 7259 Folio 782
37. Certificate of Title Volume 9947 Folio 899
38. Certificate of Title Volume 9530 Folio 619
39. Certificate of Title Volume 9396 Folio 890
40. Certificate of Title Volume 10043 Folio 594
41. Certificate of Title Volume 9767 Folio 654
42. Certificate of Title Volume 10372 Folio 802
43. Certificate of Title Volume 10372 Folio 801
44. Certificate of Title Volume 10037 Folio 867
45. Certificate of Title Volume 5859 Folio 720
46. Certificate of Title Volume 2897 Folio 251
47. Certificate of Title Volume 10458 Folio 465
48. Certificate of Title Volume 10583 Folio 924
49. Certificate of Title Volume 9835 Folio 072
50. ~~Certificate of Title Volume 9439 Folio 815~~
51. Certificate of Title Volume 9235 Folio 828
52. Certificate of Title Volume 8561 Folio 704
53. Certificate of Title Volume 9297 Folio 504
54. Certificate of Title Volume 9022 Folio 345
55. Certificate of Title Volume 8598 Folio 015
56. Certificate of Title Volume 8035 Folio 156
57. Certificate of Title Volume 9231 Folio 008
58. Certificate of Title Volume 8100 Folio 881
59. Certificate of Title Volume 10777 Folio 618

DAC674741E-3-6

AMENDED
13 APR 2004
With consent of
Current Practitioner for
Parties 4

Approval No. 476022A

A1

1. If there is insufficient space to accommodate the required informat
   insert the words "See Annexure Page 2" (or as the case may be)
   Annexure Page under the appropriate heading. **THE BACK OF TE**
   BE USED.
2. If multiple copies of a mortgage are lodged, original Annexure Page:
3. The Annexure Pages must be properly identified and signed by the parties to the approved Form to which it is annexed.
4. All pages must be attached together by being stapled in the top left corner.

AC674741E
17/02/2004 $90 45

rm
the
TO

ANNEXURE PAGE

Transfer of Land Act 1958

Approved Form A1

Victorian Land Titles Office

This is page 4 of **Transfer of Land** dated between Pioneer Concrete (Vic) Pty Ltd ACN 004 375 302 and Pioneer Construction Materials Pty Ltd ACN 009 679 734

Signature of parties

Victoria Vincent

Pioneer Concrete (Vic) Pty Ltd Pioneer Construction Materials Pty Ltd

Panel Heading

Execution and attestation:

Executed by **Pioneer Concrete (Vic) Pty Ltd ACN 004 375 302** by being signed by those persons who are authorised to sign for the company

X ←
Signature of director

V ←
Signature of ~~director~~/company secretary
(Please delete as applicable)

Giuseppe
X G. TRESCA
Full name (print)

Kevin Gerard
VK. G. GLUSKIE
Full name (print)

V 601 DONCASTER RD. DONCASTER.
Usual address (print)

V 601 DONCASTER RD. DONCASTER.
Usual address (print)

Executed by **Pioneer Construction Materials Pty Ltd ACN 009 679 734** by being signed by those persons who are authorised to sign for the company

X Victoria Vincent ←
Signature of director

X ←
Signature of director/company secretary
(Please delete as applicable)

X VICTORIA VINCENT
Full name (print)

V LESLIE CADZOW
Full name (print)

V Level 6, 35 Clarence St Sydney
Usual address (print)

V Level 6, 35 Clarence St Sydney
Usual address (print)

Approval No. 476022A

A1

OFFICE OF TITLES VICTORIA

AC674741E
17/02/2004 $90
45

1. If there is insufficient space to accommodate the required information in a panel of the Approved Form insert the words "See Annexure Page 2" (or as the case may be) … rmation on the Annexure Page under the appropriate heading. **THE BA… E IS NOT TO BE USED.**
2. If multiple copies of a mortgage are lodged, original Ann… h.
3. The Annexure Pages must be properly identified and sign… orm to which it is annexed.
4. All pages must be attached together by being stapled in the … corner.

**Department of
Sustainability and Environment**

Customer Services Section
Phone: (03) 8636 2010
Fax: (03) 8636 2091

10/03/2004 C

MELBOURNE AND METROPOLITAN BOARD OF WORKS
625 LITTLE COLLINS STREET
MELBOURNE 3000

DRC674741E-3-2

URGENT NOTICE TO CAVEATOR
Pursuant to Section 90 (1) of the Transfer of Land Act 1958

As Caveator: MELBOURNE AND METROPOLITAN BOARD OF WORKS
Under Caveat No: G325500
Registered Proprietor: PIONEER CONCRETE (VIC) PTY LTD

PLEASE NOTE : DEALING/S HAS/HAVE BEEN LODGED FOR REGISTRATION.

TRANSFER AC674741E to PIONEER CONSTRUCTION MATERIALS PTY LTD

NOTICE SENT: 11/03/2004

BARBARA FLETT
Registrar of Titles

Per:

FOR LAND TITLES OFFICE USE ONLY

☑ Time expired. No action taken. ☐ Caveat remains

☐ Caveat will lapse to permit registration of ______ ______ Caveat remains.

☑ Caveat will lapse (*as to*) * 8561 - 704
on the registration of AC674741E (~~Caveat remains~~)

☐ Consent lodged, Caveat will remain in operation.

☐ Other ______

Date 2 8 APR 2004

OFFICE OF TITLES VICTORIA

DO NOT DETACH

LAND VICTORIA, 570 Bourke Street Melbourne Victoria 3000
P.O. Box 500 East Melbourne Victoria 3002, DX 250639
Telephone: (03) 8636 2010 Facsimile: (03) 8636 2005
ABN 90719052204

MinterEllison
LAWYERS

RIALTO TOWERS 525 COLLINS STREET MELBOURNE
GPO BOX 769G MELBOURNE VIC 3001 AUSTRALIA
DX 204 MELBOURNE www.minterellison.com
TELEPHONE +61 3 8608 2000 FACSIMILE +61 3 8608 1000

13 April 2004

BY HAND

Land Registry
570 Bourke Street
MELBOURNE VIC 3000

DAC674741E-6-1

Dear Sirs

Dealing no: AC674741E - Removal of title from transfer

We refer to dealing number AC674741E and request that you remove Certificate of Title Volume 9439 Folio 815 (which is numbered 50) from the Transfer of Land dated 3 February 2004, transferring titles from Pioneer Concrete (Vic) Pty Ltd ACN 004 375 302 to Pioneer Construction Materials Pty Ltd ACN 009 679 734.

If you have any queries, please do not hesitate to contact us.

Yours faithfully
MINTER ELLISON

Contact:	Olivia Craze Direct phone: +61 3 8608 2337 Direct fax: +61 3 8608 1316
Email:	olivia.craze@minterellison.com
Partner responsible:	Anthony Poynton Direct phone: +61 3 8608 2014
Our reference:	AP:OFC 20-4380483

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Document Type	**Instrument**
Document Identification	**AD414146Q**
Number of Pages (excluding this cover sheet)	**10**
Document Assembled	**14/12/2023 15:35**

AD414146Q
04/02/2005 $90 173

OFFICE OF TITLES
P.S
VICTORIA

Form 13

Section 181

APPLICATION BY A RESPONSIBLE AUTHORITY FOR THE MAKING OF A RECORDING OF AN AGREEMENT

***Planning and Environment Act* 1987**

Lodged at the Land Titles Office by:

Name: Maddocks
Phone: 9288 0555
Address: 140 William Street, Melbourne 3000 or DX 259 Melbourne
Ref: TGM:JYM:LGC:5092776 **Customer Code:** 1167E

The Authority having made an agreement referred to in section 181(1) of the *Planning and Environment Act* 1987 requires a recording to be made in the Register for the land.

Land: Volume 5859 Folio 720

Authority: Cardinia Shire Council of Henty Way, Pakenham

Section and Act under which agreement made: Section 173 of the *Planning and Environment Act* 1987.

A copy of the agreement is attached to this application

Signature for the Authority: Tracey Parker

Name of officer: TRACEY PARKER

Office held: MANAGER DEVELOPMENT SERVICES.

Date: 25/1/05

[5092776/JYM/M0347384 1]

DAD414146Q-1-1

PRICE BRENT
SOLICITORS
MELBOURNE

AGREEMENT PURSUANT TO SECTION 173 PLANNING AND ENVIRONMENT ACT 1987

THIS AGREEMENT made the TENTH day of AUGUST 1994 pursuant to Division 2 of Part 9 of the Planning and Environment Act 1987 ("the Act") **BETWEEN** the Responsible Authority and the Owner **WITNESSES THAT:-**

A. The Owner is registered or entitled to be registered as the proprietor of the Site.

B. The Site is within the area to which the Scheme applies and within the proposed Sand Extraction Transport Management Plan area for Lang Lang.

C. The Responsible Authority is the relevant responsible authority under the Scheme and enters into this Agreement pursuant to Section 173 of the Act.

NOW THEREFORE IT IS EXPRESSLY AGREED as follows:-

1. This Agreement is made pursuant to Division 2 of Part 9 of the Act. X

2. This Agreement is entered into as required by and pursuant to Condition 2 of Planning Permit No. CW 2959.

3. In this Agreement words importing the singular or plural number shall include the plural or singular number respectively and words importing the masculine gender shall include the feminie and neuter genders.

4. In this Agreement a reference to an Act of Parliament or Section thereof or any Regulation shall be deemed to include any statutory modification or re-enactment thereof.

5. In this Agreement where the Owner constitutes more than one person, the obligations on the part of the Owner shall be deemed to be joint and several/

6. The Owner's obligations hereunder are intended to take effect as covenants which shall be annexed to and run at law and in equity with the Site and bind the Owner thereof and any part thereof and the successors, assignees, transferees and registered proprietor or proprietors for the time being of the site and every part thereof.

7. The Owner shall do all things necessary and expedient to enable the Responsible Authority to register this Agreement with the Registrar of Titles against the title to the Site pursuant to Section 181 of the Act. The Responsible Authority shall request the Registrar of Titles to withdraw registration of this Agreement from such title upon the termination of the Agreement or the Owner's obligations hereunder being satisfied and fulfilled.

8. This Agreement commences upon the Commencement Date.

9. The Owner warrants and covenants that:-

9.1 the Owner is the registered proprietor or entitled to become the registered proprietor of the Site and the beneficial owner thereof;

9.2 there are no mortgages, liens, charges or other encumbrances or leases or any rights inherent in any person other than the Owner affecting the Site not disclosed by the usual searches or notified to the Responsible Authority.

9.3 no part of the Site is subject to any rights obtained by adverse possession or subject to any easements or rights described or referred to in Section 42 of the Transfer of Land Act;

9.4 the Owner shall not sell, transfer, dispose of, assign, mortgage or otherwise part with the possession of the Site or any part thereof without first disclosing to any intended purchaser, transferee, assignee or mortgagee the existence and nature of this Agreement.

10. **Notices**

Any notice, consent, offer, demand, request or other instrument required or authorised to be given or served upon either party to this Agreement shall be in the English language and in writing and may be given by telex, telegram, facsimile transmission, cable, post or hand to that party delivered to the last or most usual address of that party known to the party giving such notice. Any instrument given or served by telex, telegram, facsimile transmission or cable shall be deemed to have been received on the date following the day of its dispatch. Any instrument having been given or served by post to an address in the same state in which it is posted shall be deemed to have been received on the third day following the day of posting. Any instrument given or served by hand shall be served at the time of delivery.

11. The Owner shall pay all stamp duty applicable to this Agreement and the reasonable legal costs of the Responsible Authority of and incidental to this Agreement including costs and fees for registration of a copy of this Agreement against the title's to the Site pursuant to Section 181 of the Act.

12. Any monies owing pursuant to this Agreement shall, if not paid within 14 days of demand, bear interest at the rate prescribed under the Penalty Interest Rates Act payable on such monies from the time those monies fell due until paid.

13. Upon the Commencement Date Condition 2 of the Planning Permit shall be deemed to have been satisfied.

14. **Owner's Specific Obligations**

14.1 The Owner shall notify all persons carting or transporting or removing sand, soil or other extracted material from the Site ("extracted material") that no such material shall be carried from the Site on any road other than Westernport Road, between the Site and McDonalds Track and on McDonalds Track from Westernport Road to the South Gippsland Highway at Lang Lang ("the Authorised Route") and shall undertake all reasonable means to ensure that no extracted material is carted from the Site to South Gippsland Highway by any other road under the management or control of the Responsible Authority without the consent of the Responsible Authority.

14.2 Until any event as described in Clause 14.5 occurs, the Owner shall pay to the Responsible Authority on or within 7 days from 1 October in each year, commencing on 1 October 1994, a levy calculated as follows:-

> for each truck load of extracted material carried from the Site over the Authorised Route, the sum of $1.00 until 1 October 1995, and thereafter an amount per truck load equivalent to the amount charged in the immediately preceding year ("the base sum") adjusted by multiplying the base sum by a fraction whereof the divider represents the base sum and the multiplier represents the CPI all groups Melbourne last published immediately before

the adjustment date (being the commencement of each new year of the term of this Agreement).

14.3 The levy of $1.00 per truck load has been assessed having regard to recent experience in maintenance costs of the Authorised Route being $3,000.00 per kilometre per year for the maintenance and $12,000.00 per kilometre for every 10 years for resealing. The $1.00 represents 30% of the estimated maintenance and resealing costs, the other 70% being provided by the Responsible Authority and Vic Roads. The Responsible Authority will where agreement is reached charge all truck loads of extracted material using the Authorised Route the same amount.

14.4 For the purposes of this Agreement "truck load" means a part or full load of extracted material carried in a motor vehicle or heavy trailer combination as defined in the Road Safety Act 1986 or in a truck and trailer being towed by a prime mover whether or not the extracted material is in one and not the other of such containers.

14.5 **Contingent event:-**

In the event of the Responsible Authority receiving funds for the maintenance of the Authorised Route from the State or Federal Government or from any other source (other than the Owners of the Site and the Owners of the Site known as McLeod's Crown Allotments 78A and 78B Parish of Lang Lang McDonalds Track, Lang Lang as described in Planning Permit 890967) the levy shall either be reduced or cease absolutely at the reasonable discretion of the Responsible Authority but having regard to:-

14.5.1 the extent of recovery by the Responsible Authority of monies due by Owners who have executed Agreements pursuant to Section 173 for contribution of funds towards the maintenance of the Authorised Route;

14.5.2 the amount of additional or alternate funding or income including any other levies, received by the Responsible Authority in respect of any additional extracted materials carried or transported on the Authorised Route.

14.6 **Keeping of Records**

The Owner shall ensure that proper and complete records of the number of loads of extracted material carried or transported from the Site are kept up to date and made available for inspection of the Responsible Authority upon demand. Payments of the levy shall be made to the satisfaction of the Responsible Authority and shall be in accordance with such records unless there is patent error, or unless the Responsible Authority has itself kept an alternative record in which case the latter shall prevail.

15. **Responsible Authority's Specific Responsibility**

15.1 The Responsible Authority shall not use or apply any of the levies paid pursuant to this Agreement for any purpose other than maintenance of the Authorised Route or any part or parts of it. "Maintenance" includes:-

15.1.0 repairs, upgrading, and realignment of the foundations and surfaces of the roads constituting the Authorised Route, and the resealing of surfaces at least once every 10 years;

15.1.1 structures, including culverts and bridges; signage and safety devices and any other traffic management requirements to prevent or reduce adverse effects on roads and adjacent environmental amenity and beneficial uses to the satisfaction of the Responsible Authority.

15.2 The Responsible Authority shall use its best endeavours to ensure that all other owners of sites from which extracted material is carted or transported on the Authorised Route, or the operators of any such motor vehicles, or the extractors of any such material are charged appropriate amounts for the maintenance of the Authorised Route.

15.3 The Responsible Authority shall use its best endeavours to have established a regional scheme or enacted government legislation to ensure all sand or crushed rock cartage operators contribute to the maintenance costs of the Authorised Route, and other roads being used for the cartage of extracted material, within the proposed Sand Extraction Transport Management Plan Area for Lang Lang.

15.4 The Responsible Authority acknowledges and agrees that Council, VicRoads and State Government funds shall meet all reconstruction costs of McDonalds Track and Westernport Road as soon as those funds become available, and further that the Owner shall not be obliged to contribute to such reconstruction costs.

15.5 The Responsible Authority covenants and agrees that in the absence of a regional scheme or enacted government legislation being established within five years in accordance with Clause 15.3 of this Agreement, that a review of the maintenance levy shall be carried out in accordance with Clause 14.5 of this Agreement.

16. **Additional Clauses**

The Responsible Authority shall have no obligation to undertake maintenance of the Authorised Route or any part of it in the event of default in payment of any of the levies. The obligation on the Responsible Authority to apply levies towards the maintenance of the Authorised Route shall apply notwithstanding the provisions of the Local Government Act 1989 as amended.

17. The Owner shall pay all costs and expenses reasonably incurred by the Responsible Authority as a result of any default in the performance of any of the Owner's obligations hereunder. Should there by any dispute as to the amount of any professional legal costs payable under this Agreement, the same may be assessed by the Law Institute of Victoria Costs Service and, in this event, the Owner and the Responsible Authority shall be bound by any such assessment. Any fee payable for such assessment shall be paid equally by the Owner and the Responsible Authority.

18. Without limiting the operation or effect of this Agreement:

18.1 the Owner shall use its best endeavours to have any successor in title to the Site and any occupier of the Site give effect to and comply with the Owner's obligations under this Agreement and execute under seal a deed agreeing to be bound by the terms of this Agreement;

18.2 this obligation shall not apply whilst a memorandum of this Agreement is entered ~~in~~ the Register Book against the title to the Site.

19. The Owner and the Responsible Authority shall respectively execute any further documents and deeds and do all other acts or things reasonably required to implement this Agreement.

AD414146Q
04/02/2005 $90 173

SCHEDULE

KB.

1.	The Owner:	HANS ALFRED BULACH and KATHLEEN IRIS BULACH of ~~"Riverlea", Patullos Road, Yannathan, 3984~~. "EDENDARRY" PRINCES HIGHWAY TYNONG
2.	The Responsible Authority:	The Council of the City of Cranbourne of Sladen Street, Cranbourne
3.	The Site:	Crown Allotment 100B Parish of Lang Lang East Westernport Road, Yannathan being the land comprised in Certificate/s of Title Volume 5859 Folio 720.
4.	The Scheme:	The Cranbourne Planning Scheme.
5.	Commencement Date:	The date of this Agreement.

DAD414146Q-9-6

AD414146Q
04/02/2005 $90 173

IN WITNESS WHEREOF the parties hereto have duly executed this Agreement on the date of it.

THE COMMON SEAL OF THE CITY OF CRANBOURNE was hereunto affixed in the presence of:)

.... Mayor/Councillor

.... Councillor

.... Chief Executive Officer

DAD414146Q-10-3

SIGNED by the said **HANS ALFRED BULACH** in the presence of:) x H Bulach

John Dodson

SIGNED by the said **KATHLEEN IRIS BULACH** in the presence of:) x K. Bulach.

John Dodson

AD414146Q
04/02/2005 $90 173

Imaged Document Cover Sheet

Document Type	**Plan**
Document Identification	**TP406858H**
Number of Pages (excluding this cover sheet)	**1**
Document Assembled	**14/12/2023 15:34**

TITLE PLAN		EDITION 1	TP 406858H

Location of Land

Parish: LANG LANG EAST
Township:
Section:
Crown Allotment: 100B
Crown Portion:

Last Plan Reference:
Derived From: VOL 5859 FOL 720
Depth Limitation: 50 FEET

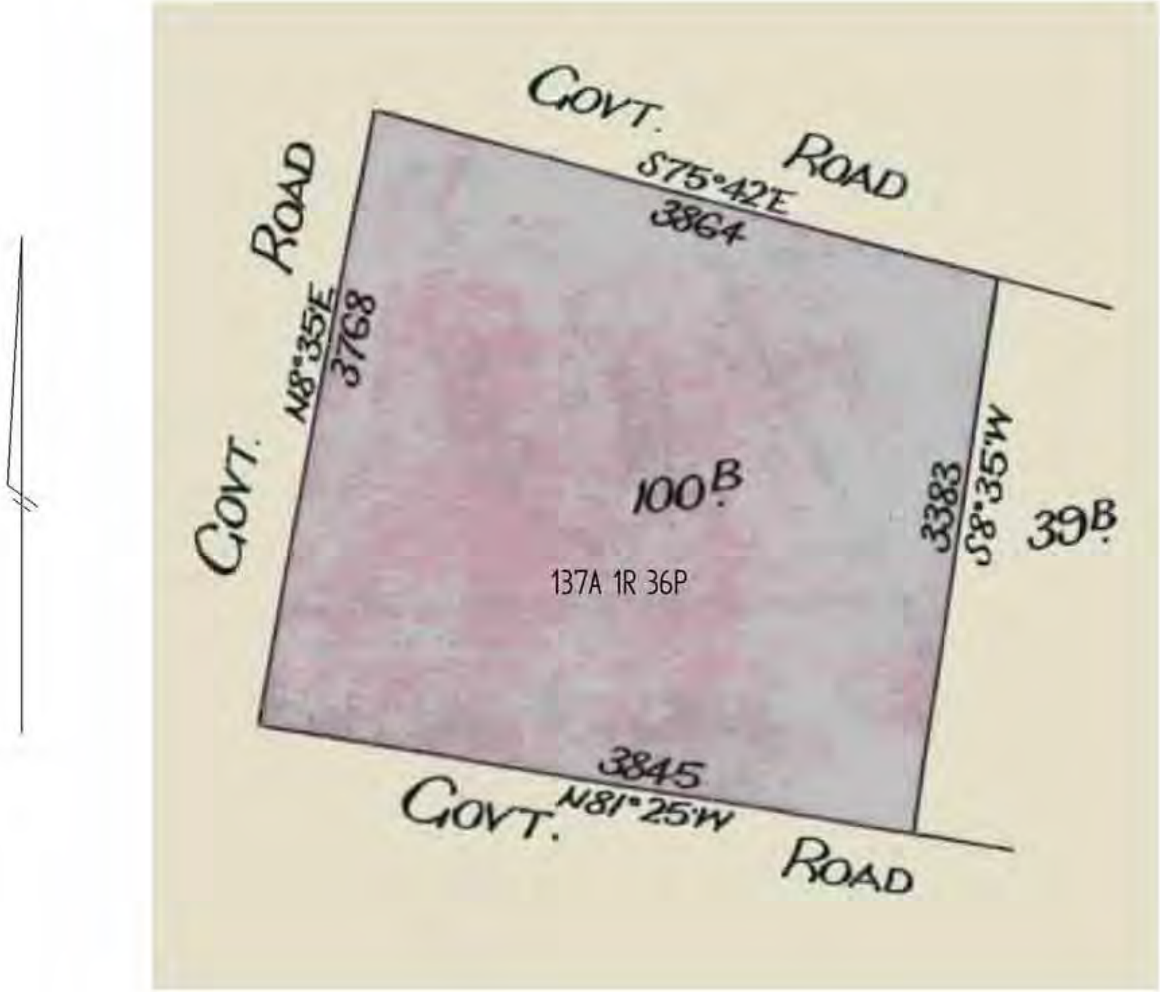
Notations

ANY REFERENCE TO MAP IN THE TEXT MEANS THE DIAGRAM SHOWN ON THIS TITLE PLAN

Description of Land / Easement Information

THIS PLAN HAS BEEN PREPARED FOR THE LAND REGISTRY, LAND VICTORIA, FOR TITLE DIAGRAM PURPOSES AS PART OF THE LAND TITLES AUTOMATION PROJECT

COMPILED: 15/04/2000
VERIFIED: AD



LENGTHS ARE IN LINKS	Metres = 0.3048 x Feet Metres = 0.201168 x Links		Sheet 1 of 1 sheets

REGISTER SEARCH STATEMENT (Title Search) Transfer of Land Act 1958

VOLUME 11017 FOLIO 204

Security no : 124111304444M
Produced 14/12/2023 03:33 PM

LAND DESCRIPTION

Crown Allotment 39B Parish of Lang Lang East.
PARENT TITLE Volume 02897 Folio 251
Created by instrument AF167697G 29/06/2007

REGISTERED PROPRIETOR

Estate Fee Simple
Sole Proprietor
HANSON CONSTRUCTION MATERIALS PTY LTD of 601 DONCASTER ROAD DONCASTER VIC 3108
AC674741E 17/02/2004

ENCUMBRANCES, CAVEATS AND NOTICES

For details of any other encumbrances see the plan or imaged folio set out under DIAGRAM LOCATION below.

DIAGRAM LOCATION

SEE TP529800E FOR FURTHER DETAILS AND BOUNDARIES

ACTIVITY IN THE LAST 125 DAYS

NIL

------------------------END OF REGISTER SEARCH STATEMENT------------------------

Additional information: (not part of the Register Search Statement)

Street Address: 910 WESTERNPORT ROAD YANNATHAN VIC 3981

DOCUMENT END

Imaged Document Cover Sheet

The document following this cover sheet is an imaged document supplied by LANDATA®, Secure Electronic Registries Victoria.

Document Type	**Instrument**
Document Identification	**AF167697G**
Number of Pages (excluding this cover sheet)	**1**
Document Assembled	**14/12/2023 15:33**

OFFICE OF TITLES
M.S.
VICTORIA

AF167697G
29/06/2007 $120.70 32-2

Application for a new folio of the Register
Section 32 Transfer of Land Act 1958

Lodged by:
Name: HANSON CONSTRUCTION MATERIALS PTY. LTD ABN. 90 009 679 734 (FORMERLY PIONEER CONSTRUCTION MATERIALS PTY. LTD.
Phone: (03) 9 274 3757 MS. S. LANGHORNE
Address: 601 DONCASTER ROAD, DONCASTER. 3108.
Ref: S. LANGHORNE
Customer Code: ....

The applicant applies for the creation of a new folio of the Register for the land.

Land: *(volume and folio reference(s))*

VOLUME 05859 FOLIO 720
VOLUME 02897 FOLIO 251

Applicant: *(full name(s) and address(es) including postcode to be set out on the new certificate(s) of title)*

HANSON CONSTRUCTION MATERIALS PTY. LTD. OF
601 DONCASTER ROAD, DONCASTER. 3108

Reason for request: *(tick the appropriate box)*

☑ Change of name
(complete the accompanying statutory declaration)

☐ Change manner of holding

☐ Consolidation of interest(s)

☐ Damaged certificate of title

☐ Separate certificate(s) of title for the following interest(s)
(specify number of certificates of title requested and the respective interest(s))

Manner of holding : *(if unchanged leave blank)*

Date: 23 / 4 / 07 Signed in accordance with s127 of the Corporations Act by Hanson Construction Materials Pty Ltd:

Signed: LESLIE CADZOW
Level 6, 35 Clarence St Sydney
DIRECTOR

VICTORIA VINCENT
Level 6, 35 Clarence St Sydney
Victoria Vincent
DIRECTOR

Applicant HANSON CONSTRUCTION MATERIALS PTY. LTD.
601 DONCASTER ROAD
DONCASTER. 3108.

or

Current Practitioner under the *Legal Practice Act 1996* for applicant ....

THE BACK OF THIS FORM MUST NOT BE USED

AP32

Land Registry, 570 Bourke Street, Melbourne, 3000, Phone 8636-2010

Imaged Document Cover Sheet

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Document Type	**Instrument**
Document Identification	**AC674741E**
Number of Pages (excluding this cover sheet)	**6**
Document Assembled	**14/12/2023 15:34**

TRANSFER OF LAND

Section 45 Transfer of Land Act 1958

C.J.

T1
AC674741E ce

Lodged by:
Name: **MINTER ELLISON**
Phone: 525 COLLINS STREET
Address: Melbourne 3000
Ref: OFC: 20-4380483
Customer Code: 781-Q

MADE AVAILABLE/CHANGE CONTROL
Land Titles Office Use Only

The transferor at the direction of the directing party (if any) transfers to the transferee the estate and interest specified in the land described for the consideration expressed and subject to the encumbrances affecting the land including any created by dealings lodged for registration before the lodging of this transfer.

Land: *(volume and folio reference)*
See annexure pages 2 and 3

CAVEAT

Estate and Interest: *(e.g. "all my estate in fee simple")*
all its estate in fee simple

NOTICE SENT
11 MAR 2004
G 325500
RE CAVEAT

Consideration:
Entitlement in equity

Transferor: *(full name)*
Pioneer Concrete (Vic) Pty Ltd ACN 004 375 302

Transferee: *(full name and address including postcode)*
Pioneer Construction Materials Pty Ltd ACN 009 679 734 of 601 Doncaster Road, Doncaster 3108

Directing Party: *(full name)*

Dated: 3 February 2004

Execution and attestation

See annexure page 4

DAC674741E-1-6

see annexure pgs. 2-4

Approval No. 476022A

ORDER TO REGISTER
Please register and issue title to

Signed

Cust. Code

Not Chargeable Pursuant To
Section 250
Trn: 1402277 06-FEB-2004
SRO Victoria Duty, LXP1

T1

cat
4/3/04

LTE 17/2/04

THE BACK OF THIS FORM MUST NOT BE USED

MEL4_853578_1 (W97)

ANNEXURE PAGE

Approved Form A1

Transfer of Land Act 1958

Victorian Land Titles Office

This is page 2 of **Transfer of Land** dated between Pioneer Concrete (Vic) Pty Ltd ACN 004 375 302 and Pioneer Construction Materials Pty Ltd ACN 009 679 734

Signature of parties

Victoria Vincent

Pioneer Concrete (Vic) Pty Ltd Pioneer Construction Materials Pty Ltd

Panel Heading

Land:

1. Certificate of Title Volume 9738 Folio 981
2. Certificate of Title Volume 8272 Folio 785
3. Certificate of Title Volume 8321 Folio 774
4. Certificate of Title Volume 8289 Folio 481
5. Certificate of Title Volume 8548 Folio 208
6. Certificate of Title Volume 8548 Folio 209
7. Certificate of Title Volume 8548 Folio 214
8. Certificate of Title Volume 8548 Folio 211
9. Certificate of Title Volume 8548 Folio 210
10. Certificate of Title Volume 9022 Folio 620
11. Certificate of Title Volume 9346 Folio 757
12. Certificate of Title Volume 9595 Folio 974
13. Certificate of Title Volume 9432 Folio 893
14. Certificate of Title Volume 1119 Folio 792
15. Certificate of Title Volume 7422 Folio 201
16. Certificate of Title Volume 8708 Folio 431
17. Certificate of Title Volume 9306 Folio 259
18. Certificate of Title Volume 9350 Folio 734
19. Certificate of Title Volume 9861 Folio 905
20. Certificate of Title Volume 4695 Folio 817
21. Certificate of Title Volume 7652 Folio 026
22. Certificate of Title Volume 8539 Folio 653
23. Certificate of Title Volume 9260 Folio 879
24. Certificate of Title Volume 10736 Folio 509
25. Certificate of Title Volume 10164 Folio 157
26. Certificate of Title Volume 8392 Folio 788
27. Certificate of Title Volume 8479 Folio 871
28. Certificate of Title Volume 8536 Folio 006
29. Certificate of Title Volume 8536 Folio 007
30. Certificate of Title Volume 8565 Folio 592
31. Certificate of Title Volume 8686 Folio 156

Approval No. 476022A

A1

AC674741E
17/02/2004 $90 45

1. If there is insufficient space to accommodate the required inf ed Form insert the words "See Annexure Page 2" (or as the case ma on the Annexure Page under the appropriate heading. **THE BACK O OT TO BE USED.**
2. If multiple copies of a mortgage are lodged, original Annexure P
3. The Annexure Pages must be properly identified and signed by t to which it is annexed.
4. All pages must be attached together by being stapled in the top left corner.

MEL4_853578_1 (W97)

ANNEXURE PAGE

Approved Form A1

Transfer of Land Act 1958

Victorian Land Titles Office

This is page 3 of **Transfer of Land** dated between Pioneer Concrete (Vic) Pty Ltd ACN 004 375 302 and Pioneer Construction Materials Pty Ltd ACN 009 679 734

Signature of parties

Victoria Vincent

Pioneer Concrete (Vic) Pty Ltd Pioneer Construction Materials Pty Ltd

Panel Heading

Land:

32. Certificate of Title Volume 8942 Folio 750
33. Certificate of Title Volume 9082 Folio 872
34. Certificate of Title Volume 9237 Folio 643
35. Certificate of Title Volume 8836 Folio 814
36. Certificate of Title Volume 7259 Folio 782
37. Certificate of Title Volume 9947 Folio 899
38. Certificate of Title Volume 9530 Folio 619
39. Certificate of Title Volume 9396 Folio 890
40. Certificate of Title Volume 10043 Folio 594
41. Certificate of Title Volume 9767 Folio 654
42. Certificate of Title Volume 10372 Folio 802
43. Certificate of Title Volume 10372 Folio 801
44. Certificate of Title Volume 10037 Folio 867
45. Certificate of Title Volume 5859 Folio 720
46. Certificate of Title Volume 2897 Folio 251
47. Certificate of Title Volume 10458 Folio 465
48. Certificate of Title Volume 10583 Folio 924
49. Certificate of Title Volume 9835 Folio 072
50. ~~Certificate of Title Volume 9439 Folio 815~~
51. Certificate of Title Volume 9235 Folio 828
52. Certificate of Title Volume 8561 Folio 704
53. Certificate of Title Volume 9297 Folio 504
54. Certificate of Title Volume 9022 Folio 345
55. Certificate of Title Volume 8598 Folio 015
56. Certificate of Title Volume 8035 Folio 156
57. Certificate of Title Volume 9231 Folio 008
58. Certificate of Title Volume 8100 Folio 881
59. Certificate of Title Volume 10777 Folio 618

DAC674741E-3-6

AMENDED
13 APR 2004
With consent of
Current Practitioner for
Parties 4

Approval No. 476022A

A1

1. If there is insufficient space to accommodate the required informat insert the words "See Annexure Page 2" (or as the case may be) Annexure Page under the appropriate heading. **THE BACK OF TE BE USED.**
2. If multiple copies of a mortgage are lodged, original Annexure Page:
3. The Annexure Pages must be properly identified and signed by the parties to the approved Form to which it is annexed.
4. All pages must be attached together by being stapled in the top left corner.

AC674741E
17/02/2004 $90 45

ɪrm the TO

ANNEXURE PAGE

Transfer of Land Act 1958

Approved Form A1

Victorian Land Titles Office

This is page 4 of **Transfer of Land** dated between Pioneer Concrete (Vic) Pty Ltd ACN 004 375 302 and Pioneer Construction Materials Pty Ltd ACN 009 679 734

Signature of parties

Victoria Vincent

Pioneer Concrete (Vic) Pty Ltd Pioneer Construction Materials Pty Ltd

Panel Heading

Execution and attestation:

Executed by **Pioneer Concrete (Vic) Pty Ltd ACN 004 375 302** by being signed by those persons who are authorised to sign for the company

X ←

Signature of director

✓ ←

Signature of ~~director~~/company secretary
(Please delete as applicable)

Giuseppe
X G. TRESCA
Full name (print)

Kevin Gerard.
✓K. G. GLUSKIE
Full name (print)

✓ 601 DONCASTER RD. DONCASTER.
Usual address (print)

✓ 601 DONCASTER RD. DONCASTER.
Usual address (print)

Executed by **Pioneer Construction Materials Pty Ltd ACN 009 679 734** by being signed by those persons who are authorised to sign for the company

X Victoria Vincent ←

Signature of director

X ←

Signature of director/company secretary
(Please delete as applicable)

X VICTORIA VINCENT
Full name (print)

✓ LESLIE CADZOW
Full name (print)

✓ Level 6, 35 Clarence St Sydney
Usual address (print)

✓ Level 6, 35 Clarence St Sydney
Usual address (print)

Approval No. 476022A

A1

OFFICE OF TITLES VICTORIA

1. If there is insufficient space to accommodate the required information in a panel of the Approved Form insert the words "See Annexure Page 2" (or as the case may be) and [illegible] information on the Annexure Page under the appropriate heading. THE BA[illegible] E IS NOT TO BE USED.
2. If multiple copies of a mortgage are lodged, original Ann[illegible] h.
3. The Annexure Pages must be properly identified and sign[illegible] orm to which it is annexed.
4. All pages must be attached together by being stapled in the [illegible] corner.

AC674741E
45
17/02/2004 $90

Department of Sustainability and Environment

Page 1 of 1

Customer Services Section
Phone: (03) 8636 2010
Fax: (03) 8636 2091

10/03/2004 C

MELBOURNE AND METROPOLITAN BOARD OF WORKS
625 LITTLE COLLINS STREET
MELBOURNE 3000

DRC674741E-2-2

URGENT NOTICE TO CAVEATOR
Pursuant to Section 90 (1) of the Transfer of Land Act 1958

As Caveator: MELBOURNE AND METROPOLITAN BOARD OF WORKS
Under Caveat No: G325500
Registered Proprietor: PIONEER CONCRETE (VIC) PTY LTD

PLEASE NOTE : DEALING/S HAS/HAVE BEEN LODGED FOR REGISTRATION.

TRANSFER AC674741E to PIONEER CONSTRUCTION MATERIALS PTY LTD

NOTICE SENT: 11/03/2004

BARBARA FLETT
Registrar of Titles

Per:

FOR LAND TITLES OFFICE USE ONLY

☒ Time expired. No action taken. ☐ Caveat remains
☐ Caveat will lapse to permit registration of ______________________ Caveat remains.
☒ Caveat will lapse (*as to*) 8561 - 704
on the registration of AC674741E (~~Caveat remains~~)
☐ Consent lodged, Caveat will remain in operation.
☐ Other

Date 28 APR 2004

OFFICE OF TITLES VICTORIA

DO NOT DETACH

LAND VICTORIA, 570 Bourke Street Melbourne Victoria 3000
P.O. Box 500 East Melbourne Victoria 3002, DX 250639
Telephone: (03) 8636 2010 Facsimile: (03) 8636 2005
ABN 90719052204

Victoria
The Place To Be

MinterEllison
LAWYERS

13 April 2004

RIALTO TOWERS 525 COLLINS STREET MELBOURNE
GPO BOX 769G MELBOURNE VIC 3001 AUSTRALIA
DX 204 MELBOURNE www.minterellison.com
TELEPHONE +61 3 8608 2000 FACSIMILE +61 3 8608 1000

BY HAND

Land Registry
570 Bourke Street
MELBOURNE VIC 3000

DAC674741E-6-1

Dear Sirs

Dealing no: AC674741E - Removal of title from transfer

We refer to dealing number AC674741E and request that you remove Certificate of Title Volume 9439 Folio 815 (which is numbered 50) from the Transfer of Land dated 3 February 2004, transferring titles from Pioneer Concrete (Vic) Pty Ltd ACN 004 375 302 to Pioneer Construction Materials Pty Ltd ACN 009 679 734.

If you have any queries, please do not hesitate to contact us.

Yours faithfully
MINTER ELLISON

Contact: Olivia Craze Direct phone: +61 3 8608 2337 Direct fax: +61 3 8608 1316
Email: olivia.craze@minterellison.com
Partner responsible: Anthony Poynton Direct phone: +61 3 8608 2014
Our reference: AP:OFC 20-4380483

MEL5_49685_1 (W97)

Imaged Document Cover Sheet

Document Type	**Plan**
Document Identification	**TP529800E**
Number of Pages (excluding this cover sheet)	**1**
Document Assembled	**14/12/2023 15:33**

TITLE PLAN

EDITION 1

TP 529800E

Location of Land

Parish:	LANG LANG EAST
Township:	
Section:	
Crown Allotment:	39B
Crown Portion:	
Last Plan Reference:	
Derived From:	VOL 2897 FOL 251
Depth Limitation:	NIL

Notations

ANY REFERENCE TO MAP IN THE TEXT MEANS THE DIAGRAM SHOWN ON THIS TITLE PLAN

Description of Land / Easement Information

THIS PLAN HAS BEEN PREPARED FOR THE LAND REGISTRY, LAND VICTORIA, FOR TITLE DIAGRAM PURPOSES AS PART OF THE LAND TITLES AUTOMATION PROJECT

COMPILED: 08/06/2000

VERIFIED: P.C.

LENGTHS ARE IN METRES

Metres = 0.3048 x Feet

Metres = 0.201168 x Links

Sheet 1 of 1 sheets

Appendix B Planning Property Reports

PLANNING PROPERTY REPORT

From www.planning.vic.gov.au at 30 May 2023 10:15 AM

PROPERTY DETAILS

Crown Description:	**Allot. 39B PARISH OF LANG LANG EAST**	
Address:	**910 WESTERNPORT ROAD YANNATHAN 3981**	
Standard Parcel Identifier (SPI):	**39B\PP2969**	
Local Government Area (Council):	**CARDINIA**	www.cardinia.vic.gov.au
Council Property Number:	**4912655700**	
Planning Scheme:	**Cardinia**	Planning Scheme - Cardinia
Directory Reference:	**Vicroads 96 C5**	

UTILITIES

Rural Water Corporation:	**Southern Rural Water**
Melbourne Water Retailer:	**South East Water**
Melbourne Water:	**Inside drainage boundary**
Power Distributor:	**AUSNET**

View location in VicPlan

STATE ELECTORATES

Legislative Council:	**EASTERN VICTORIA**
Legislative Assembly:	**BASS**

OTHER

Registered Aboriginal Party:	**Bunurong Land Council Aboriginal Corporation**

Planning Zones

GREEN WEDGE ZONE (GWZ)
GREEN WEDGE ZONE - SCHEDULE 1 (GWZ1)

🟩	**GWZ - Green Wedge**	🟨	**PUZ1 - Public Use-Service and Utility**	▩	**TRZ2 - Principal Road Network**
▨	**TRZ3 - Significant Municipal Road**	🟦	**Water area**	—	**Water course**

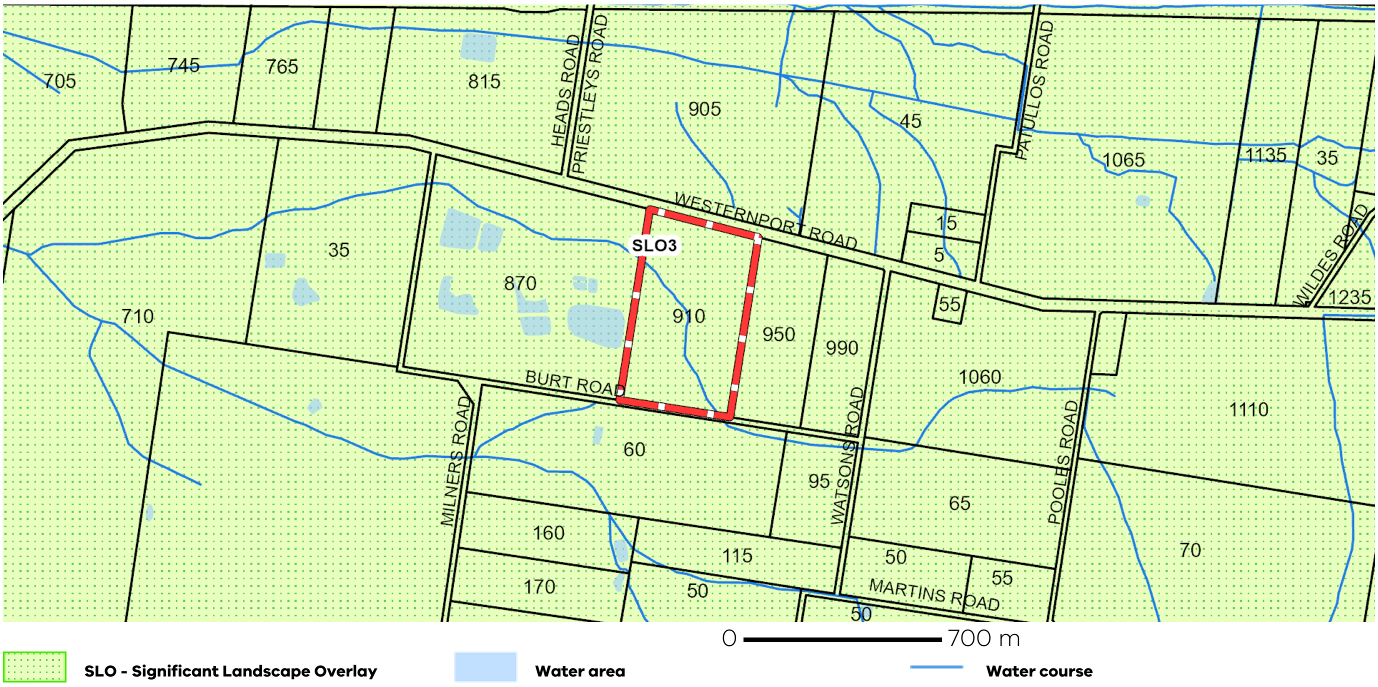
Note: labels for zones may appear outside the actual zone - please compare the labels with the legend.

Notwithstanding this disclaimer, a vendor may rely on the information in this report for the purpose of a statement that land is in a bushfire prone area as required by section 32C (b) of the Sale of Land 1962 (Vic).

Planning Overlays

SIGNIFICANT LANDSCAPE OVERLAY (SLO)

SIGNIFICANT LANDSCAPE OVERLAY - SCHEDULE 3 (SLO3)



Note: due to overlaps, some overlays may not be visible, and some colours may not match those in the legend

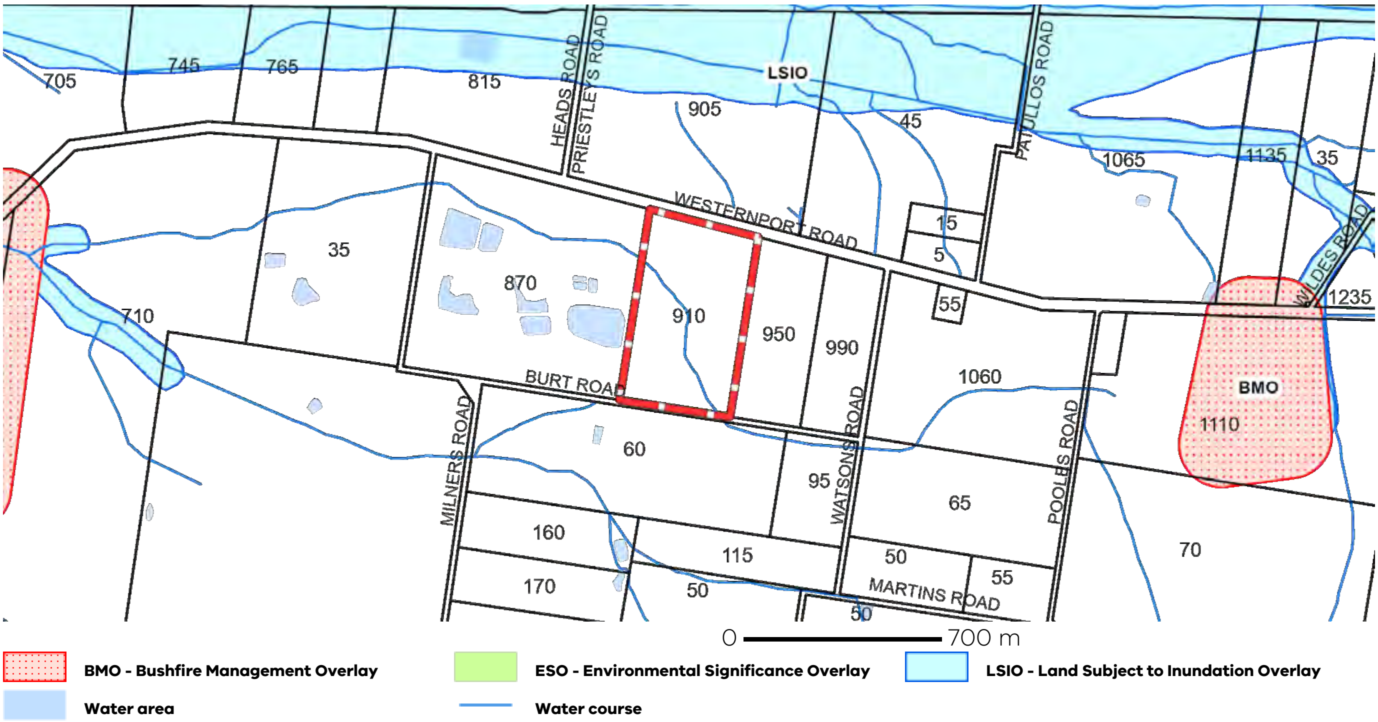
OTHER OVERLAYS

Other overlays in the vicinity not directly affecting this land

BUSHFIRE MANAGEMENT OVERLAY (BMO)

ENVIRONMENTAL SIGNIFICANCE OVERLAY (ESO)

LAND SUBJECT TO INUNDATION OVERLAY (LSIO)



Note: due to overlaps, some overlays may not be visible, and some colours may not match those in the legend

Notwithstanding this disclaimer, a vendor may rely on the information in this report for the purpose of a statement that land is in a bushfire prone area as required by section 32C (b) of the Sale of Land 1962 (Vic).

Areas of Aboriginal Cultural Heritage Sensitivity

All or part of this parcel is an 'area of cultural heritage sensitivity'.

'Areas of cultural heritage sensitivity' are defined under the Aboriginal Heritage Regulations 2018, and include registered Aboriginal cultural heritage places and land form types that are generally regarded as more likely to contain Aboriginal cultural heritage.

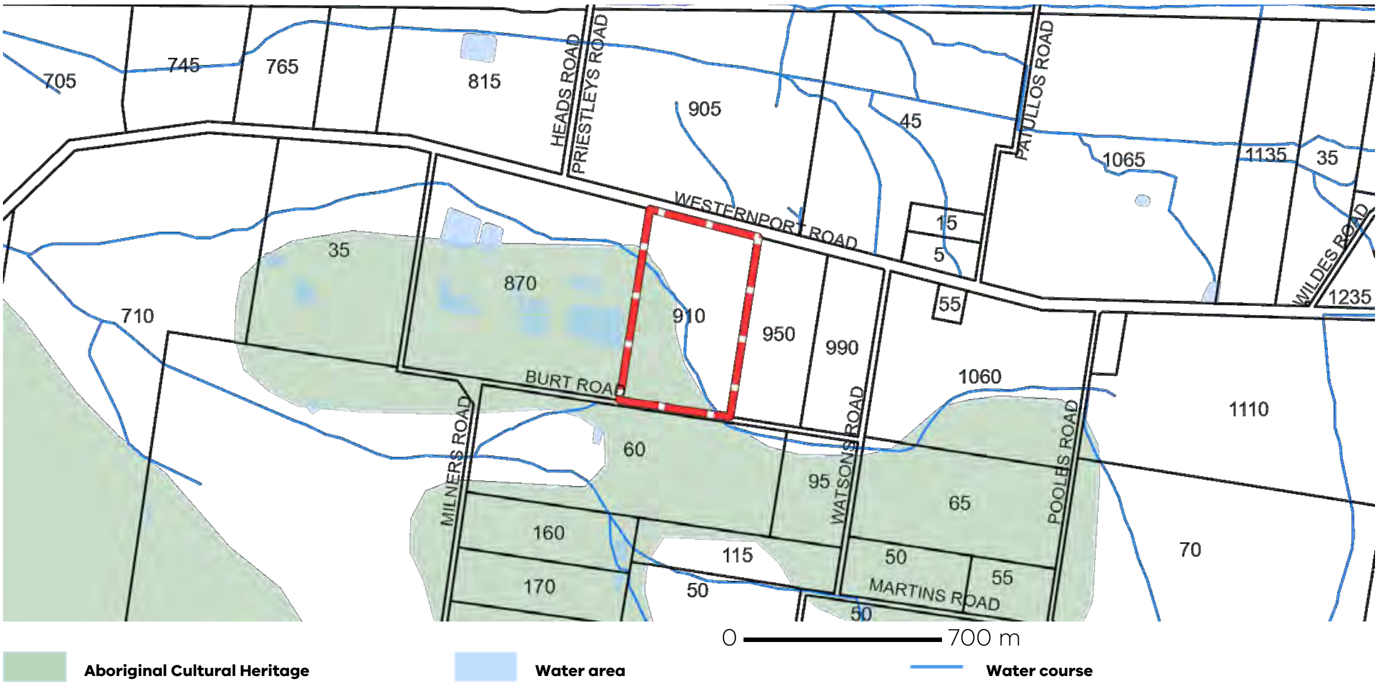
Under the Aboriginal Heritage Regulations 2018, 'areas of cultural heritage sensitivity' are one part of a two part trigger which require a 'cultural heritage management plan' be prepared where a listed 'high impact activity' is proposed.

If a significant land use change is proposed (for example, a subdivision into 3 or more lots), a cultural heritage management plan may be triggered. One or two dwellings, works ancillary to a dwelling, services to a dwelling, alteration of buildings and minor works are examples of works exempt from this requirement.

Under the Aboriginal Heritage Act 2006, where a cultural heritage management plan is required, planning permits, licences and work authorities cannot be issued unless the cultural heritage management plan has been approved for the activity.

For further information about whether a Cultural Heritage Management Plan is required go to
http://www.aav.nrms.net.au/aavQuestion1.aspx

More information, including links to both the Aboriginal Heritage Act 2006 and the Aboriginal Heritage Regulations 2018,
can also be found here - https://www.aboriginalvictoria.vic.gov.au/aboriginal-heritage-legislation



Notwithstanding this disclaimer, a vendor may rely on the information in this report for the purpose of a statement that land is in a bushfire prone area as required by section 32C (b) of the Sale of Land 1962 (Vic).

Further Planning Information

Planning scheme data last updated on 24 May 2023.

A **planning scheme** sets out policies and requirements for the use, development and protection of land.
This report provides information about the zone and overlay provisions that apply to the selected land.
Information about the State and local policy, particular, general and operational provisions of the local planning scheme that may affect the use of this land can be obtained by contacting the local council
or by visiting https://www.planning.vic.gov.au

This report is NOT a **Planning Certificate** issued pursuant to Section 199 of the ***Planning and Environment Act 1987.***
It does not include information about exhibited planning scheme amendments, or zonings that may abut the land.
To obtain a Planning Certificate go to Titles and Property Certificates at Landata - https://www.landata.vic.gov.au

For details of surrounding properties, use this service to get the Reports for properties of interest.

To view planning zones, overlay and heritage information in an interactive format visit https://mapshare.maps.vic.gov.au/vicplan

For other information about planning in Victoria visit https://www.planning.vic.gov.au

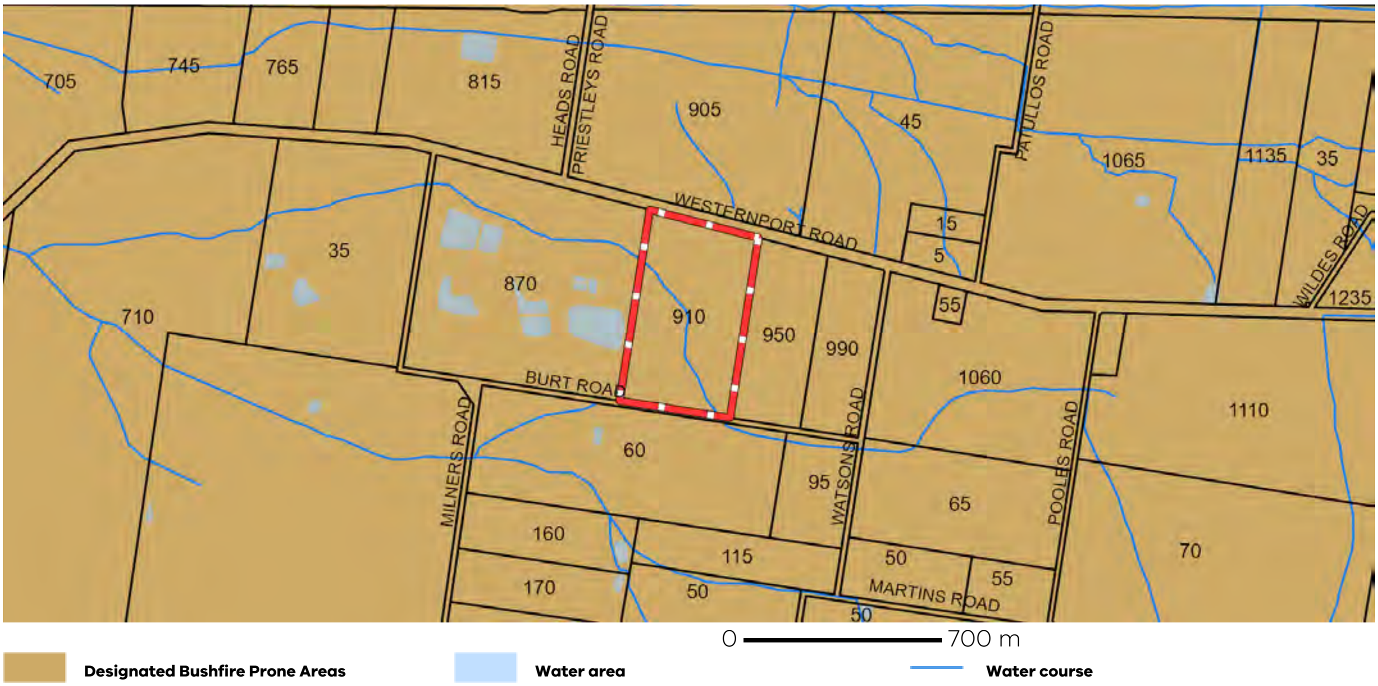
Notwithstanding this disclaimer, a vendor may rely on the information in this report for the purpose of a statement that land is in a bushfire prone area as required by section 32C (b) of the Sale of Land 1962 (Vic).

Designated Bushfire Prone Areas

This parcel is in a designated bushfire prone area. Special bushfire construction requirements apply to the part of the property mapped as a designated bushfire prone area (BPA). Planning provisions may apply.

Where part of the property is mapped as BPA, if no part of the building envelope or footprint falls within the BPA area, the BPA construction requirements do not apply.

Note: the relevant building surveyor determines the need for compliance with the bushfire construction requirements.



Designated BPA are determined by the Minister for Planning following a detailed review process. The Building Regulations 2018, through adoption of the Building Code of Australia, apply bushfire protection standards for building works in designated BPA.

Designated BPA maps can be viewed on VicPlan at https://mapshare.vic.gov.au/vicplan/ or at the relevant local council.

Create a BPA definition plan in VicPlan to measure the BPA.

Information for lot owners building in the BPA is available at https://www.planning.vic.gov.au.

Further information about the building control system and building in bushfire prone areas can be found on the Victorian Building Authority website https://www.vba.vic.gov.au. Copies of the Building Act and Building Regulations are available from http://www.legislation.vic.gov.au. For Planning Scheme Provisions in bushfire areas visit https://www.planning.vic.gov.au.

Native Vegetation

Native plants that are indigenous to the region and important for biodiversity might be present on this property. This could include trees, shrubs, herbs, grasses or aquatic plants. There are a range of regulations that may apply including need to obtain a planning permit under Clause 52.17 of the local planning scheme. For more information see Native Vegetation (Clause 52.17) with local variations in Native Vegetation (Clause 52.17) Schedule

To help identify native vegetation on this property and the application of Clause 52.17 please visit the Native Vegetation Information Management system https://nvim.delwp.vic.gov.au/ and Native vegetation (environment.vic.gov.au) or please contact your relevant council.

You can find out more about the natural values on your property through NatureKit NatureKit (environment.vic.gov.au)

Notwithstanding this disclaimer, a vendor may rely on the information in this report for the purpose of a statement that land is in a bushfire prone area as required by section 32C (b) of the Sale of Land 1962 (Vic).

Extractive Industry Work Authorities (WA)

All or parts of this property are within 500 metres of Extractive Industry Work Authorities (both current and application).

On 22 March 2022, Amendment VC219 introduced changes to all planning schemes in Victoria to support the ongoing operation of extractive industry across Victoria and increase amenity protection for nearby accommodation in rural zones.

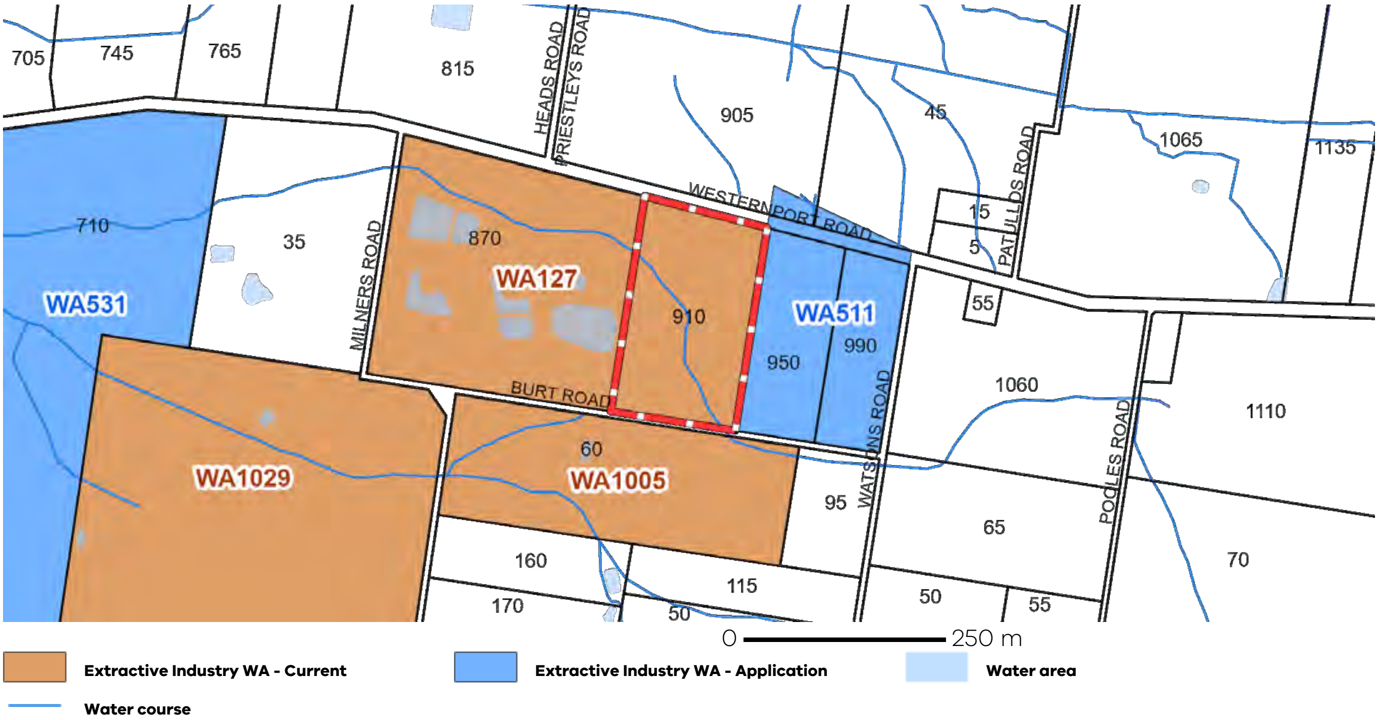
The amendment made changes to the Rural Living Zone, Green Wedge Zone, Green Wedge Zone A, Rural Activity Zone, Farming Zone and Rural Conservation Zone, introducing a permit requirement for accommodation and building and works associated with accommodation that is located within 500 metres from the nearest title boundary of land on which a work authority has been applied for or granted under the Mineral Resources (Sustainable Development) Act 1990 (MRSD Act).

The Amendment also introduced new referral and notice requirements, and decision guidelines.

VicPlan mapping shows property information, including whether a work authority application has been made or approved under the MRSD Act.

Guidance on accessing work authority maps is detailed at the DELWP Extractive Resources (planning.vic.gov.au) webpage.

Further information on extractive and mining activities in Victoria can be found on the (GeoVic - Earth Resources) website which is maintained by the Resources Branch within the Department of Jobs, Precincts and Regions. Limited information is available for unregistered users (anonymous user).



Notwithstanding this disclaimer, a vendor may rely on the information in this report for the purpose of a statement that land is in a bushfire prone area as required by section 32C (b) of the Sale of Land 1962 (Vic).

PLANNING PROPERTY REPORT

From www.planning.vic.gov.au at 30 May 2023 10:13 AM

PROPERTY DETAILS

Crown Description:	**Allot. 100B PARISH OF LANG LANG EAST**	
Address:	**870 WESTERNPORT ROAD YANNATHAN 3981**	
Standard Parcel Identifier (SPI):	**100B\PP2969**	
Local Government Area (Council):	**CARDINIA**	www.cardinia.vic.gov.au
Council Property Number:	**4912655600**	
Planning Scheme:	**Cardinia**	Planning Scheme - Cardinia
Directory Reference:	**Vicroads 96 C5**	

UTILITIES

Rural Water Corporation:	**Southern Rural Water**
Melbourne Water Retailer:	**South East Water**
Melbourne Water:	**Inside drainage boundary**
Power Distributor:	**AUSNET**

STATE ELECTORATES

Legislative Council:	**EASTERN VICTORIA**
Legislative Assembly:	**BASS**

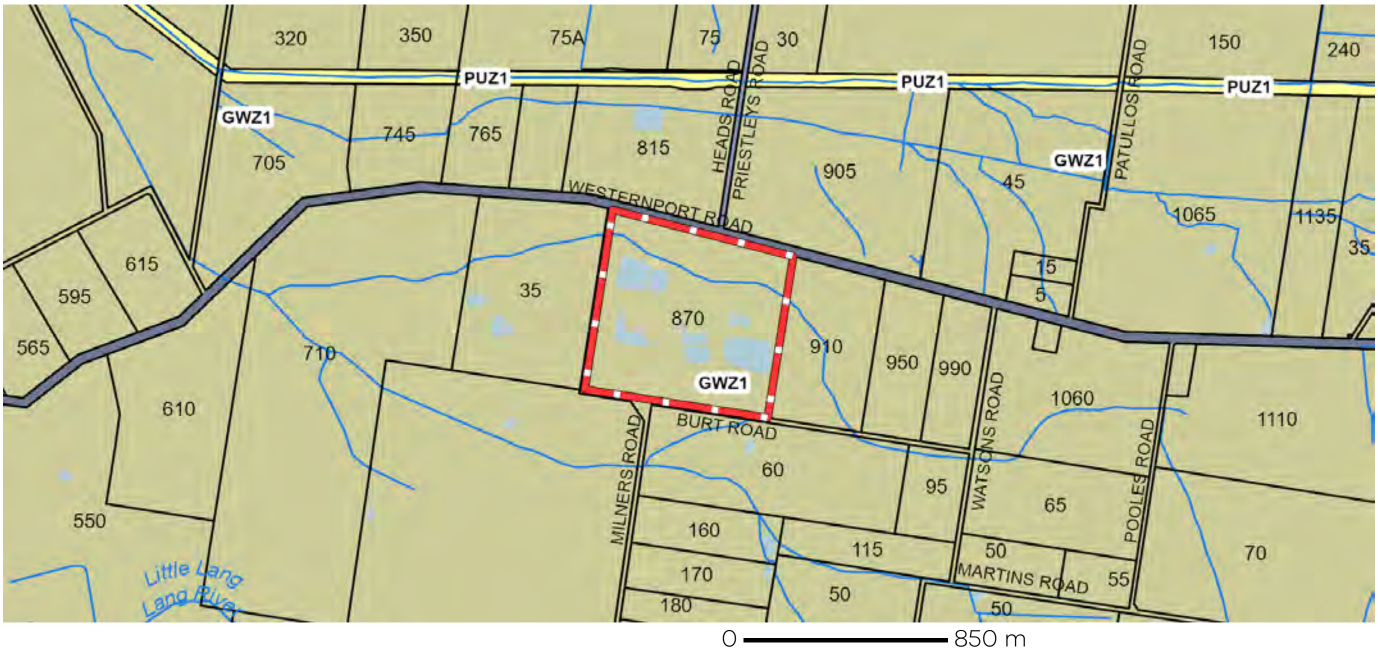
OTHER

Registered Aboriginal Party:	**Bunurong Land Council Aboriginal Corporation**

View location in VicPlan

Planning Zones

GREEN WEDGE ZONE (GWZ)
GREEN WEDGE ZONE - SCHEDULE 1 (GWZ1)



🟫 **GWZ - Green Wedge**
🟨 **PUZ1 - Public Use-Service and Utility**
⬛ **TRZ2 - Principal Road Network**
▨ **TRZ3 - Significant Municipal Road**
🟦 **Water area**
— **Water course**

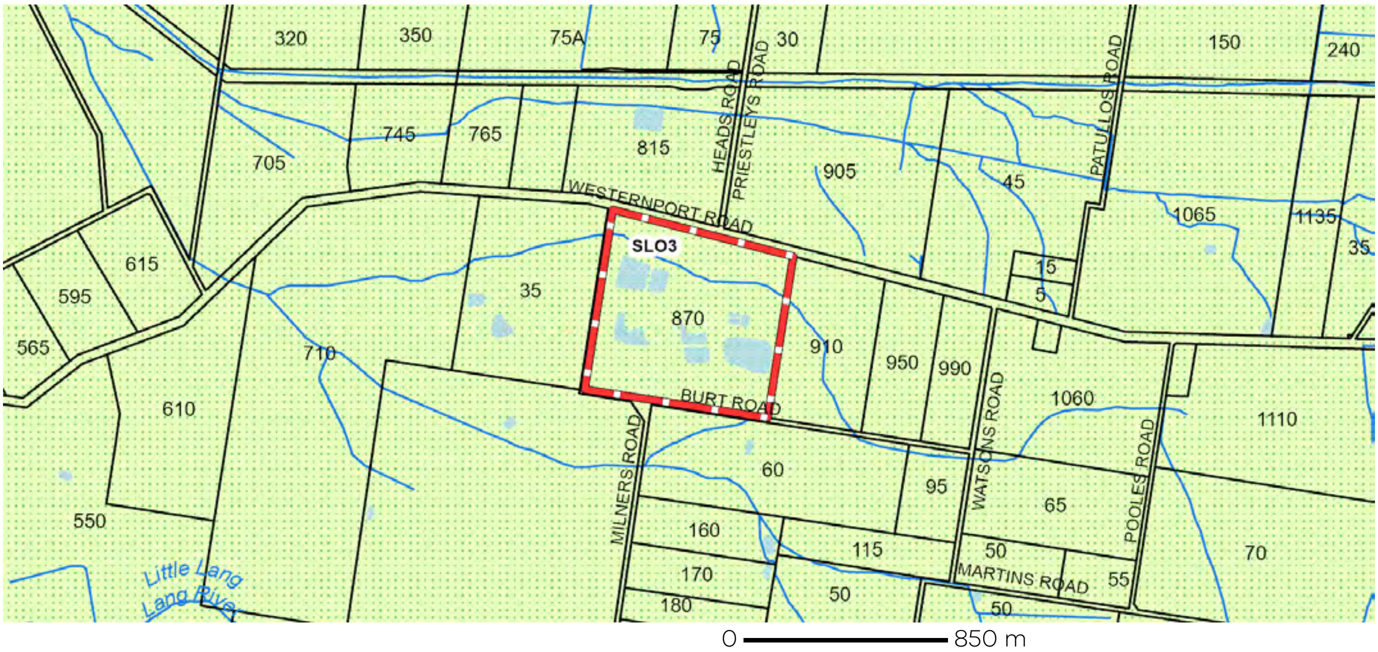
Note: labels for zones may appear outside the actual zone - please compare the labels with the legend.

Notwithstanding this disclaimer, a vendor may rely on the information in this report for the purpose of a statement that land is in a bushfire prone area as required by section 32C (b) of the Sale of Land 1962 (Vic).

Planning Overlays

SIGNIFICANT LANDSCAPE OVERLAY (SLO)

SIGNIFICANT LANDSCAPE OVERLAY - SCHEDULE 3 (SLO3)



🟩 **SLO - Significant Landscape Overlay** 🟦 **Water area** — **Water course**

Note: due to overlaps, some overlays may not be visible, and some colours may not match those in the legend

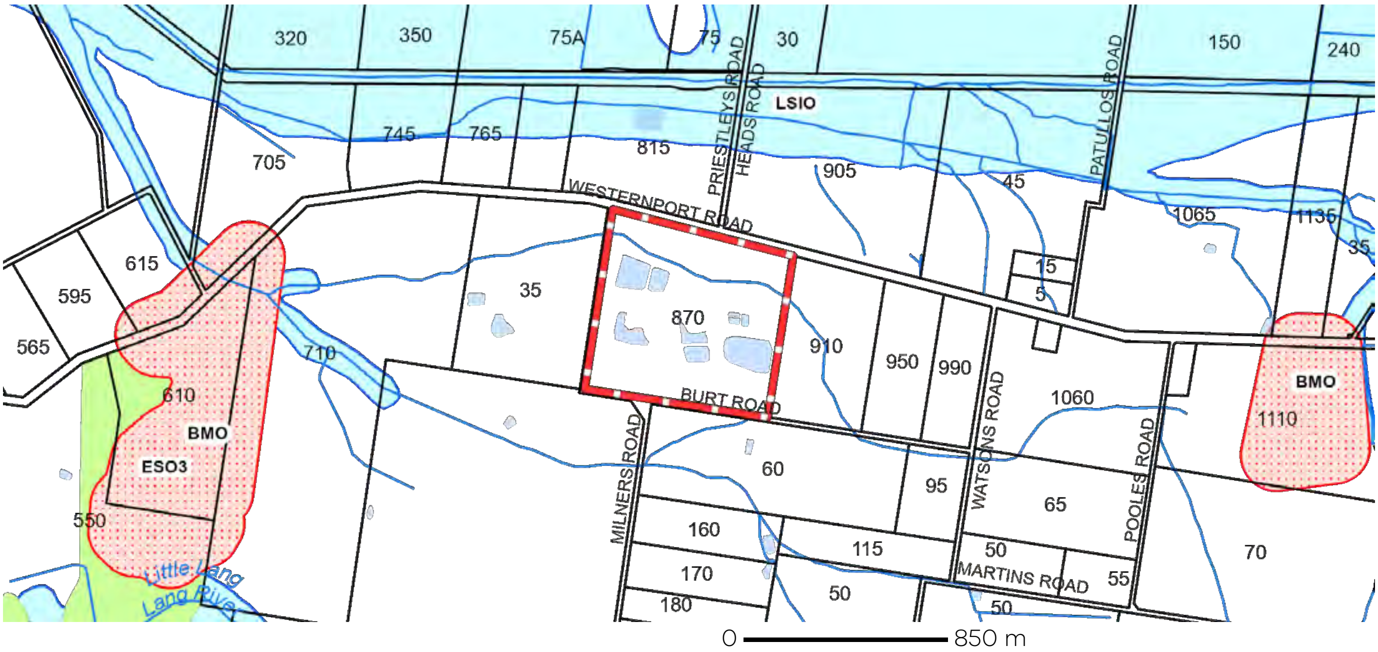
OTHER OVERLAYS

Other overlays in the vicinity not directly affecting this land

BUSHFIRE MANAGEMENT OVERLAY (BMO)

ENVIRONMENTAL SIGNIFICANCE OVERLAY (ESO)

LAND SUBJECT TO INUNDATION OVERLAY (LSIO)



🟥 **BMO - Bushfire Management Overlay** 🟩 **ESO - Environmental Significance Overlay** 🟦 **LSIO - Land Subject to Inundation Overlay**

🟦 **Water area** — **Water course**

Note: due to overlaps, some overlays may not be visible, and some colours may not match those in the legend

Notwithstanding this disclaimer, a vendor may rely on the information in this report for the purpose of a statement that land is in a bushfire prone area as required by section 32C (b) of the Sale of Land 1962 (Vic).

Areas of Aboriginal Cultural Heritage Sensitivity

All or part of this parcel is an 'area of cultural heritage sensitivity'.

'Areas of cultural heritage sensitivity' are defined under the Aboriginal Heritage Regulations 2018, and include registered Aboriginal cultural heritage places and land form types that are generally regarded as more likely to contain Aboriginal cultural heritage.

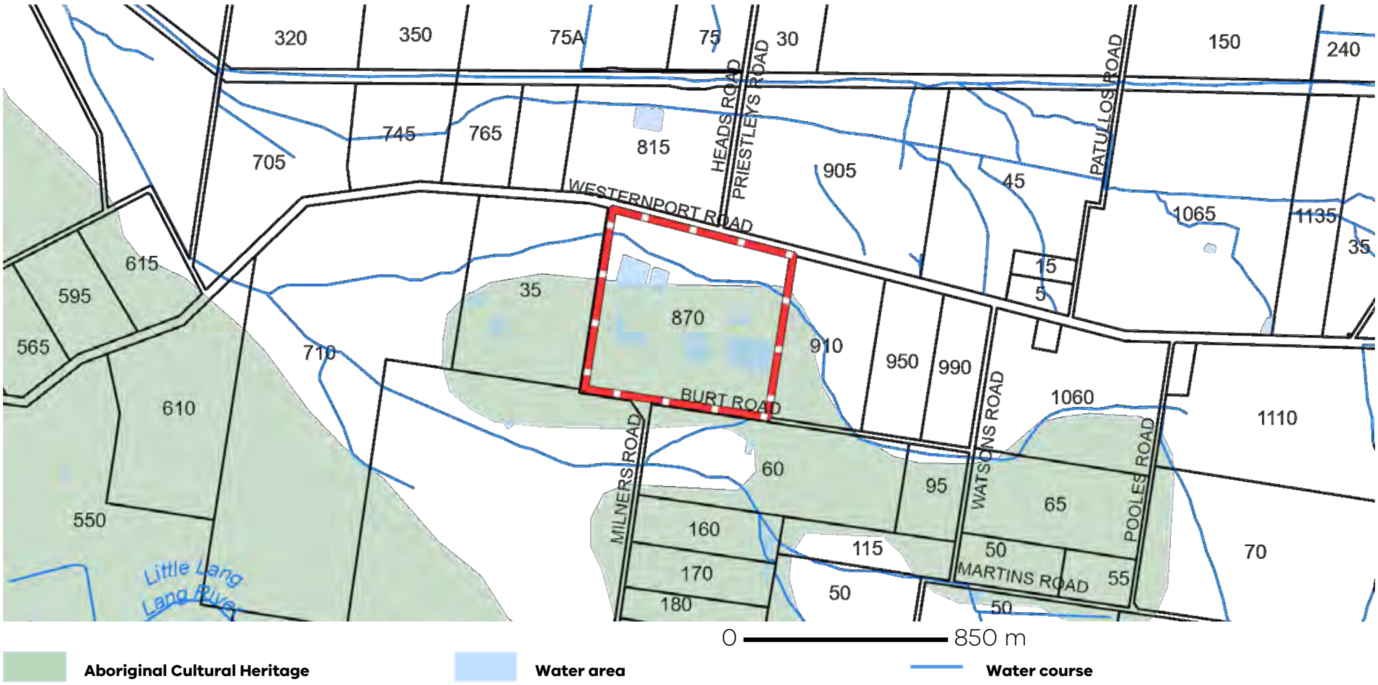
Under the Aboriginal Heritage Regulations 2018, 'areas of cultural heritage sensitivity' are one part of a two part trigger which require a 'cultural heritage management plan' be prepared where a listed 'high impact activity' is proposed.

If a significant land use change is proposed (for example, a subdivision into 3 or more lots), a cultural heritage management plan may be triggered. One or two dwellings, works ancillary to a dwelling, services to a dwelling, alteration of buildings and minor works are examples of works exempt from this requirement.

Under the Aboriginal Heritage Act 2006, where a cultural heritage management plan is required, planning permits, licences and work authorities cannot be issued unless the cultural heritage management plan has been approved for the activity.

For further information about whether a Cultural Heritage Management Plan is required go to
http://www.aav.nrms.net.au/aavQuestion1.aspx

More information, including links to both the Aboriginal Heritage Act 2006 and the Aboriginal Heritage Regulations 2018,
can also be found here - https://www.aboriginalvictoria.vic.gov.au/aboriginal-heritage-legislation



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Further Planning Information

Planning scheme data last updated on 24 May 2023.

A **planning scheme** sets out policies and requirements for the use, development and protection of land.
This report provides information about the zone and overlay provisions that apply to the selected land.
Information about the State and local policy, particular, general and operational provisions of the local planning scheme that may affect the use of this land can be obtained by contacting the local council
or by visiting https://www.planning.vic.gov.au

This report is NOT a **Planning Certificate** issued pursuant to Section 199 of the ***Planning and Environment Act 1987.***
It does not include information about exhibited planning scheme amendments, or zonings that may abut the land.
To obtain a Planning Certificate go to Titles and Property Certificates at Landata - https://www.landata.vic.gov.au

For details of surrounding properties, use this service to get the Reports for properties of interest.

To view planning zones, overlay and heritage information in an interactive format visit
https://mapshare.maps.vic.gov.au/vicplan

For other information about planning in Victoria visit https://www.planning.vic.gov.au

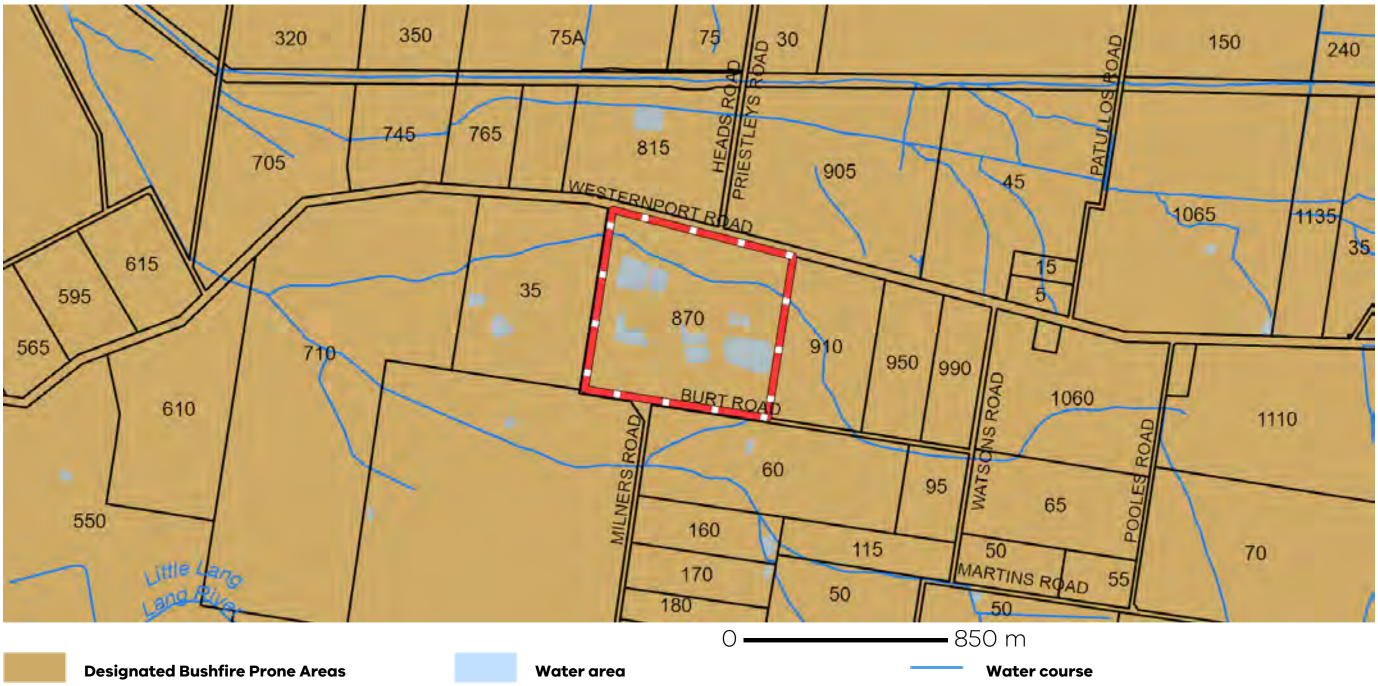
Notwithstanding this disclaimer, a vendor may rely on the information in this report for the purpose of a statement that land is in a bushfire prone area as required by section 32C (b) of the Sale of Land 1962 (Vic).

Designated Bushfire Prone Areas

This parcel is in a designated bushfire prone area. Special bushfire construction requirements apply to the part of the property mapped as a designated bushfire prone area (BPA). Planning provisions may apply.

Where part of the property is mapped as BPA, if no part of the building envelope or footprint falls within the BPA area, the BPA construction requirements do not apply.

Note: the relevant building surveyor determines the need for compliance with the bushfire construction requirements.



Designated BPA are determined by the Minister for Planning following a detailed review process. The Building Regulations 2018, through adoption of the Building Code of Australia, apply bushfire protection standards for building works in designated BPA.

Designated BPA maps can be viewed on VicPlan at https://mapshare.vic.gov.au/vicplan/ or at the relevant local council.

Create a BPA definition plan in VicPlan to measure the BPA.

Information for lot owners building in the BPA is available at https://www.planning.vic.gov.au.

Further information about the building control system and building in bushfire prone areas can be found on the Victorian Building Authority website https://www.vba.vic.gov.au. Copies of the Building Act and Building Regulations are available from http://www.legislation.vic.gov.au. For Planning Scheme Provisions in bushfire areas visit https://www.planning.vic.gov.au.

Native Vegetation

Native plants that are indigenous to the region and important for biodiversity might be present on this property. This could include trees, shrubs, herbs, grasses or aquatic plants. There are a range of regulations that may apply including need to obtain a planning permit under Clause 52.17 of the local planning scheme. For more information see Native Vegetation (Clause 52.17) with local variations in Native Vegetation (Clause 52.17) Schedule

To help identify native vegetation on this property and the application of Clause 52.17 please visit the Native Vegetation Information Management system https://nvim.delwp.vic.gov.au/ and Native vegetation (environment.vic.gov.au) or please contact your relevant council.

You can find out more about the natural values on your property through NatureKit NatureKit (environment.vic.gov.au)

Notwithstanding this disclaimer, a vendor may rely on the information in this report for the purpose of a statement that land is in a bushfire prone area as required by section 32C (b) of the Sale of Land 1962 (Vic).

Extractive Industry Work Authorities (WA)

All or parts of this property are within 500 metres of Extractive Industry Work Authorities (both current and application).

On 22 March 2022, Amendment VC219 introduced changes to all planning schemes in Victoria to support the ongoing operation of extractive industry across Victoria and increase amenity protection for nearby accommodation in rural zones.

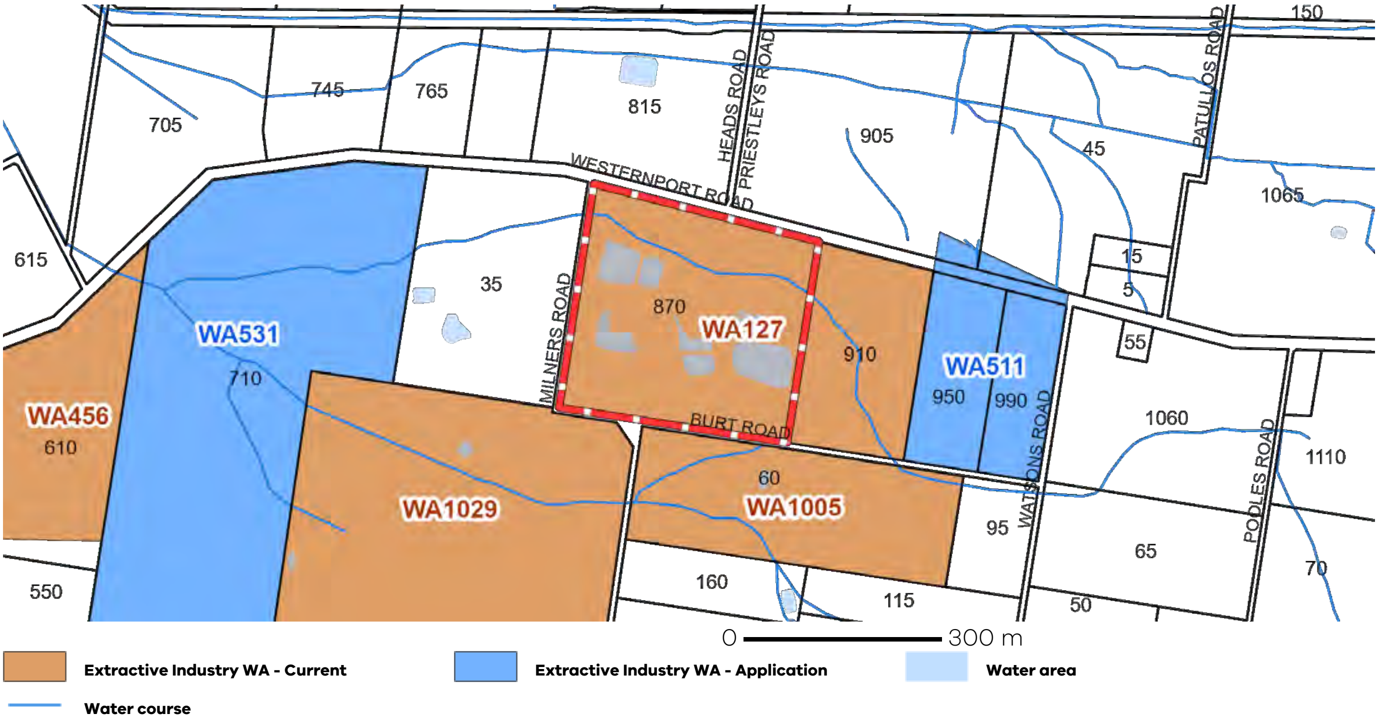
The amendment made changes to the Rural Living Zone, Green Wedge Zone, Green Wedge Zone A, Rural Activity Zone, Farming Zone and Rural Conservation Zone, introducing a permit requirement for accommodation and building and works associated with accommodation that is located within 500 metres from the nearest title boundary of land on which a work authority has been applied for or granted under the Mineral Resources (Sustainable Development) Act 1990 (MRSD Act).

The Amendment also introduced new referral and notice requirements, and decision guidelines.

VicPlan mapping shows property information, including whether a work authority application has been made or approved under the MRSD Act.

Guidance on accessing work authority maps is detailed at the DELWP Extractive Resources (planning.vic.gov.au) webpage.

Further information on extractive and mining activities in Victoria can be found on the (GeoVic - Earth Resources) website which is maintained by the Resources Branch within the Department of Jobs, Precincts and Regions. Limited information is available for unregistered users (anonymous user).



Notwithstanding this disclaimer, a vendor may rely on the information in this report for the purpose of a statement that land is in a bushfire prone area as required by section 32C (b) of the Sale of Land 1962 (Vic).

Appendix C SRW Licence

Southern
Rural Water
Managing Water. Serving Communities.

05 Jul 2022

HANSON CONSTRUCTION
By email Gunther.Benedek@hanson.com.au

Dear Sir/Madam,

Application type:	Temporary volume transfer
Application number:	BET018548
Delivery system:	UNC-Koo Wee Rup (Koo Wee Rup (GMU))
Transfer volume:	19.5 ML
Transfer from:	PETER THOMAS JUBB ANNE DENISE JUBB
Transfer to:	HANSON CONSTRUCTION

The above application for a temporary transfer of 19.5 megalitres to your licence to take and use water BEE025109 has been approved. The transfer will expire on 30 Jun 2023.

If your extraction is not currently metered please contact Southern Rural Water to speak to a field officer for your region.

Should you wish to discuss this matter please contact Simone Vale on 1300 139 510 and quote the application number listed above.

We encourage you to tell us how you felt about our service. We value your thoughts and would welcome any feedback you may have. To submit your feedback, please complete our short survey at: http://www.surveymonkey.com/s/Appsfeedback

Yours sincerely

Trevor McDevitt
Manager Applications

Appendix D Surface Water Management Plan

Hanson Construction Materials

Yannathan Quarry Extension

Surface Water Management Plan

September 2022

V1259_002-REP-001-6

Job no. and Project Name: V1259_002 Yannathan SWA
Doc Path File: \\online.com\files\ManagementMelbourne\Projects\V1259 Hanson Construction Materials\V1259_002 Yannathan SWA\07 Deliv\Docs\Report\V1259_002_REP_001_6_Yannathan SWA.docx

Rev	**Date**	**Description**	**Author**	**Reviewer**	**Project Mgr.**	**Approver**
2	29/03/2022	Client Issue	Milan Wickramarachchi / Julian Giannetti	Glenn Ottrey	Glenn Ottrey	Nick Andrewes
3	12/04/2022	Client Issue	Milan Wickramarachchi / Julian Giannetti	Glenn Ottrey	Glenn Ottrey	Nick Andrewes
4	14/04/2022	Client Issue	Milan Wickramarachchi / Julian Giannetti	Glenn Ottrey	Glenn Ottrey	Nick Andrewes
5	14/09/2022	Client Issue	Julian Giannetti	Glenn Ottrey	Glenn Ottrey	Nick Andrewes
6	26/09/2022	Client Issue	Julian Giannetti	Glenn Ottrey	Glenn Ottrey	Nick Andrewes
Signatures						

DISCLAIMER

This Report has been prepared on behalf of and for the exclusive use of Hanson Construction Materials and is subject to and issued in accordance with Hanson Construction Materials instruction to Engeny Water Management (Engeny). The content of this Report was based on previous information and studies supplied by Hanson Construction Materials.

Engeny accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this Report by any third party. Copying this Report without the permission of Hanson Construction Materials or Engeny is not permitted.

Contents

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GLOSSARY

12d Model – Civil Engineering and Surveying Software Package is used to undertake terrain modelling

AEP – Annual Exceedance Probability. For example, a 1 % AEP storm event has a 1 % chance of occurring, or being exceeded, in any one year.

ARI – Average Recurrence Interval. It is the average or expected value of periods between exceedances of a given rainfall over a given duration.

ARR 2019 – Australian Rainfall and Runoff (2019) is a guideline supported by Melbourne Water that is used to estimate rainfall and runoff entering the catchment

ERR – Earth Resources Regulation. Victoria's regulator of exploration, mining, quarrying, petroleum, recreational prospecting and other earth resource activities.

HEC-RAS - Hydrologic Engineering Centre’s River Analysis System is used to determine peak water levels within a waterway

IFD – Intensity Frequency Duration. Design rainfall estimate datasets available from the Bureau of Meteorology which specify the expected intensity of rainfall for specific durations of storms for a range of annual exceedance probability (AEP)

RORB – Run Off Routing on a Boroughs is a hydrologic software used to estimate flows

SWMP – Surface Water Management Plan

WPV - Work Plan Variation

1 INTRODUCTION

1.1 SITE CONTEXT

Hanson Construction Materials is preparing a Work Plan Variation to expand their quarrying operations towards the northern boundary of their sand quarry located at 870-910 Westernport Road in Yannathan (Figure 1-1). There is an existing drainage channel (identified by Melbourne Water as Creek 2412) within the location of the proposed expansion, as shown in blue in Figure 1-1. The expansion will require the realignment of the existing channel towards the northern boundary of the site as shown indicatively by the red line in Figure 1-1.

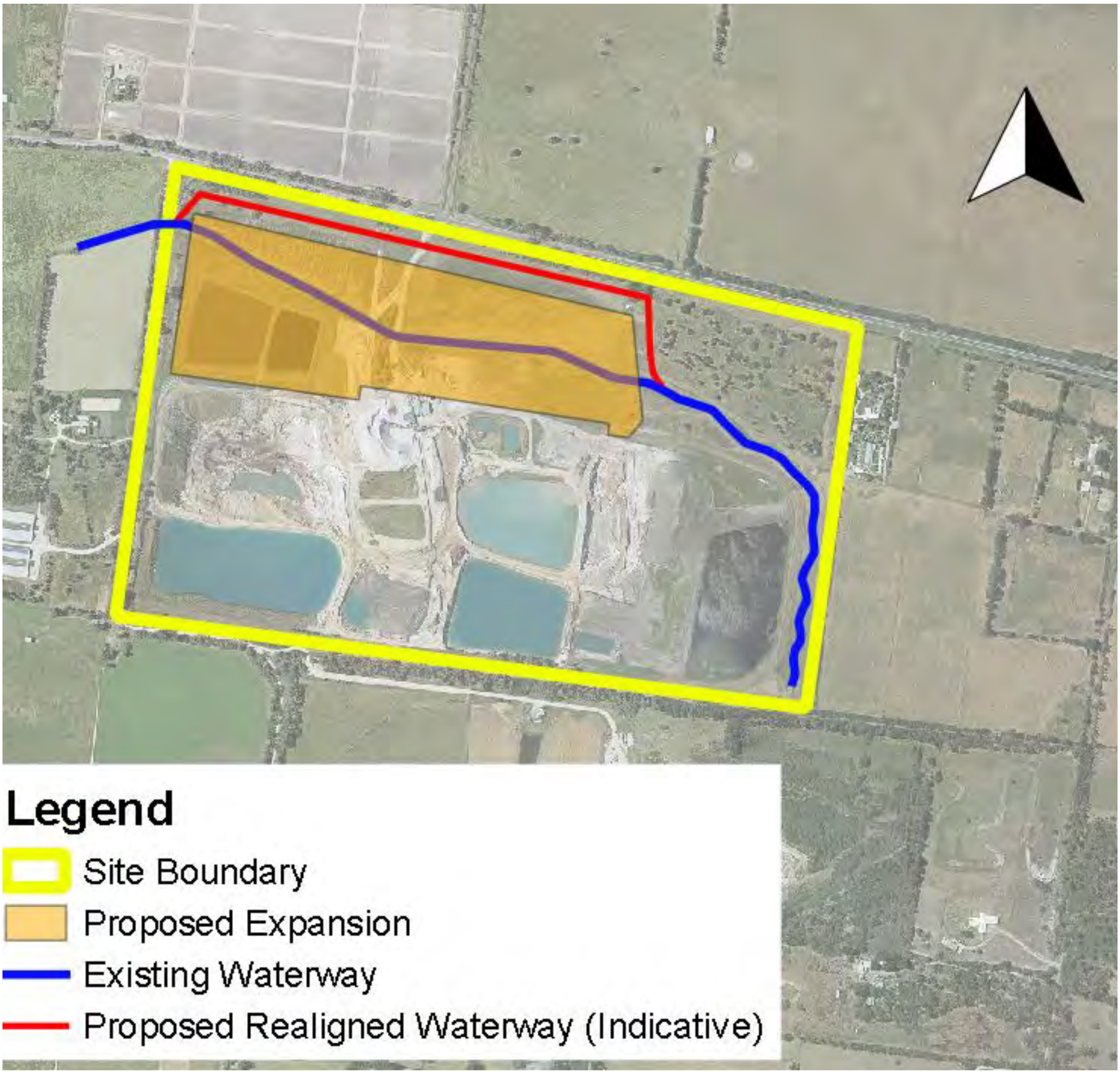


Figure 1-1: Proposed expansion and indicative realigned channel alignment

The existing drainage channel and waterway on the site have been modified from their pre-European settlement form. Approximately half of the length of channel through the site was realigned as a constructed waterway (compound form) with pools, riffles and a low flow meandering channel in 2013. This realigned section of the waterway was designed and constructed based on the concept design undertaken by ATC Williams (Refer to **Appendix A** for report provided by Melbourne Water) with a detailed design completed by GHD.

The remaining section of channel through the site which is now proposed to be realigned is a reasonably straight rural drainage channel which was presumably constructed when the land was utilised for agricultural purposes prior to its use as a sand quarry. Given the flat nature of the area it is likely that prior to the construction of the drainage channels both on the site and in the surrounding area much of the land in this area would have been swampy/boggy for large parts of the year.

1.2 OBJECTIVES

Engeny Water Management (Engeny) has been engaged to undertake a Surface Water Management Plan (SWMP) of the site and associated upstream catchments to address the requirements of the Work Plan Variation (WPV).

The SWMP includes:

- Determination of the requirements of responsible authorities including Earth Resources Regulation (ERR) and Melbourne Water.
- Estimation of stormwater flows derived from catchments internal and external to the proposed expansion area.
- Design of a constructed waterway required to convey external catchment flows around the proposed expansion area. Engeny have been engaged to prepare conceptual and functional documentation to support the proposed design. The design will consider requirements during the operational and rehabilitated phases of the site.

This document will be updated as the design develops from a concept to detailed design. It is expected that Melbourne Water will be engaged at each stage to ensure that all requirements from Melbourne Water are addressed at each stage of the design.

1.3 SCOPE

The following tasks have been undertaken as part of the scope of works:

- One site meeting with Ricardo and Hanson.
- Hydrological modelling of the subject catchment area to estimate catchment flows entering the site.
- Hydraulic modelling to determine the required size of the proposed realigned waterway.
- Terrain modelling to determine the proposed extent of the proposed realigned waterway.
- Concept and functional design of the recommended drainage infrastructure as required by the responsible authorities.

1.4 APPROACH

The hydrological modelling has been undertaken using methods outlines in the Australian Rainfall and Runoff (ARR) 2019. All intensity-frequency duration (IFD) design rainfall intensities, temporal patterns and associated approaches to hydrological losses have been obtained from this publication.

Modelling has been undertaken using the following software programs:

Hydrological Modelling – RORB was developed by Monash University with support from Melbourne Water. It is a general runoff and streamflow routing program that is used to estimate design hydrographs and peak flows for a given catchment. These design flows are then used to develop the hydraulic model.

Hydraulic Modelling – HEC-RAS was developed by the US Army Corps of Engineers which is a 1d and 2d hydraulic software that is supported by Melbourne Water. HEC-RAS is used to perform one and two-dimensional hydraulic calculations to determine sizing and geometry for a given waterway. This will provide the minimum cross-sectional area required to convey the peak flow calculated in the hydrologic model.

Terrain Modelling – 12d Model is a terrain modelling and civil engineering software package that is used to determine the extent of the proposed waterway including its longitudinal grade and interface with the existing surface. 12d Model has been used to inform the extent of works shown on the concept design documentation.

1.5 STAGING OF WORKS

To extend the extraction area as shown in Figure 1-1, the proposed sequencing of works (from a stormwater perspective) is expected to be as follows:

1. Commence extraction of the area north of the existing waterway (no impact on the existing waterway).
2. Once extraction of the area north of the existing waterway is completed, backfill will be undertaken with a suitable material, preferably material sourced from the site, as required, to provide a corridor for the proposed realigned waterway. The specification of this backfill material will be developed by a suitably qualified geotechnical engineer and confirmed with Melbourne Water and provided during the functional design stage.
3. Existing waterway is to be realigned over the backfilled area. This waterway will be designed and constructed in accordance with the Melbourne Water Constructed Waterway Design Manual.
4. Commence extraction of the area south of the realigned waterway, including removal of the existing waterway.
5. Rehabilitation of the site to be undertaken once extraction completed. The rehabilitation of the site post extraction is proposed to involve filling some areas of the excavations which a suitable material and revegetating with native plants. Other areas of the site will be retained as open dams. The dams will be bunded off from the realigned waterway so that no flows from events up to and including the 1% AEP event can spill into the dams. Figure 1-2 shows the concept plan of the proposed site rehabilitation once the extraction has been completed.

At each stage of the works the quarrying pits will be protected from flooding in up to a 1% AEP event to prevent water from flowing into any of the pits.

Figure 1-2: Proposed rehabilitation plan (concept design for context)

2 SITE INSPECTION

2.1 OVERVIEW

Engeny has undertaken a site visit to the quarry site on 9 February 2021. The inspected channel has been split into three reaches (A, B and C) which is summarised as follows and as shown in Figure 2-1:

Reach A – Realigned section of the existing waterway as part of the most recent Work Plan Variation dated in October 2013.

Reach B – Existing waterway alignment that is to be realigned as part of the proposed variation of the current Work Plan (approx. 800 m in length).

Reach C – Existing waterway alignment that is to be retained (not modified) as part of the proposed variation of the current Work Plan.

The inspection involved undertaking measurements of the existing culverts and to obtain information regarding the conditions of the current. In addition, an understanding of the design constraints and requirements of the proposed diversion channel were developed.

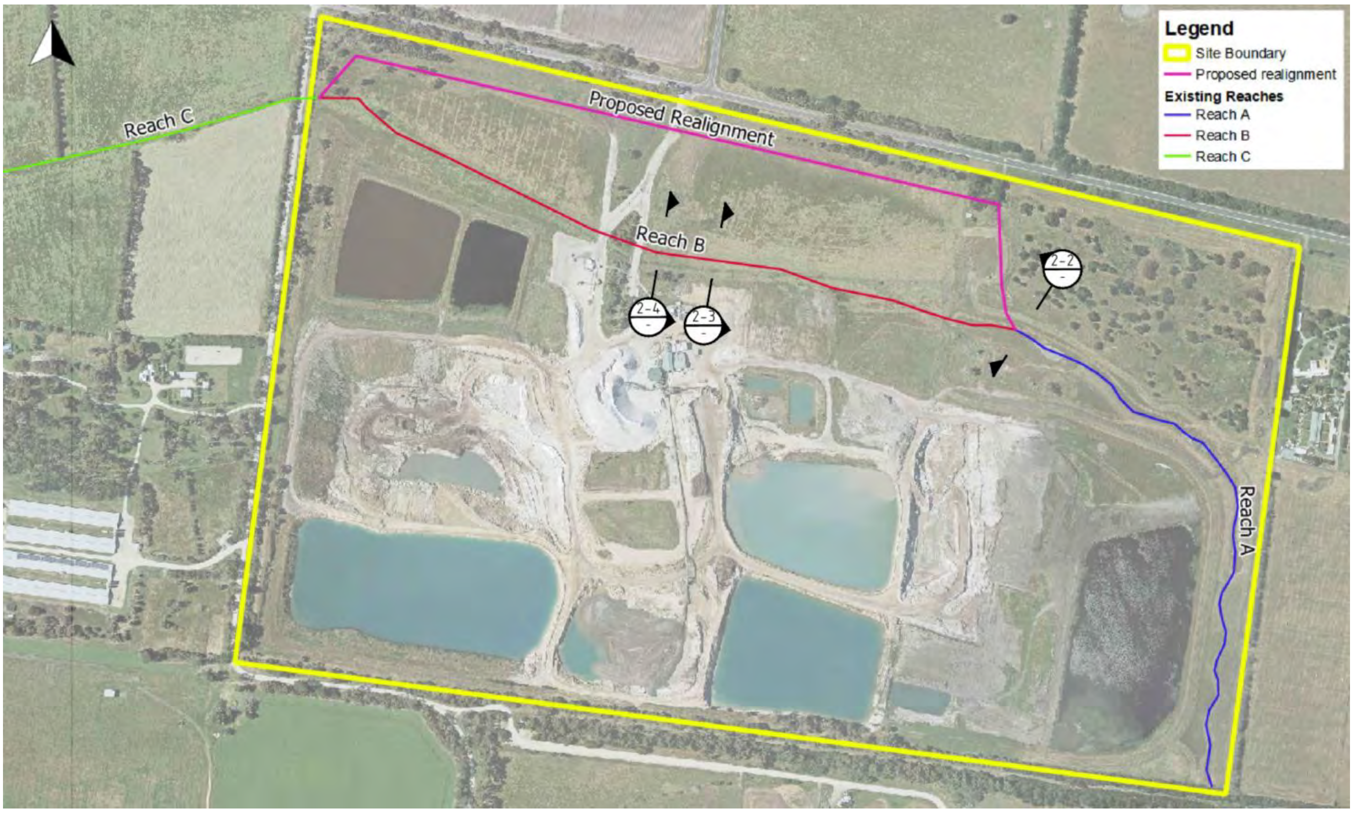


Figure 2-1: Site Waterway Reaches

2.2 SITE CHARACTERISTICS

2.2.1 Reach A

Reach A represents a previously re-aligned constructed waterway from the east of the quarry site flowing in the north-west direction towards Reach B. The waterway has low vegetation with some pasture grasses within some sections as shown in Figure 2-2. The surrounding broad floodplain consists mostly of a low-lying groundcover of pasture.

Figure 2-2: Constructed low flow channel (Reach A)

2.2.2 Reach B

Reach B features a shallow low–flow channel, in the order of 200 to 300 mm deep, and therefore water overtops to the surrounding floodplain once the low-flow channel depth is exceeded in a rainfall event. The floodplain surrounding the eastern section of this reach, is made of low-lying groundcover of pasture grasses consistent with findings along Reach A. The floodplain surrounding the western section of this reach is made up of dense groundcover consisting mostly of pasture grasses, with some dispersed trees on its floodplain further downstream towards the western boundary of the site.

The in-channel vegetation is thick, spreading across the channel at various sections (Figure 2-3). Some ponding was observed along this reach of the waterway (Figure 2-4). Isolated areas of localised ponding likely formed after a storm event were observed along the length of the reach east of the access road leading to the upstream end of Reach B.

Figure 2-3: Channel at Reach B flows on broad floodplain

Figure 2-4: Extended ponding upstream of Reach B

2.3 EXISTING CULVERT CROSSINGS

Due to the dense vegetation, Engeny was unable to observe the existing culverts at the two road crossings that cross Reach B. However, Hanson has advised Engeny that there are approximately six to eight 300 mm diameter circular pipes at each of the two access road crossings, therefore, the hydraulic modelling has assumed that there are six culverts under each of the two access roads to the site.

Additionally, Hanson have confirmed that the box culvert at Milners Road has dimensions of 1200 mm wide and 500 mm high. This culvert has also been included in the hydraulic model.

Refer to Figure 2-5 for existing culvert crossing locations.

Figure 2-5: Existing Culvert Crossing Locations

3 RESPONSIBLE AUTHORITY REQUIREMENTS

Earth Resources Regulation (ERR), Melbourne Water and Cardinia Shire Council are the responsible authorities to permit work within the site.

ERR and Cardinia Shire Council have not been contacted by Engeny and it is understood that Hanson will facilitate these communications.

Engeny have submitted a Pre-Development Advice application through Melbourne Water (MWA-1188291) dated 9 October 2020.

Melbourne Water has provided Engeny the advice to satisfy the proposed quarry extension. This email, dated 18 December 2020, is attached in **Appendix B**. A summary of the requirements and advice is shown on Table 3-1**.**

Table 3-1 Summary of Melbourne Water's requirements

Melbourne Water requirement	Action
Geotechnical / geomorphological report	Engeny has undertaken a geomorphological assessment of the site, which outlines the geomorphic values of the site, the feasibility of the proposed realignment and stream velocities and shear stresses. Refer to **Appendix C**
Channel capacity and freeboard	Details are provided in Section 6 of this report
Flora and Fauna Investigation (Biodiversity Assessment)	Refer to **Appendix D**
The location and species of vegetation affected by any proposed realignment at the project site as well as upstream and downstream of the project site	Refer to **Appendix D**
Sediment control elements	Sediment control elements such as silt traps can be recommended as part of the functional or detailed design documentation, however it will be ultimately up to the contractor or group undertaking the civil works to ensure that appropriate sediment control measures are implemented to protect the downstream water quality during construction and establishment of the realigned waterway.
Waterway corridor zones and/or design, including appropriate revegetation setbacks, revegetation treatment, exclusion zone and maintenance access on both sides of the waterway	Footprint of the realigned waterway is up to approximately 60 metres wide which include areas for revegetation. Maintenance access can be provided from the southern side of the waterway

4 HYDROLOGIC MODELLING

The stormwater management plan has assessed two scenarios for runoff to enter the site as summarised below:

1. Local Catchment (Scenario 1) – Based on the catchment delineation undertaken by Engeny and informed by LiDAR data
2. Little Lang Lang Catchment (Scenario 2) – Based on the ATC Williams modelling undertaken in 2011 to inform the previously realigned waterway (Reach A) and advice provided by Melbourne Water from a regional flood model of the Little Lang Lang River.

4.1 LOCAL CATCHMENT (SCENARIO 1)

4.1.1 Overview

Engeny developed a hydrological model using RORB software in accordance with Australian Rainfall and Runoff 2019 (ARR 2019) to generate inflows to the HEC-RAS hydraulic model for the 1 % AEP storm event from the local catchment.

Appendix E provides technical details relating to the development of the RORB hydrological model for this study.

4.1.2 Catchment delineation

Most of the site is low-lying with a gentle slope of approximately 2 % towards the existing waterway. The topography of the area lends to very shallow drainage depressions in most areas. Broad flat plains also characterise large parts of the contributing catchment while the site extremities extend into the surrounding bund adjacent to Westernport Road along the northern site boundary. The existing channel flows north-west around the boundary of the site, from the south-eastern site boundary to the north- western boundary.

As part of the hydrological model development, a catchment delineation has been undertaken for the site to determine the expected catchment area that would contribute flows to the site. Engeny has determined an upstream catchment area of approximately 2.7 km^2 would contribute flows to the site. Refer to Figure 4-1 for catchment area.

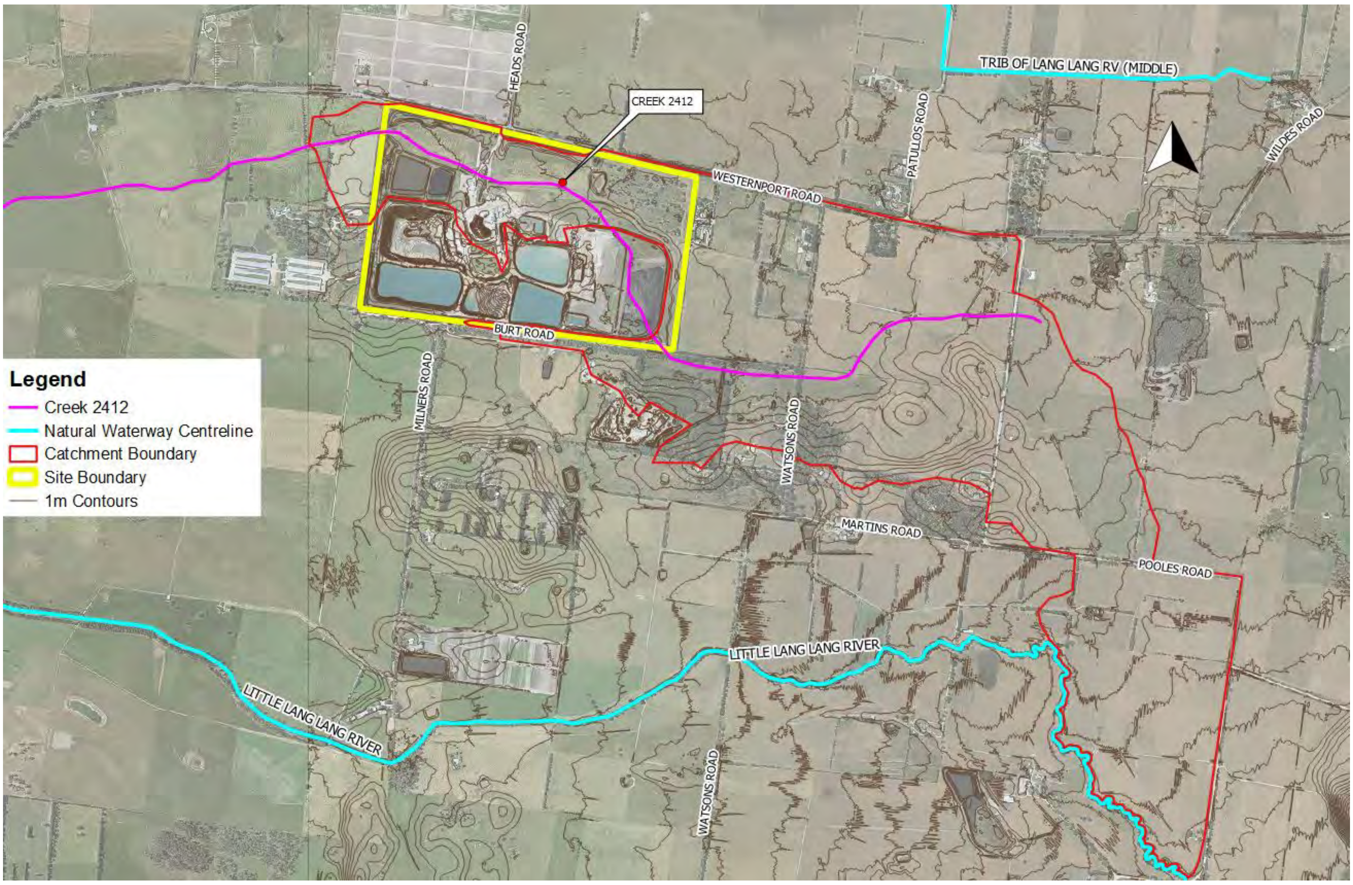


Figure 4-1: Local catchment contributing flows to the study area (delineated by Engeny)

The catchment and sub-catchments (subareas) were delineated considering the following information:

- The Digital Elevation Model (DEM) generated from the available LiDAR data and terrain contours created from the DEM.
- Land use identified in the Victorian Planning Scheme.
- Property boundaries.
- Aerial photography.

As shown in Figure 4-1, the local catchment extends up to the northern bank of the Little Lang Lang River in some locations. There is a high bank/bund at the top of the waterway channel and the land then fall gently north away from the river. This also facilitates breakout flow from Little Lang Lang River which is discussed further in Section 4.2.

Appendix Figure E-1 presents the RORB hydrological model catchment delineation by Engeny. The subareas were delineated taking into consideration of overland flow paths.

The local catchment identified by Melbourne Water is shown in Figure 4-2. Compared to the catchment delineation undertaken by Engeny for the local catchment which shows the upstream boundary to end at Pooles Road, the information provided by Melbourne Water shows the catchment boundary extend further east to the ridges south of Mount Lyall Road.

Figure 4-2 has been provided by Melbourne Water which shows the Little Lang Lang River, Creek 2412 and other watercourses (natural waterways that are above Melbourne Water’s limit).

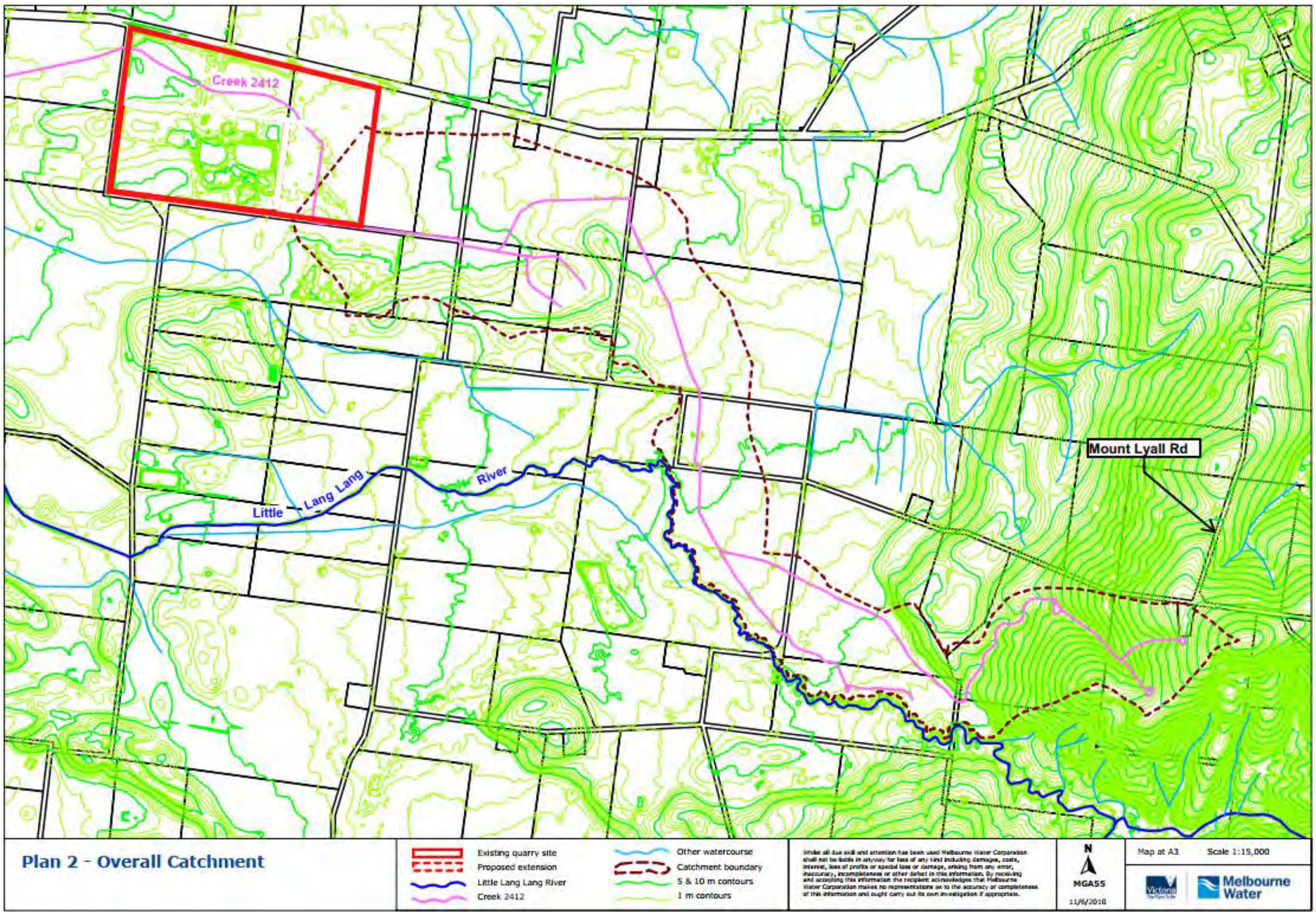


Figure 4-2: Larger catchment contributing flows to the study area from Little Lang Lang River (identified by Melbourne Water)

Catchment Delineation Comparison

As shown in Figure 4-3, Tributary A (nominally labelled for this study as a tributary of the Little Lang Lang River) flows into Little Lang Lang River and therefore was not considered to contribute to the local catchment flows of the site. Furthermore, analysis of the Pooles Road surface levels indicates embankments on the eastern side of Pooles Road, as shown on Figure 4-4. Therefore, flows flowing from the east towards Pooles Road are expected to be diverted along the eastern embankment and flow towards Haysoms Road without contributing to flows at the quarry site.

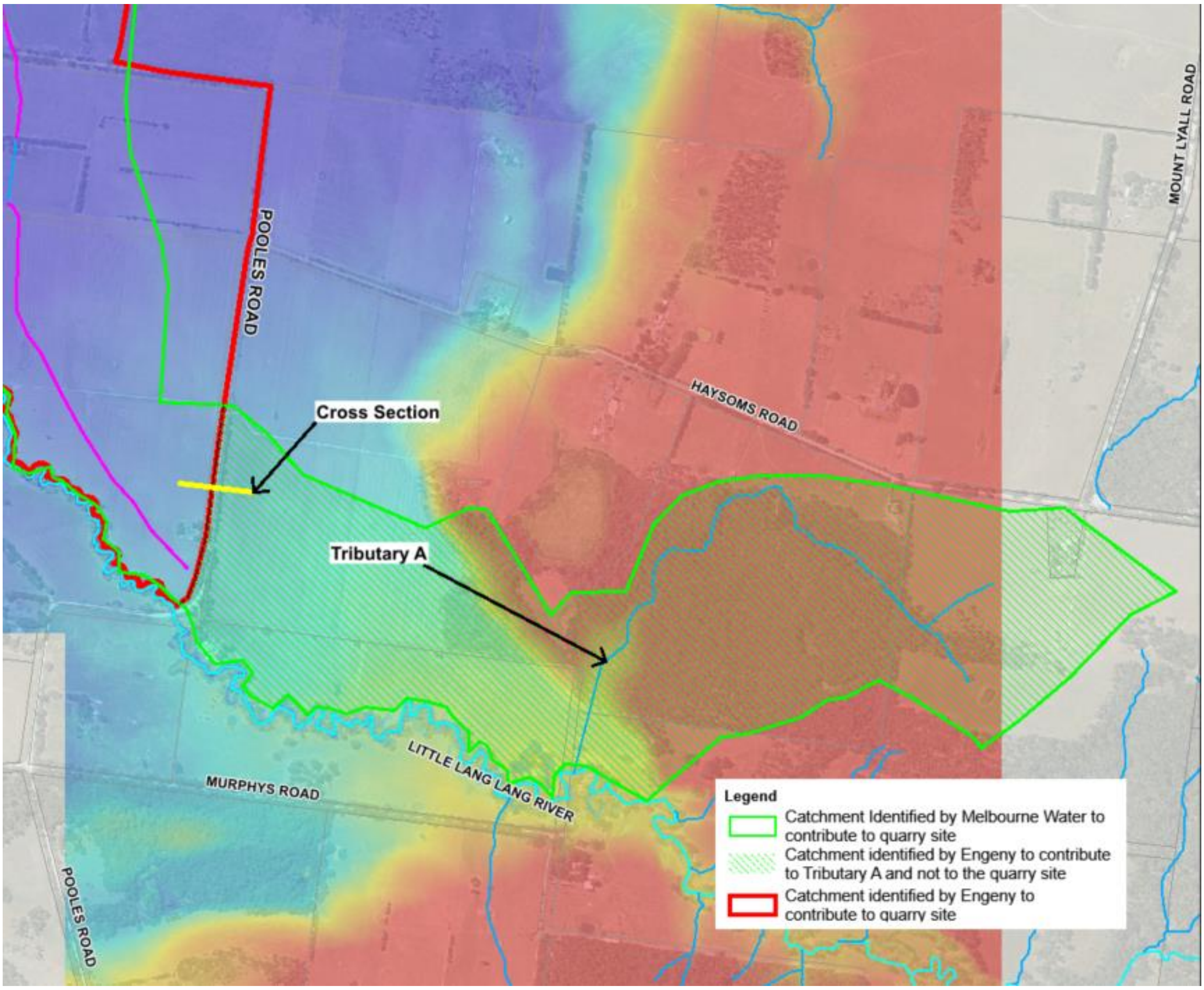


Figure 4-3: Digital Terrain Model east of Pooles Road

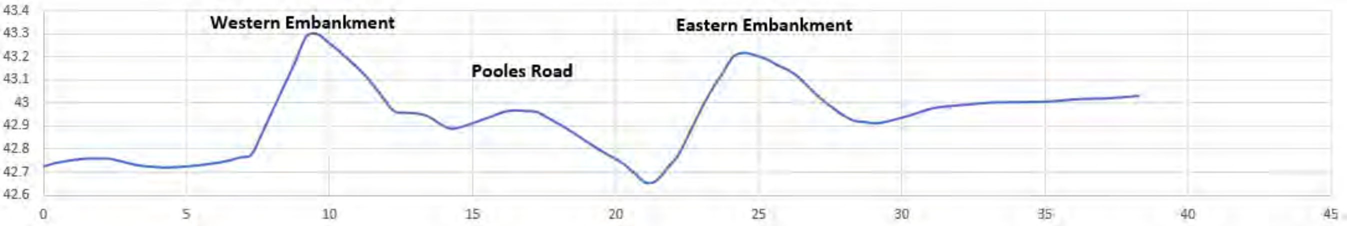


Figure 4-4: Pooles Road (location of eastern catchment boundary) cross-section

A site investigation was undertaken by Engeny on 24 March 2022 to validate whether surface water upstream of Pooles Road, to the east, would be directed towards the quarry site or diverted north along Pooles Road. The findings of the site investigation confirmed embankments on both the eastern and western side of Pooles Road, for the entire length of the road that direct flows towards a channel on the east side of Pooles Road at the intersection of Pooles Road and Haysoms Road as shown in Figure 4-5.

Figure 4-5: Channel along Pooles Road

This channel runs north, along the eastern side of Pooles Road and directs flow north, towards Westernport Road as shown in Figure 4-6.

Figure 4-6: Channel towards Westernport Road

A cattle crossing was found that crosses Pooles Road, south of Haysoms Road, however a diversion channel was observed at the upstream end of the crossing, that directs flow along the western embankment and towards Haysoms Road. Refer to for diversion channel location.

Figure 4-7: Cattle Crossing

4.1.3 Adopted Catchment

Engeny submitted the catchment delimitation shown in Figure 4-1 to Melbourne Water as part of the initial submission of this strategy. Melbourne Water has provided feedback that they require the catchment to be expanded to include the additional area shown in Figure 4-2 and Figure 4-3. While Engeny disagrees with Melbourne Water's assessment of the catchment boundary we have updated the RORB modelling to include this additional catchment area in accordance with what is required by Melbourne Water.

Figure 4-8 shows the adopted RORB model catchment layout including the additional catchment area to the east of Pooles Road.

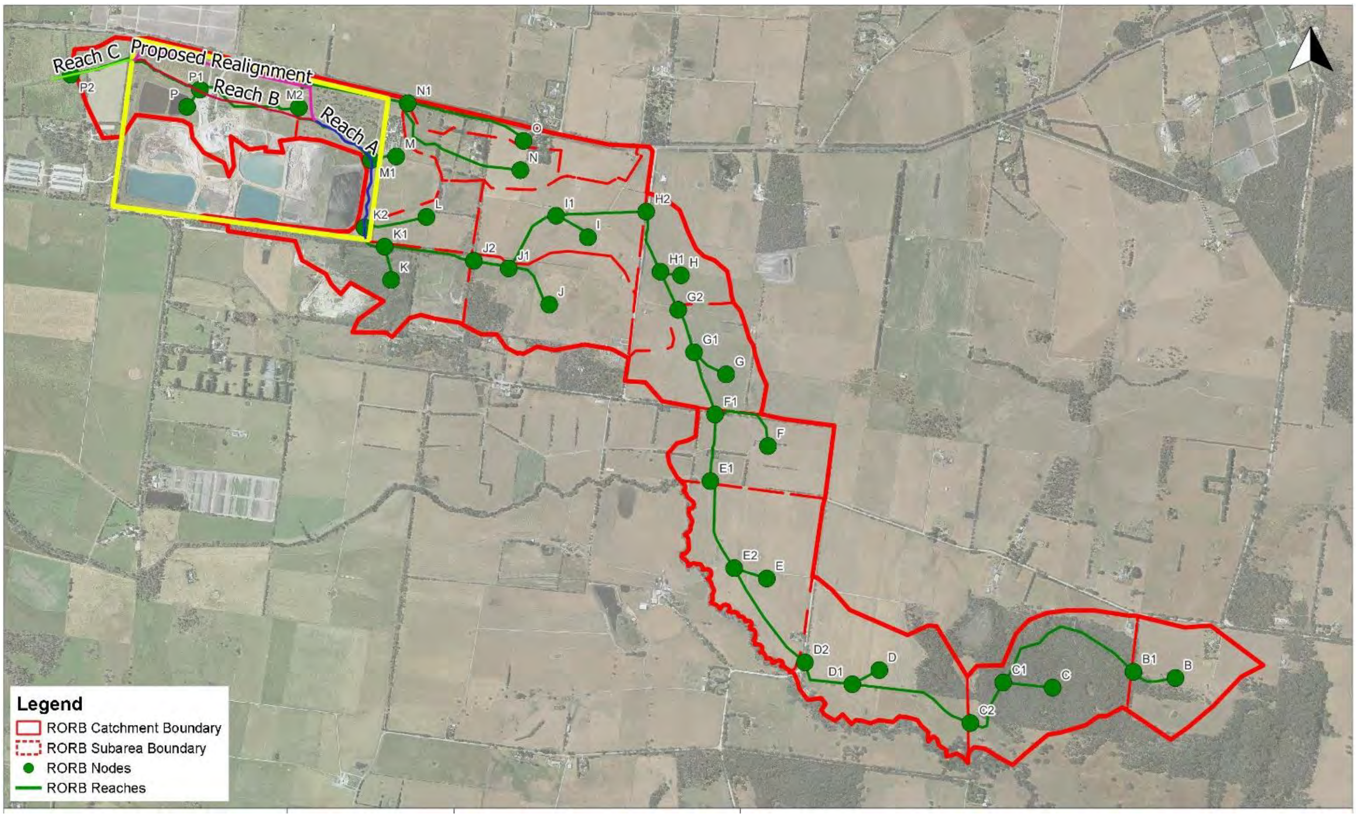


Figure 4-8: Adopted Yannathan RORB model layout

4.1.4 Fraction Impervious

The impervious fraction (FI) values were assigned at a parcel scale based on the recommended values for different planning zones and allotment size (Melbourne Water MUSIC Guidelines, 2018 and Melbourne Water Technical Specifications, September 2019). A visual assessment of these initial values was undertaken, and values were adjusted to better reflect the extent of current development and land use (defined by Modella 2018 DELWP aerial dataset) across the study area. Figure 4-9 displays the fraction impervious adopted across the study area.

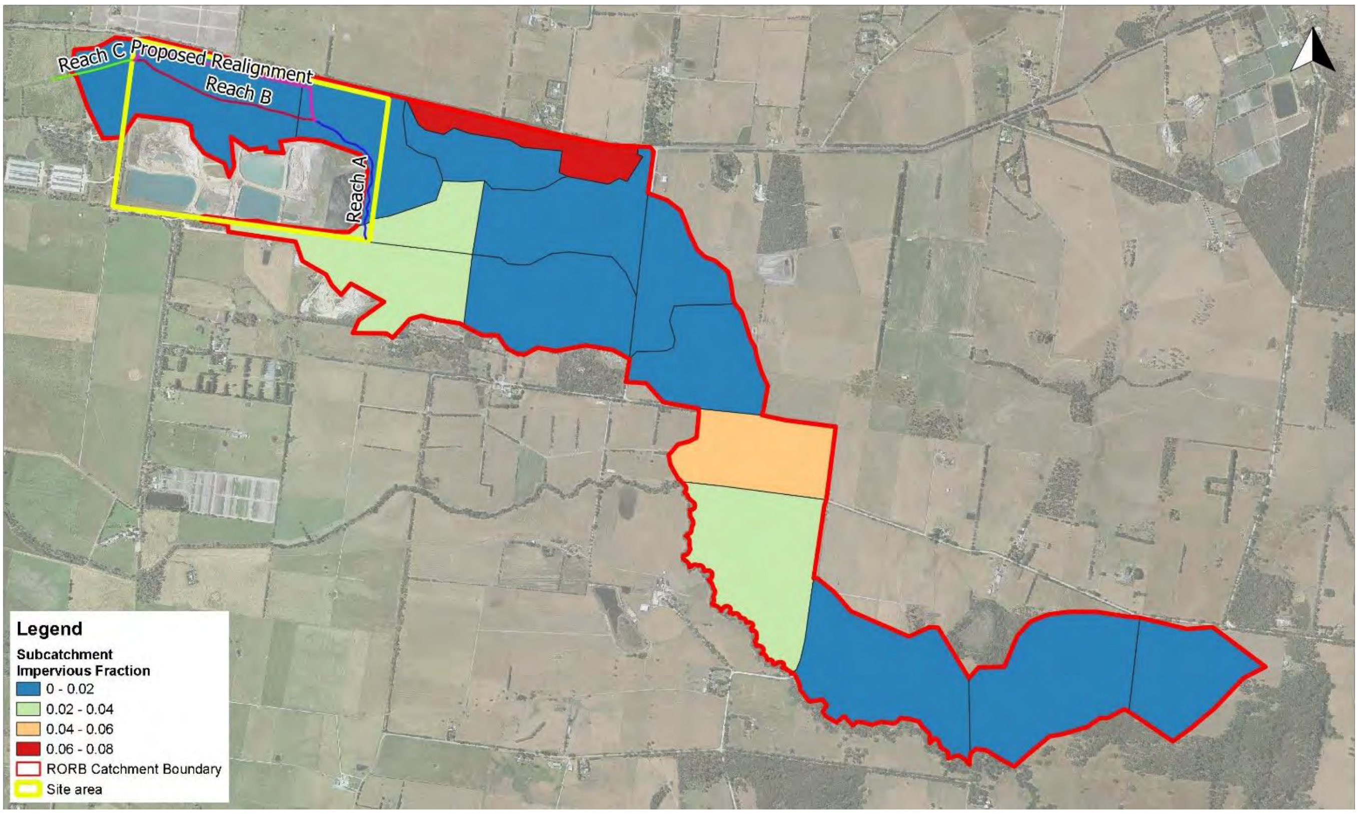


Figure 4-9: Yannathan RORB Fraction Impervious

4.1.5 Design Flows

A design flow of 10.6 m^3/s was obtained from the RORB modelling for the 1 % AEP (1 in 100 year ARI) design storm event and included in the hydraulic modelling.

4.2 LITTLE LANG LANG RIVER CATCHMENT

4.2.1 Overview

Further correspondence between Melbourne Water and Engeny on 5 August 2021 includes advice relating to the realigned waterway (Reach A) that was provided in 2011. Refer to **Appendix F** for email correspondence. In summary, previous correspondence provided in 2011 confirmed that Melbourne Water has previously undertaken modelling of the Little Lang Lang River. This modelling indicated that there was a breakout of flow from the main Little Lang Lang River channel to the north of approximately 64 m^3/s in a 1 % AEP event. Melbourne Water have then estimated that 27 m^3/s of that breakout flow *"would reach Pooles Rd south of Westernport Rd and continue westerly to the quarry site".* This figure of 27 m^3/s is similar to the flow that was provided to ATC Williams, who completed the design of the already realigned section of waterway (Reach A).

As per Melbourne Water correspondence and the ATC Williams report, a flow of 27.8 m^3/s has been adopted in the HECRAS modelling. Figure 4-10 shows the flood modelling results provided by Melbourne Water for the 1 % AEP event.

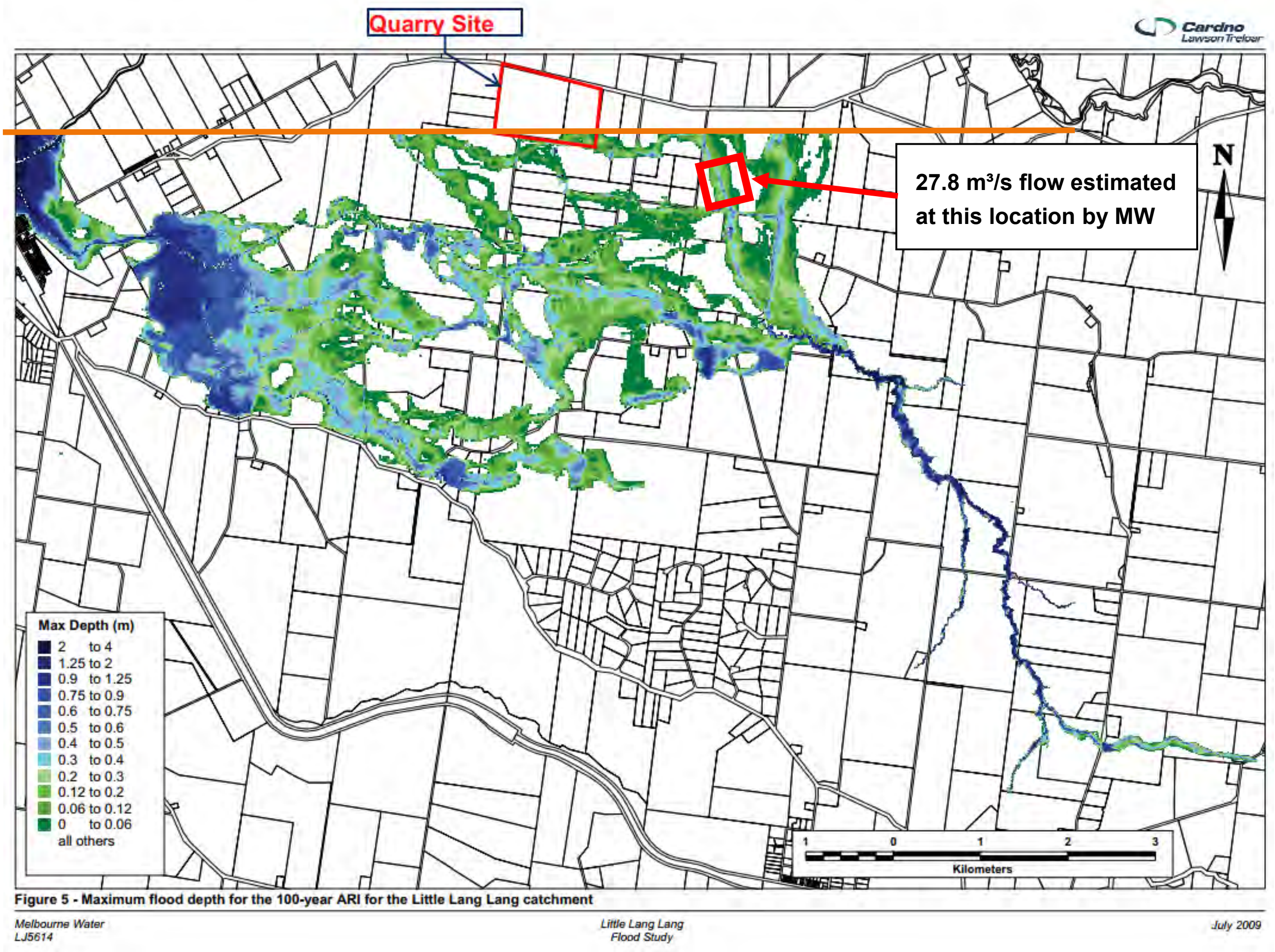


Figure 4-10: Little Lang Lang River 1 % AEP (100-year ARI) Flood Mapping

Engeny note that the flood modelling results are cut off in a horizontal line (marked by Engeny in orange on Figure 4-10). Engeny believes this may represents the boundary of the hydraulic model. This potential model boundary location is also very close to the entry to the quarry site. Results obtained from hydraulic models in close proximity to a boundary can be influenced by the presence of the boundary.

4.2.2 Design Flows

Engeny has modelled a design flow of 27.8 m^3/s, as part of the scenario 2 analysis to model flows from the Little Lang Lang River Catchment. This includes the reported flow of 27 m^3/s that continues west to the quarry site and 0.8 m^3/s from the runoff reporting from the previously diverted channel, upstream of the proposed works, as outlined on ATC Williams' Site Drainage Report.

5 HYDRAULIC MODELLING

5.1 MODELLING APPROACH

Engeny has used HEC-RAS for the hydraulic modelling of the following scenarios:

- Scenario 1A: flows from the local catchment only, for existing conditions
- Scenario 1B: flows from the local catchment only, for design conditions
- Scenario 2A: breakaway flows from Little Lang Lang River, for existing conditions
- Scenario 2B: breakaway flows form Little Lang Lang River, for design conditions

Existing Conditions – The current drainage arrangement on site including the realigned section of the existing waterway (Reach A).

Design Conditions – Realignment of the existing waterway around the proposed extension for quarry activities (Reach B).

The HECRAS model extents are from the south-east boundary of the quarry site at the upstream end to approximately 150 metres west of Milners road at the downstream end, past the north-west boundary of the quarry site (Figure 5-1). A summary of the parameters used for the existing conditions and design conditions modelling is shown on Table 5-1.

Figure 5-1: HECRAS Model Extents

Table 5-1: HEC-RAS Modelling Parameters

Modelling Parameter	Values	Basis
1 % AEP Design Flow (m^3/s) (Scenario 1)	10.6	Local catchment RORB model
1 % AEP Design Flow (m^3/s) (Scenario 2)	27.8	Provided by Melbourne Water and ATC Williams
Flow Regime	Mixed	
Upstream Boundary Condition	Normal Depth, slope = 0.0016	Measured using LiDAR data
Downstream Boundary Condition	Normal Depth, slope = 0.004587	Measured using LiDAR data
Manning's 'n' values – existing conditions model	0.08 (main channel)	E.g. Chow – site observations
	0.05 (left and right banks on quarry site)	E.g. Chow – site observations
	0.035 (left and right banks on downstream property)	E.g. Chow – site observations
Manning's 'n' values – design conditions model	0.08 (main channel for the cross-sections that are not going to be changed from existing conditions)	
	0.07 (main channel for the cross-sections of the design diversion)	Assumed that the proposed channel will ultimately contain similar vegetation to the existing channel
	0.05 (left and right banks on quarry site)	
	0.035 (left and right banks on downstream property)	
Existing Culverts	The culvert on Milners Road is a 500 mm deep by 1200 mm wide box culvert.	Advice from Hanson
	Existing culverts under each of the two quarry access roads were modelled as being six (6) 300 mm diameter culverts	Number of culverts is consistent with the advice provided by Hanson that there are six to eight 300 mm culverts under the site's access roads. Modelling six rather than 8 culverts will also provide a slightly higher and more conservative flood level.
Proposed Culverts	Five (5) 600 mm (wide) by 450 mm (high) box culverts at the access road to the site, with the top of deck levels modelled as the same existing surface levels on the access road with the assumption there will be no change	Proposed culverts were sized to achieve safe overtopping depths and velocities in the design flow from the local catchment runoff of 10.6 m^3/s. Box culvert sizes are also such that there is a minimum 500 mm of cover from the top of box culvert to the road deck levels
Left and right bank locations	River banks locations have been modelled at the top of the low-flow channel for both cross-sections that will be unchanged from existing conditions and cross-sections of the proposed design	

5.2 RESULTS

Appendix G and H shows the HEC-RAS long-section plots and cross-section plots of the existing and design conditions modelling. As outlined in Section 6, the proposed waterway in the section to be diverted has conveyance capacity for the scenario 2 design flow of 27.8 m^3/s and does not overtop the channel bund in this flood event. Freeboard that is achieved in the scenario 1 and 2 analysis is also outlined in Section 6.

5.2.1 Site access and safety

The proposed five (5) 600 mm (wide) by 450 mm (high) box culverts on the quarry site, underneath the existing access road exhibits an overtopping depth of 0.30 metres in scenario 1B. Based on the ARR 2019 guidelines for flood hazard assessment, as shown in Figure 5-2, a hazard rating of H1 is generally safe for people, vehicles and buildings. For scenario 1B, the overtopping velocity multiplied by the overtopping depth (V x D) is 0.25 m^2/s. This is within the H1 category and therefore meets Melbourne Water's Floodway Safety Criteria requirements.

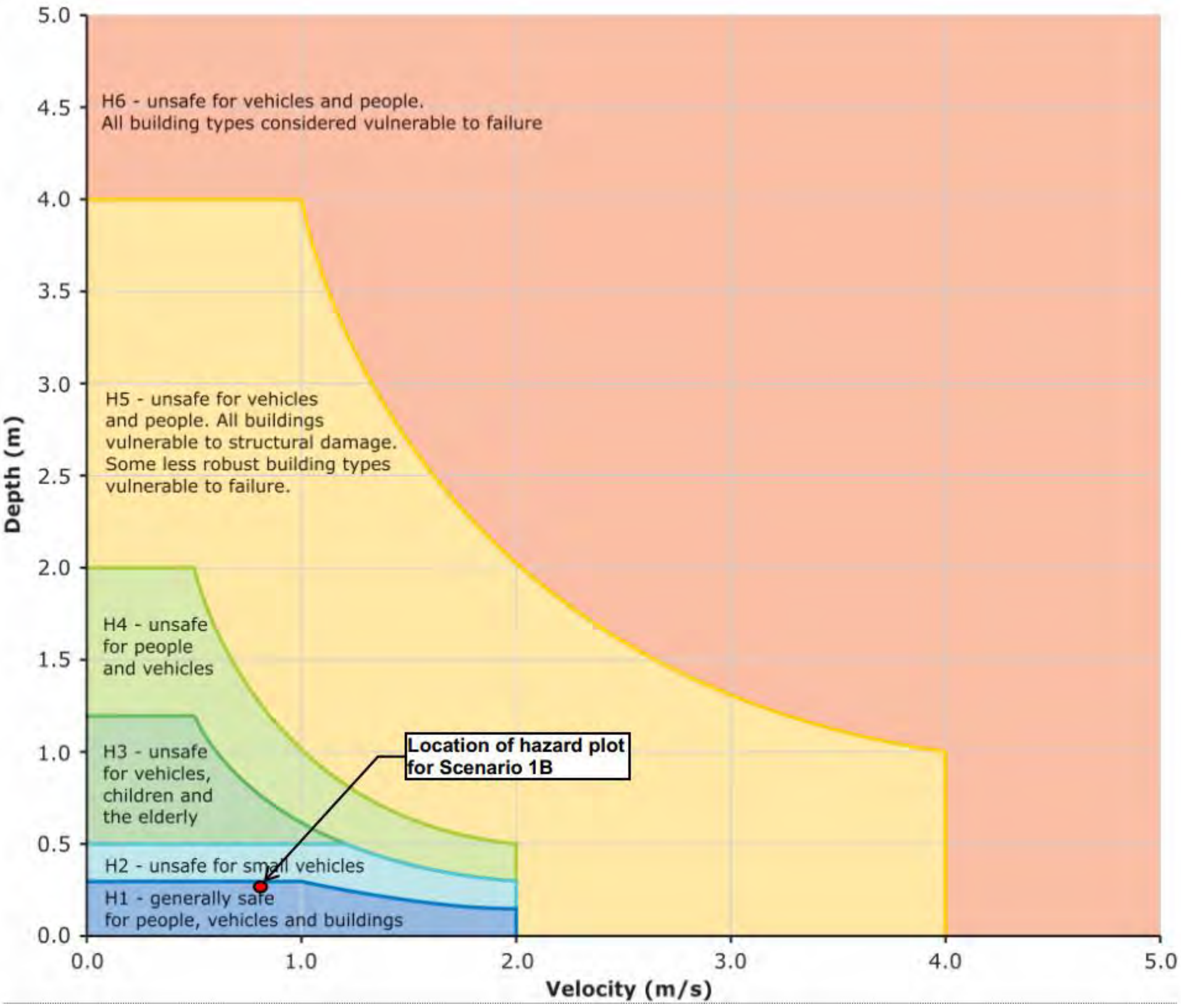


Figure 5-2: Flood Hazard Curve

In Scenario 2, existing conditions, based on the capacity of the culverts under the access road and the existing waterway capacity, the expected depth and velocity of overtopping are 0.88 m and 0.19 m/s respectively resulting in a hazard rating of H3 which is classified as unsafe for people and vehicles.

Under Scenario 2 design conditions, there is a more significant overtopping of the access road into the site compared to scenario 1. The expected depth and velocity of the overtopping are **0.65 m** and **1.28 m/s**, where the overtopping velocity multiplied by the overtopping depth (V x D) is 0.83 m^2/s. This corresponds to a hazard category of H4. This exceeds Melbourne Water's recommended safety criteria for overtopping. The value quoted for the peak hazard rating is at the peak of the flood event, so there would be a significant portion of the flood event where the access path would still meet Melbourne Water's safety criteria. There is also an alternative access route out of the site to the south onto Burt Road which could be used in the event of an emergency to evacuate the site. Safety considerations should also be made during the detailed design of the culvert crossing to minimise the risk of vehicles being swept from the access road. More detailed hydraulic modelling of the Little Lang Lang River breakout flow would also allow for a more accurate assessment of that flow to be made. This modelling may determine a lower flow which would need to be conveyed through the site, reducing the depth and velocity of overtopping of the culverts. A flood emergency management plan could also be implemented for the site if required, pending the outcome of a more detailed investigation of Little Lang Lang River breakout flows.

5.2.2 Changes in flood levels on adjacent properties

Modelling for the local catchment flows (scenario 1) shows that the proposed design does not increase flood levels on the adjacent downstream property. Upstream of the proposed works, modelling shows that the proposed design causes a reduction in flooding of between **10 mm and 250 mm** for up to approximately 380 metres upstream of the start of the channel diversion.

Modelling for the Little Lang Lang River breakout flows (scenario 2) also shows the proposed design does not increase flood levels, upstream of the site. Downstream of the site, there is approximately 5 mm increase in the peak water level.

5.2.3 Velocity of flows

Melbourne Water have specified in their email dated 5 August 2021 (appendix F) that the flow velocity must not increase by more than 10 %. A comparison of velocities is provided in Table 5-2 below. The results within Table 5-2 include an analysis of velocities upstream and downstream of the proposed diversion waterway. It is shown that there are increases in velocity however they are generally relatively small and the maximum velocity in in the realigned channel is just over 1 m/s, which is quite manageable within the context of a constructed waterway. Figure 5-3 shows the locations of the river stations (chainages) for existing conditions (scenarios 1A and 2A) and Figure 5-4 shows the locations of the river stations (chainages) for design conditions (scenarios 1B and 2B). The locations of the cross sections to not match exactly as the cross sections need to be aligned perpendicular to the main direction of flow and a single set of cross sections could not achieve this for the existing and developed catchments.

Table 5-2: Velocity Comparison (Scenario 2 (Q=27.8 m^3/s) for Existing and Design Conditions)

Existing Conditions		Design Conditions	
River Station (Chainage) (m)	Velocity (m/s)	River Station (Chainage) (m)	Velocity (m/s)
1745.4	0.14	1745.25	0.17
1720.4	0.18	1720.24	0.2
1670.31	0.25	1670.16	0.28
1641.45	0.26	1641.3	0.3
1602.27	0.27	1602.12	0.31
1554.38	0.32	1554.23	0.34
1496.07	0.44	1495.92	0.5
1471.16	0.67	1471.01	0.53
1446.15	0.59	1446	0.64
1421.23	0.56	1421.07	0.53
1388.44	0.7	1388.28	0.72
1371.22	0.66	1371.07	0.68
1339.66	0.73	1339.51	0.77
1321.53	0.62	1321.38	0.63

Existing Conditions		Design Conditions	
River Station (Chainage) (m)	Velocity (m/s)	River Station (Chainage) (m)	Velocity (m/s)
1271.31	0.66	1271.16	0.64
1246.31	0.72	1246.16	0.64
1225.07	0.79	1224.92	0.64
1196.35	0.79	1196.2	0.6
1171.4	0.84	1171.25	0.62
1146.4	0.65	1146.24	0.53
1121.39	0.82	1121.24	0.61
1096.38	0.96	1096.23	0.38
1077.25	0.92	1068.41	0.56
1048.91	0.79	1025.86	0.53
1011.38	1.28	1000.86	0.51
969.6	0.74	973.94	0.49
943.61	0.53	958.8	0.48
918.28	0.28	943.44	0.47
892.83	0.19	928.31	0.46
824.15	0.15	914.02	0.45
797.35	0.14	900.88	0.44
772.15	0.12	875.88	0.43
746.78	0.11	850.88	0.41
721.42	0.1	825.88	0.4
698.89	0.09	801.41	0.39
673.79	0.09	775.93	0.38
648.69	0.1	750.88	0.37
622.99	0.2	725.88	0.36
605.96	0.13	700.88	0.35
591	0	675.88	0.34
571.82	0.62	650.88	0.33
559.43	2.54	624.96	0.32
546.81	0.64	603.92	0.31
543	0	590	0

Existing Conditions		Design Conditions	
River Station (Chainage) (m)	Velocity (m/s)	River Station (Chainage) (m)	Velocity (m/s)
531.99	0.8	585.84	0.91
522.06	0.46	574.97	0.95
499.53	0.42	549.97	0.91
473.2	0.43	524.97	0.91
447.18	0.39	499.97	0.91
421.71	0.38	474.97	0.92
396.79	0.36	449.97	0.93
370.99	0.31	424.97	0.92
345.1	0.3	399.97	0.93
318.5	0.28	374.97	0.95
291.91	0.29	347.99	0.96
264.67	0.35	324.97	0.98
214.45	0.41	299.97	1
178.92	1.67	279.97	1.04
166.16	0.31	251.44	0.98
165	0	224.99	1.14
140.12	0.5	178.92	1.89
109.4	0.42	166.16	0.42
86.03	0.36	165	0
61.86	0.42	140.12	0.71
38.03	0.42	109.4	0.51
11.59	0.5	86.03	0.41
		61.86	0.47
		38.03	0.46
		11.59	0.53
1745.4	0.14	1745.25	0.17
1720.4	0.18	1720.24	0.2
1670.31	0.25	1670.16	0.28

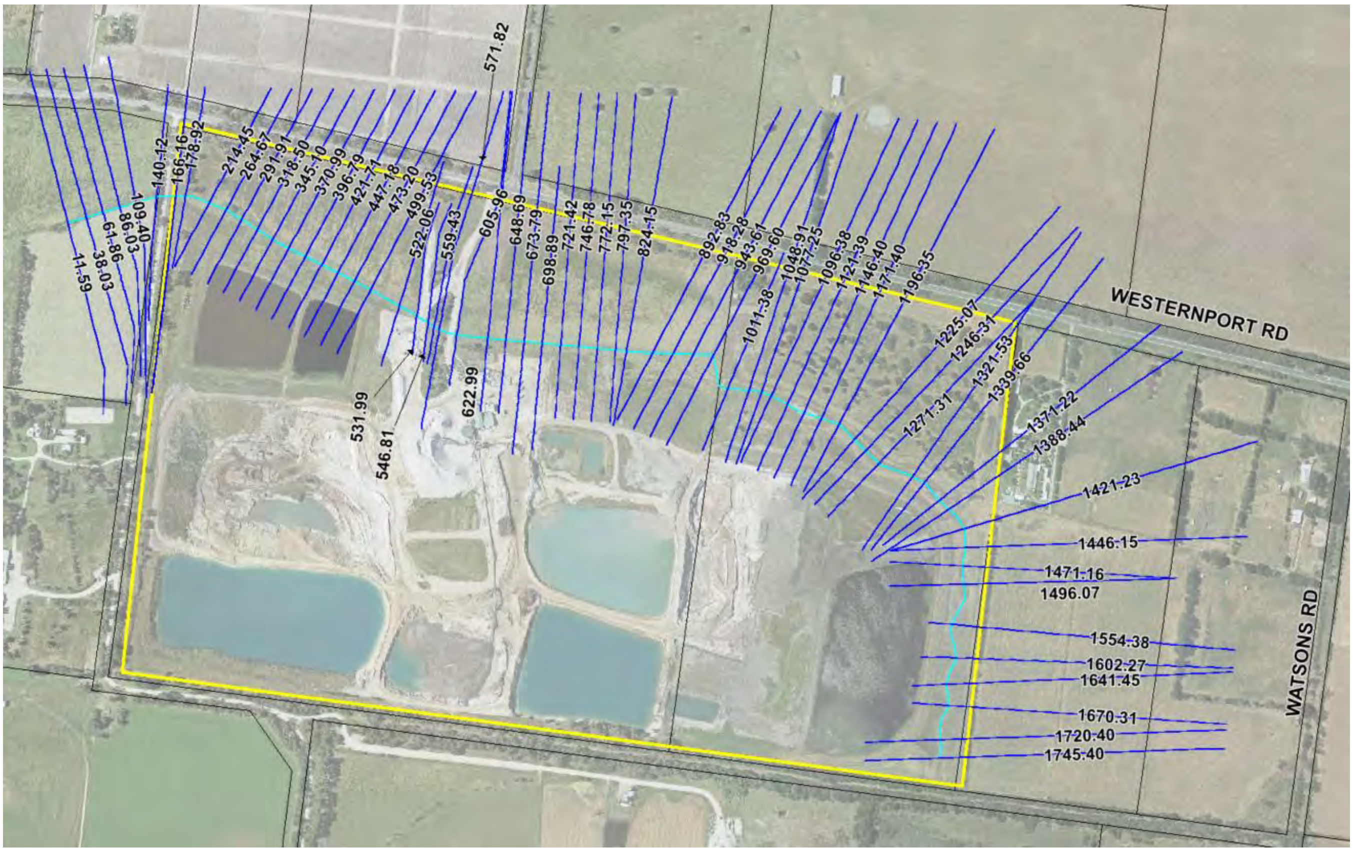


Figure 5-3: Existing Conditions River Stations (Chainages)

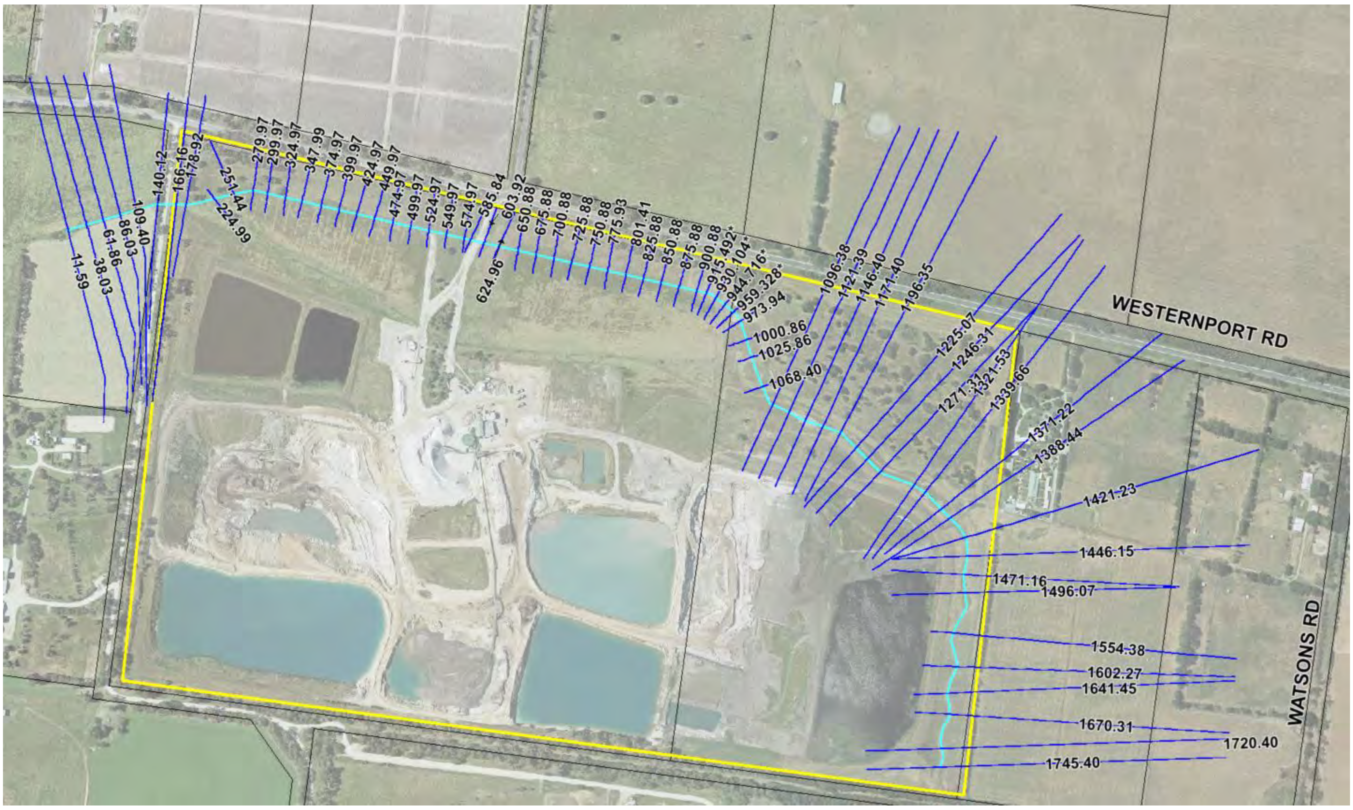


Figure 5-4: Design Conditions River Stations (Chainages)

5.2.4 Flood storage volume

Engeny has assessed the floodplain storage provide on the site under a range of conditions. The floodplain storage has been determined using the HECRAS model to create a water surface elevation digital elevation model (DEM) which has been exported to 12d. in 12d the water surface elevation DEM from each of the scenarios has been compared to the existing or design ground level DEM (as appropriate). This has enabled an estimate of the available floodplain storage on the site to be made.

When assessing the floodplain storage provided on the site, it was noted that the internal site access roads are acting as a levee and holding additional water back on the site. These access roads have not been engineered to act as a levee and so cannot be relied upon to hold back flood water on the site. The modelling also shows that in a 1% AEP event, with breakout flows from the Lang Lang River impacting the site that these roads would be inundated to a significant depth and that erosion of the road is a likely outcome. To provide a clearer estimate of pre developed conditions, a versions of the HECRAS model with the access roads removed has been run and the storage remaining on the site calculated for the purpose of comparing to the developed conditions modelling with the constructed waterway.

Table 5-3 shows an approximate comparison of the floodplain storage on the site based on the HEC-RAS modelling undertaken. As the results show the internal access road is responsible for creating approximately 35,000 m³ of floodplain storage on the site. As the road is not engineered to hold back flood water or to withstand significant overtopping, as would occur in a 1% AEP event with breakout flows form the Lang Lang River the volume of storage within the road has been calculated.

The table also shows that under developed conditions there is approximately 2,000m³ increase in floodplain storage compared to the existing conditions of the site without the storage behind the road considered. Given the total expected extent of a flood and available floodplain storage in a 1% AEP event this net loss of floodplain storage is not expected to significantly impact on flood levels. The HECRAS modelling also demonstrates that from a conveyance point of view there are minimal changes in flood levels as a result of the proposed works. The HECRAS model is also quite conservative as it assumes a steady state simulation with an effective inflow rate of 27.8 m³/s. The actual flood event would have a hydrograph which peaks at 27.8 m³/s (according to MW modelling) and would then recede, meaning not all of the floodplain area may be engaged.

Table 5-3: Floodplain storage comparison (scenario 2)

Scenario	Available floodplain storage (approx.)
Existing conditions including access road storage	127,000 m^3
Existing conditions with access road removed	90,000 m^3
Proposed developed conditions (includes raising the access road to 27.80 RL	92,000 m^3

6 CONCEPT DESIGN

To provide a larger area for the quarry operations, it is proposed for a portion of the existing waterway (Reach B) to be removed and a new realigned waterway to be constructed along the northern property boundary and adjacent to the existing bund. **Appendix I** presents the concept design of the proposed channel, showing the layout and typical profiles of the channel. The design basis for the realigned waterway is summarised as follows:

- 1 % AEP flow (27.8 m^3/s) conveyance capacity for the Scenario 2 flows.
- A cross section profile that is predominantly in cut but utilises the existing noise and dust control bund (northern bund) and a new bund (southern bund) for conveyance of flows.
- A longitudinal gradient 1 in 393.
- Alignment avoids existing vegetation that is along the east of the site.
- The offset from the northern property boundary to the southern end of the proposed channel works varies but is mostly within 80 metres from the northern boundary.
- Separate low-flow pilot channel to convey the 4 EY flows from the local catchment and the main channel to convey the 1 % AEP flows (Lang Lang River breakaway flows 27.8 m^3/s).
- 3 metre wide and 0.5 metres deep pilot channel with batters of 1 in 3.
- The high-flow portion of the channel has a total base width of 26 metres, therefore having 10 metre wide benches on either side of the channel.
- The low flow channel will have space to meander within the waterway corridor which will allow for the connection between the low flow channel and the floodplain to be maintained (within the corridor).
- A bund on the southern side of the channel is required as part of the high-flow channel, which functions to contain the 1 % AEP flows in the channel so 600 mm of freeboard is achieved from the 1 % AEP Top Water Level (TWL) to the top of the channel. The top of the bund will be 1.4 to 1.55 metres higher than the base of the high-flow channel and have 1 in 5 side batters.
- The proposed diversion channel will match into existing surface levels at the upstream and downstream ends and the existing culvert on Milners Road will be retained.
- The total channel width at the tie in location with the existing ground surface varies but is generally approximately 60 metres.

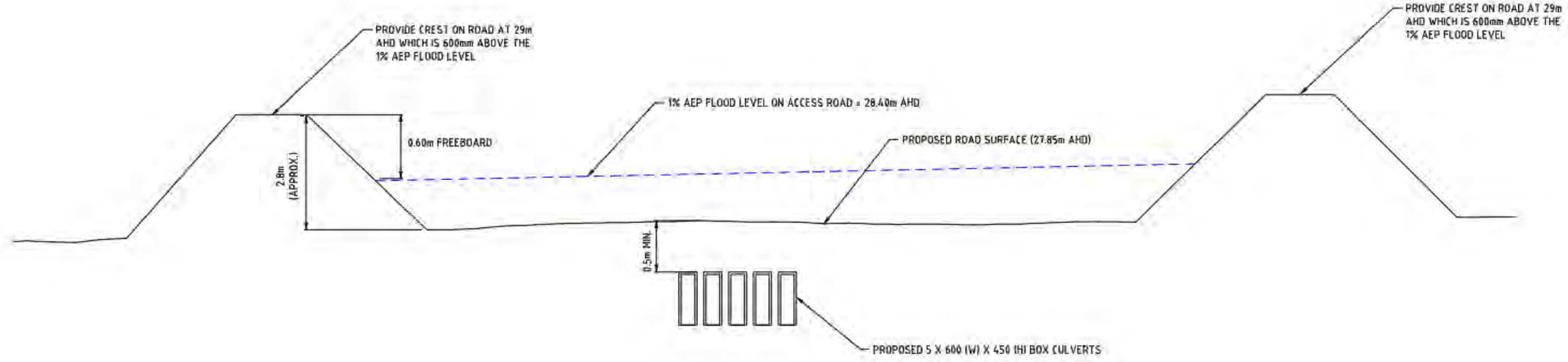
The functional design includes additional elements to facilitate surface water management in the future site. This includes:

- Five (5) 600 mm (wide) by 450 mm (high) box culverts at the access road to the site.
- Existing bund along the northern side of the channel to be extended closer to the access road to the site to prevent water from overtopping the channel.
- A raised road crossing at the access road to the site, above the proposed culverts as shown in Figure 6-1. A high point or apex in the access road one each side of the culvert crossing will be required to be 600 mm above the 1 % AEP top water level (from the Lang Lang catchment analysis, Scenario 2B) at the road which is 28.40 m AHD. Therefore, the high point or apex of the crossing is required to be no lower than 29 m AHD. This requires an approximate 2.8 m rise from the existing road level.

The detailed design will also include

- Fencing to prevent access of livestock into the waterway corridor
- Provision of a maintenance access path.

Figure 6-1: Road Crossing Typical Section



It is expected that groundwater monitoring will be required to ensure that the proposed engineered fill face of the quarry pit is not compromised by water leakage from the realigned waterway during rainfall events. A Ground Control Management Plan has been prepared for the site (CMW (2022). Proposed Quarry Expansion, Hanson Yannathan Sand Quarry, 870-910 Westernport Road, Yannathan, Ground Control Management Plan (GCMP). 1 September 2022). A “Fill Specification for Construction of Waterway Diversion” is provided as Appendix D of: CMW (2022) (Proposed Sand Quarry Expansion, Yannathan, Victoria, Geotechnical Assessment, 1 September 2022, Rev 2) which details the geotechnical engineering requirements of the backfill material to ensure that the diverted waterway is stable.

6.1 FREEBOARD

- In the Scenario 1B analysis, in which a flow of 10.6 m^3/s was modelled, a minimum freeboard of approximately 1 metre has been achieved to the top of the channel bund, within the section of channel that is proposed to be diverted.
- In the Scenario 2B analysis, in which a flow of 27.8 m^3/s was modelled, modelling shows that a minimum freeboard of 600 mm has been achieved for the section of channel that is proposed to be diverted.

7 GEOMORPHIC ASSESSMENT SUMMARY

In 2021 Engeny undertook a geomorphic assessment of the current and proposed waterway through the quarry site. A full copy of the report is contained within Appendix C. Figure 7-1 shows the waterway locations and the reach (segments) breakdowns which was used in the assessment.

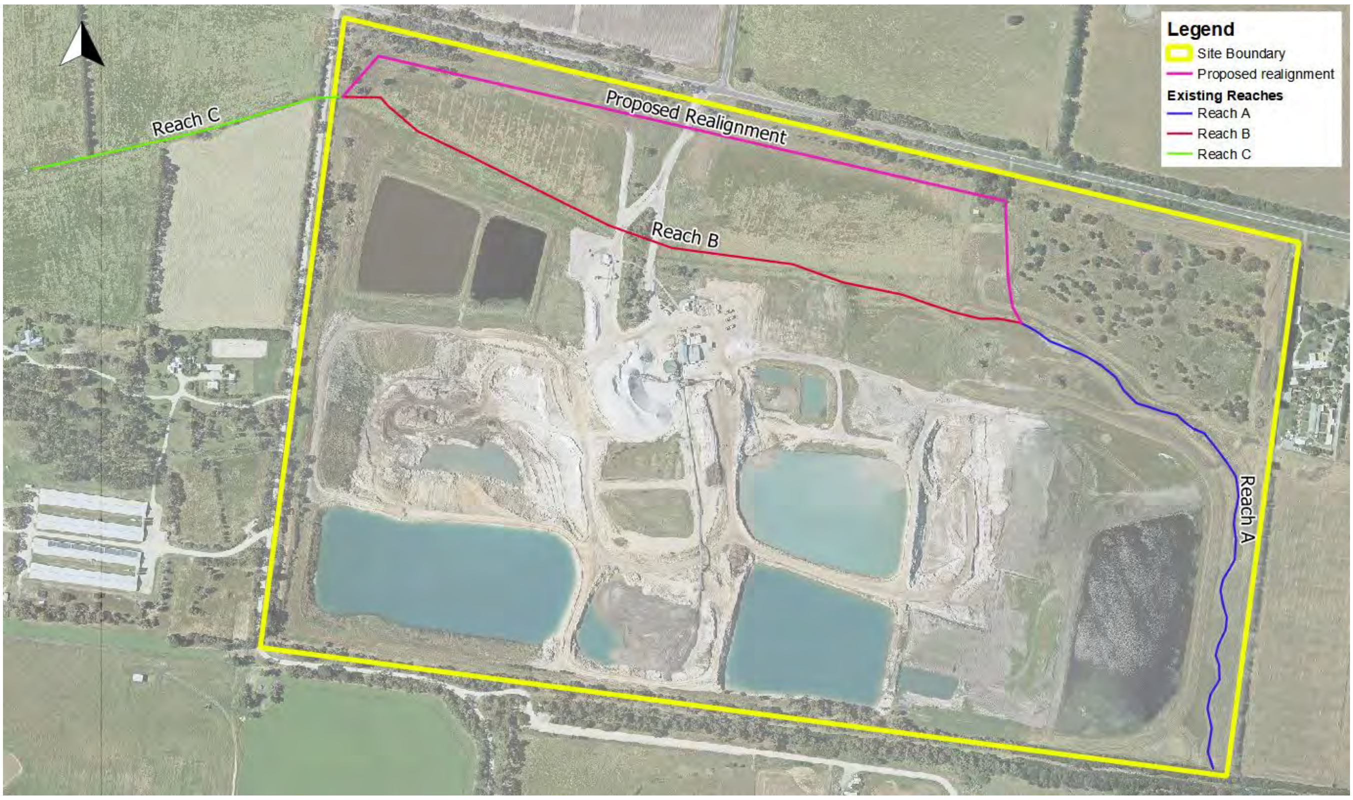


Figure 7-1: Site Waterway Reaches

Table 7-1 provides the different geomorphic condition categories and explanation of each and Table 7-2 provides the different geomorphic condition assigned to the inspected reaches.

Table 7-1: Geomorphic condition categories

Geomorphic condition	Definition
Intact	Reach form in natural condition, presents all the typical features of the stream type, no evidence of erosion processes.
Good	Reach form in near natural condition, some limited impacts but most of the typical features of the stream type are retained.
Moderate	Reach form impacted by erosion or land use practices. Some features of the stream type may be retained but the majority of the features are highly modified.
Poor	Reach in a degraded condition due to extensive erosion or modified due to land use practices changing the form of the stream type.

Table 7-2: Geomorphic condition categorisation of inspected reaches

Reach	Condition	Justification
Reach A	Moderate	Reach has some bank instability, and limited habitat diversity. some lateral connectivity value. Reach form partly impacted by land use activities.
Reach B	Poor	Reach form impacted by land use activities, little to no geomorphic characteristics, limited instream habitat value, no erosion, limited riparian vegetation, some lateral connectivity value, dense homogenous vegetation, no marked erosion noted
Reach C	Poor	Little to no geomorphic characteristics, limited instream habitat value, no erosion.

Table 7-3 summarises the geomorphic value assigned to each inspected reach.

Table 7-3: Geomorphic value categorisation of inspected reaches.

Reach	Representativeness	Rarity	Diversity	Condition	Geomorphic Value
Reach A	Anthropogenic/Constructed channel	Common	Homogenous	Moderate	Low
Reach B	Anthropogenic/Constructed channel	Common	Homogenous	Poor	Low
Reach C	Anthropogenic/Constructed channel	Common	Homogenous	Poor	Low

Overall, the assessment shows that Reach A (the constructed waterway previously constructed by Hanson's) has the highest value of the three waterway reaches on the site. Reaches B and C have low geomorphic values and are basically farm drains. The proposal is to build a similar style of constructed waterway to what now exists in Reach A. On this basis it would be expected that the waterway diversion would improve the overall condition of reaches B and C of the waterway once the diversion construction is completed.

8 SUMMARY

The hydrologic and hydraulic modelling has assisted to inform the required sizing of the channel to be diverted along the northern boundary of the site. The following summarises key outcomes of the analysis:

- The channel section to be diverted is required to have a pilot channel of base width of 3 metres and a depth of 0.5 metres at 1 in 3 batters.
- The high – flow channel is required to have a base width of approximately 26 metres and have a minimum height of 0.8 metres.
- Within the design channel section that is to be diverted, a minimum freeboard of 600 mm is achieved from the 1 % AEP top water to the top of the channel in both the scenario 1B and 2B analysis, respectively for the local catchment 1 % AEP flow of 10.6 m^3/s and the 1 % AEP flow from Lang Lang River of 27.8 m^3/s.

9 QUALIFICATIONS

a) In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

b) Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

c) Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:

   i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or

   ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.

d) Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.

e) This document is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this Report.

f) If any claim or demand is made by any person against Engeny on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the Report or information therein, Engeny will rely upon this provision as a defence to any such claim or demand.

g) This Report does not provide legal advice.

Appendix A:

ATC Williams Site Drainage Report

Appendix K

ATC Williams Site Drainage Report

ATC Williams
GROUNDED IN DESIGN

Our Ref: 110441.01 - 001

4 October 2010

Hanson Construction Materials
Ground Floor
601 Doncaster Road
DONCASTER VIC 3108

ATTENTION: Peter Browne

Dear Sir,

YANNATHAN DIVERSION CHANNEL ANALYSIS AND DESIGN

1 INTRODUCTION

This Report presents the findings of a hydrological analysis undertaken by ATC Williams (ATCW) to simulate the routing of 1 in 100 year flood flows in a diversion channel. The diversion channel is to be constructed around the perimeter of the proposed Hanson Constructions Materials (Hanson) Yannathan aggregate quarry expansion.

The scope of the assessment is in accordance with our email proposal to Hanson dated 28 April 2010 as subsequently modified following discussions with Mark Warren, Floodplain Services, Waterways Group, Melbourne Water.

2 SITE DESCRIPTION

The Hanson Yannathan aggregate quarry is located on the southern side of Westernport Road in Yannathan, some 7 km east of Lang Lang. The area around the quarry is open farm land, which is low lying and virtually level with a slight fall to the east towards Western Port Bay. The quarry is located approximately mid way between the Lang Lang River (to the north) and the Little Lang Lang River (to the south). Drainage from the site is limited but the catchment area for storm events is relatively large. The area around the site is susceptible to minor flooding after periods of heavy rain, however it is understood that the flooding subsides within a few days.

The surface level of the paddock and site of the proposed quarry expansion is generally RL 28.5, but has a central swale with a level of approximately RL 28 m. The swale drains to the northeast where the surface level is RL 27.5.

A locality Plan is presented as **Figure 1**. The plan shows the existing quarry, the proposed expansion, local drainage channels and rivers and the catchment boundaries.

An existing conditions Site Plan is presented as **Figure 2**. This plan shows the surface levels and existing drainage channel in the swale.

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3 PROJECT BACKGROUND

3.1 General

Hanson is looking to enlarge the Yannathan aggregate quarry by relocating the eastern pit boundary approximately 450 metres further east. As a result, an existing drainage channel, located within the expanded quarry, will require relocation along the south and eastern perimeter of the quarry expansion as shown in **Figure 3**.

The existing drainage channel comprises a small (approximately 1 m wide) shallow (approximately 0.5 m deep) 'U' shaped grass lined swale located within a topographical depression several hundred metres wide. Melbourne Water reports the topographical depression provides significant additional flow capacity for large flood flows reporting from the Little Lang Lang River catchment.

The proposed quarry expansion will cut off this topographical depression so the proposed diversion drain is required to provide a similar flow capacity.

3.2 Hydrological Requirements

Melbourne Water states that the replacement diversion channel is required to pass a 1-in-100 year flood flow of 27 cumecs reporting as overflow from the Little Lang Lang River as well as the upstream catchment to the diversion channel. Melbourne Water states that the Little Lang Lang River flood is the result of a time of concentration (T_c) rainfall event of 9 hours which corresponds to rainfall intensity of 10.2 mm/hr or 91.8mm in total (**Figure 3**).

Evaluation of the diversion channel upstream catchment area (**Figure 4**) was carried in accordance with the requirements of Australian Rainfall and Runoff Manual **[Ref 1]**. It was determined this catchment has a T_c of 69 minutes which corresponds to rainfall intensity of approximately 38 mm/hr or 43.5 mm (**Figure 3**). As this time of concentration was significantly less than the Little Lang Lang River catchment, a check will be required to ensure the channel will be able to convey the peak runoff flow originating from this rainfall event. It has been assumed that the shorter T_c rainfall will not result in overflows from the Little Lang Lang River catchment.

3.3 Diversion Channel Design

The diversion channel was designed to accommodate:

- A base flow of 27 cumecs (Little Lang Lang River overflow) plus the diversion channel catchment runoff for a rainfall event with a T_c = 9 hrs.
- The diversion channel catchment for a rainfall event with a T_c = 69 minutes.
- The very flat terrain with an overall elevation change of 2.5 metres from start of channel to the outlet (approximately 1200 metres).
- The channel is required to be stable against erosion under peak flow conditions.
- A maximum flood elevation of RL 29.0 metres at the existing buildings located adjacent to the Westernport Road northeast of the expanded pit. This is equivalent to a flood depth of 0.5 m to 1.0 m in the area of the proposed quarry expansion.

The overall riding design constraints are the flat slopes that need to be accommodated while not creating higher flood conditions at the Westernport Road buildings. These constraints meant that instead of using hydraulic efficient deep, moderately sloping channel, a shallow very gently sloping wide channel had to be utilised. Accordingly, a wide shallow trapezoid channel section has been used as the basis for the design.

The channel will comprise:

- a 20 metre wide base width,
- 3:1 (H:V) side slopes,
- channel slopes to accommodate the local topography while ensuring sufficient flow depth (minimum of 0.75 metres but varies with the natural surface level), and
- erosion protection with the use of well established grasses.

The perimeter bund to the quarry has been modelled with:-

- a 1 m crest width;
- a crest level of RL 29.0 m (This is the same level as the estimated flood depth in the vicinity of the Westernport Road buildings, refer to **Section 4** following);
- 2:1 (H:V) side slopes.

The minimum perimeter bund dimensions presented above maximize the quarry area but provide negligible freeboard to peak flood levels. A crest level of RL 29.5 to 30.0 m (+) will provide better flood protection to the quarry. A crest width of at least 3 m will permit plant to traffic the crest of the bund. However both of these changes will result in the perimeter bund encroaching further into the quarry reserves.

Consideration of the most appropriate crest width and level of the perimeter bund is beyond the scope of this report and is an issue best considered by Hanson along with the risk of flooding of the quarry and the cost of pumping water from the quarry against the quarry reserves sterilized.

The layout of the diversion channel with the minimum perimeter bund is presented on **Figure 5.**

The 20 m wide channel base with 3:1 (H:V) side slopes and the perimeter bund to the quarry requires a set back from the boundary that is greater than the nominal 20 m set back. The channel and perimeter bund encroaches on the original quarry boundary on the southern and part of the eastern sides as shown on **Figure 5**. To compensate for the loss of quarry reserves it is recommended that the boundary on the north east corner is moved toward the north east. The arrangement presented on **Figure 5** results in a potential net gain in quarry reserves.

Note that a sound bund located to the north of the northeast corner of the quarry extension has been rotated through 45 degrees and repositioned on **Figure 5**. The sound bund may need to be redesigned.

Figure 6 and 7 provides a long section and a typical cross-section, through the channel respectively.

4 HYDROLOGICAL ANALYSYS

4.1 Methodology

The hydrological analysis was performed using the computer program HydroCAD a hydrological routing package that incorporates both the rational methodology and the US Army Corp of Engineers TR-20 methodology. As recommended by the Australian Rainfall and Runoff manual **[Ref 1]**, the rational methodology was used.

The inputs to the program comprised.

- The base flow reporting from the Little Lang Lang River of 27 cumecs.
- Rainfall intensity for a Tc of 9 hours and a Tc of 69 minutes.

- The diversion channel subcatchment areas as outline in **Appendix A**.
- The diversion channel base slopes as determined by the existing ground elevation.
- Subcatchment time of concentrations and runoff coefficients as per the recommendations of the Australian Rainfall and Runoff Manual **[Ref 1]**.
- The rainfall distribution for the two design events as determined by recommendations and procedures outlined by the Australian Rainfall and Runoff Manual **[Ref 1]**.

4.2 Results of Analysis

The results of the two analyses are as follows,

- The runoff reporting from the diversion channel for the 9 hour storm event is only a minor component of the total flow being approximately 0.8 cumecs for a total flow in the channel of 27.8 cumecs.
- A peak flow depth of 0.91 metres is calculated for the diversion channel for the 9 hour event with the 27 cumecs overflow. This is estimated to result in a flood depth on the order of RL 29.0 metres in the vicinity of the Westernport Road buildings.
- A peak velocity of 1.26 m/s is estimated for the channel. This velocity is within the stable range for a well established grass channel liner.
- The Tc rainfall event for the diversion channel catchment generates a peak flow on the order of 1.2 cumecs.
- A peak flow depth of 0.14 metres is calculated for the diversion channel, therefore the entire runoff flow is contained within the channel with no overtopping.
- A peak flow velocity of 0.42 m/s was calculated which is well within accepted design specifications for a grass lined channel.

Details of each analysis are provided in **Appendix A**.

5 RECOMMENDATIONS AND ADDITIONAL COMMENTS

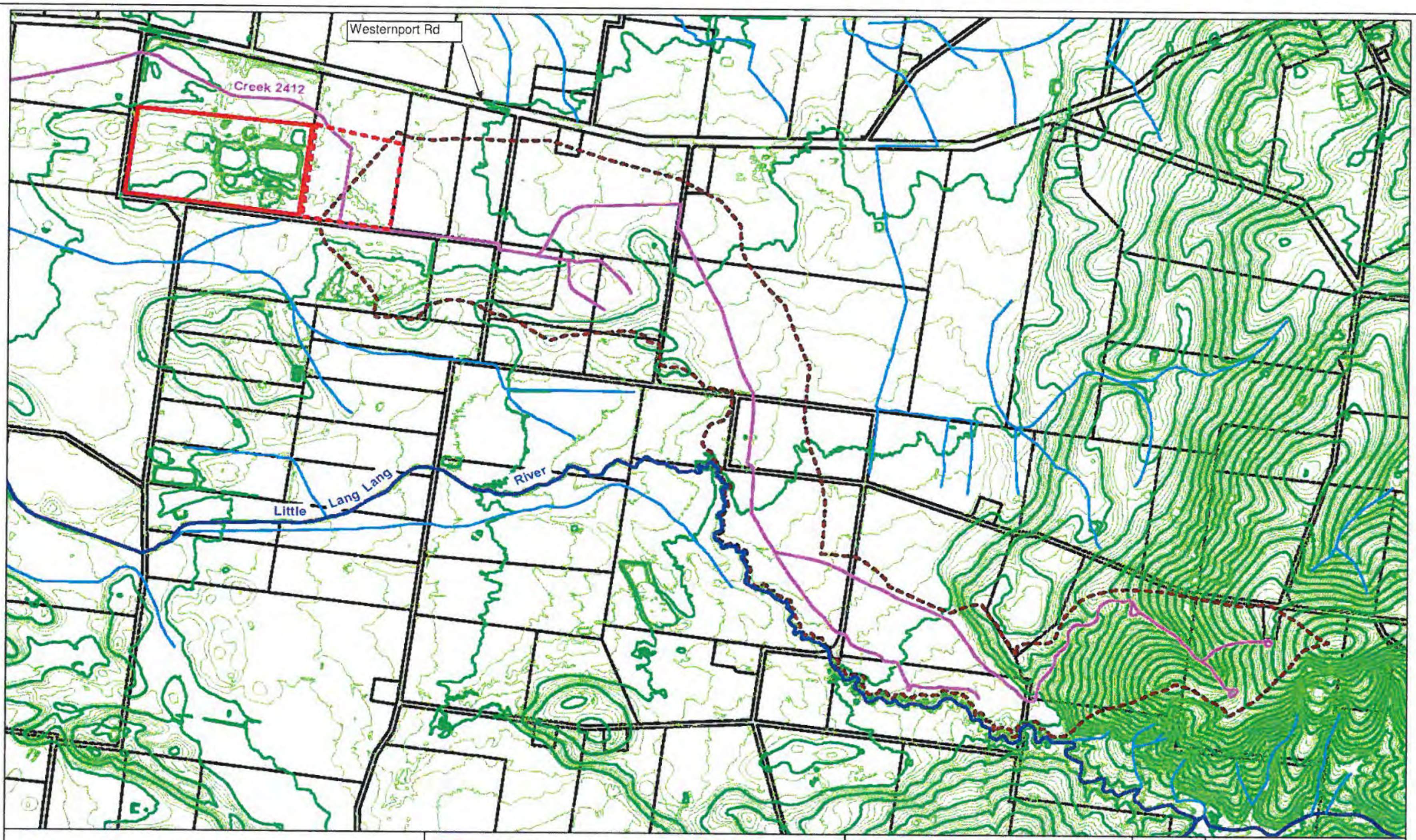
Based upon the hydrological analysis, the underflow diversion channel should comprise of a grass lined trapezoidal channel with a base width of 20 metres, 3H:1V side slopes and the profile and cross-section provided in **Figures 5 and 6**.

We trust the information contained within this report is sufficient for your current needs. If you need any further information or clarification regarding any of the information provided, please contact either Peter Reid or myself.

Yours Sincerely,

DAVID MACHIN
ATC Williams Pty Ltd

FIGURES



Plan 2 - Overall Catchment

🟥	Existing quarry site
🟥	Proposed extension
〰	Little Lang Lang River
〰	Creek 2412
〰	Other watercourse
▨	Catchment boundary
〰	5 & 10 m contours
〰	1 m contours

N
MGA55
11/6/2010

Map at A3
Scale 1:15,000

Melbourne Water

This plan is produced from information provided by Melbourne Water

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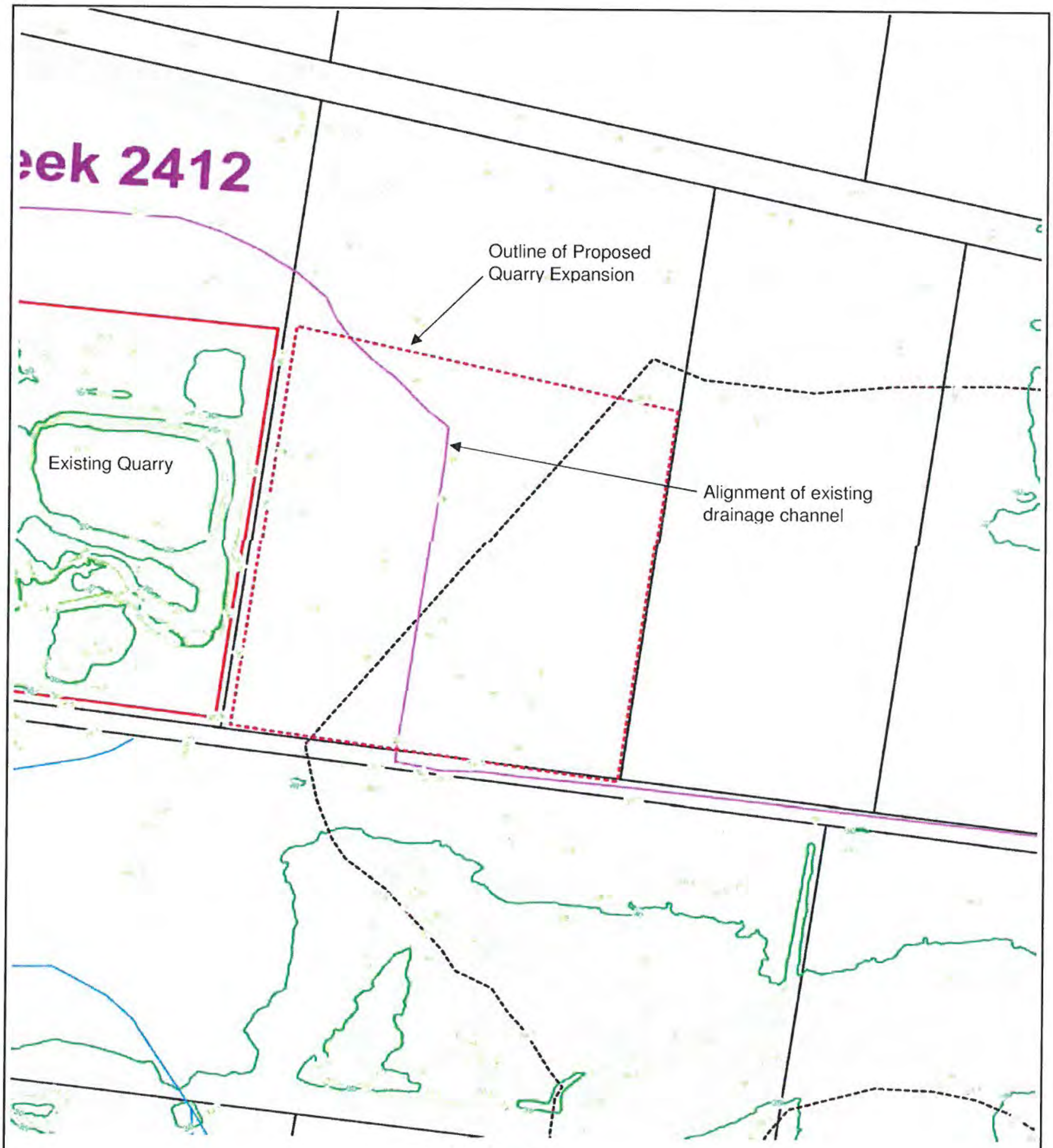
HANSON CONSTRUCTION MATERIALS

YANNATHAN AGGREGATE QUARRY

DIVERSION DRAIN

LOCALITY PLAN

Date:	8/09/2010	Job No:	110441.01	FIGURE 1



NOTE TO SCALE

This plan drawn from information supplied by Melbourne water

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YANNATHAN AGGREGATE QUARRY
DIVERSION DRAIN

SITE PLAN
EXISTING CONDITIONS

Job No:	110441.01
Date:	8/09/2010

FIGURE 2

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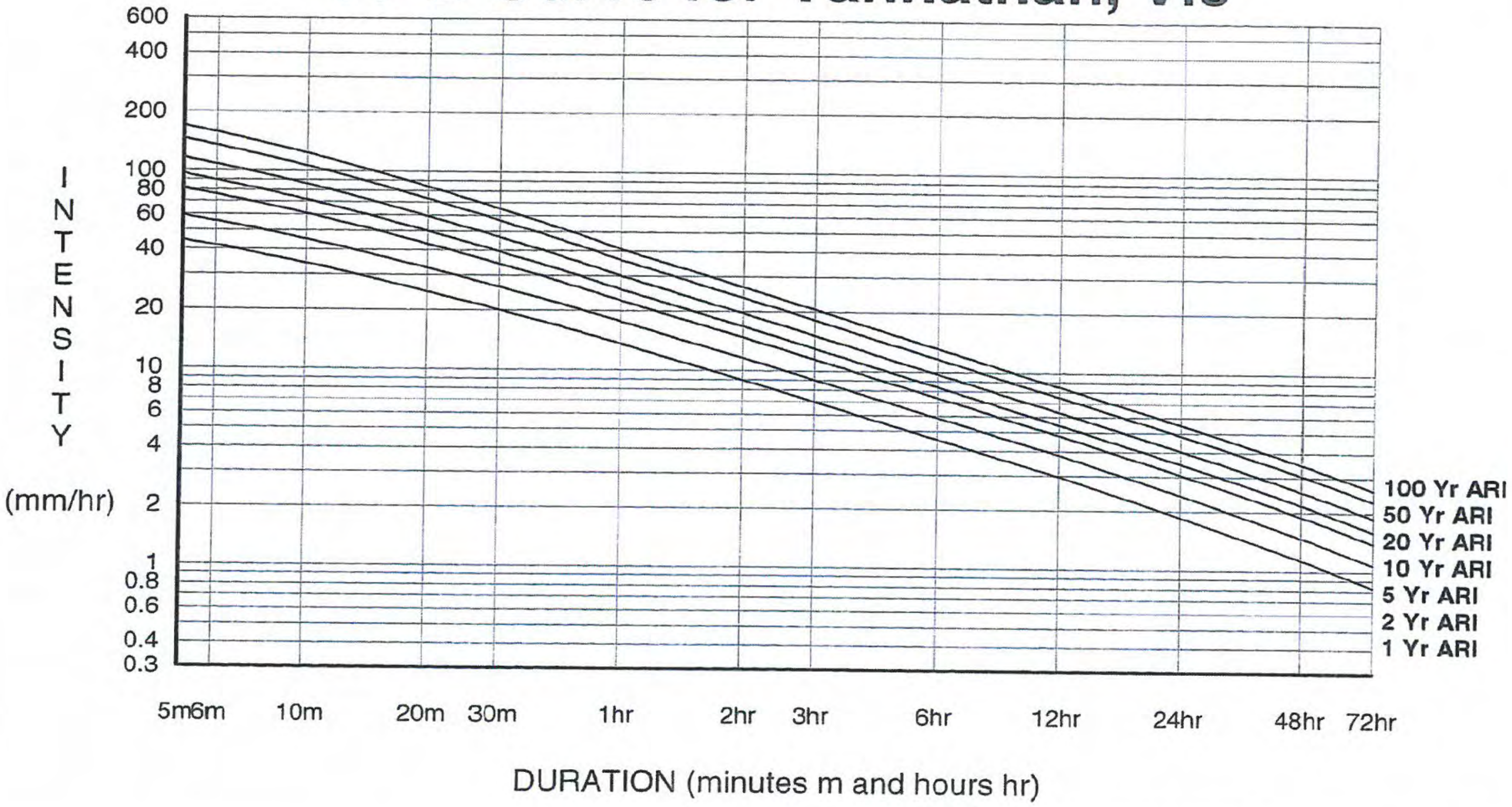
J:\Synergy\Projects\110\110441 Yannathan Diversion Drain (Hanson)\02 Design Yannathan Diversion Drain\Drawings and Figures\Figure 2 Existing Conditions A4 Portrait

I F D Curve for Yannathan, Vic



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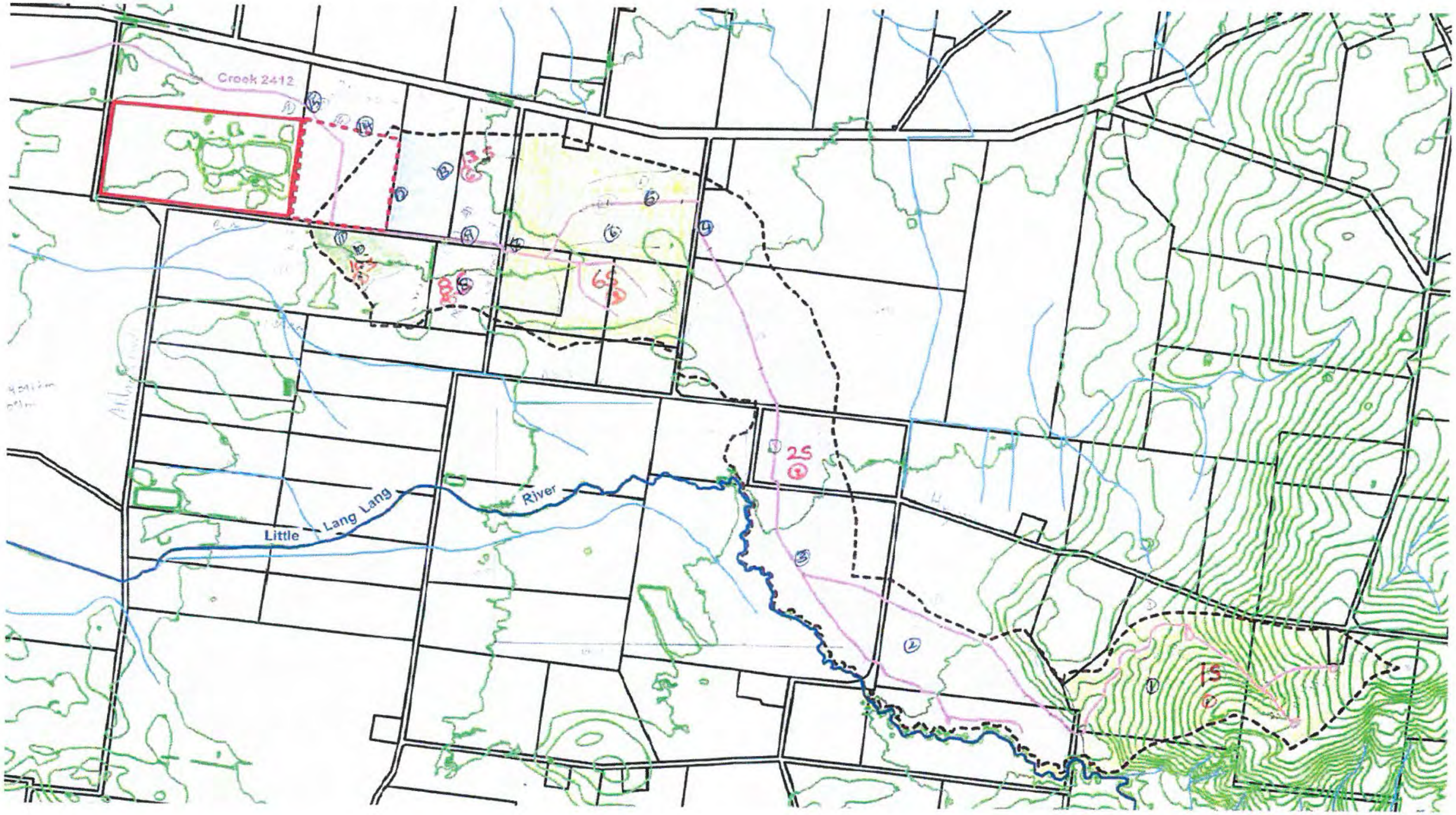
Intensity - Frequency - Duration Curve for Yannathan, Victoria

Date:	8/09/2010	Job No:	110441.01	**FIGURE 3**

J:\Synergy\Projects\110\110441 Yannathan Diversion Drain (Hanson)\02 Design Yannathan Diversion Drain\Drawings and Figures\Figure 3 IFD Curve.xls A3 Landscape



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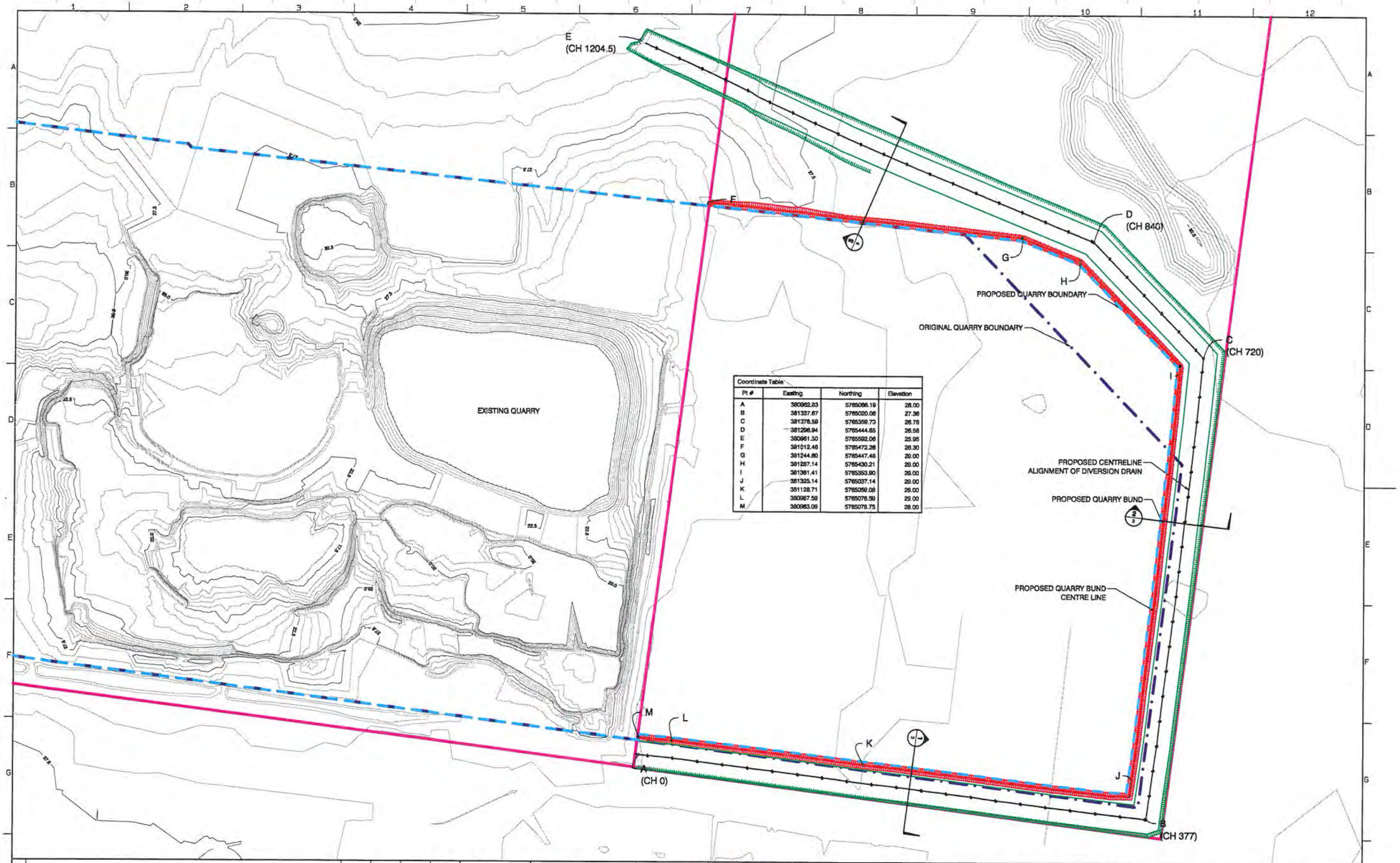
Yannathan Upstream Catchment Modelling Diagram

Date:	8/09/2010	Job No:	110441.01	FIGURE 4

J:\Synergy\Projects\110\110441 Yannathan Diversion Drain (Hanson)\02 Design Yannathan Diversion Drain\Drawings and Figures\Figure 4 Upstrean catchment modelling diagram.xls A3 Landscape



Coordinate Table

Pt #	Easting	Northing	Elevation
A	380962.83	5765066.19	28.00
B	381337.67	5765020.06	27.36
C	381378.59	5765359.73	26.76
D	381298.94	5765444.65	26.58
E	380961.30	5765592.06	25.95
F	381012.46	5765472.26	28.30
G	381244.80	5765447.48	29.00
H	381287.14	5765430.21	29.00
I	381361.41	5765353.90	29.00
J	381325.14	5765037.14	29.00
K	381128.71	5765059.08	29.00
L	380987.59	5765076.59	29.00
M	380963.09	5765078.75	28.00

No.	DESCRIPTION	DATE	DRAWN	CHECK'D	APPR'D

SCALE 1:2500	
JOB No.	110441.02
DATE	30.09.10
DESIGN	PMR
DRAWN	GH
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DIVERSION DRAIN LAYOUT
WITH SOUND BUNDS

FIGURE 5

CLIENT No.
CAD REF. 110441
REV. No. A
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SHEET 1 OF 1

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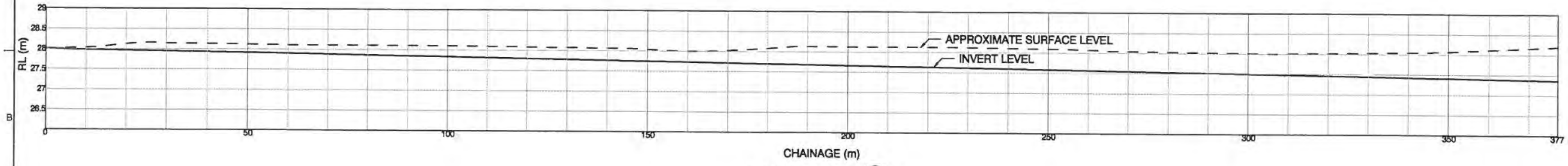
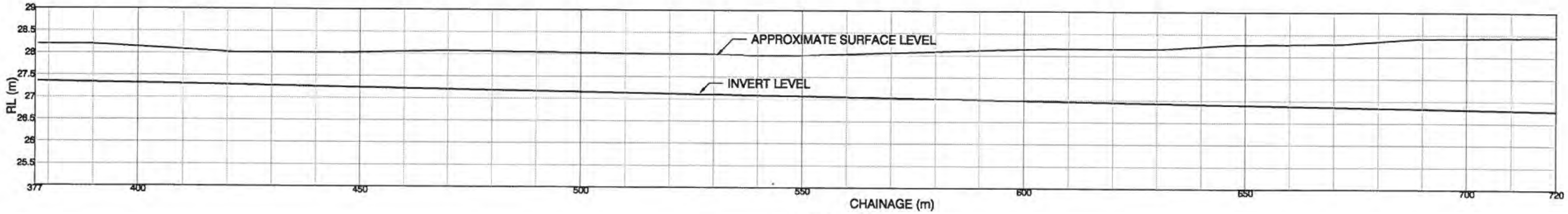


LONG SECTION 1/1

SOUTHERN DRAIN AND BUND

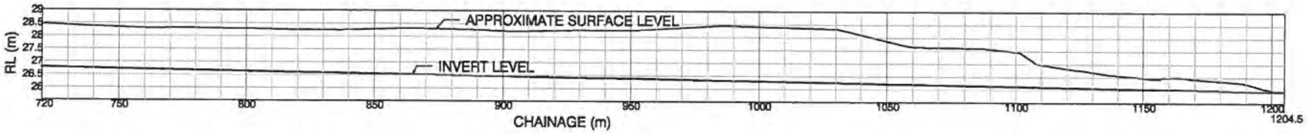
SCALE H 1:1000 V 1:100



LONG SECTION 2/1

EASTERN WALL AND BUND

SCALE H 1:1000 V 1:100



LONG SECTION 3/1

NORTHERN DRAIN AND BUND

SCALE H 1:2000 V 1:200

No.	DESCRIPTION	DATE	DRAWN	CHECK'D	APPR'D

SCALE AS SHOWN	
JOB No.	110441.02
DATE	01.10.10
DESIGN	PMR
DRAWN	GH
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HANSON CONSTRUCTION MATERIALS
YANNATHAN AGGREGATE QUARRY

DIVERSION DRAIN - LONG SECTIONS

FIGURE 6

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REV. No. A
SHT SIZE A3
SHEET 1 OF 1

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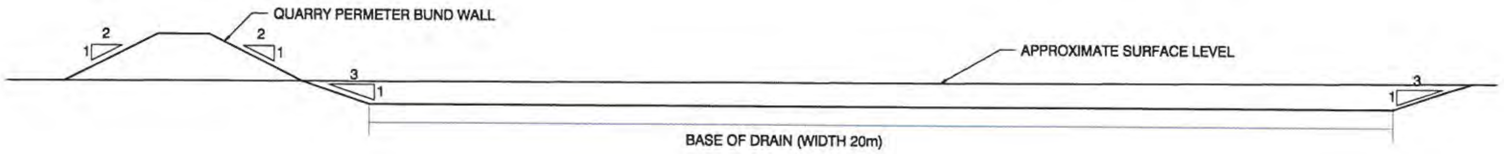
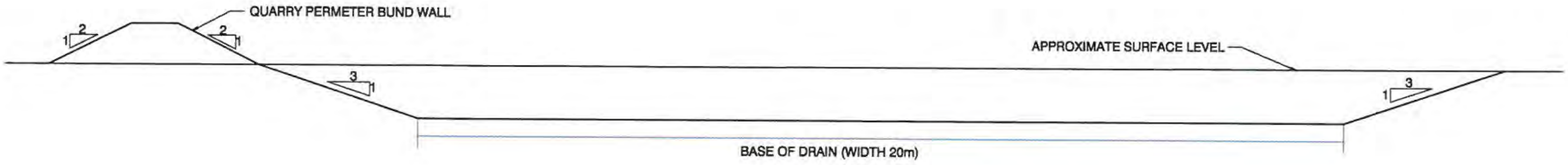
NOTE:
SOW AND MAINTAIN GRASS COVER WITHIN THE DRAIN AND ON THE BUND



SECTION ①/1

TYPICAL SECTION OF THE SOUTH DRAIN AND BUND

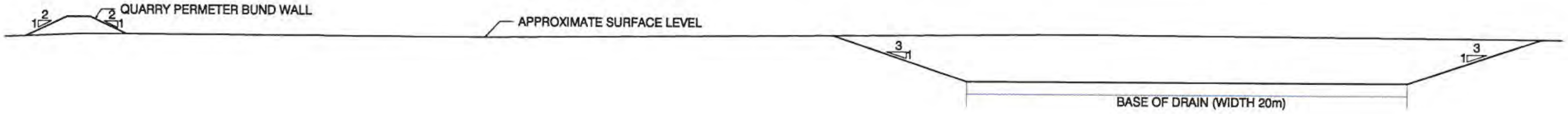
SCALE 1:100



SECTION ②/1

TYPICAL SECTION OF THE EAST DRAIN AND BUND

SCALE 1:100



SECTION ③/1

TYPICAL SECTION OF THE NORTH DRAIN AND BUND

SCALE 1:200

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JOB No.	110441.02
DATE	01.10.10
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DIVERSION DRAIN - TYPICAL CROSS SECTION

FIGURE 7

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SHEET 1 OF 1

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Appendix B:

Melbourne Water Preliminary Advice Email (18th December 2020)

Milan Wickramarachchi

From: Melbourne Water <No_reply@melbournewater.com.au>
Sent: Friday, 18 December 2020 9:52 AM
To: Julian Giannetti
Subject: MWA-1188291 Re-alignment of waterway advice

Hi Julian,

Further to your email, please consider the following preliminary advice for Realignment of waterway/channel:

If waterway/s are proposed to be diverted within the quarry site these diversions must be included and outlined within the Work Authority and submitted to Melbourne Water for approval.

1. Any proposed realignment of the waterway must be submitted to Melbourne Water for approval at concept design, functional design and detailed design stages. Each submission must include the following information:

a. The proposed centreline and alignment of the realigned section;
b. A geotechnical/geomorphologic report by a suitably qualified professional identifying the geomorphic values of the existing waterway and providing assessment of the significance of those values within the local, regional and state context.
c. A geotechnical/geomorphologic report by a suitably qualified professional addressing the feasibility of any proposed realignment, with reference to soil types, topography and any future possible channel movement. Within the report, the proponent must demonstrate the hydraulic function including:
    i. channel capacity; (normally required to contain 100 year ARI flow plus freeboard, freeboard amount to be determined by risk assessment of the consequences of flows exceeding the channel capacity);
    ii. stream velocities;
    iii. shear stresses and stream powers at different flow rates likely to be experienced by the realigned section (according to the flow regime and proposed channel geometry) in order to determine the likely impact on channel stability.

2. The report must demonstrate that the hydraulic function of the realigned section:

i. causes no significant change from base conditions (i.e. the current hydraulics of the existing channel), where the existing channel is in good geomorphic condition and not exhibiting unstable behaviour
ii. that channel stability and in channel vegetation is not negatively impacted by the hydraulics of the realigned section
iii. minimises the requirement for rock lining and scour protection
iv. potential consequence of lengthening channel in relation to sediment accumulation.
v. outlines the predicted rate of meander and impact on intended design and riparian reserve width;

d. Waterway corridor zones and/or design, including appropriate revegetation setbacks, revegetation treatment, exclusion zone and maintenance access on both sides of the waterway.

- The realigned waterway must be re-vegetated with an appropriate indigenous Ecological Vegetation Class. Vegetation must be established and provide stability for the realigned waterway prior to the waterway's flows being redirected into the final waterway re-alignment.

- An appropriate exclusion zone is required (e.g. minimum 100m from the waterway (top of bank)) to protect the waterway from any direct (e.g. quarrying) or indirect (e.g. water quality) impacts from extraction activities.
- Maintenance access (vehicle) must be designated on both sides of the waterway (and within the proponent's property title) to ensure that any future waterway rectification or maintenance works can be safely undertaken.

e. Detailed flora and fauna investigation of the affected areas will need to be undertaken by an appropriately qualified consultant on behalf of the proponent and submitted to Melbourne Water for approval. These investigations must take into account the proposed subject site as well as the upstream, downstream and adjacent areas that may be affected. Appropriate measures to mitigate any potential impacts must be identified. Note that Melbourne Water reserves the right to ask for surveys to be repeated or targeted where required.

f. The location and species of vegetation affected by any proposed realignment at the project site as well as upstream and downstream of the project site, and

g. Provide details of sediment control elements (e.g. silt traps) that will be incorporated during the construction and establishment of the new waterway alignment to protect downstream water quality.

3. Melbourne Water recommends rehabilitation of the riparian corridor include fencing and revegetation with trees, shrubs and groundcover species. It is recommended that the waterway frontage be fenced at the required setback distance prior to works commencing to minimise damage to the waterway. A rehabilitation plan is to be forwarded to Melbourne Water for approval. Revegetation is to be undertaken with indigenous plant species.

Please be advised in order to receive final formal approval from Melbourne Water regarding the proposed re-alignment, a works offer application must be submitted via: https://apply.melbournewater.com.au/develop/online.html?ApplicationType=OOCW

The above information is only preliminary and is subject to change upon submission of further information and plans.

Please email us at DevConnect@melbournewater.com.au quoting MWA-1188291 in the subject line.

This email is sent from a notification-only email address that does not accept incoming email.

For general development enquiries contact our Customer Service Centre on 131 722.

Regards,

Segujja Kakembo | Planner , Development Planning Services | Melbourne Water
T: 131 722 | 990 La Trobe Street, Docklands, VIC 3008 | PO Box 4342 Melbourne VIC 3001
| melbournewater.com.au

Enhancing Life and Liveability

Appendix C:

Geomorphological Assessment

Hanson Construction Materials

Yannathan Quarry

Geomorphic Assessment

April 2022

V1259_003_REP_001_3

Job no. and Project Name: V1259_003 – Yanathan Geomorph
Doc Path File: \\online.com\files\ManagementMelbourne\Projects\V1259 Hanson Construction Materials\V1259_003 Yannathan Geomorph\07 Deliv\2. Report\V1259_003_REP_001_3_Yannathan Geomorph Assesment.docx

Rev	**Date**	**Description**	**Author**	**Reviewer**	**Project Mgr.**	**Approver**
0	10/09/2021	For Issue	Desmond Anim	David Sexton	Julian Giannetti	Glenn Ottrey
1	30/09/2021	For Issue	Desmond Anim	David Sexton	Julian Giannetti	Glenn Ottrey
2	17/12/2021	For Issue	Desmond Anim	Glenn Ottrey	Julian Giannetti	Glenn Ottrey
3	12/04/2022	For Issue	Desmond Anim	Glenn Ottrey	Julian Giannetti	Glenn Ottrey
Signatures						

DISCLAIMER

This Report has been prepared on behalf of and for the exclusive use of Hanson Construction Materials and is subject to and issued in accordance with Hanson Construction Materials instruction to Engeny Water Management (Engeny). The content of this Report was based on previous information and studies supplied by Hanson Construction Materials.

Engeny accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this Report by any third party. Copying this Report without the permission of Hanson Construction Materials or Engeny is not permitted.

Contents

Appendices

List of Tables

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1 INTRODUCTION

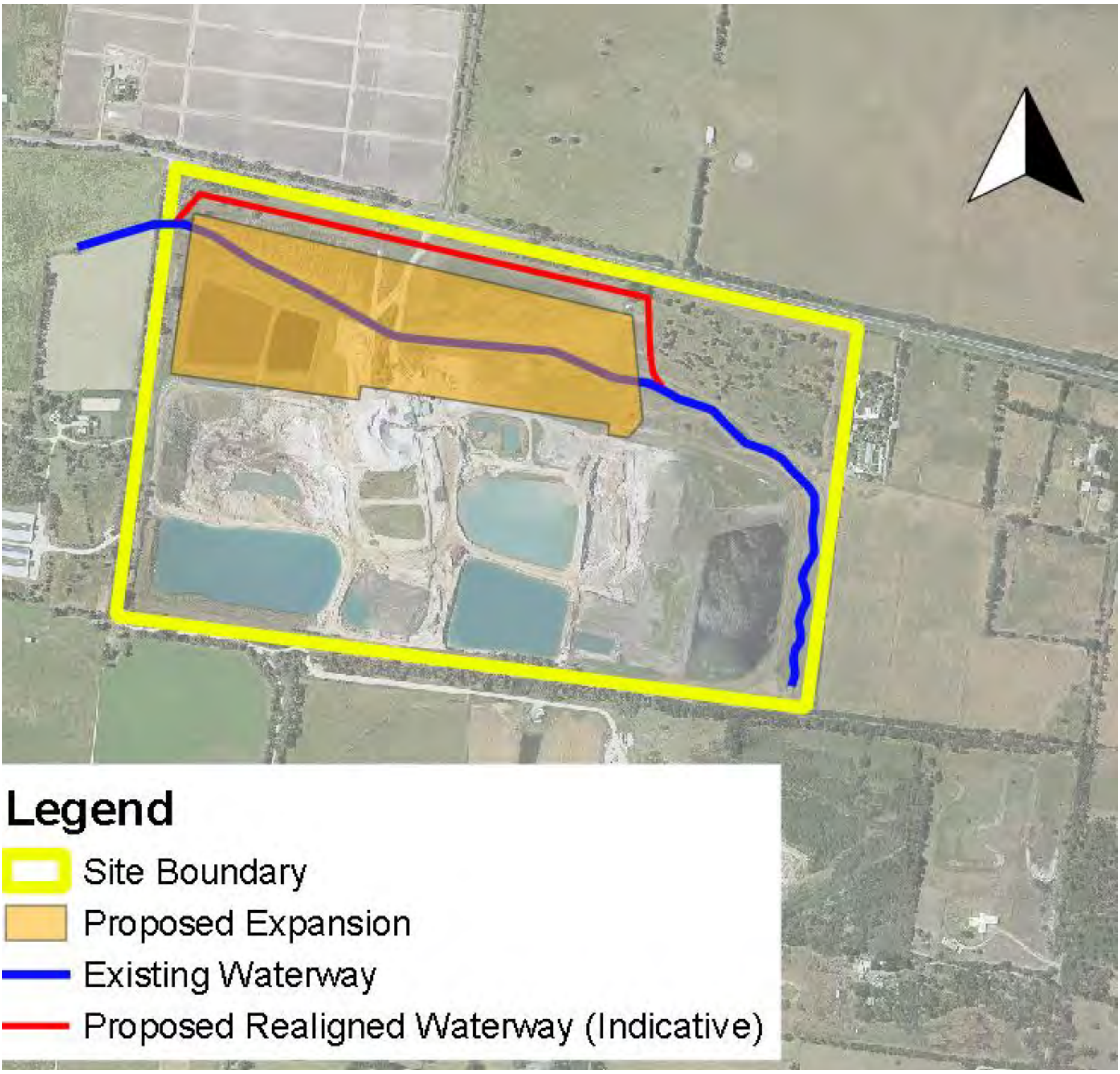
1.1 PROJECT BACKGROUND AND OBJECTIVES

Hanson Construction Materials is proposing to extend extraction activities at 870-910 Westernport Road in Yannathan to the north of the current extraction area within the existing Work Authority (Figure 1.1). There is an existing drainage channel within the location of the proposed expansion, as shown in blue in Figure 1.1. The expansion will require the realignment of the existing channel towards the northern boundary of the site.

A geomorphic assessment has been requested by Melbourne Water as a key part of the proposed channel realignment for the expansion of quarry activities. This geomorphic assessment:

- Examines the geomorphic condition and values and trajectory of the existing channel within the site.
- Identifies the hydraulic condition, including shear stresses and velocities at different flow rates that are likely to be experienced by the realigned channel (according to the flow regime and proposed channel geometry), to determine the likely impact on channel stability.
- Addresses the feasibility of any proposed realignment with reference to soil type, topography and defines the degree and type of management intervention needed (if any) to ensure the long terms stability of the channel and mitigate against any future possible channel movement.

Figure 1.1: Proposed expansion and approximate realigned channel alignment



1.2 APPROACH

Melbourne Water has provided a preferred methodology for the geomorphic assessment. Based on this information and Engeny Water Management's (Engeny's) experience in similar assessments, the following primary tasks have been undertaken:

- Information review and initial desktop assessment of site.
- Field inspection of the length of the existing channel within the site.
- Geomorphic condition and value assessment of the existing channel.
- Hydraulic assessment of proposed channel realignment and potential upstream and downstream impacts.
- Identification of management consideration and recommendations.

2 SITE DESCRIPTION AND DESKTOP ASSESSMENT

2.1 INFORMATION REVIEW

Pertinent background information of the project area was reviewed including:

- Port Philip and Westernport Geological/Geomorphological landform mapping and explanatory notes (Agriculture Victoria 2018 a).
- Aerial photography (historical and current) accessed via Nearmap viewer to identify natural and anthropogenic changes of the channel.
- Topographical mapping (Digital Elevation Model).

2.2 STUDY AREA AND SITE CHARACTERISTICS

The study area is located at 870-910 Westernport Road in Yannathan about 76 km south-east of central Melbourne. It is on the southern edge of the Koo Wee Rup Swamp and south of the Lang Lang River which discharges to Western Port Bay. The majority of the study area is bounded by farmlands (grazing modified pastures land) and the quarry activities (Figure 2.1). Westernport Road forms the Northern portion of the site boundary. The site falls in the Bunyip basin within the Port Phillip and Westernport region. Most waterways within the basin are rated to have a poor stream condition based on the 2010 Index of Stream Condition (The Third Benchmark of Victoria River Condition (ISC3) report).

The drainage channel traverses the site from the eastern boundary towards the northern edge of the existing quarry operations and exits at the western boundary. The upstream section of the waterway has been previously re-aligned in 2011 as shown in Figure 2.1 to allow for quarry works expansion towards the eastern boundary at that point in time.

Figure 2.1: Site overview

2.2.1 Geology and Soils

Engeny has reviewed the geology of the site based on information provided in Victorian Resources Online for Port Phillip and Westernport (Agriculture Victoria 2018 b). This information shows that areas around the site is underlain by Neogene sediments (aeolian and riverine). The site falls within a region with a Tier 1, 2 and 3 geomorphologies of Eastern Plains (EP), Low relief Southern Uplands and Prior Stream Plains (Agnes, Yarram, Yinnar, Tinamba, Clydebank) respectively (Agriculture Victoria 2020).

Generally, most of the flat country east of Kooweerup and near the Lang Lang River where the study area is located, comprises of soils on alluvium, derived from the Cretaceous uplands and to a lesser extent, from the older basalt cappings near Warragul (Sargeant, 1975). The Australian Soil Classification (Agriculture Victoria 2018 c) also identifies the soil in this region as Humose, Humic/Sesquic, Semiaquic PODOSOL which is strongly acidic, low salinity and non-sodic.

2.2.2 Site topography and drainage

Figure 2.2 shows the topography across the study area using 2 m contour lines. The majority of the site is low-lying with a gentle slope of approximately 2 % towards the existing waterway. The topography of the area lends to very shallow drainage depressions in most areas. Broad flat plains also characterise large parts of the contributing catchment while the site extremities extend into the surrounding bund adjacent to Westernport Road along the northern site boundary. The existing channel flows north-west around the boundary of the site, from the south-eastern site boundary to the north- western boundary. A local external drainage catchment of approximately 2.7 km^2 contributes flows to the study area, the larger coming from the south-east as shown in Figure 2.3. Areas of natural local ponding occur throughout the waterway.

Figure 2.2: Site Topography (2 m contours)

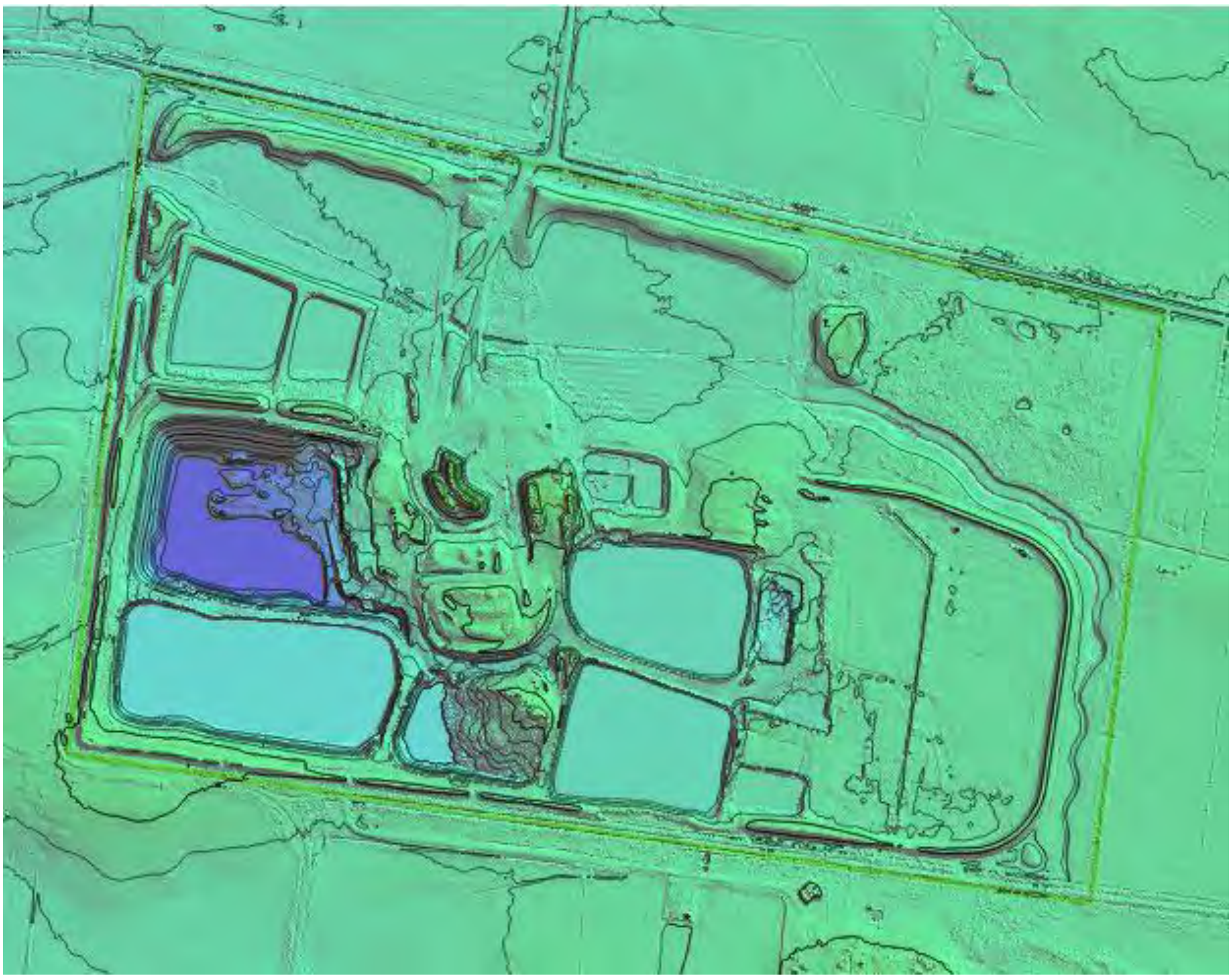
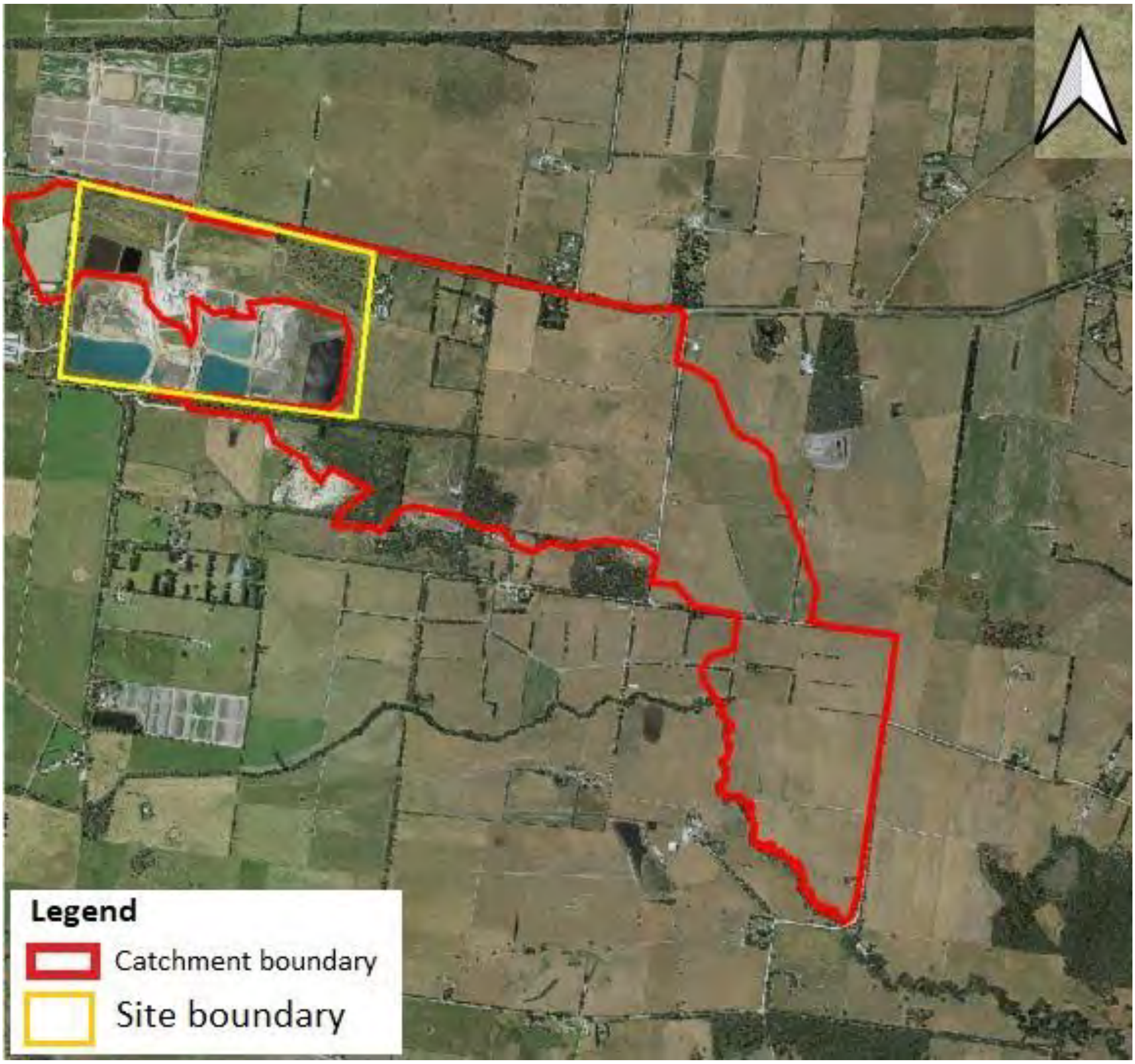


Figure 2.3: Catchment area contributing flows to the study area



2.3 CULTURAL HERITAGE ASSESSMENT

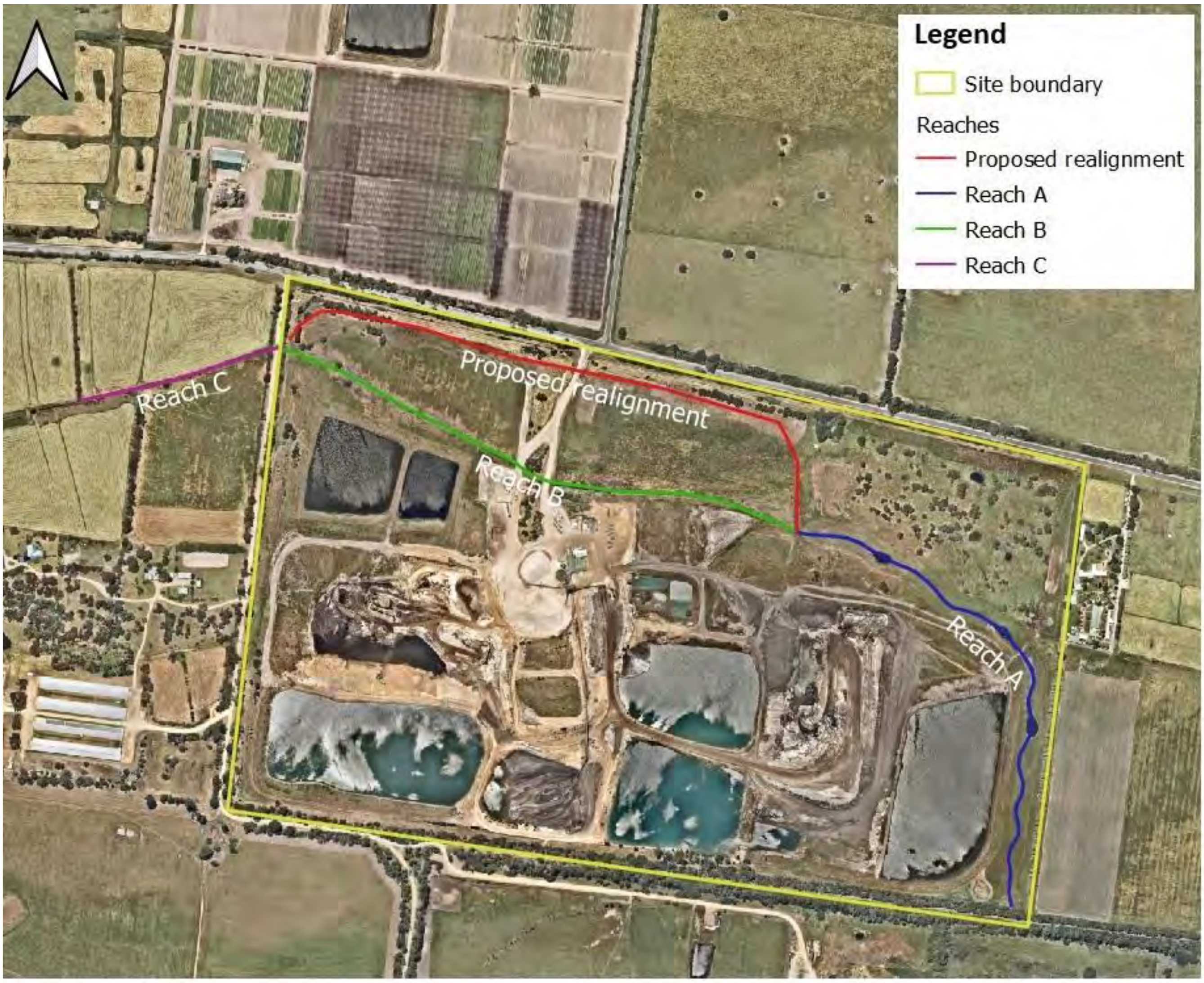
Heritage Insight have been involved throughout the geomorphic assessment and have provided insights to address the potential of soil/sand within the current landscape within the study area that may contain deposits of culturally sensitive Aboriginal material. Refer to Appendix B for advice from Heritage Insight.

3 GEOMORPHIC ASSESSMENT

3.1 SITE INSPECTION

A site inspection was undertaken by Engeny on 30th July 2021. The inspected channel has been split into three reaches (A, B and C) which includes the section of the channel (Reach B) to be affected by the proposed expansion (~ 800 m), as well as upstream (Reach A) and downstream (Reach C) segments comprising of approximately 1.2 km of the total channel length (Figure 3.1). The inspection involved a rapid geomorphic assessment of the reaches and corridor to define geomorphic processes, waterway features, geomorphologic risks and inform the proposed realignment works.

Figure 3.1: Site Waterway Reaches



Key findings from the site assessment are summarised below in Table 3.1 with photos of typical features included in Figures 3.2 to 3.16.

Table 3.1: Summary of field observations for each inspected reach

Channel segment	Key Observations
A	This reach represents a previously re-aligned constructed channel from the east of the quarry site flowing in the north-west direction to the current proposed segment to be re-aligned. Reach A primarily consists of a defined shallow low flow meandering channel and localised chain-of-ponds. The channel is lightly vegetated with some pasture grasses within some sections (Refer to figures below of photos that were taken on site. Figure 3.2, Figure 3.3). The surrounding broad floodplain consists mostly of low-lying groundcover made up of a mixture of weed, turf/pasture grasses (Figure 3.7). Most sections of this reach have no defined channel banks (Figure 3.3). The banks of the localised pools have been stabilised by rock work in some locations (Figure 3.6). Some isolated bank areas show signs of instability (Figure 3.4, Figure 3.5). These isolated bank areas have lost vegetation with exposed clayey-silt soil-based banks. This reach is generally considered stable with no incision.
B	Reach B is the proposed section to be re-aligned. The reach has no well-defined channel, and the waterway flows through the broad floodplain (Figure 3.8, Figure 3.9). The surrounding floodplain of this reach, upstream of the access road crossing is made of low-lying groundcover of pasture grasses consistent with Reach A (Figure 3.11). The floodplain downstream of the road crossing is made up of dense groundcover consisting mostly of a mixture of weeds and some pasture grasses, with some dispersed trees on its floodplain further downstream towards the western boundary of the site (Figure 3.12). The in-channel vegetation (mostly pasture grasses) is very thick, filling / choking the channel at various sections (Figure 3.9, Figure 3.10, Figure 3.16). Midway through the reach, the channel is impacted by backwater from the access road crossing (Figure 3.14) which causes extended ponding up to about 20 m from the low-flow channel (Figure 3.15). Isolated areas of localised ponding likely formed after storm event were observed along the length of the reach after the access road leading up to the downstream section of the reach. No evidence of incision, bank erosion or instream works was noted.
C	The proposed realignment of reach B will connect to the upstream section of this reach. Access to visually assess this reach was not possible, hence the assessment was undertaken using aerial imagery. The reach consists of a straight shallow channel (Figure 3.18, Figure 3.19). The channel is lightly vegetated and the floodplain on both sides of the channel is covered by predominately moderately dense low-lying pasture grasses. The channel seems relatively stable under existing land use. No evidence of instream works was identified.

3.2 CONDITION ASSESMENT

A condition assessment was undertaken for the inspected reaches based on the findings from the field assessment considering the channel form, channel stability (bank and bed), in-channel habitat and riparian vegetation. Table 3.2 provides the different geomorphic condition categories and explanation of each.

Table 3.3 provides the different geomorphic condition assigned to the inspected reaches.

Table 3.2: Geomorphic condition categories

Geomorphic condition	Definition
Intact	Reach form in natural condition, presents all the typical features of the stream type, no evidence of erosion processes.
Good	Reach form in near natural condition, some limited impacts but most of the typical features of the stream type are retained.
Moderate	Reach form impacted by erosion or land use practices. Some features of the stream type may be retained but the majority of the features are highly modified.
Poor	Reach in a degraded condition due to extensive erosion or modified due to land use practices changing the form of the stream type.

Table 3.3: Geomorphic condition categorization of inspected reaches

Reach	Condition	Justification
Reach A	Moderate	Reach has some bank instability, and limited habitat diversity. some lateral connectivity value. Reach form partly impacted by land use activities.
Reach B	Poor	Reach form impacted by land use activities, little to no geomorphic characteristics, limited instream habitat value, no erosion, limited riparian vegetation, some lateral connectivity value, dense homogenous vegetation, no marked erosion noted
Reach C	Poor	Little to no geomorphic characteristics, limited instream habitat value, no erosion.

3.3 GEOMORPHIC VALUE ASSESMENT

Table 3.4 summarises the geomorphic value assigned to each inspected reach.

Table 3.4: Geomorphic value categorization of inspected reaches.

Reach	Representativeness	Rarity	Diversity	Condition	Geomorphic Value
Reach A	Anthropogenic/Constructed channel	Common	Homogenous	Moderate	Low
Reach B	Anthropogenic/Constructed channel	Common	Homogenous	Poor	Low
Reach C	Anthropogenic/Constructed channel	Common	Homogenous	Poor	Low

Refer to figures below of photos that were taken on site.

Figure 3.2: Constructed low flow channel (Reach A)

Figure 3.3: Section of channel (Reach A)

Figure 3.4: Typical chain of ponds at Reach A showing signs of bank instability

Figure 3.5: Localised areas of bank instability at Reach B

Figure 3.6: Pools sections at Reach A with rockwork

Figure 3.7: Floodplain reach A

Figure 3.8: Reach B with no clearly defined channel

Figure 3.9: Channel at Reach B flows on broad floodplain (no defined channel)

Figure 3.10: Channel at Reach B with excessive pasture grass growth filling the channel

Figure 3.11: Floodplain Reach B (upstream of access road crossing)

Figure 3.12: Floodplain Reach B (downstream of access road crossing)

Figure 3.13: Areas of chain of ponds created in channel separated by dense vegetation (Reach B)

Figure 3.14: Extended ponding upstream of Reach B

Figure 3.15: Access Road crossing at Reach B

Figure 3.16: In-channel (highly dense) vegetation covers channel depth

Figure 3.17: Access Road crossing channel upstream at Reach B

Figure 3.18: Aerial image showing Reach C in the west of study area boundary

Figure 3.19: Channel in Reach C and associate floodplain

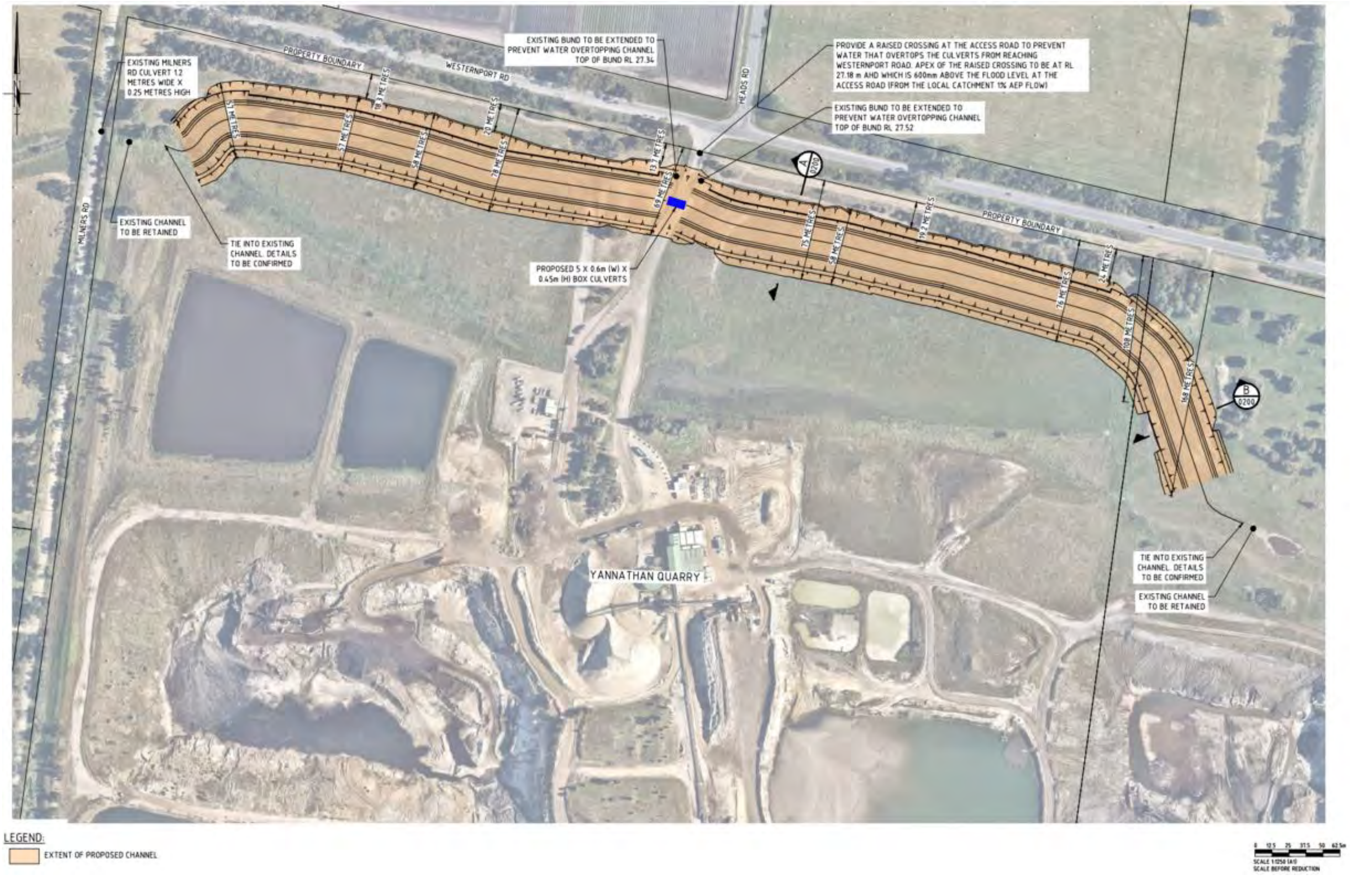
4 HYDRAULIC OUTPUT ASSESMENT

4.1 PROPOSED CHANNEL

As part of the proposed expansion of the existing quarry site, the existing drainage channel will need to be realigned to divert flows through the site. The re-aligned channel will tie into the existing topography in regards to the levels of the existing channel upstream and downstream. Refer to Figure 4.1 for conceptual layout of the proposed channel.

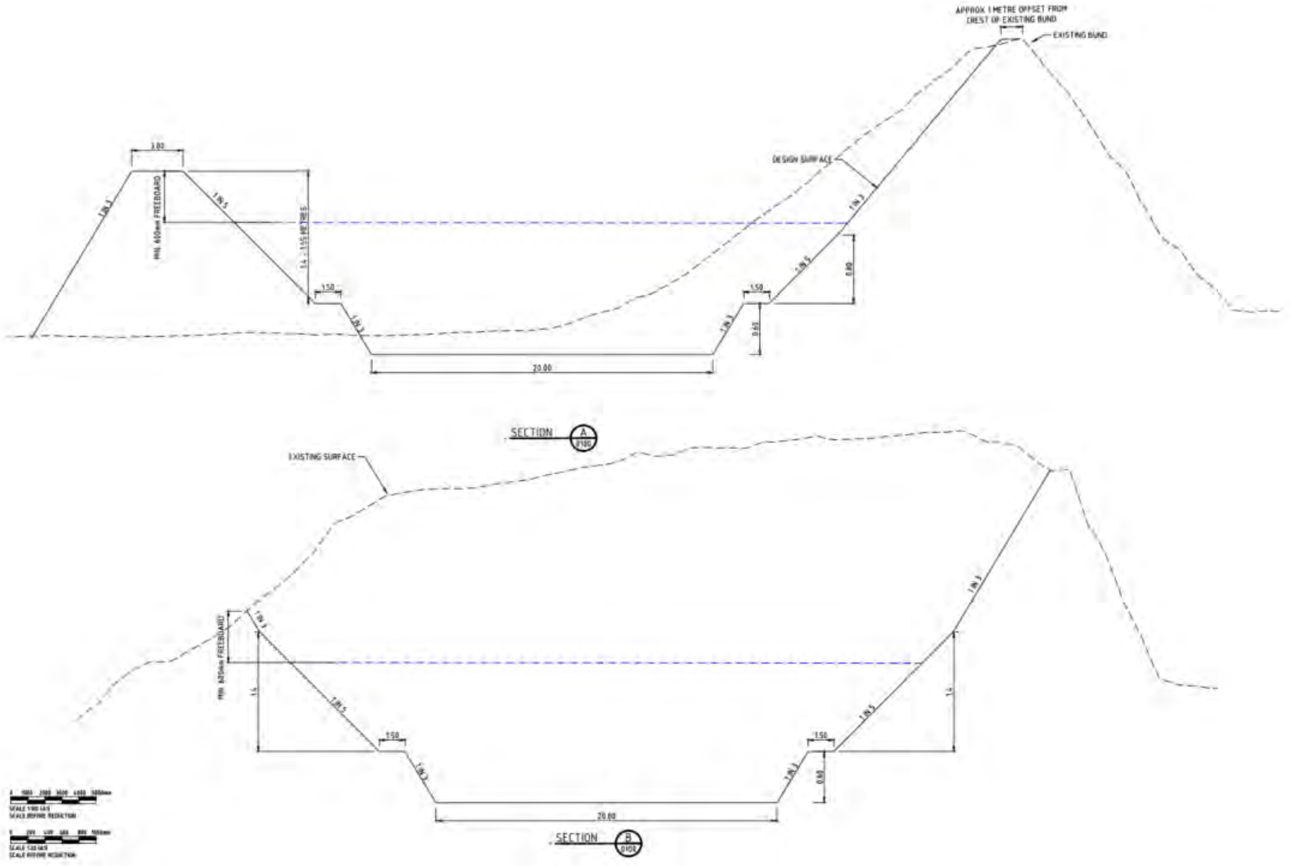
The re-aligned channel has a longitudinal grade of approximately 1 in 400 to ensure that it can tie into the existing channel at the downstream end.

Figure 4.1: Realigned Channel – Concept Layout



A typical cross section profile has been provided in Figure 4.2 which shows that the channel is in cut and utilises the existing visual screening bund (northern bund) and proposes a new bund to the south of the realigned channel to contain the 1 % AEP peak flow.

Figure 4.2: Re-aligned Channel – Typical Cross Section



Refer to **Appendix A** for concept design, noting that this concept design is subject to change based on outcomes of this geomorphic assessment and discussions with Melbourne Water and Hanson.

4.2 WATERWAY STABILITY

Engeny completed a HEC-RAS hydraulic model for both the existing and proposed re-alignment channel configuration to:

- Identify whether the proposed realignment result significant change in Shear Stress and Velocity when compared to base/existing conditions.
- Ensure downstream in-channel features (e.g., channel geometry, vegetation) not negatively impacted by the hydraulics of the realigned section.

For the geomorphologic assessment, shear stresses and velocity values for different design events were extracted from the hydraulic model and used as a guide to identify the likely impact on channel stability. The assessment considered the results for the 1 % (1 in 100 ARI) AEP event using the existing and proposed channel topography. The hydraulic values (shear stress, and velocity) results are based on the 1 % AEP flow of 27.8 m^3/s, which is the estimated flow rate (provided by Melbourne Water and is discussed in the Yannathan SWMP) for local catchment flows, inclusive of break out flows from the Little Lang Lang River during the 1 % AEP design storm event.

The results from the model have been compared with the 2019 Melbourne Water Constructed Waterways Design (MWCWD) Manual guidelines for acceptable values of shear stresses and velocity. This was conducted to determine how the modelled values compare with acceptable limits to maintain good channel condition.

The existing channel condition was used as a ‘natural’ analogue for comparison with the development scenario (post-development) for each of the reaches above. However, it is acknowledged that the existing channel is in poor condition and does not provide a ‘natural’ analogue for a channel performing well. Thus, the comparison generally provides an understanding of how the proposed re-alignment compares with existing conditions. In addition, the comparison of modelled hydraulic values with published acceptable values helps to provide guidance for detailed design as well as guide the extent of the re-aligned channel that may require different levels of treatments (e.g., vegetation, rock lining) for scour/erosion protection.

The modelled hydraulic output provides depth-averaged shear stress at different cross-sections for the banks and main channel. Following the 2019 MWCWD guidelines, the depth-averaged shear stresses calculated by HEC-RAS were factored up to estimate the maximum shear stresses occurring on the bed and sides of the cross section. A scale-factor was adopted based on the relationship of the base width (low flow or high flow channel) divided by the depth of the 1 % AEP flow and the side slope. A scale factor of 1.5 and 1.7 was used for the channel bed and sides respectively by adopting a conservative approach that selects the highest scale factor and applying to the entire channel as recommended by MWCWD guidelines.

The shear stress values provided by the HEC-RAS model will generally be compared against Table 4.1 and Table 4.2. In general, a threshold velocity of 1.5 m/s is often referred to by Melbourne Water as a limiting velocity before scour may potentially occur or for above which channel stabilisation measured may be required.

Table 4.1: Shear stress and velocity erosion threshold for different waterway boundary materials (2019 Melbourne Water Constructed Waterways Design Manual, Fischenich 2001)

Boundary Category	Boundary Type	Shear stress (N/m^2)	Velocity (m/s)
Soils	Fine colloidal sand	1.5	0.5
	Alluvial silt and silty loam (non-colloidal)	3	0.5 – 0.7
	Firm loam and fine gravels	4	0.8
	Stiff clay and alluvial silts (colloidal)	12	1 – 1.5
Gravel/Cobble	25 mm, 51 mm, 152 mm and 305 mm	16, 32, 96 and 192 respectively	0.8 - 1.5, 0.9 - 1.8, 1.2 - 2.3, and 1.7 - 3.7 respectively
Vegetation	Turf	45 to 177	1 – 2.5
	Long native grasses	80	1.2 – 1.8
	Short native and bunch grass	45	0.9 – 1.2

Table 4.2: Shear stress thresholds for different parts of the channel materials (2019 Melbourne Water Constructed Waterways Design Manual)

Design event (AEP)	Low Flow Channel	High Flow Channel
5 %	Thresholds exceeded by no more than 10 %	Below threshold for boundary material
2 %	Thresholds exceeded by no more than 10 %	Below threshold for boundary material
1 %	Thresholds exceeded by no more than 10 %	Below threshold for boundary material

Engeny have assessed the existing and proposed channel conditions hydraulic outputs for the 1 % AEP peak flow and compared to the MWCWD tolerable limits, focusing on the distribution frequency. Table 4.3 shows the frequency distribution of hydraulic conditions (shear stresses and velocities) for both the existing and proposed realigned channels.

The hydraulic conditions (shear stresses and velocities) within the existing and proposed channels are generally within MWCWD guidelines acceptable ranges. Shear stress and velocities are generally below the acceptable thresholds, primarily around 15 - 60 N/m^2 and 0.5 -1.0 m/s respectively. The proposed channel has generally increased the shear stresses occurring within the ranges 30-60 N/m^2 for the channel bed and 15-45 N/m^2 for the channel sides. Similarly, there is slight increases in velocities mostly occurring in the range of 0.5 -1.0 m/s. These predicted increases in shear stresses and velocities in the proposed channel are below the MWCWD thresholds and are within acceptable ranges for a vegetated channel. This minimises the requirement for rock lining and scour protection. This will also help maintain sediment transport reducing the likelihood of excess sediment accumulation or deposition. These modelled shear stress and velocity ranges in the proposed channel are also indicative that the downstream channel hydraulics and channel vegetation will not have a significant impact.

Table 4.3: Distribution of hydraulic parameters across modelled reach for the existing and proposed channel.

Range Distribution	1 in 100 Year (Channel bed) (frequency of occurrence)		1 in 100 Year (channel sides) (frequency of occurrence)	
	Existing	Proposed	Existing	Proposed
Shear Stress(N/m^2)				
0-15	30	9	39	20
15-30	13	9	18	40
30-45	10	39	5	13
45-60	7	15	1	2
60-80	1	4	0	2
80-100	1	1	0	0
100-120	0	0	0	0
120-200	1	0	2	0
>200	3	1	1	1
Velocity (m/s)				
< 0.2	13	2	12	3
0.2-0.5	15	6	19	8
0.5-1.0	31	67	29	64
1.0-1.5	1	0	2	0
1.5-2.0	3	1	1	1
> 2.0	0	0	0	0

5 CONCLUSIONS, CONSIDERATIONS AND RECOMMENDATION

The geomorphic assessment has assisted in informing the geomorphic condition of the existing channel and to evaluate the viability and implications of the proposed realignment of section of the channel to the northern site boundary. The following summarises the findings and considerations:

- It is noted that the proposed realigned channel does not cause significant deviations in hydraulic conditions from the existing state, and where any deviations do occur, they can primarily be addressed using vegetation.
- The modelling showed only a slight increase in shear stress in the proposed channel, but this is below the MWCWD thresholds and the acceptable ranges for a vegetated channel. This will help maintain sediment transport reducing the likelihood of excess deposition as seen in the existing channel.
- Velocities and shear stresses for the 1 % AEP scenario are generally within the acceptable thresholds, primarily around 0.5-1.0 m/s and 15-60 N/m^2 respectively. This indicates that variety of vegetation such as native grass, shrubs, and trees are deemed appropriate surface treatments to provide means of long-term stability and reduce the risk of erosion and channel movement in the proposed channel reach. This minimises the requirement for rock lining and scour protection.
- The hydraulic condition of the proposed re-aligned channel suggests that the re-alignment will not have a significant impact on the downstream reach.
- It is recommended to introduce a suitable range of vegetation in the channel design. Riparian buffer and fencing should be considered in the design to exclude livestock and impact from grazing activities as well as providing buffer against erosion. Vegetation is to be selected to ensure that it can withstand the seasonal variation in rainfall and water levels throughout the year to improve survivability and establishment.
- The proposed channel is to be designed to provide a smooth transition into existing downstream reach.

6 QUALIFICATIONS

a) In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

b) Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

c) Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:

    i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or

    ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.

d) Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.

e) This document is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this Report.

f) If any claim or demand is made by any person against Engeny on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the Report or information therein, Engeny will rely upon this provision as a defence to any such claim or demand.

g) This Report does not provide legal advice.

7 REFERENCES

Agriculture Victoria (2018 a). Port Phillip & Westernport Geomorphological Units <http://vro.agriculture.vic.gov.au/dpi/vro/portregn.nsf/pages/ppw_gmu> (accessed on 25th July 2021)

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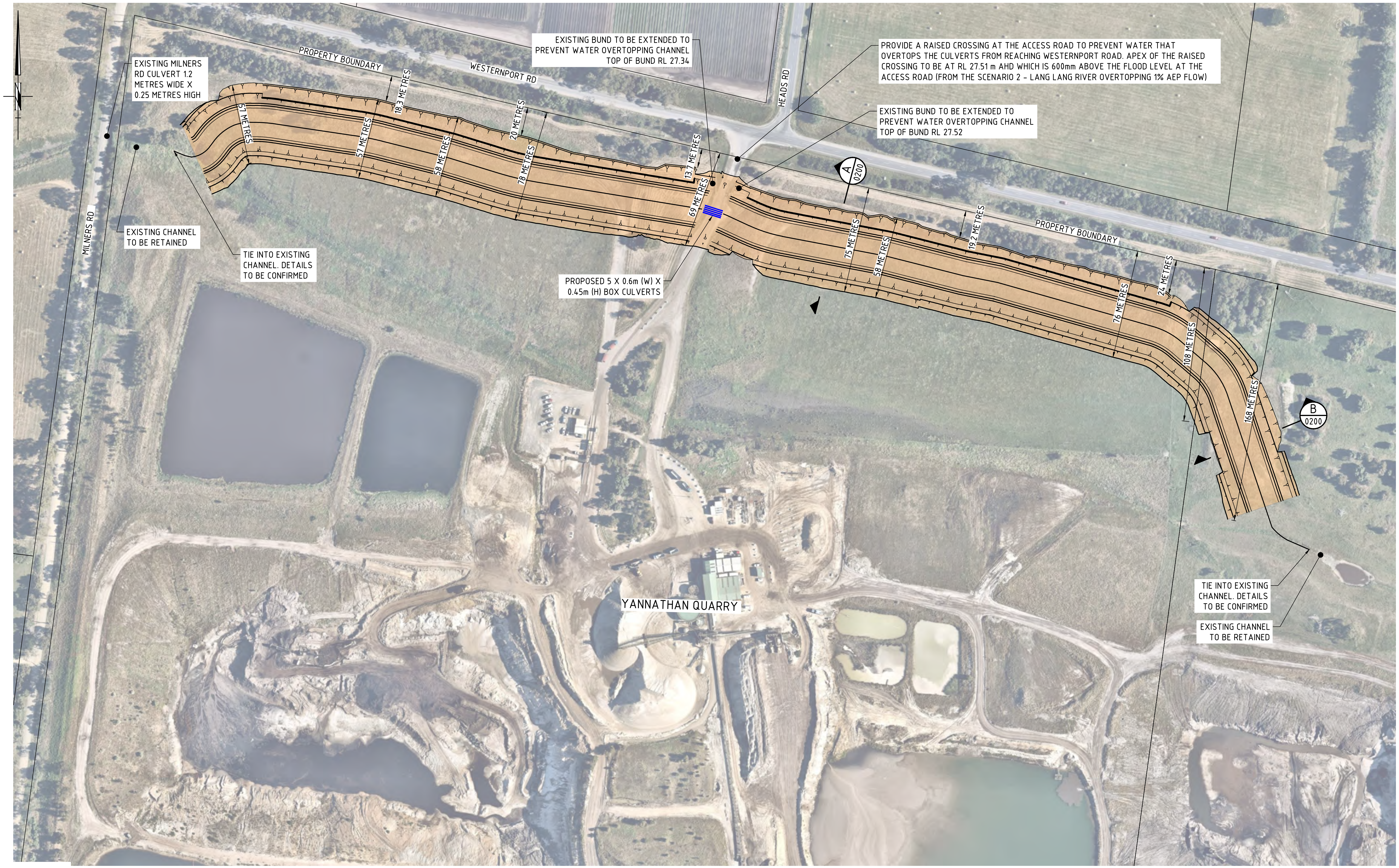
Sargeant I.J. (1975). Soil Survey Western Port Bay Catchment, Soil Survey Report No. 52 <http://vro.agriculture.vic.gov.au/DPI/Vro/portregn.nsf/0d08cd6930912d1e4a2567d2002579cb/1ca124db000368d3ca2574ea001bbfad/$FILE/PP_westernport_bay.pdf> (accessed on 25th July 2021)

Third Index of Stream Condition report. The Third Benchmark of Victoria River Condition (ISC3). DEPI, <https://www.water.vic.gov.au/water-reporting/third-index-of-stream-condition-report> (accessed on 25th July 2021)

Appendix A:

Concept Design of Proposed Channel



LEGEND:

🟧 EXTENT OF PROPOSED CHANNEL

0 12.5 25 37.5 50 62.5m

SCALE 1:1250 (A1)
SCALE BEFORE REDUCTION

CAD REF:V:\PROJECTS\V1259 HANSON CONSTRUCTION MATERIALS\V1259_002 YANNATHAN SWA\05 DESIGN\AUTOCAD\DRAWINGS\CONCEPT DESIGN\V1259-002-DWG-0100.DWG

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REV	BY	DATE	REVISION DESCRIPTION	PM APPD.
A				

DOC. NUMBER	DOCUMENT TITLE
REFERENCE DOCUMENTS	

Hanson

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WATER MANAGEMENT

STATUS
NOT FOR CONSTRUCTION - FOR REVIEW

Ph. 03 9888 6978

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360 Elizabeth St
Melbourne VIC

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DESIGNED		CHECKED	
DRAWN		CHECKED	
PM APPD.		PD APPD.	
CPENG		CPENG No.	

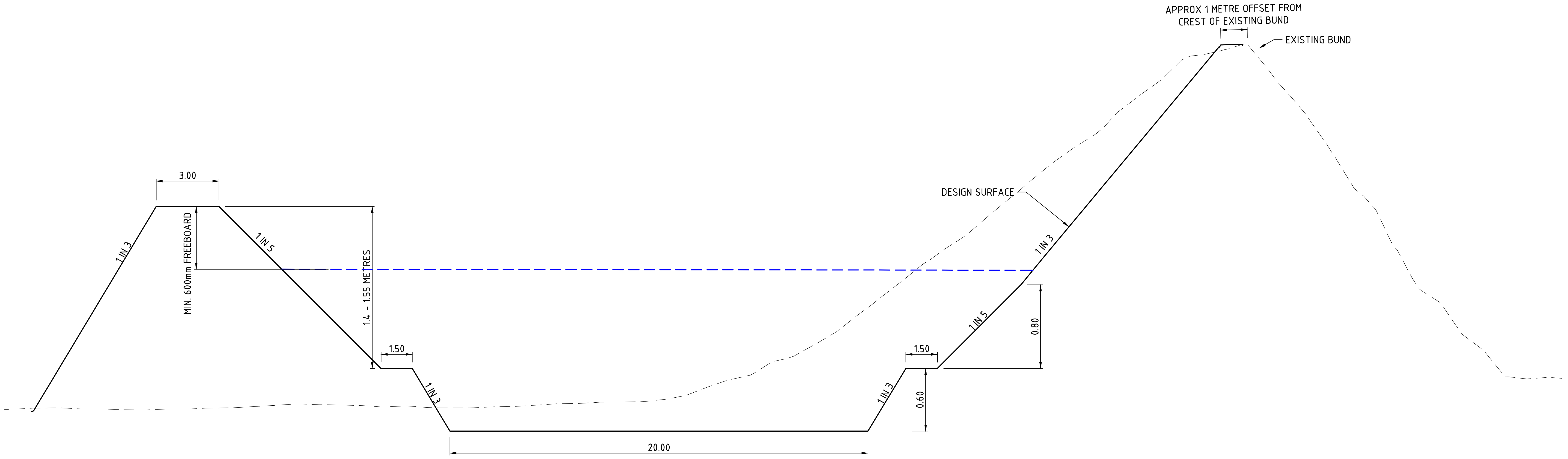
HANSON CONSTRUCTION MATERIALS

YANNATHAN SURFACE WATER ASSESSMENT
CONCEPT LAYOUT PLAN

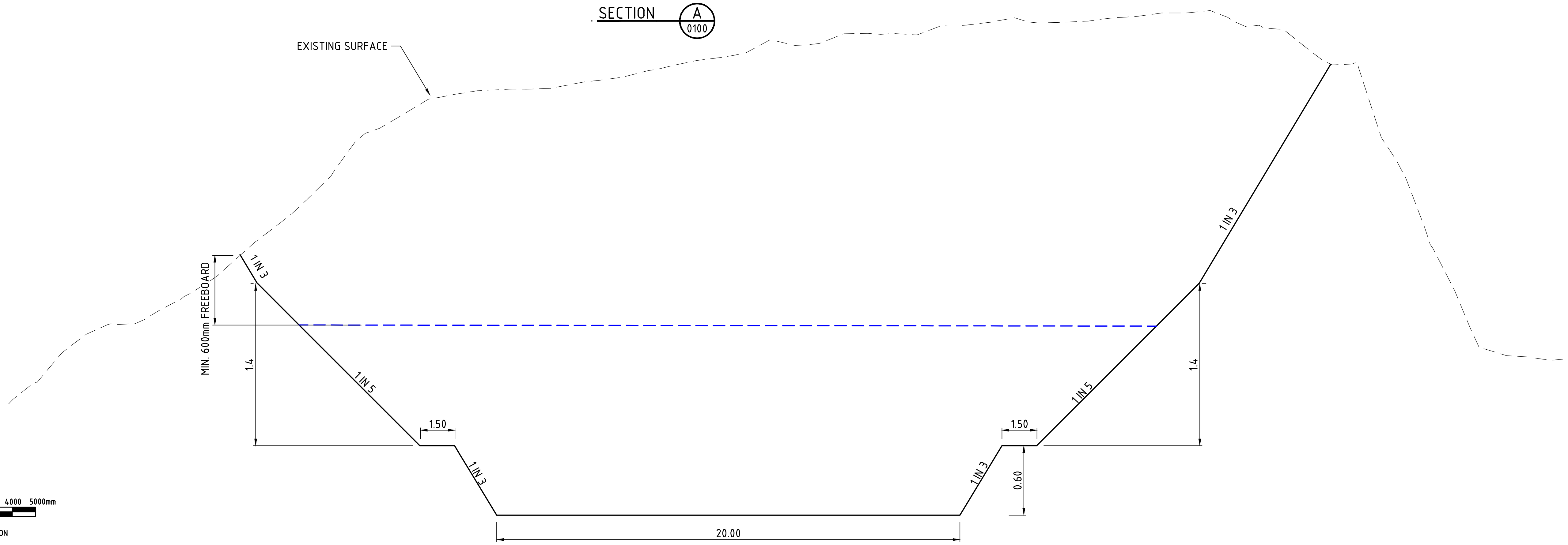
ORIGINAL SIZE: A1

DWG NO.: V1259-002-DWG-0100

REV.: A



SECTION A 0100



SECTION B 0100

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SCALE BEFORE REDUCTION

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SCALE 1:20 (A1)
SCALE BEFORE REDUCTION

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DRAWN		CHECKED	
PM APPD.		PD APPD.	
CPENG		CPENG No.	

HANSON CONSTRUCTION MATERIALS

YANNATHAN SURFACE WATER ASSESSMENT
CONCEPT TYPICAL SECTION

ORIGINAL SIZE A1

DWG NO. V1259-002-DWG-0200

REV. A

Appendix B:

Cultural Heritage Advice

40,000 years of Aboriginal Occupation within the Westernport Region

The current landscape is the product of environmental changes that have occurred before and within the last 10,000 years. Human occupation within the region may potentially be considerably older by a magnitude of 30,000 years or more, during which environmental conditions would have been significantly different and therefore highly consequential for Aboriginal occupation and movement within the region. Aboriginal people moving throughout what is now the Port Phillip region during the Pleistocene period they would have encountered a very different landscape from today, most notably the Bassian land bridge which existed from c.40,000–36,000 BP until c.14,000 BP (although tenuous land bridges may have existed prior to this ~76, 000, 68,000 to 62,000 and 46,000 BP), joining Tasmania with mainland Australia (Lambeck and Chappell, 2001, pp. 684–5).

During the last glacial maximum (LGM) c. 20–25,000 BP, glacial conditions seen elsewhere in the world (e.g., New Zealand and Chile) translated into extreme arid conditions throughout Australia (Bowler *et al.*, 1976; Bowler, 2009), with a concomitant expansion of dune fields (de Deckker, 2001). It is therefore likely that the sand plains and dunes of the region were reworked during this dry period; throughout Australia there is also little evidence for swamp or bog communities during the height of the glacial period. However, geomorphological evidence from archaeological excavations conducted at Bend Road (Dandenong South) indicates that wetland areas did exist in parts of Victoria during the Pleistocene (Kershaw, 1995, p. 664; Joyce *et al.*, 2003, p. 556; Hewitt and De Lange, 2007, p. 124). However, there would probably have been periods of stability when wetter and less windy conditions permitted vegetation to colonise the dunes, thus affording Aboriginal peoples opportunities to exploit otherwise impermissive settings (Ellender, Luebbers and Bowler, 2009, p. 101). The earliest occupation at Bend Road is dated to 30–35,000 BP, although it has been argued that this date range is unexceptional (Hewitt and Allen, 2010, p. 13) given the presence of Pleistocene dated sites elsewhere in the Victoria (Ossa, Marshall and Webb, 1995; Bird, Frankel and van Waarden, 1998; Cupper, White and L. Neilson, 2003; Rhodes, 2004; Richards *et al.*, 2007). This is suggestive of human occupation prior to the period of maximum aridity c. 25–20,000 BP. It is therefore feasible that given the assumed but comparable age of the sand sheet observed at Westernport Road that there exists the potential for evidence of very old human occupation at the site.

By the Late Pleistocene and Early Holocene, the environment had become less arid and more conducive to human occupation. The late glacial and Pleistocene-Holocene boundary was however a period of rapid environmental transformation with several climatic reversals (such as the younger Dryas c.11,000–10,000 BP) and changes in vegetation cover, with 12,000–9,000 BP witnessing the greatest change in pollen assemblages (Kershaw 1995). It can be said with confidence that by the time of the mid-Holocene Aboriginal occupation within the region was firmly established, as indicated by the prevalence of the Australian Small Tool Tradition (small stone artefacts utilised in the manufacture of multi-component tools, such as spears) on many intensively occupied sites within the region which are chronologically aligned with mid-Holocene deposits.

A review of Aboriginal Places located within the broader geographic region shows that stone artefact scatters are commonly associated with high points within the landscape, although they are not solely limited to sandy rises. It can be concluded that sandy rises and high points would have been utilised as lookouts, camp sites and routes through the landscape when traversing from north to south along the coast of Western Port Bay and the margins of Koo Wee Rup Swamp to the north and east

Therefore, it is probable that any Aboriginal occupation present at Westernport Road relates to a similar pattern of mid-Holocene occupation which focused on wetland margins and sandy ridgelines seen elsewhere in the region. However, the possibility of older phases of Aboriginal occupation at Westernport Road is also feasible.

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ENGENY
WATER MANAGEMENT

Appendix D:

Biodiversity Assessment

Final Report

Biodiversity Assessment for proposed expansion to the Yannathan Sand Quarry: 870 and 910 Western Port Road, Yannathan, Victoria

Prepared for

Ricardo Energy Environment and Planning

September 2022

Ecology and Heritage Partners Pty Ltd

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DOCUMENT CONTROL

Assessment type	Biodiversity Assessment for proposed expansion to the Yannathan Sand Quarry
Address	870 and 910 Western Port Road, Yannathan, Victoria
Project number	14023
Project manager	Claire Ranyard (Senior Botanist)
Report reviewer	Shannon LeBel (Geelong Resource Manager / Associate Ecologist)
Other EHP staff	Nerissa Crabbe (Botanist); Anneke Martin (Consultant Botanist)
Mapping	Dr Monique Elsley (GIS Coordinator)
File name	14023_EHP_BA_YannathanQuarryExpansion_Final_16092022
Client	Ricardo Energy Environment and Planning
Bioregion	Gippsland Plain
Catchment Management Authority	Port Phillip and Westernport
Council	Cardinia Shire Council

VERSION CONTROL

Report versions	Comments	Comments made by:	Date submitted
Draft	Report sent to client for review	-	23/02/2021
Preliminary Final	Updated impact footprint, reassessment of significant flora and fauna under updated FFG Act, updated Avoid and Minimise statement, updated offset register search statement, and reference updates.	SLB/AM	06/09/2022
Final	Minor grammatical updates. Amended watercourse realignment shown.	SLB	16/09/2022

SUMMARY

Introduction

Ecology and Heritage Partners Pty Ltd was commissioned by Ricardo Energy Environment and Planning to conduct an Ecological Assessment of the proposed extension to the Yannathan Sand Quarry.

This assessment was undertaken to identify and characterise the vegetation on-site, determine the presence (or likelihood thereof) of any significant flora and fauna species and/or ecological communities, and address any implications under Commonwealth and State environmental legislation.

Methods

A field assessment was undertaken on 17 December 2020 to obtain information on terrestrial flora and fauna values within the study area. Vegetation within the study area was assessed according to the habitat hectare methodology, which is described in the Vegetation Quality Assessment Manual.

Results

Flora

Thirty flora species (13 native and 17 non-native) were recorded within the study area during the field assessment. Two flora species listed as protected under the *Flora and Fauna Guarantee Act 1988* were present within the study area. No additional significant flora species were recorded in the study area. Based on the highly modified nature of the study area, historical and ongoing land-uses, landscape context and the proximity of previous records, significant flora species are considered unlikely to occur within the study area due to the absence of suitable habitat and high levels of disturbance.

Fauna

No significant fauna species are considered likely to occur within the study area, due to the lack of suitable habitat features (e.g. wetlands, structurally diverse vegetation, hollow bearing trees), and modified state of the study area through previous removal of vegetation for agricultural use and construction of two large water retention basins.

Communities

Vegetation within the study area did not meet the condition thresholds that define any significant ecological communities.

Removal of native vegetation (the Guidelines)

The naturally established patches of Swampy Riparian Woodland shown on Figure 2 are not included in the impact assessment, due to being classified as ‘regrowth’ which has naturally established on the land within the last ten years.

The vegetation proposed to be removed is within Location 2, with one Large scattered tree (with an extent of 0.0703 hectares) proposed to be removed. As such, the permit application falls under the Intermediate Assessment pathway.

The offset requirement for native vegetation removal is 0.015 General Habitat Units (HUs) and one Large Tree.

Legislative and Policy Implications

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act - Federal)

No nationally significant values were recorded within the study area or are considered likely to occur, and the proposed action is unlikely to have a significant impact on any matter of NES. As such, a referral to the Commonwealth Environment Minister is not required regarding matters listed under the EPBC Act.

Flora and Fauna Guarantee Act 1988 (FFG Act - Victoria)

Two species listed as protected under the FFG Act were recorded within the study area, Prickly Moses *Acacia verticillata* and Shiny Cassinia *Cassinia longifolia*. A total of two Prickly Moses and approximately 15 Shiny Cassinia are proposed to be removed. The study area occurs within private property, therefore a permit under the FFG Act will not be required for the removal of these species.

Mineral Resources (Sustainable Development) Act 1990 (MRSD Act)

A work plan variation will need to be prepared as the proposed development does not meet any of the exemptions listed under the Act. In order for a Work Plan to be approved, the relevant State Government departments must be satisfied of “all necessary planning consents and approvals” including where Victoria’s native vegetation policy requires action has been addressed.

Planning and Environment Act 1987

The clearing of native vegetation for extractive industries is exempt from the requirement for a planning permit subject to an assessment as part of the work plan approval process.

Other Legislation and Policy

Implications relating to other local and State policy (*Wildlife Act 1975*, *Catchment and Land Protection Act 1994*, local government authorities) as well as additional studies or reporting that may be required (Conservation Management Plan, Weed Management Plan, Construction Environment Managements Plan) are provided in Section 4.

CONTENTS

1 INTRODUCTION

1.1 Background

Ecology and Heritage Partners Pty Ltd was commissioned by Ricardo Energy Environment and Planning on behalf of Hanson Construction Materials Pty Ltd (Hanson)to undertake a Biodiversity Assessment for proposed expansion to the Yannathan Sand Quarry at 870 and 910 Western Port Road, Yannathan, Victoria.

We understand that Hanson plan to extend the sand quarry extraction area boundary beyond the current Work Plan and realign the existing watercourse. As such, the Work Plan Variation requires an updated ecological assessment corresponding to the proposed extraction areas and watercourse.

The purpose of the assessment was to identify the extent and type of native vegetation present within the study area and to determine the presence of significant flora and fauna species and/or ecological communities. This report presents the results of the assessment and discusses the potential ecological and legislative implications associated with the proposed action. The report also provides recommendations to address or reduce impacts and, where necessary, highlights components that require further investigation.

1.2 Study Area

The study area is located in the north western section of 870 and 910 Western Port Road, Yannathan and is approximately 80 kilometres south-east of Melbourne's CBD (Figure 1). The study area covers approximately 23 hectares and is bound by the existing quarry along the southern boundary, Milners Road to the west, Western Port Road to the north, and agricultural land to the east. Past land use within the study area has historically been used for grazing activities and predominantly cleared of native vegetation (Plate 1).

In addition to grazing land, the study area supports four water retention basins, existing buildings, laydown areas, the main access road into the quarry and grazing land (Plate 2). It is generally flat, with no ridges, crests within or immediately adjacent to the site. A minor drainage line is present within the study area, running east to west through the middle of the site, which is proposed to be realigned.

For the purposes of this assessment, the proposed 'extension area' and 'realigned watercourse' areas (as shown in Figure 2) were subject to the on-ground assessment.

According to the Department of Environment, Land, Water and Planning (DELWP) NatureKit Map (DELWP 2022a), the study area is located within the Gippsland Plain bioregion, Port Phillip and Westernport Catchment Management Authority (CMA) and Cardinia Shire Council.

2 METHODS

2.1 Desktop Assessment

Relevant literature, online-resources and databases were reviewed to provide an assessment of flora and fauna values associated with the study area. The following information sources were reviewed:

- The DELWP NatureKit Map (DELWP 2022a) and Native Vegetation Information Management (NVIM) Tool (DELWP 2022b) for:
    - Modelled data for location risk, native vegetation patches, scattered trees and habitat for rare or threatened species; and,
    - The extent of historic and current Ecological Vegetation Classes (EVCs).
- EVC benchmarks (DELWP 2022c) for descriptions of EVCs within the relevant bioregion;
- The Victorian Biodiversity Atlas (VBA) for previously documented flora and fauna records within the project locality (DELWP 2022d);
- The Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool (PMST) for matters of National Environmental Significance (NES) protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (DCCEEW 2022);
- Relevant listings under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act), including the latest Threatened (DELWP 2022e) and Protected (DELWP 2019) Lists;
- The online VicPlan Map (DELWP 2022f) to ascertain current zoning and environmental overlays in the study area;
- Aerial photography of the study area; and
- Previous ecological assessments relevant to the study area; including;
    - Flora and Fauna Assessment and Net Gain Analysis of the Proposed Expansion of the Hanson Yannathan San Extraction Quarry, Victoria. Ecology and Heritage Partners 2013.

2.2 Field Assessment

A field assessment was undertaken on 17 December 2020 to obtain information on flora and fauna values within the study area. The study area was walked, with all commonly observed vascular flora and fauna species recorded, significant records mapped and the overall condition of vegetation and habitats noted. Ecological Vegetation Classes (EVCs) were determined with reference to DELWP pre-1750 and extant EVC mapping (DELWP 2022a) and their published descriptions (DELWP 2022c).

Plate 1. Previously disturbed agricultural land within the study area.

Plate 2. Water retention dams within the study area.

2.3 Removal, Destruction or Lopping of Native Vegetation (the Guidelines)

The clearing of native vegetation for mining and extractive industries is exempt from the requirement for a planning permit under the *Planning and Environment Act 1987* subject to an assessment as part of the work plan approval process required under the *Mineral Resources (Sustainable Development) Act 1990* (MRSD Act). The removal of native vegetation for the Earth Resources Industry (ERI) is regulated through the Mining and Extractive Industry Work Approvals Process. A Memorandum of Understanding (MoU) between the former DSE and DPI recognises that native vegetation should be offset in accordance with the relevant legislation.

Further information regarding the legislative requirements are provided in Section 4.

2.3.1 *Assessment Pathway*

The Guidelines manage the impacts on biodiversity from native vegetation removal using an assessment-based approach. Two factors – extent risk and location category – are used to determine the assessment pathway. The location category (1, 2 or 3) has been determined for all areas in Victoria and is available on DELWP's NVIM Tool (DELWP 2022b). Determination of assessment pathway is summarised in Table 1.

Table 1. Assessment pathways for applications to remove, destroy or lop native vegetation (DELWP 2017).

Extent		Location		
		1	2	3
Native Vegetation	Less than 0.5 hectares and not including any large trees	Basic	Intermediate	Detailed
	Less than 0.5 hectares and including one or more large trees	Intermediate	Intermediate	Detailed
	0.5 hectares or more	Detailed	Detailed	Detailed

Notes: For the purpose of determining the assessment pathway of an application to remove native vegetation the extent includes any other native vegetation that was permitted to be removed on the same contiguous parcel of land with the same ownership as the native vegetation to be removed, where the removal occurred in the five year period before an application to remove native vegetation is lodged.

2.3.2 *Vegetation Assessment*

Native vegetation (as defined in Table 2) is assessed using two key parameters: extent (in hectares) and condition. For the purposes of this assessment, both condition and extent were determined as part of the habitat hectare assessment.

Table 2. Determination of a patch of native vegetation (DELWP 2017).

Category	Definition	Extent	Condition
Patch of native vegetation	An area of vegetation where at least 25 per cent of the total perennial understorey plant cover is native; OR An area with three or more native canopy trees where the drip line of each tree touches the drip line of at least one other tree, forming a continuous canopy; OR any mapped wetland included in the *Current Wetlands map*, available in DELWP systems and tools.	Measured in hectares. Based on hectare area of the native patch.	Vegetation Quality Assessment Manual (DSE 2004). Modelled condition for *Current Wetlands*.
Scattered tree	A native canopy tree that does not form part of a native patch.	Measured in hectares. Each Large scattered tree is assigned an extent of 0.071 hectares (30m diameter). Each Small scattered tree is assigned a default extent of 0.31 hectares (10 metre diameter)	Scattered trees are assigned a default condition score of 0.2 (outside a patch).

Notes: Native vegetation is defined in the Victoria Planning Provisions as 'plants that are indigenous to Victoria, including trees, shrubs, herbs and grasses'.

2.3.3 *Impact Avoidance and Minimisation*

All applications to remove native vegetation must demonstrate the three-step approach of avoid, minimise and offset. This is a precautionary approach that aims to ensure that the removal of native vegetation is restricted to what is reasonably necessary, and that biodiversity is appropriately compensated for any native vegetation removal that is approved.

2.3.4 *Offsets*

Biodiversity offsets are required to compensate for the permitted removal of native vegetation. Offset obligations and offset site criteria are determined in accordance with the Guidelines (DELWP 2017) and are divided into two categories, being General Habitat Units and Species Habitat Units.

The offset requirements for native vegetation removal are calculated by DELWP and presented in a Native Vegetation Removal (NVR) Report, which are based on the vegetation condition scores determined during the biodiversity assessment.

2.4 Assessment Qualifications and Limitations

This report has been written based on the quality and extent of the ecological values and habitat considered to be present or absent at the time of the desktop and/or field assessments being undertaken.

The 'snapshot' nature of a standard biodiversity assessment meant that migratory, transitory or uncommon fauna species may have been absent from typically occupied habitats at the time of the field assessment. In addition, annual or cryptic flora species such as those that persist via underground tubers may also be absent.

A comprehensive list of all terrestrial flora and fauna present within the study area was not undertaken as this was not the objective of the assessment. Rather a list of commonly observed species was recorded to assist in determining the broader biodiversity values present within the study area.

Ecological values identified within the study area were recorded using a hand-held GPS or tablet with an accuracy of +/-3 metres. This level of accuracy is considered to provide an accurate assessment of the ecological values present within the study area; however, this data should not be used for detailed surveying purposes.

Targeted flora or fauna surveys were not undertaken, as this was beyond the preliminary scope of the project. Nevertheless, the terrestrial flora and fauna data collected during the field assessment and information obtained from relevant desktop sources is considered to adequately inform an accurate assessment of the ecological values present within the study area.

3 RESULTS

3.1 Vegetation Condition

Several patches of native vegetation, regrowth and one scattered native tree were recorded within the study area. The remainder of the study area comprised introduced and planted vegetation, present as pasture grass and screen plantings around buildings and along the property boundary.

A list of all flora species recorded during the field assessment are provided in Appendix 1.1.

3.1.1 *Patches of Native Vegetation*

Native vegetation in the study area is representative of one EVC: Swampy Riparian Woodland (EVC 83). The presence of this EVC is generally consistent with the modelled pre-1750s native vegetation mapping (DELWP 2022a), however the vegetation comprised within the patches has naturally regrown since the previous assessment undertaken in 2013 (Ecology and Heritage Partners 2013). Specific details relating to the observed EVC is provided below.

The results of the habitat hectare assessment are provided in Appendix 1.2.

Swampy Riparian Woodland

Swampy Riparian Woodland (SRW) was recorded within and directly adjacent to the study area, present in varying conditions. A linear strip of SRW was recorded adjacent to the western boundary of the study area, containing several large trees and an understory dominated by Swamp Paperbark *Melaleuca ericifolia* (SRW1, Figure 2). This patch is considered to be remnant

Within the study area, SRW occurred as naturally established (regrowth) vegetation. Previous vegetation mapping of the study area did not record any patches of SRW within the current study area (Ecology and Heritage Partners 2013), which is consistent with the historical imagery for the study area. The patches of SRW mapped in the recent assessment primarily comprised of scattered understory species, such as Shiny Cassinia *Cassinia longifolia*, Prickly Moses *Acacia verticillata,* Prickly Tea-tree *Leptospermum continentale* and Blackwood *Acacia melanoxylon* (SRW2, SRW3, SRW4, SRW5, SRW6, SRW 9, SRW10, SRW11, SRW12, SRW13, Figure 2*),* or patches of Common *Reed Phragmites australis,* Pale Rush *Juncus pallidus* and Tall Spike-rush *Eleocharis sphacelata* (SRW7 [Plate 3]; SRW8 [Plate 4], Figure 2). No patches contained large trees, supporting the conclusion that they have naturally established since the previous assessment was undertaken.

3.1.2 *Large Trees in Patches*

Five Large Trees, comprising four Swamp Gums *Eucalyptus ovata* and one stag, were recorded in the Swampy Riparian Woodland patch located along the western boundary of the study area (Plate 5; Figure 2).

3.1.3 *Scattered Trees*

One scattered tree, a large Swamp Gum, was recorded within the study area (Plate 6; Figure 2).

Plate 3. Patch of Rush establishment along the modified drainage line within the study area.

Plate 4. Patch of Tall Spike-rush establishment along the modified drainage line within the study area.

Plate 5. Large tree in a Swampy Riparian Woodland patch along the western boundary of the study area.

Plate 6. A large scattered Swamp Gum present in the north western corner of the study area.

3.1.4 Introduced and Planted Vegetation

Areas not supporting native vegetation had a high cover (>95%) of exotic grass species, dominated by environmental weeds such as Rye-grass *Lolium* spp., Sweet Vernal-grass *Anthoxanthum odoratum*, Yorkshire Fog *Holcus lanatus*, Brown-top Bent *Agrostis capillaris* and Prairie Grass *Bromus catharticus*.

Planted species occurred throughout the study area, with a selection of mixed native shrub species planted around the site office, containing Black Sheoak *Allocasuarina littoralis*, Prickly Tea-tree, Swamp Paperbark *Melaleuca ericifolia* and Blackwood. The location of planted vegetation is shown on Figure 2, which is mainly located on bund walls surrounding the outer edge of the western and northern side of the current study area (Plate 7).

Noxious weeds were present within the study area, with Blackberry *Rubus fruticosus* spp. agg. mainly located along the dam fringes and Spear Thistle *Cirsium vulgare* present in limited numbers within the study area's southern half (Plate 8; Figure 2). Blackberry is also a Weed of National Significance (WoNS).

Plate 7. A row of planted trees along the study area's western boundary.

Plate 8. A noxious weed, Spear Thistle, present along the dam edge within the study area.

3.2 Fauna Habitat

Most of the study area consisted of paddocks and existing dams, which contained improved exotic pastures, likely to be used as a foraging resource by common generalist bird species that are tolerant of modified open areas. Fauna observed using this habitat included; Pacific Black Duck *Anas superciliosa*, Australian Magpie *Cracticus tibicen*, Common Blackbird *Turdus merula*, Welcome Swallow *Hirundo neoxenica* and Eastern Banjo Frog *Limnodynastes dumerilii.*

It should be noted that since the assessment was undertaken, the two dams present within the proposed extension area have been removed as per a directive from Earth Resources Regulations (ERR), and aquatic habitat is no longer present.

3.3 Removal, Destruction or Lopping of Native Vegetation (the Guidelines)

The below clearing scenario is based on the removal of native vegetation present within the current study area, as provided by Ricardo Energy Environment and Planning on 25 August 2022 (Figure 2). The naturally established patches of Swampy Riparian Woodland shown on Figure 2 are not included in the below assessment due to being classified as regrowth which has naturally established on the land within the last ten years (See Section 4.3.2 for further details). This includes 0.73 hectares of naturally established Swampy Riparian Woodland within the proposed extension area.

3.3.1 Vegetation proposed to be removed

The study area is within Location 2, with 0.0703 hectares of native vegetation proposed to be removed (Figure 2). As such, the permit application falls under the Intermediate assessment pathway (Table 3).

Table 3. Removal of Native Vegetation (the Guidelines) (DELWP 2017).

Assessment pathway	Intermediate
Location Category	2
Total Extent (past and proposed) (ha)	0.0703
Extent of past removal (ha)	0.00
Extent of proposed removal (ha)	0.0703
Large Trees (scattered and in patches) to be removed (no.)	1
EVC Conservation Status of vegetation to be removed	Endangered (Swampy Riparian Woodland)

3.3.2 *Offset Targets*

The offset requirement for native vegetation removal is 0.015 General Habitat Units and 1 Large Tree.

A summary of proposed vegetation losses and associated offset requirements is presented in Table 4 and the Native Vegetation Removal (NVR) report is presented in Appendix 3.

Table 4. Offset Targets.

General Offsets Required	0.015 General Habitat Units
Large Trees	1
Vicinity (catchment/council)	Port Phillip and Westernport CMA / Cardinia Shire Council
Minimum Strategic Biodiversity Value*	0.352

*The minimum Strategic Biodiversity Value is 80% of the weighted average score across habitat zones where a General offset is required.

3.4 Significance Assessment

3.4.1 *Flora*

The VBA contains records of one nationally significant and nine State significant flora species previously recorded within 10 kilometres of the study area (DELWP 2022d) (Figure 3). The PMST nominated 12 additional nationally significant species which have not been previously recorded but have the potential to occur in the locality (DCCEEW 2022) (Appendix 1.4).

No national or State significant flora were recorded during the site assessment, and based on the highly modified and disturbed condition of the study area, landscape context and the proximity of previous records, significant flora species are considered unlikely to occur within the study area due to the and high levels of disturbance through past agricultural activities (e.g. pasture paddocks), construction of two large water retention dams and absence of suitable habitat.

3.4.2 *Fauna*

The VBA contains records of 11 nationally significant and 12 State significant fauna species previously recorded within 10 kilometres of the study area (DELWP 2022d) (Figure 4). The PMST nominated an additional 19 nationally significant species which have not been previously recorded but have the potential to occur in the locality (DCCEEW 2022) (Appendix 2.1).

There are 155 previous records of Southern Brown Bandicoot *Isoodon obesulus* within 10 kilometres of the study area (Figure 4; Appendix 2.1). The habitat preferences of Southern Brown Bandicoot are relatively broad, with the species known to occur in a variety of habitats, including seemingly disturbed areas dominated by exotic species (e.g. Blackberry *Rubus* spp.) (Maclagan *et al.* 2018).

However, the vegetation within the proposed extraction extension footprint did not contain any of the preferred habitat characteristics of Southern Brown Bandicoot, with a lack of structural vegetation (e.g. shrubs or large tussocks). Further, the study area is relatively isolated from nearby habitat corridors. As a result, Southern Brown Bandicoot are considered unlikely to occur within the expansion footprint or use the vegetation within the extraction footprint as a habitat corridor to traverse between other habitats. Linear corridors of vegetation are present surrounding the study area within the road reserves of Milners Road and Burt Road, however no impacts are proposed to these areas.

The nearby past Southern Brown Bandicoot records are largely confined to Adams Creek Nature Conservation Reserve, which is a large bushland reserve located approximately six kilometres south of the study area (Figure 4).

Based on the modified nature of the study area, the removal of the dams (as per an ERR directive), landscape context and the proximity of previous records, additional significant fauna species are considered unlikely to rely on habitat within the study area for foraging or breeding purposes due to the lack of suitable and/or important habitat features (e.g. large, hollow bearing trees).

3.4.3 *Ecological Communities*

No national or State-significant communities are present within the study area.

4 LEGISLATIVE AND POLICY IMPLICATIONS

4.1 *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) establishes a Commonwealth process for the assessment of proposed actions likely to have a significant impact on any matters of National Environment Significance (NES), described in Table 5.

Table 5. Potential impacts to matters of National Environmental Significance (NES)

Matter of NES	Potential Impacts
World Heritage properties	The proposed action will not impact any properties listed for World Heritage.
National heritage places	The proposed action will not impact any places listed for national heritage.
Ramsar wetlands of international significance	The study area occurs upstream of one Ramsar wetland (DCCEEW 2022): Westernport Ramsar site (10 – 15 kms) Provided management practices and construction techniques are consistent with Construction Techniques for Sediment Pollution Control (EPA 1991) and Environmental Guidelines for Major Construction Sites (EPA 1996), the proposed action is highly unlikely to impact the ecological character of any Ramsar wetland.
Threatened species and ecological communities	No nationally significant flora species were recorded within the study area.
Migratory and marine species	There is no marine habitat within the study area. Further, the study area would not be classed as an 'important habitat' as defined under the EPBC Act Policy Statement 1.1 Principal Significant Impact Guidelines (DoE 2013), in that it does not contain: • Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; • Habitat utilised by a migratory species which is at the limit of the species range; or, • Habitat within an area where the species is declining.
Commonwealth marine area	The proposed action will not impact any Commonwealth marine areas.
Nuclear actions (including uranium mining)	The proposed action is not a nuclear action.
Great Barrier Reef Marine Park	The proposed action will not impact the Great Barrier Reef Marine Park.
Water resources impacted by coal seam gas or mining development	The proposed action is not a coal seam gas or mining development.

4.1.1 *Implications*

No nationally significant values were recorded within the study area or are considered likely to occur, and the proposed action is highly unlikely to have a significant impact on any matter of NES. As such, a referral to the Commonwealth Environment Minister is not required regarding matters listed under the EPBC Act.

4.2 *Flora and Fauna Guarantee Act 1988* (Victoria)

The FFG Act is the primary legislation dealing with biodiversity conservation and sustainable use of native flora and fauna in Victoria. Proponents are required to apply for an FFG Act Permit to 'take' listed and/or protected flora species, listed vegetation communities and listed fish species in areas of public land (i.e. within road reserves, drainage lines and public reserves). An FFG Act permit is generally not required for removal of species or communities on private land, or for the removal of habitat for a listed terrestrial fauna species.

No species listed under the FFG Act were recorded within the study area during the field assessment. The following threatening processes listed under the FFG Act should be considered in relation to the proposed development:

- Invasion of native vegetation by 'environmental weeds'.
- Alteration to the natural flow regimes of rivers and streams.

4.2.1 *Implications*

Two species listed as protected under the FFG Act were recorded within the study area, Prickly Moses and Shiny Cassinia. A total of two Prickly Moses and approximately 15 Shiny Cassinia are proposed to be removed. The study area occurs within private property, therefore a permit under the FFG Act will not be required for the removal of these species.

4.3 *Planning and Environment Act 1987* (Victoria)

The *Planning and Environment Act 1987* outlines the legislative framework for planning in Victoria and for the development and administration of planning schemes. All planning schemes contain native vegetation provisions at Clause 52.17 which require a planning permit from the relevant local Council to remove, destroy or lop native vegetation on a site of more than 0.4 ha, unless an exemption under Clause 52.17-7 of the Victorian Planning Schemes applies.

Importantly, under the exemptions outlined in Clause 52.17-7 of the Cardinia Shire Planning Scheme, a permit is not required where native vegetation that is to be removed, destroyed or lopped to the minimum extent necessary to enable the carrying out of extractive industry in accordance with a work plan approved under the *Mineral Resources (Sustainable Development) Act 1990* and authorised by a work authority under that Act.

4.3.1 *Local Planning Scheme*

The study area is located within the Cardinia Shire Council. The study area is zoned Green Wedge Zone 1 (GWZ 1) and is covered by a Significant Landscape Overlay – Schedule 3 (SLO3) (DELWP 2022f).

4.3.2 *Implications*

Extractive Industry

The clearing of native vegetation for mining and extractive industries is exempt from the requirement for a planning permit subject under the 'Stone Extraction' exemption detailed in Clause 52.17-7 of the Cardinia Shire Planning Scheme subject to an assessment as part of the work plan approval process (MRSD Act).

Regrowth

No permit is required to remove, destroy or lop native vegetation that has naturally established or regenerated on land lawfully cleared of naturally established native vegetation, and is less than 10 years old.

The native vegetation within the current proposed extraction footprint was previously assessed in 2013, which did not record any patches of Swampy Riparian Woodland at the time. The initial vegetation clearing of the property occurred prior to 1995 (when Hanson purchased the land), with the previous land use as agriculture, and the vegetation with the study area maintained as cleared land through regular slashing (pers. comm. Yannathan Quarry Manager).

Based upon the vegetation mapping completed in 2013 (Ecology and Heritage Partners 2013), historical land use of the study area and a review of the aerial imagery, it is considered that the SRW patches within the 'extension area' have naturally regenerated on land lawfully cleared of naturally established native vegetation, and is less than 10 years old, and therefore meets the definition of 'regrowth' as per Clause 52.17-7 of the Cardinia Shire planning scheme. As such, these areas have been excluded from the native vegetation impact assessment detailed in Section 3.3.

Significant Landscape Overlay – Schedule 3

No permit under the SLO is required for vegetation that is to be removed, destroyed or lopped to the minimum extent necessary to enable the carrying out of extractive industry in accordance with a work plan approved under the *Mineral Resources (Sustainable Development) Act 1990* and authorised by a work authority granted under that Act.

4.4 *Mineral Resources (Sustainable Development) Act 1990* (Victoria)

Mineral exploration and mining in Victoria are regulated under the *Mineral Resources (Sustainable Development) Act 1990* (MRSD Act). The purpose of this Act is to encourage an economically viable mining industry that operates in a way that is compatible with the environmental, social and economic objectives of the State.

One of the key objectives of this legislation is to establish a legal framework to ensure that mineral resources are developed in ways that minimise the impacts on the environment. The Act requires that a licensee proposing to work under a mining licence submit a Work Plan.

Section 79 of the Act requires that the Work Plan includes a 'Rehabilitation Plan' for the progressive rehabilitation of land disturbed by the project.

The 'Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019' require that, as of 1 July 2020, the Rehabilitation Plan component of the draft mining Work Plan must include the proposed land uses after rehabilitation, which must consider the community views expressed during consultation.

The Regulations also require that the draft mining Work Plan must include an identification and assessment of the risks that may require monitoring, maintenance, treatment or other ongoing land management activities after rehabilitation is complete, in relation to the environment, any member of the public, or land, property or infrastructure in the vicinity of the rehabilitated land.

4.4.1 *Implications*

In order for a Work Plan to be approved, DELWP and the Department of Jobs, Precincts and Regions (DJPR) must be satisfied of "all necessary planning consents and approvals" including where Victoria's native vegetation policy requires action, has been addressed (DPI 2009).

4.4.2 *The Guidelines*

The State Planning Policy Framework and the decision guidelines at Clause 12.01 Biodiversity and Clause 52.17 Native Vegetation require Planning and Responsible Authorities to have regard for the Guidelines (DELWP 2017).

The vegetation proposed to be removed is within Location 2, with one Large scattered tree (with an extent of 0.0703 hectares) proposed to be removed. As such, the permit application falls under the Intermediate Assessment pathway.

The offset requirement for native vegetation removal is 0.015 General Habitat Units (HUs) and one Large Tree.

4.5 *Catchment and Land Protection Act 1994* (Victoria)

Two weeds listed as noxious under the *Catchment and Land Protection Act 1994* was recorded during the assessment, Blackberry and Spear Thistle (Figure 2). Similarly, there is evidence that the study area is currently occupied by several pest fauna species listed under the CaLP Act, European Rabbit *Oryctolagus cuniculus*, Red Fox *Vulpes vulpes*. Listed noxious weeds/pests should be appropriately controlled throughout the study area.

4.6 *Wildlife Act 1975* and Wildlife Regulations 2013 (Victoria)

The *Wildlife Act 1975* (and associated Wildlife Regulations 2013) is the primary legislation in Victoria providing for protection and management of wildlife. Authorisation for habitat removal may be obtained under the *Wildlife Act 1975* through a licence granted under the *Forests Act 1958*, or under any other Act such as the *Planning and Environment Act 1987*. Any persons engaged to remove, salvage, hold or relocate native fauna during construction must hold a current Management Authorisation under the *Wildlife Act 1975*, issued by DELWP.

5 MITIGATION MEASURES

5.1 Avoid and Minimise Statement

The study area has not been subject to a strategic level planning process for the purposes of detailing native vegetation removal. However, the study area is within covered by the Cardinia Western Port green Wedge Management Plan (Cardinia Shire Council 2017).

It is not possible to avoid impacts to native vegetation without undermining the requirements of the project. Due to the nature of the proposed development (extractive industry) and the location of the resource in the ground, the extraction footprint is proposed to extend north from the existing extraction pit.

The extent of native vegetation within the study area is minimal, and predominately comprises of low quality vegetation which has re-established over the past ten years. One large native scattered tree is located in the north western corner. When identified during the site assessment, the tree was observed partially lying down, likely to have fallen during strong winds over the previous years, although still appeared to be surviving (Section 3.1.3, Plate 5).

In the context of the development, the modified condition of ecological values proposed to be impacted, and the extent of native vegetation proposed to be retained and enhanced within the study area, it is considered that the minimisation measures implemented are appropriate in this instance.

No feasible opportunities exist to further avoid or minimise impacts on native vegetation without undermining the key objectives of the proposal

5.2 Best Practice Mitigation Measures

Recommended measures to mitigate impacts upon terrestrial and aquatic values present within the study area may include:

- Ensuring any proposed works remain within the intended extraction (and greater development) footprint, i.e. not disturbing or removing areas of native vegetation outside the proposed works area. This also applies to machinery storage, materials stockpiles, personnel rest areas and access roads;
- Minimise impacts to native vegetation and habitats through construction and micro-siting techniques, including fencing retained areas of native vegetation. If indeed necessary, trees should be lopped or trimmed rather than removed. Similarly, soil disturbance and sedimentation within wetlands should be avoided or kept to a minimum, to avoid, or minimise impacts to fauna habitats;
- All contractors should be aware of ecologically sensitive areas to minimise the likelihood of inadvertent disturbance to areas marked for retention. Native vegetation (areas of sensitivity) should be included as a mapping overlay on any construction plans;
- Where possible, construction stockpiles, machinery, roads, and other infrastructure should be placed away from areas supporting native vegetation and wetlands;
- Ensure that best practice sedimentation and pollution control measures are undertaken at all times, in accordance with Environment Protection Authority guidelines (EPA 1991; EPA 1996; Victorian Stormwater Committee 1999) to prevent offsite impacts to waterways and wetlands; and,

- As indigenous flora provides valuable habitat for indigenous fauna, it is recommended that any landscape plantings that are undertaken as part of the proposed works are conducted using indigenous species sourced from a local provenance, rather than exotic deciduous trees and shrubs.

5.3 Offset Impacts and Strategy

According to DELWPs Native Vegetation Offset Register (DELWP 2022g), there are 23 offset sites within the Port Phillip and Westernport CMA and/or Cardinia Shire Council region that can be used to satisfy the General Habitat Unit and Large tree offset requirements.

An offset register search statement identifying the relevant offsite sites is provided in Appendix 4.

6 FURTHER REQUIREMENTS

Further requirements associated with development of the study area, as well as additional studies or reporting that may be required, are provided in Table 6.

Table 6. Further requirements associated with development of the study area.

Relevant Legislation	Implications	Further Action
Environment Protection and Biodiversity Conservation Act 1999	No nationally significant values were recorded within the study area or are considered likely to occur, and the proposed action is unlikely to have a significant impact on any matter of NES. As such, a referral to the Commonwealth Environment Minister is not required regarding matters listed under the EPBC Act.	No further action required.
Flora and Fauna Guarantee Act 1988	Two species listed as protected under the FFG Act were recorded within the study area, Prickly Moses and Shiny Cassinia. A total of two Prickly Moses and approximately 15 Shiny Cassinia are proposed to be removed. The study area occurs within private property, therefore a permit under the FFG Act will not be required for the removal of these species.	No further action required.
Mining Resources (Sustainable Development) Act 1990	A Work Plan variation will need to be updated in order to comply with the requirements of the MRSD Act. The offset requirement for native vegetation removal is 0.015 General Habitat Units and 1 Large Tree.	Prepare and submit a variation to the Work Plan.
Planning and Environment Act 1987	The clearing of native vegetation for mining and extractive industries is exempt from the requirement for a planning permit subject under the 'Stone Extraction' exemption detailed in Clause 52.17-7, and Clause 42.03 (SLO) of the Cardinia Shire Council planning scheme subject to an assessment as part of the work plan approval process (MRSD Act).	No further action required (for native vegetation removal).
Catchment and Land Protection Act 1994	Two weed species listed under the CaLP Act were recorded within the study area (Blackberry and Spear Thistle). To meet requirements under the CaLP Act, listed noxious weeds should be appropriately controlled throughout the study area.	Listed noxious weeds and pests should be appropriately controlled throughout the study area
Wildlife Act 1975	Any persons engaged to conduct salvage and translocation or general handling of terrestrial fauna species must hold a current Management Authorisation.	Ensure wildlife specialists hold a current Management Authorisation.

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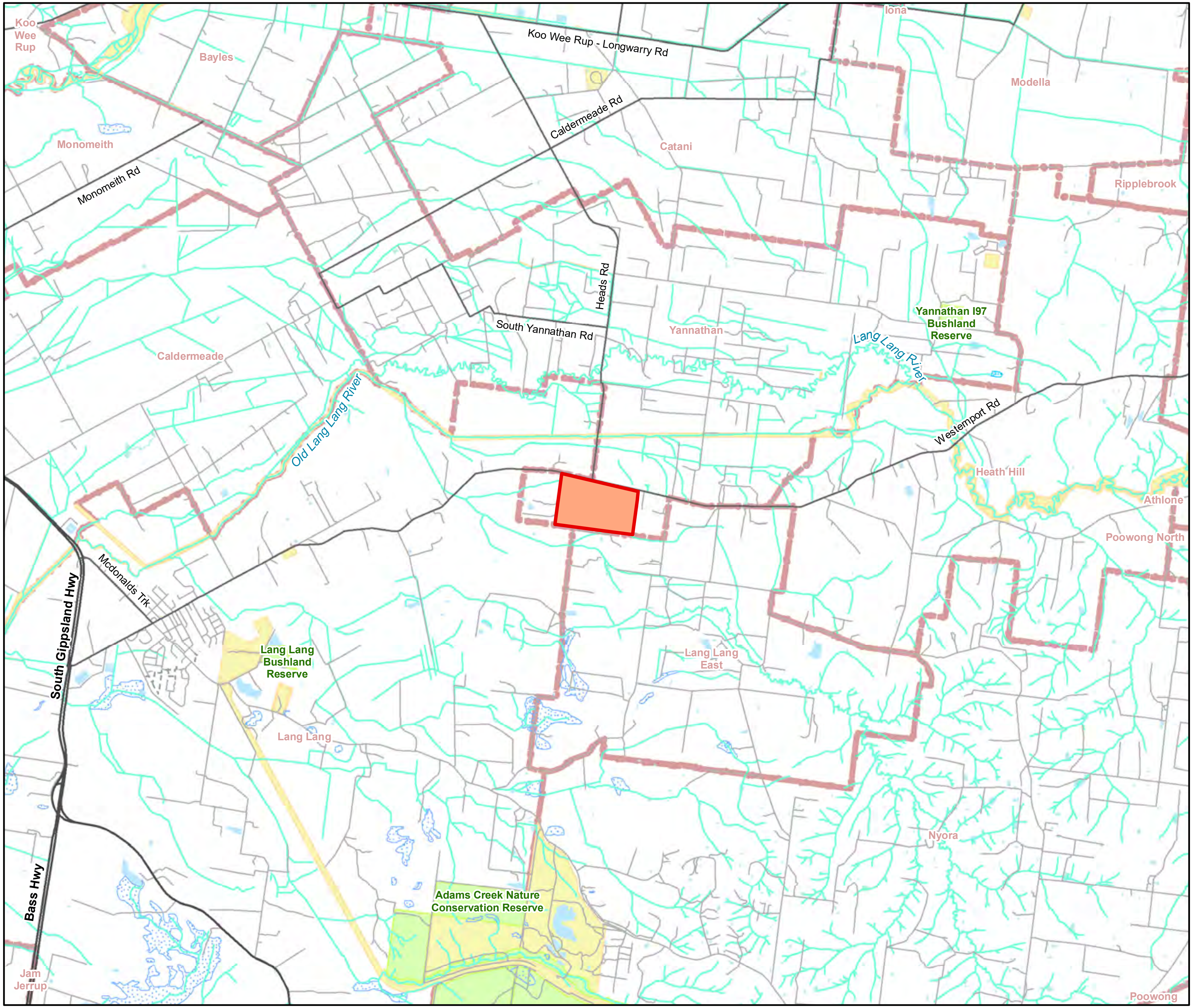


Figure 1

Location of the study area

Biodiversity Assessment at Yannathan Quarry

N

0 1 2

Kilometres

Map Scale: 1:75,000 @ A4
Coordinate System: GDA2020 MGA Zone 55

ecology & heritage partners

14023_Fig01_StudyArea_G20 24/08/2020 melsley

Figure 2

Ecological features

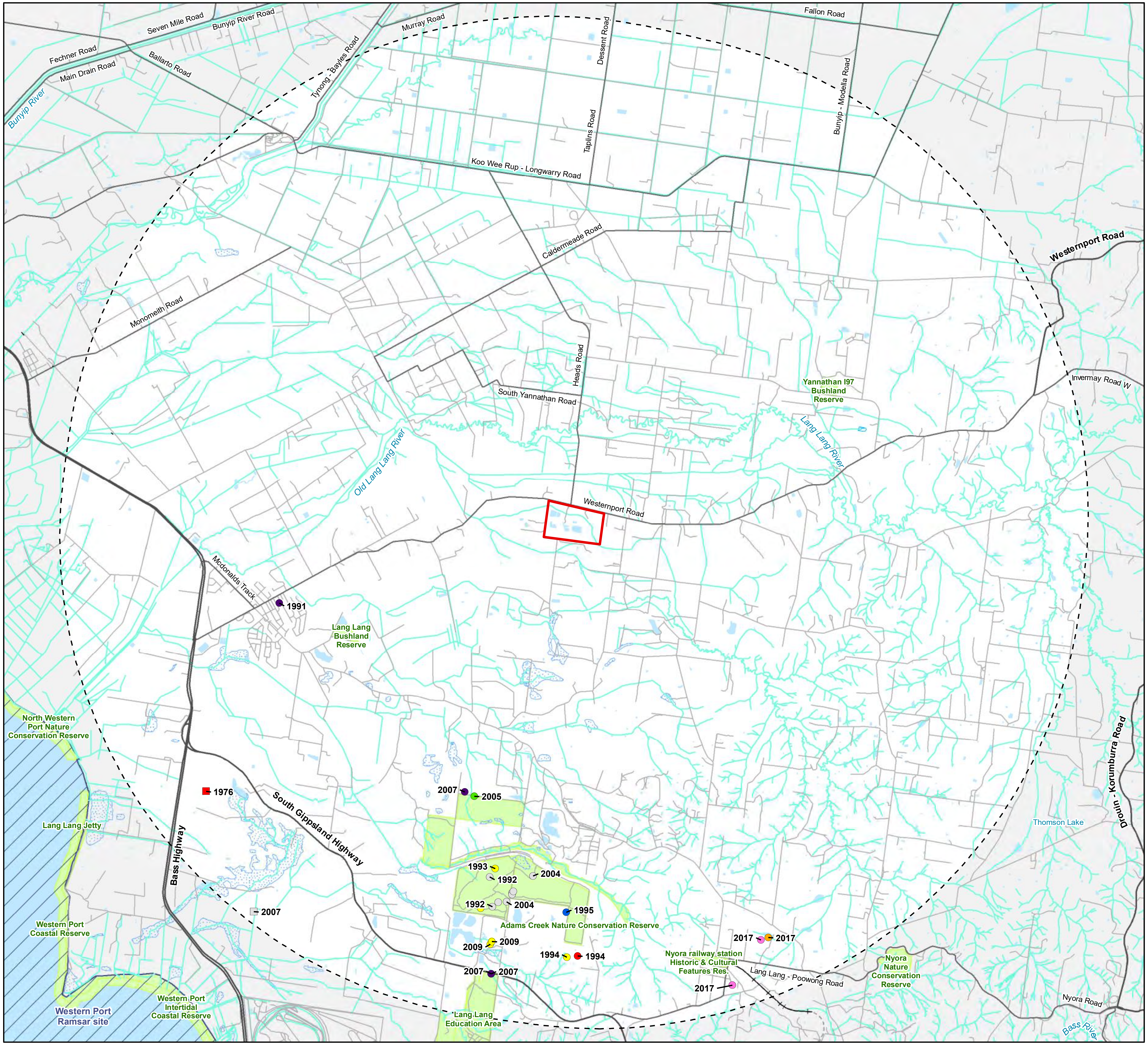
Biodiversity Assessment at Yannathan Quarry

Map Scale: 1:5,700 @ A4
Coordinate System: GDA2020 MGA Zone 55

ecology & heritage partners

14023_Fig02_EcoFeat_G20 14/09/2022 dvaladares

Aerial source: Nearmap 2020



Legend

🟥 Study Area

Significant flora

- ● Clasping Hypocreopsis
- ● Cobra Greenhood
- ● Giant Honey-myrtle
- ● Green-striped Greenhood
- ● Large-leaf Cinnamon-wattle
- ● Mauve-tuft Sun-orchid
- ● Spotted Gum
- ● Spurred Helmet-orchid
- ■ Veined Spear-grass
- ■ Velvet Apple-berry

Figure 3

Previously documented significant flora within 10km of the study area

Biodiversity Assessment at Yannathan Quarry

Map Scale: 1:75,000 @ A3
Coordinate System: GDA2020 MGA Zone 55

ecology & heritage partners

Victorian Biodiversity Atlas (VBA) // Sourced from: 'VBA_FLORA25', 'VBA_FLORA100', 'VBA_FAUNA25' and 'VBA_FAUNA100', Updated May 2022 © The State of Victoria, Department of Environment, Land, Water and Planning. Records prior to 1949 not shown.

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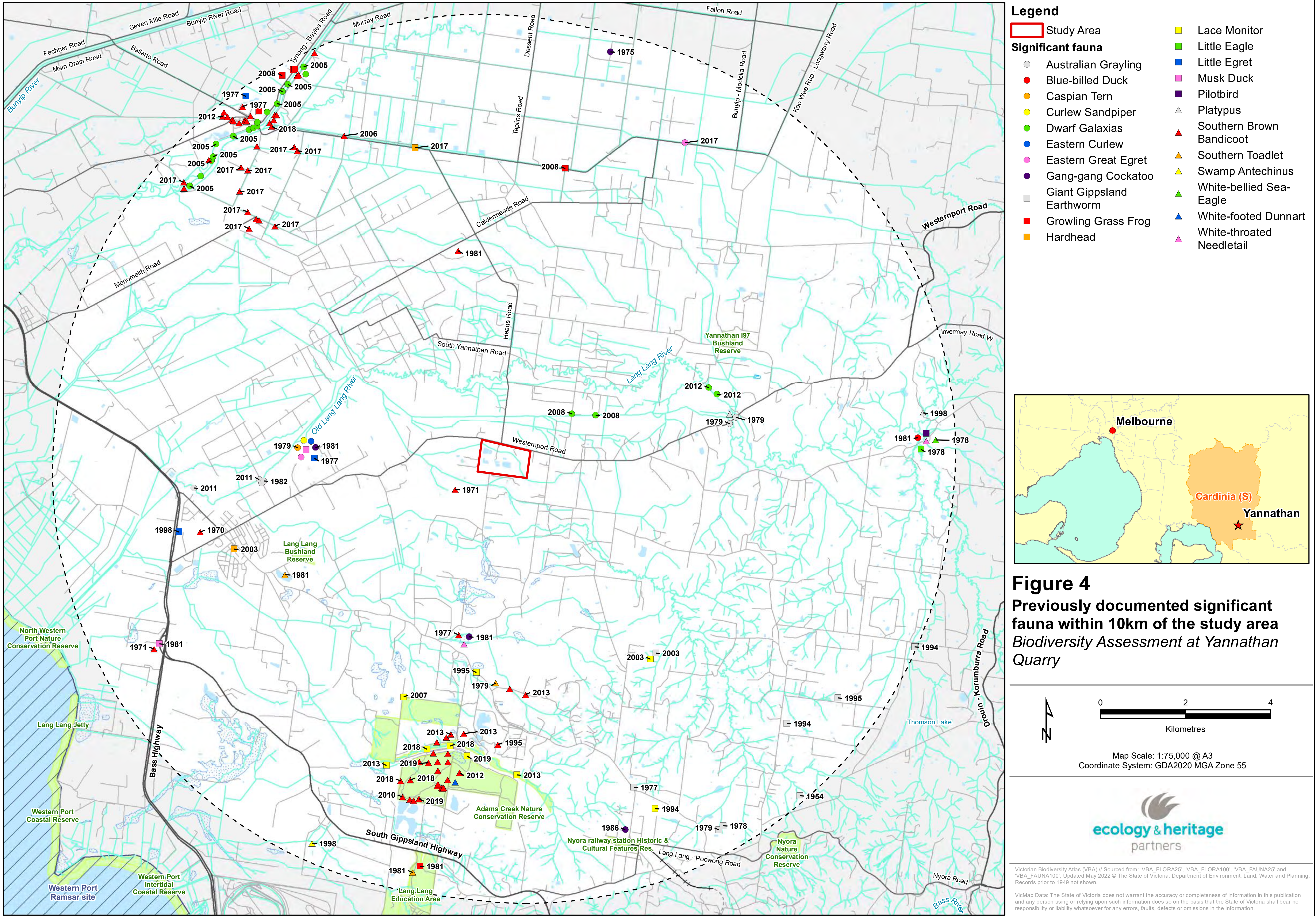


Figure 4

Previously documented significant fauna within 10km of the study area

Biodiversity Assessment at Yannathan Quarry

ecology & heritage partners

Victorian Biodiversity Atlas (VBA) // Sourced from: 'VBA_FLORA25', 'VBA_FLORA100', 'VBA_FAUNA25' and 'VBA_FAUNA100', Updated May 2022 © The State of Victoria, Department of Environment, Land, Water and Planning. Records prior to 1949 not shown.

14023_Fig04_SigFauna_G20 18/08/2022 melsley

APPENDIX 1 FLORA

Appendix 1.1 Flora Results

Legend:

I Protected under the FFG Act (DELWP 2019);

***** Listed as a noxious weed under the CaLP Act;

+ Planted indigenous species that also occur in native vegetation in the study area;

****** Planted indigenous species in the study area;

w Weed of National Significance.

Table A1.1. Flora within the study area.

Scientific Name	Common Name	Notes
INDIGENOUS SPECIES		
Acacia melanoxylon	Blackwood	-
Acacia spp.	Wattle	-
Acacia verticillata	Prickly Moses	I
Allocasuarina littoralis	Black Sheoak	**
Cassinia longifolia	Shiny Cassinia	I
Eleocharis sphacelata	Tall Spike-sedge	-
Eucalyptus ovata	Swamp Gum	+
Eucalyptus radiata s.l.	Narrow-leaf Peppermint	**
Juncus pallidus	Pale Rush	-
Juncus spp.	Rush	-
Leptospermum continentale	Prickly Tea-tree	**
Melaleuca ericifolia	Swamp Paperbark	**
Phragmites australis	Common Reed	-
NON-INDIGENOUS OR INTRODUCED SPECIES		
Agrostis capillaris	Brown-top Bent	-
Anthoxanthum odoratum	Sweet Vernal-grass	-
Brassica spp.	Turnip	-
Bromus catharticus	Prairie Grass	-
Cirsium vulgare	Spear Thistle	*
Daucus carota	Carrot	-
Holcus lanatus	Yorkshire Fog	-
Hypochaeris radicata	Flatweed	-
Lolium perenne	Perennial Rye-grass	-

Scientific Name	Common Name	Notes
Lotus angustissimus	Slender Bird's-foot Trefoil	-
Malva parviflora	Small-flower Mallow	-
Paspalum dilatatum	Paspalum	-
Plantago lanceolata	Ribwort	-
Romulea rosea	Onion Grass	-
Rubus fruticosus spp. agg.	Blackberry	*w
Sonchus asper s.l.	Rough Sow-thistle	-
Trifolium spp.	Clover	-

Appendix 1.2 Habitat Hectare Assessment

Table A1.2. Habitat Hectare Assessment Table.

Vegetation Zone		**SRF1**	**SRW7-SRF8 (regrowth)**	**SRF2-6; SRW9-13 (regrowth)**
Bioregion		Gippsland Plain	Gippsland Plain	Gippsland Plain
EVC / Tree		Swampy Riparian Woodland	Swampy Riparian Woodland	Swampy Riparian Woodland
EVC Number		83	83	83
EVC Conservation Status		Endangered	Endangered	Endangered
Patch Condition	Large Old Trees /10	9	0	0
	Canopy Cover /5	4	0	0
	Under storey /25	10	5	5
	Lack of Weeds /15	2	2	2
	Recruitment /10	3	0	3
	Organic Matter /5	3	3	4
	Logs /5	2	0	0
	Treeless EVC Multiplier	1.00	1.00	1.00
	Subtotal =	33.00	10.00	14.00
Landscape Value /25		3	3	3
Habitat Points /100		36	13	17
Habitat Score		**0.36**	**0.13**	**0.17**

Appendix 1.3 Scattered Trees and Large Trees in Patches

Table A1.3. Scattered Trees and Large Trees in Patches.

Tree # (Figure 2)	Species Name	Common Name	DBH (cm)	Size Class	Scattered / Patch	Habitat features	Status
1	Swamp Gum	*Eucalyptus ovata*	96	Large	Scattered	-	Removed (direct impact)
27	stag	-	77	Large	Patch	Hollow	Retained
28	Swamp Gum	*Eucalyptus ovata*	74	Large	Patch	-	Retained
29	Swamp Gum	*Eucalyptus ovata*	72	Large	Patch	-	Retained
30	Swamp Gum	*Eucalyptus ovata*	70	Large	Patch	-	Retained
31	Swamp Gum	*Eucalyptus ovata*	72	Large	Patch	-	Retained

Appendix 1.4 Significant Flora Species

Significant flora within 10 kilometres of the study area is provided in the Table A1.4.3 at the end of this section, with Tables A1.4.1 and A1.4.2 below providing the background context for the values in Table 1.4.3.

Table A1.4.1 Conservation status of each species for each Act. The values in this table correspond to Columns 5 and 6 in Table A1.4.3.

EPBC (*Environment Protection and Biodiversity Conservation Act 1999*):		FFG (*Flora and Fauna Guarantee Act 1988*):	
EX	Extinct	ex	Extinct
CR	Critically endangered	cr	Critically endangered
EN	Endangered	en	Endangered
VU	Vulnerable	vu	Vulnerable
#	Listed on the Protected Matters Search Tool		

Table A1.4.2 Likelihood of occurrence rankings: Habitat characteristics assessment of significant flora species previously recorded within 10 kilometres of the study area, or that may potentially occur within the study area to determine their likelihood of occurrence. The values in this table correspond to Column 7 in Table A1.4.3.

1	Known Occurrence	• Recorded within the study area recently (i.e. within ten years).
2	High Likelihood	• Previous records of the species in the local vicinity; and/or, • The study area contains areas of high-quality habitat.
3	Moderate Likelihood	• Limited previous records of the species in the local vicinity; and/or • The study area contains poor or limited habitat.
4	Low Likelihood	• Poor or limited habitat for the species, however other evidence (such as lack of records or environmental factors) indicates there is a very low likelihood of presence.
5	Unlikely	• No suitable habitat and/or outside the species range.

Table A1.4.3 Significant flora recorded within 10 kilometres of the study area.

Scientific name	Common name	Total # of documented records	Last documented record	EPBC	FFG	Likely occurrence in study area
NATIONAL SIGNIFICANCE						
Amphibromus fluitans #	River Swamp Wallaby-grass	-	-	VU	-	4
Caladenia orientalis #	Eastern Spider Orchid	-	-	EN	en	5
Caladenia tessellata #	Thick-lipped Spider-orchid	-	-	VU	-	4
Dianella amoena #	Matted Flax-lily	-	-	EN	cr	4
Eucalyptus strzeleckii #	Strzelecki Gum	-	-	VU	cr	4
Glycine latrobeana #	Clover Glycine	-	-	VU	vu	4
Lepidium aschersonii #	Spiny Pepper-cress	-	-	VU	en	4
Prasophyllum spicatum #	Dense Leek-orchid	-	-	VU	cr	4
Pterostylis chlorogramma #	Green-striped Greenhood	5	2009	VU	en	4
Pterostylis cucullata #	Leafy Greenhood	-	-	VU	en	4
Senecio psilocarpus #	Swamp Fireweed	-	-	VU	-	4
Thelymitra epipactoides #	Metallic Sun-orchid	-	-	EN	en	4
Xerochrysum palustre #	Swamp Everlasting	-	-	VU	cr	4
STATE SIGNIFICANCE						
Acacia leprosa var. *uninervia*	Large-leaf Cinnamon-wattle	1	2005	-	en	4
Austrostipa rudis subsp. *australis*	Veined Spear-grass	1	2007	-	en	4
Billardiera scandens s.s.	Velvet Apple-berry	1	1976	-	en	4
Corybas aconitiflorus	Spurred Helmet-orchid	4	2007	-	en	4
Corymbia maculata	Spotted Gum	2	2017	-	vu	4

Scientific name	Common name	Total # of documented records	Last documented record	EPBC	FFG	Likely occurrence in study area
Hypocreopsis amplectens	Clasping Hypocreopsis	9	2004	-	cr	4
Melaleuca armillaris subsp. *armillaris*	Giant Honey-myrtle	1	2017	-	en	4
Pterostylis grandiflora	Cobra Greenhood	1	1994	-	en	4
Thelymitra malvina	Mauve-tuft Sun-orchid	1	1995	-	en	4

Data source: Victorian Biodiversity Atlas (DELWP 2022d); Protected Matters Search Tool (DCCEEW 2022).

APPENDIX 2 FAUNA

Appendix 2.1 Significant Fauna Species

Significant fauna within 10 kilometres of the study area is provided in the Table A2.1.3 at the end of this section, with Tables A2.1.1 and A2.1.2 below providing the background context for the values in Table 2.1.3.

Table A2.1.1 Conservation status of each species for each Act/Plan. The values in this table correspond to Columns 5 to 7 in Table A2.1.3.

EPBC (*Environment Protection and Biodiversity Conservation Act 1999*):		FFG (*Flora and Fauna Guarantee Act 1988*):	
EX	Extinct	EX	Extinct
CR	Critically endangered	CR	Critically endangered
EN	Endangered	EN	Endangered
VU	Vulnerable	VU	Vulnerable
CD	Conservation dependent	CD	Conservation dependent
#	Listed on the Protected Matters Search Tool		

Table A2.1.2 Likelihood of occurrence rankings: Habitat characteristics assessment of significant fauna species previously recorded within 10 kilometres of the study area, or that may potentially occur within the study area to determine their likelihood of occurrence. The values in this table correspond to Column 7 in Table A2.1.3.

1	High Likelihood	• Known resident in the study area based on site observations, database records, or expert advice; and/or, • Recent records (i.e. within five years) of the species in the local area (DELWP 2018); and/or, • The study area contains the species' preferred habitat.
2	Moderate Likelihood	• The species is likely to visit the study area regularly (i.e. at least seasonally); and/or, • Previous records of the species in the local area (DELWP 2021); and/or, • The study area contains some characteristics of the species' preferred habitat.
3	Low Likelihood	• The species is likely to visit the study area occasionally or opportunistically whilst en route to more suitable sites; and/or, • There are only limited or historical records of the species in the local area (i.e. more than 20 years old); and/or, • The study area contains few or no characteristics of the species' preferred habitat.

4	Unlikely	• No previous records of the species in the local area; and/or, • The species may fly over the study area when moving between areas of more suitable habitat; and/or, • Out of the species' range; and/or, • No suitable habitat present.

Table A2.1.3 Significant fauna recorded within 10 kilometres of the study area.

Common name	Scientific name	Total # of Records (VBA)	Last Documented Record (VBA)	EPBC	FFG	Likely occurrence in study area
NATIONAL SIGNIFICANCE						
Australasian Bittern #	*Botaurus poiciloptilus*	-	-	EN	cr	4
Australian Fairy Tern #	*Sternula nereis nereis*	-	-	VU	-	4
Australian Grayling	*Prototroctes maraena*	7	2011	VU	en	4
Australian Painted Snipe #	*Rostratula australis*	-	-	EN	cr	4
Broad-toothed Rat #	*Mastacomys fuscus mordicus*	-	-	VU	vu	4
Curlew Sandpiper	*Calidris ferruginea*	1	1979	CR	cr	4
Dwarf Galaxias	*Galaxiella pusilla*	25	2012	VU	en	4
Eastern Curlew	*Numenius madagascariensis*	2	1979	CR	cr	4
Gang-gang Cockatoo	*Callocephalon fimbriatum*	8	1986	EN	-	3
Giant Gippsland Earthworm	*Megascolides australis*	9	2003	VU	en	3
Golden Sun Moth #	*Synemon plana*	-	-	VU	vu	4
Greater Glider #	*Petauroides volans*	-	-	EN	vu	4
Greater Sand Plover #	*Charadrius leschenaultii*	-	-	VU	vu	4
Grey Falcon #	*Falco hypoleucos*	-	-	VU	vu	4

Common name	Scientific name	Total # of Records (VBA)	Last Documented Record (VBA)	EPBC	FFG	Likely occurrence in study area
Grey-headed Flying-fox #	*Pteropus poliocephalus*	-	-	VU	vu	4
Growling Grass Frog	*Litoria raniformis*	9	2008	VU	vu	4
Long-nosed Potoroo #	*Potorous tridactylus trisulcatus*	-	-	VU	vu	4
Nunivak Bar-tailed Godwit #	*Limosa lapponica baueri*	-	-	VU	-	4
Orange-bellied Parrot #	*Neophema chrysogaster*	-	-	CR	vu	4
Painted Honeyeater #	*Grantiella picta*	-	-	VU	vu	4
Pilotbird	*Pycnoptilus floccosus*	2	1977	VU	en	4
Red Knot #	*Calidris canutus*	-	-	EN	en	4
Regent Honeyeater #	*Anthochaera phrygia*	-	-	CR	en	4
Smoky Mouse #	*Pseudomys fumeus*	-	-	EN	en	4
Southern Brown Bandicoot	*Isoodon obesulus obesulus*	155	2019	EN	vu	3
Spot-tailed Quoll #	*Dasyurus maculatus maculatus*	-	-	EN	vu	4
Swamp Antechinus	*Antechinus minimus maritimus*	1	1998	VU	vu	4
White-throated Needletail	*Hirundapus caudacutus*	3	1981	VU	vu	4
Yarra Pygmy Perch #	*Nannoperca obscura*	-	-	VU	vu	4
Yellow-bellied Glider #	*Petaurus australis australis*	-	-	VU	-	4
STATE SIGNIFICANCE						
Blue-billed Duck	*Oxyura australis*	1	1981	-	vu	4
Caspian Tern	*Hydroprogne caspia*	1	1979	-	vu	4
Eastern Great Egret	*Ardea alba modesta*	2	2018	-	vu	4
Hardhead	*Aythya australis*	2	2017	-	vu	3

Common name	Scientific name	Total # of Records (VBA)	Last Documented Record (VBA)	EPBC	FFG	Likely occurrence in study area
Lace Monitor	*Varanus varius*	10	2019	-	en	3
Little Eagle	*Hieraaetus morphnoides*	3	1978	-	vu	3
Little Egret	*Egretta garzetta*	3	1998	-	en	4
Musk Duck	*Biziura lobata*	2	1981	-	vu	3
Platypus	*Ornithorhynchus anatinus*	4	1998	-	vu	4
Southern Toadlet	*Pseudophryne semimarmorata*	3	1981	-	en	3
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	1	1978	-	en	4
White-footed Dunnart	*Sminthopsis leucopus*	1	2012	-	vu	3

Data source: Victorian Biodiversity Atlas (DELWP 2022d); Protected Matters Search Tool (DCCEEW 2022).

APPENDIX 3 NATIVE VEGETATION REMOVAL (NVR) REPORT

Native vegetation removal report

A report to support an application to remove, destroy or lop native vegetation in the **Intermediate** Assessment Pathway using the modelled condition score

This report provides information to support an application to remove native vegetation in accordance with the *Guidelines for the removal, destruction or lopping of native vegetation*. The report is not an assessment by DELWP or local council of the proposed native vegetation removal. Biodiversity information and offset requirements have been calculated using modelled condition scores contained in the *Native vegetation condition map*.

Date and time: **13 January 2021 13:10 PM**

Lat./Long.: -38.247882976963,145.632626126845

Address: 870 WESTERNPORT ROAD YANNATHAN 3981

Native vegetation report ID: 311-20210113-012

Assessment pathway

The assessment pathway and reason for the assessment pathway

Assessment pathway	**Intermediate Assessment Pathway**
Extent of past plus proposed native vegetation removal	0.070 hectares
No. large trees	1 large tree(s)
Location category	Location 2 The native vegetation is in an area mapped as an Endangered Ecological Vegetation Class. Removal of less than 0.5 hectares of native vegetation will not have a significant impact on any habitat for a rare or threatened species.

Offset requirement

The offset requirement that will apply if the native vegetation is approved to be removed

Offset type	General offset
Offset amount	0.015 general habitat units
Offset attributes	
Vicinity	Port Phillip And Westernport Catchment Management Authority (CMA) or Cardinia Shire Council
Minimum strategic biodiversity value score	0.352
Large trees	1 large tree(s)

Biodiversity information about the native vegetation

Description of any past native vegetation removal

Any native vegetation that was approved to be removed, or was removed without the required approvals, on the same property or on contiguous land in the same ownership, in the five year period before the application to remove native vegetation is lodged is detailed below.

Permit/PIN number	Extent of native vegetation (hectares)
None entered	0 hectares

Description of the native vegetation proposed to be removed

Extent of all mapped native vegetation	0.070 hectares
Condition score of all mapped native vegetation	0.200
Strategic biodiversity value score of all mapped native vegetation	0.440
Extent of patches native vegetation	0.000 hectares
Extent of scattered trees	0.070 hectares
No. large trees within patches	0 large tree(s)
No. large scattered trees	1 large tree(s)
No. small scattered trees	0 small tree(s)

Additional information about trees to be removed, shown in Figure 1

Tree ID	Tree circumference (cm)	Benchmark circumference (cm)	Scattered / Patch	Tree size
A	301.6	220	Scattered	Large

Other information

Applications to remove, destroy or lop native vegetation must include all the below information. If an appropriate response has not been provided the application is not complete.

Photographs of the native vegetation to be removed

Recent, dated photographs of the native vegetation to be removed must be provided with the application. All photographs must be clear, show whether the vegetation is a patch of native vegetation or scattered trees, and identify any large trees. If the area of native vegetation to be removed is large, provide photos that are indicative of the native vegetation.

Ensure photographs are attached to the application. If appropriate photographs have not been provided the application is not complete.

Topographical and land information

Description of the topographic and land information relating to the native vegetation to be removed, including any ridges, crests and hilltops, wetlands and waterways, slopes of more than 20 percent, drainage lines, low lying areas, saline discharge areas, and areas of existing erosion, as appropriate. This may be represented in a map or plan. **This is an application requirement and your application will be incomplete without it.**

The study area is generally flat, with no ridges, crests within or immediately adjacent to the site. A minor drainage line is present within the study area, running east to west through the middle of the site.

Avoid and minimise statement

This statement describes what has been done to avoid the removal of, and minimise impacts on the biodiversity and other values of native vegetation. **This is an application requirement and your application will be incomplete without it.**

See Section 5 of the Biodiversity report

Defendable space statement

Where the removal of native vegetation is to create defendable space, a written statement explaining why the removal of native vegetation is necessary. This statement must have regard to other available bushfire risk mitigation measures. This statement is not required if your application also includes an application under the Bushfire Management Overlay.

Not applicable

Offset statement

An offset statement that demonstrates that an offset is available and describes how the required offset will be secured. **This is an application requirement and your application will be incomplete without it.**

Offsets will be sourced through the Native Vegetation Credit Register, with excess of 10 sites available (Appendix 4 of the Biodiversity Report).

Next steps

Applications to remove, destroy or lop native vegetation must address all the application requirements specified in *Guidelines for the removal, destruction or lopping of native vegetation.*If you wish to remove the mapped native vegetation you are required to apply for a permit from your local council. This *Native vegetation removal report*must be submitted with your application and meets most of the application requirements. The following needs to be added as applicable.

Property Vegetation Plan

Landowners can manage native vegetation on their property in the longer term by developing a Property Vegetation Plan (PVP) and entering in to an agreement with DELWP.

If an approved PVP applies to the land, ensure the PVP is attached to the application.

Applications under Clause 52.16

An application to remove, destroy or lop native vegetation is under Clause 52.16 if a Native Vegetation Precinct Plan (NVPP) applies to the land, and the proposed native vegetation removal is not in accordance with the relevant NVPP. If this is the case, a statement that explains how the proposal responds to the NVPP considerations must be provided.

If the application is under Clause 52.16, ensure a statement that explains how the proposal responds to the NVPP considerations is attached to the application.

Authorised by the Victorian Government, 8 Nicholson Street, East Melbourne.

For more information contact the DELWP Customer Service Centre 136 186

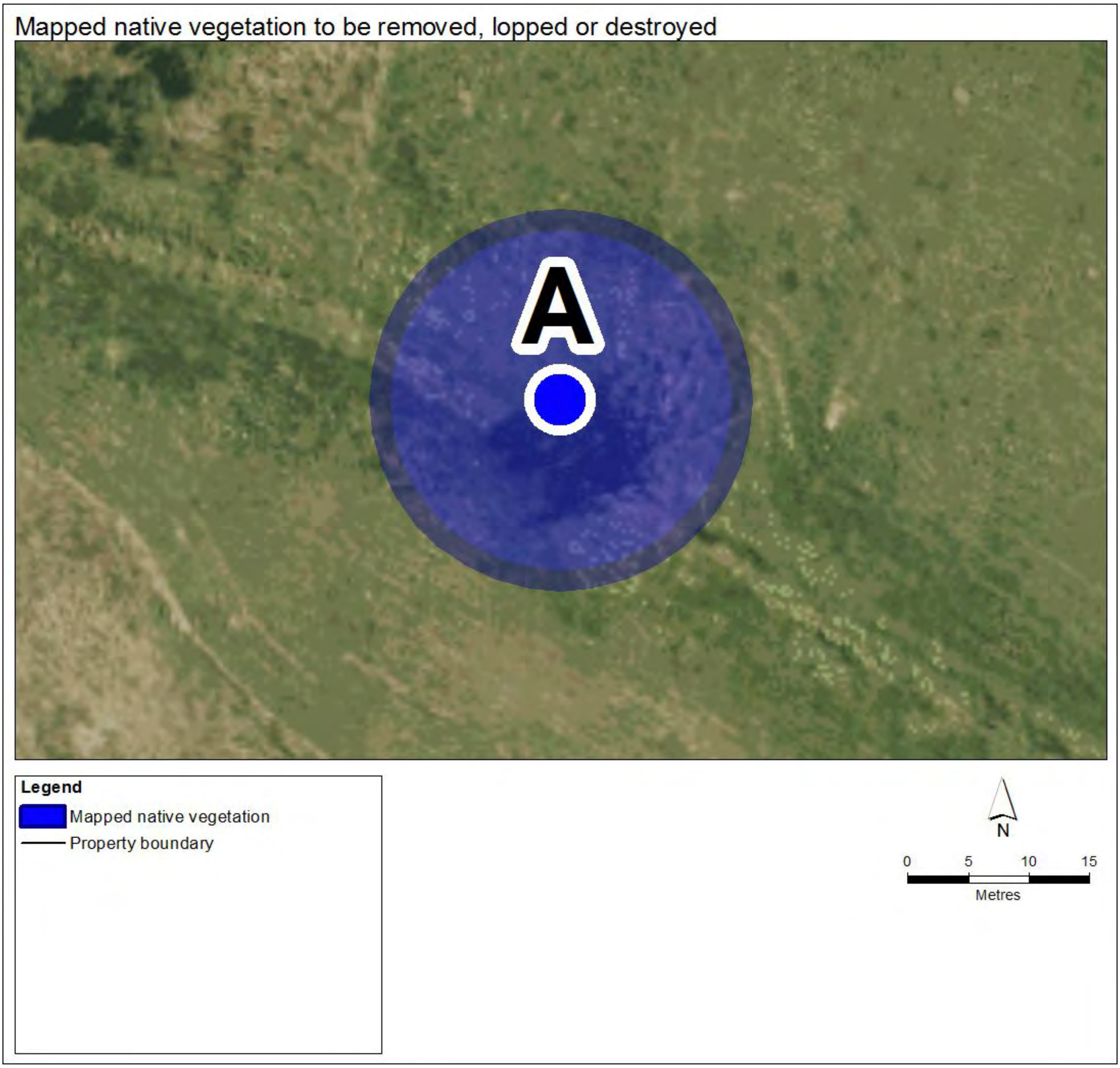
www.delwp.vic.gov.au

Disclaimer

Obtaining this publication does not guarantee that an application will meet the requirements of Clauses 52.16 or 52.17 of planning schemes in Victoria or that a permit to remove native vegetation will be granted.

Notwithstanding anything else contained in this publication, you must ensure that you comply with all relevant laws, legislation, awards or orders and that you obtain and comply with all permits, approvals and the like that affect, are applicable or are necessary to undertake any action to remove, lop or destroy or otherwise deal with any native vegetation or that apply to matters within the scope of Clauses 52.16 or 52.17 of planning schemes in Victoria.

Figure 1 – Map of native vegetation to be removed, destroyed or lopped



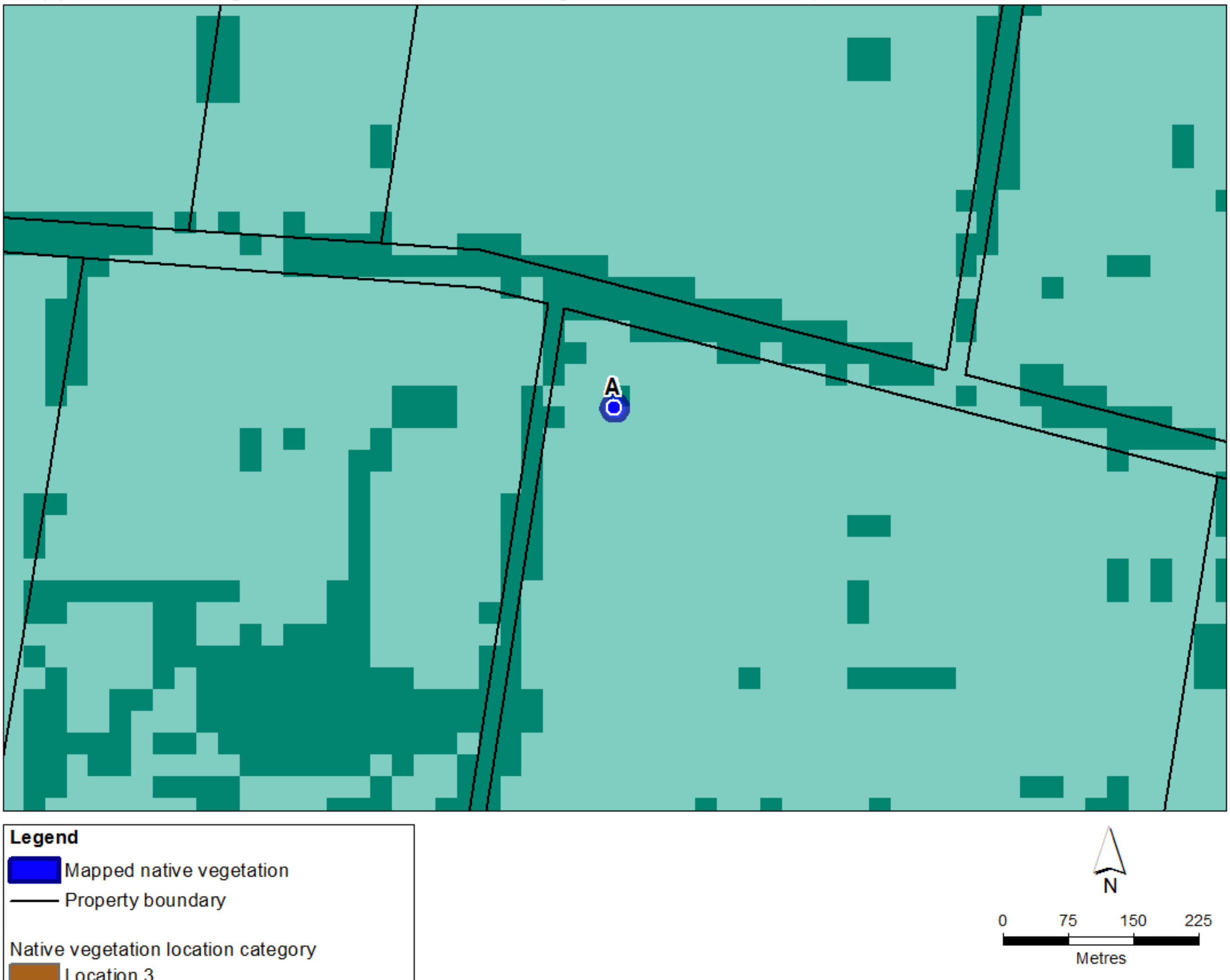
Mapped native vegetation to be removed, lopped or destroyed

Figure 2 – Map of property in context

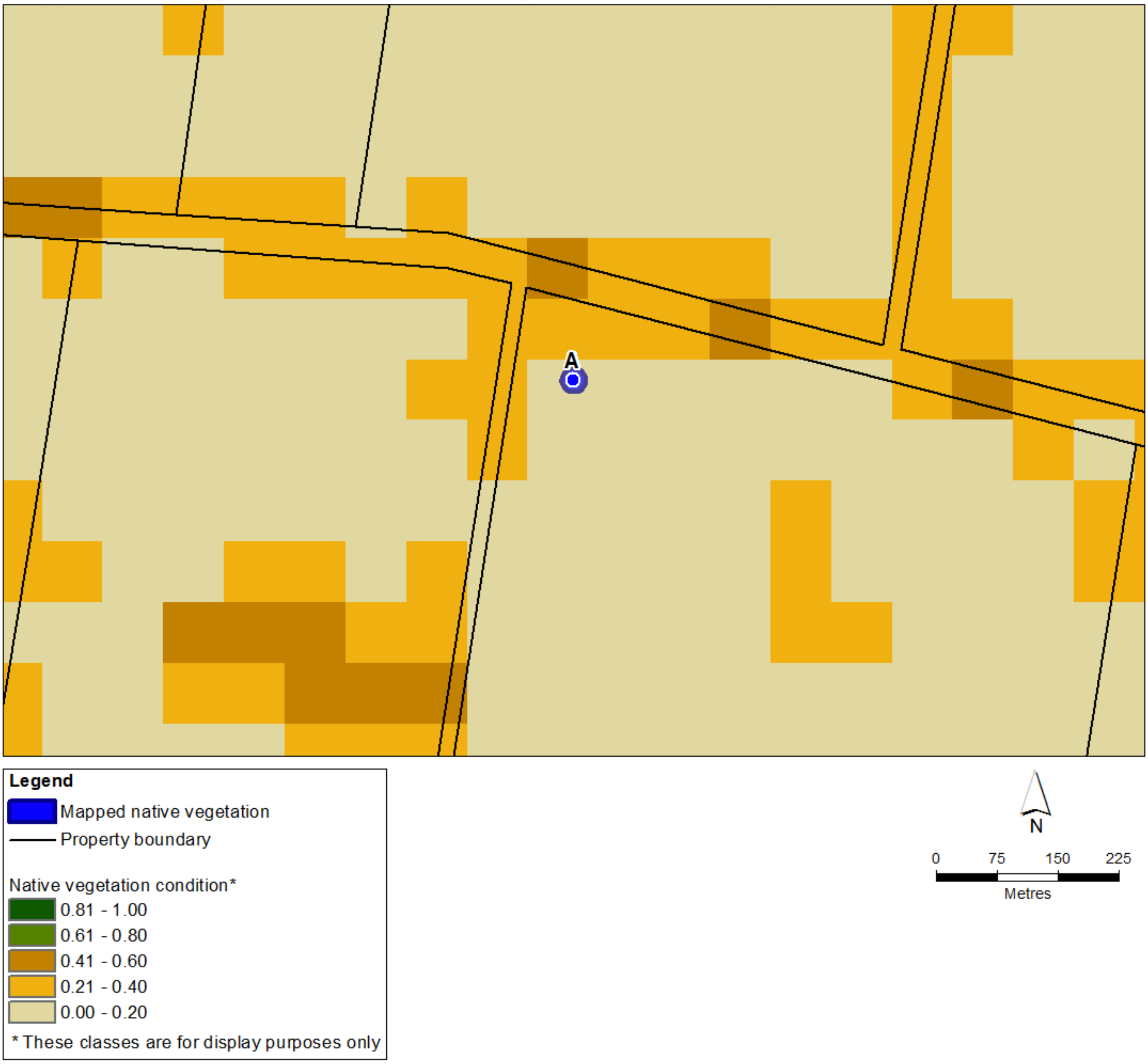
Property view of mapped native vegetation

Figure 3 – Biodiversity information maps

Mapped native vegetation and the *Native vegetation location map*



Mapped native vegetation and the *Native vegetation condition map*



Mapped native vegetation and the *Strategic biodiversity value map*

Appendix 1 - Details of offset requirements

Native vegetation to be removed

Extent of all mapped native vegetation (for calculating habitat hectares)	0.070	The area of land covered by a patch of native vegetation and/or a scattered tree, measured in hectares. Where the mapped native vegetation includes scattered trees, each tree is assigned a standard extent and converted to hectares. A small scattered tree is assigned a standard extent defined by a circle with a 10 metre radius and a large scattered tree a circle with a 15 metre radius. The extent of all mapped native vegetation is an input to calculating the habitat hectares.
Condition score*	0.200	The condition score of native vegetation is a site-based measure that describes how close native vegetation is to its mature natural state. The condition score is the weighted average condition score of the mapped native vegetation calculated using the *Native vegetation condition map.*
Habitat hectares	0.014	Habitat hectares is a site-based measure that combines extent and condition of native vegetation. It is calculated by multiplying the extent of native vegetation by the condition score: ***Habitat hectares = extent x condition score***
Strategic biodiversity value score	0.440	The strategic biodiversity value score represents the complementary contribution to Victoria's biodiversity of a location, relative to other locations across the state. This score is the weighted average strategic biodiversity value score of the mapped native vegetation calculated using the *Strategic biodiversity value map*.
General landscape factor	0.720	The general landscape factor is an adjusted strategic biodiversity value score. It has been adjusted to reduce the influence of landscape scale information on the general habitat score.
General habitat score	0.010	The general habitat score combines site-based and landscape scale information to obtain an overall measure of the biodiversity value of the native vegetation. The general habitat score is calculated as follows: ***General habitat score = habitat hectares x general landscape factor***

* **Offset requirements for partial removal:** If your proposal is to remove parts of the native vegetation in a patch (for example only understorey plants) the condition score must be adjusted. This will require manual editing of the condition score and an update to the calculations that the native vegetation removal tool has provided: habitat hectares, general habitat score and offset amount.

Offset requirements

Offset type	General offset	A general offset is required when the removal of native vegetation does not have a significant impact on any habitat for rare or threatened species. All proposals in the Basic and Intermediate assessment pathways will only require a general offset.
Offset multiplier	1.5	This multiplier is used to address the risk that the predicted outcomes for gain will not be achieved, and therefore will not adequately compensate the biodiversity loss from the removal of native vegetation.
Offset amount (general habitat units)	0.015	The general habitat units are the amount of offset that must be secured if the application is approved. This offset requirement will be a condition to any permit or approval for the removal of native vegetation. ***General habitat units required = general habitat score x 1.5***
Minimum strategic biodiversity value score	0.352	The offset site must have a strategic biodiversity value score of at least 80 per cent of the strategic biodiversity value score of the native vegetation to be removed. This is to ensure offsets are located in areas with a strategic biodiversity value that is comparable to the native vegetation to be removed.
Vicinity	Port Phillip And Westernport CMA or Cardinia Shire Council	The offset site must be located within the same Catchment Management Authority boundary or municipal district as the native vegetation to be removed.
Large trees	1 large tree (s)	The offset site must protect at least one large tree for every large tree removed. A large tree is a native canopy tree with a Diameter at Breast Height greater than or equal to the large tree benchmark for the local Ecological Vegetation Class. A large tree can be either a large scattered tree or a large patch tree.

APPENDIX 4 AVAILABLE NATIVE VEGETATION CREDITS

Report of available native vegetation credits

This report lists native vegetation credits available to purchase through the Native Vegetation Credit Register.

This report is **not evidence** that an offset has been secured. An offset is only secured when the units have been purchased and allocated to a permit or other approval and an allocated credit extract is provided by the Native Vegetation Credit Register.

Date and time: 06/09/2022 03:15 **Report ID: 15759**

What was searched for?

General offset

General habitat units	Strategic biodiversity value	Large trees	Vicinity (Catchment Management Authority or Municipal district)	
0.015	0.352	1	CMA	Port Phillip and Westernport
			or LGA	Cardinia Shire

Details of available native vegetation credits on 06 September 2022 03:15

These sites meet your requirements for general offsets.

Credit Site ID	GHU	LT	CMA	LGA	Land owner	Trader	Fixed price	Broker(s)
BBA-0670	17.745	147	Port Phillip and Westernport	Cardinia Shire	No	Yes	No	Abezco, VegLink
BBA-0677	16.525	1492	Port Phillip and Westernport	Whittlesea City	No	Yes	No	Abezco, VegLink
BBA-0678	46.362	2627	Port Phillip and Westernport	Nillumbik Shire	No	Yes	No	VegLink
BBA-0678_2	0.388	59	Port Phillip and Westernport	Nillumbik Shire	No	Yes	No	VegLink
BBA-2774	0.020	9	Port Phillip and Westernport	Greater Geelong City	Yes	Yes	No	VegLink
BBA-2789	1.317	14	Port Phillip and Westernport	Baw Baw Shire	Yes	Yes	No	Contact NVOR
BBA-2790	2.911	116	Port Phillip and Westernport	Baw Baw Shire	Yes	Yes	No	Contact NVOR
BBA-2870	2.544	431	Port Phillip and Westernport	Yarra Ranges Shire	Yes	Yes	No	VegLink
BBA-2871	16.335	1668	Port Phillip and Westernport	Yarra Ranges Shire	Yes	Yes	No	VegLink
TFN-C1650	0.098	20	Port Phillip and Westernport	Yarra Ranges Shire	Yes	Yes	Yes	Yarra Ranges SC
TFN-C1663	0.109	27	Port Phillip and Westernport	Yarra Ranges Shire	Yes	Yes	Yes	Yarra Ranges SC
TFN-C1664	2.570	65	Port Phillip and Westernport	Yarra Ranges Shire	Yes	Yes	No	Yarra Ranges SC
TFN-C1962	0.098	9	Goulburn Broken, Port Phillip and Westernport	Macedon Ranges Shire	No	Yes	No	Contact NVOR

VC_CFL-0838_01	0.209	697	Port Phillip And Westernport	Yarra Ranges Shire	Yes	Yes	No	VegLink
VC_CFL-3084_01	0.498	386	Port Phillip And Westernport	Cardinia Shire	Yes	Yes	No	VegLink
VC_CFL-3084_02	0.613	56	Port Phillip And Westernport	Cardinia Shire	Yes	Yes	No	VegLink
VC_CFL-3687_01	0.728	78	Port Phillip And Westernport	Baw Baw Shire	Yes	Yes	No	Baw Baw SC
VC_CFL-3708_01	0.199	511	Port Phillip And Westernport	Yarra Ranges Shire	Yes	Yes	No	VegLink
VC_CFL-3709_01	0.139	395	Port Phillip And Westernport	Yarra Ranges Shire	Yes	Yes	No	VegLink
VC_CFL-3729_01	0.016	6	Port Phillip And Westernport	Melton City	Yes	Yes	No	VegLink
VC_CFL-3740_01	1.756	96	Port Phillip And Westernport	Cardinia Shire, Yarra Ranges Shire	Yes	Yes	No	Bio Offsets
VC_CFL-3740_01	0.365	22	Port Phillip And Westernport	Yarra Ranges Shire	Yes	Yes	No	Bio Offsets
VC_CFL-3762_01	0.549	125	Port Phillip And Westernport	Moorabool Shire	Yes	Yes	No	VegLink

These sites meet your requirements using alternative arrangements for general offsets.

Credit Site ID	GHU	LT	CMA	LGA	Land owner	Trader	Fixed price	Broker(s)

There are no sites listed in the Native Vegetation Credit Register that meet your offset requirements when applying the alternative arrangements as listed in section 11.2 of the Guidelines for the removal, destruction or lopping of native vegetation.

These potential sites are not yet available, land owners may finalise them once a buyer is confirmed.

Credit Site ID	GHU	LT	CMA	LGA	Land owner	Trader	Fixed price	Broker(s)
VC_CFL-3710_01	7.606	322	Port Phillip And Westernport	Yarra Ranges Shire	Yes	Yes	No	VegLink
VC_CFL-3744_01	3.717	384	Port Phillip And Westernport	Macedon Ranges Shire	Yes	Yes	No	VegLink
VC_CFL-3746_01	4.962	563	Port Phillip And Westernport	Macedon Ranges Shire	Yes	Yes	No	VegLink
VC_CFL-3764_01	12.037	55	Port Phillip And Westernport	Yarra Ranges Shire	Yes	Yes	No	VegLink
VC_CFL-3769_01	2.617	77	Port Phillip And Westernport	Nillumbik Shire	Yes	Yes	No	VegLink

LT - Large Trees *CMA - Catchment Management Authority* *LGA - Municipal District or Local Government Authority*

Next steps

If applying for approval to remove native vegetation

Attach this report to an application to remove native vegetation as evidence that your offset requirement is currently available.

If you have approval to remove native vegetation

Below are the contact details for all brokers. Contact the broker(s) listed for the credit site(s) that meet your offset requirements. These are shown in the above tables. If more than one broker or site is listed, you should get more than one quote before deciding which offset to secure.

Broker contact details

Broker Abbreviation	Broker Name	Phone	Email	Website
Abezco	Abzeco Pty. Ltd.	(03) 9431 5444	offsets@abzeco.com.au	www.abzeco.com.au
Baw Baw SC	Baw Baw Shire Council	(03) 5624 2411	bawbaw@bawbawshire.vic.gov.au	www.bawbawshire.vic.gov.au
Bio Offsets	Biodiversity Offsets Victoria	0452 161 013	info@offsetsvictoria.com.au	www.offsetsvictoria.com.au
Contact NVOR	Native Vegetation Offset Register	136 186	nativevegetation.offsetregister@delwp.vic.gov.au	www.environment.vic.gov.au/native-vegetation
Ecocentric	Ecocentric Environmental Consulting	0410 564 139	ecocentric@me.com	Not avaliable
Ethos	Ethos NRM Pty Ltd	(03) 5153 0037	offsets@ethosnrm.com.au	www.ethosnrm.com.au
Nillumbik SC	Nillumbik Shire Council	(03) 9433 3316	offsets@nillumbik.vic.gov.au	www.nillumbik.vic.gov.au
TFN	Trust for Nature	8631 5888	offsets@tfn.org.au	www.trustfornature.org.au
VegLink	Vegetation Link Pty Ltd	(03) 8578 4250 or 1300 834 546	offsets@vegetationlink.com.au	www.vegetationlink.com.au
Yarra Ranges SC	Yarra Ranges Shire Council	1300 368 333	biodiversityoffsets@yarraranges.vic.gov.au	www.yarraranges.vic.gov.au

For more information contact the DELWP Customer Service Centre 136 186 or the Native Vegetation Credit Register at nativevegetation.offsetregister@delwp.vic.gov.au

Disclaimer

Obtaining this publication does not guarantee that the credits shown will be available in the Native Vegetation Credit Register either now or at a later time when a purchase of native vegetation credits is planned.

Notwithstanding anything else contained in this publication, you must ensure that you comply with all relevant laws, legislation, awards or orders and that you obtain and comply with all permits, approvals and the like that affect, are applicable or are necessary to undertake any action to remove, lop or destroy or otherwise deal with any native vegetation or that apply to matters within the scope of Clauses 52.16 or 52.17 of the Victoria Planning Provisions and Victorian planning schemes

Appendix E:

RORB Hydrological Model Development

E.1 INTENSITY-FREQUENCY-DURATION (IFD) DATA

Intensity-Frequency-Duration IFD information was sourced from the Bureau of Meteorology (BoM) using the online ARR IFD request tool. The coordinates used for the tool were based on the geographic centroid of the catchment being modelled. The resultant IFD's for the catchment are shown in Appendix E Table 1.

Appendix E Table 1: Yannathan Design Rainfall Depths in millimetres (38.2625 °S, 144.6625°E)

Duration	1 %
10 min	21.2
15 min	26.1
30 min	35.1
1 hour	44.7
2 hours	55.3
3 hours	62.5
6 hours	77.8
12 hours	98.8

E.2 LOSSES

The RORB model utilises an initial loss (IL) /continuing loss (CL) model approach, in accordance with the recommendations of ARR 2019. Losses in RORB were assigned based on three surface types:

Effective Impervious Area (EIA) – comprising areas which are effectively impervious and connected to the drainage system. As the Yannathan catchment area does not contain any areas directly to a drainage system, these losses have not been applied.

Indirectly Connected Area (ICA) – comprising impervious areas which are not directed to the drainage system (e.g. a paved patio or footpath) and pervious areas that interact with impervious areas which are not directly connected (e.g. nature strips and garden areas)

Pervious Area (Rural) – comprising of pervious areas such as parkland and bushland that do not interact with impervious areas or provide flow to piped or lined drainage systems

Appendix E Table 2 provides a summary of the loss parameters used in the RORB model.

Appendix E Table 2: Hydrological Losses

Surface Type	Initial Loss	Continuing Loss
ICA	14.7 mm (70 % of Rural IL sourced from ARR Data Hub – ARR 2019 recommends 60-80 % of Rural IL)	2.5 mm/hr (ARR 2019 recommends a CL of 2.5 mm/h for South-East Australia, range 1-3 mm/h)
Rural	21 mm (sourced from ARR Data Hub)	4.6 mm/hr (sourced from ARR Data Hub)

E.3 AREAL REDUCTION FACTORS

The IFD data provided by the BoM is applicable for rainfall in small catchments. As catchment size increases the chance of that average intensity of rainfall occurring over the entire catchment decreases. To address this issue an Areal Reduction Factor (ARF) is applied to the IFD data to account for the larger catchment area, this is applicable for areas greater than 1 km².

The total study catchment is approximately 3.6 km². The upstream catchment area from the site is approximately 2.8 km^2, therefore an ARF of 2.8 km^2 has been applied to the RORB model.

E.4 RAINFALL SPATIAL PATTERNS

As the catchment area does not exceed 20 km², a uniform spatial rainfall pattern has been used in accordance with ARR 2019 and Melbourne Water's Flood Mapping Projects Guidelines and Technical Specifications.

E.5 PRE-BURST RAINFALLS

The rural initial losses obtained from the ARR Data Hub correspond to complete storms (abbreviated as IL_s), however the IFD data provided by the Bureau of Meteorology is associated to rainfall bursts only. To account for this difference, ARR 2019 recommends reducing the rural initial loss (storm) to represent the initial burst loss (IL_b).

$$IL_{Burst} = IL_{STORM} - Preburst\ rainfall\ depth\ (mm)$$

Initial burst losses were applied in RORB as duration factors, which were calculated as ratios between a burst initial loss (IL_B) for each duration and AEP and storm initial loss (IL_S). For example, the duration factor for the 1 % AEP storm of 60 minutes duration was determined as follows:

$$Duration\ factor\ (1\%\ AEP, 60\ min) = \frac{ILs - Preburst\ rainfall\ depth}{ILs}$$

$$Duration\ factor\ (1\%\ AEP, 60\ min) = \frac{21\ mm - 1.1\ mm}{21\ mm} = 0.95$$

As pre-burst depths are not provided for storm durations of less than 60 minutes, the pre-burst rainfall is assumed to be the same for durations of 60 minutes and less in accordance with Melbourne Waters Flood Mapping Guidelines and Technical Specifications (Melbourne Water, 2019). Appendix E Table 3 summarises the pre-burst duration factors used.

Appendix E Table 3: Pre-burst Duration Factors

Duration	1 %
10 min	0.95
15 min	0.95
30 min	0.95
1 hour	0.95
2 hours	0.99
3 hours	0.77
6 hours	0.72
12 hours	0.64

E.6 KC (ROUTING PARAMETER)

There are no gauging stations against which the flow levels determined by the model can be compared to, against measured data. Therefore, a range of K_c values were trialled to determine the peak flow values calculated. A Kc value based on the DVA equations was adopted based on the region receiving approximately 800 mm/yr of rainfall. The following formula was adopted:

$$Kc = 1.53A^{0.55}$$

With a total catchment area of 3.62 km^2, the K_c value adopted

Appendix F:

Melbourne Water Lang Lang Catchment Flows Email (5th August 2021)

From:	Melbourne Water <No_reply@melbournewater.com.au>
Sent:	Thursday, 5 August 2021 10:40 AM
To:	Julian Giannetti
Subject:	Response to your application for Pre-development advice - MWA-1188291 - 870 Westernport Road Yannathan
Attachments:	MWA1188291 Plans.zip

Dear Julian Giannetti,

Further to your email of 11 June 2021, the following advice is provided:

- Melbourne Water may be willing to consider a channel capacity less than the 1% AEP but it will need to be justified as to why the 1% AEP capacity can’t be managed, what the risk assessment shows and how the flows up to the 1% AEP will be managed.
- Please see attached zip files and plans.

Additionally, our hydraulic engineer has provided further advice on the previous re-allignment of this waterway- Back in 2011, the requirements for the waterway realignment from the drainage and flooding perspective were:

- The watercourse passing along the northern edge of the existing quarry operations (we refer to it as Creek 2412 since it doesn't have a regular name) and continues upstream through the middle of the proposed quarry extension and on up the catchment which I highlighted on the Topo Plan as well as showing it on the attached "Plan2 - Overall Catchment". Plan 2 also includes the contours we have that makes identifying the catchment boundary a lot easier. The catchment as outlined on the plan totals 285 hectares.
- Modelling that has previously been undertaken for the Little Lang Lang River indicates that for the 100 Year ARI event, around 64 cumecs breaks away to the north into the Creek 2412 catchment. Some of this flow also breaks away into the adjoining catchment and continues to the north and across Westernport Rd. Although the modelling did not fully extend along the catchment of Creek 2412, I have been able to estimate that around 27 cumecs would reach Pooles Rd south of Westernport Rd and continue westerly to the quarry site.
- There must be no detrimental increase in the 100 Year ARI flood levels for the flow of 27 cumecs. We normally allow an increase of no more than 0.05m (50mm) as being tolerable however this will be dependent upon the floor levels of any buildings effected by the increased flood levels. If there is any building floor level that ends up being less than 300mm above the flood level, then the increase is not allowed.
- Some channelling of the flows is permitted however we do not want the flow velocity to increase any more than 10%. This together with the flat gradients along the waterway will not provide much opportunity of speeding up the flow through a significantly narrower constructed channel.

Plans included in the previous advice have also been attached;

- Plan 1 - Marked up Topo.pdf
- Plan 2 - Overall Catchment.pdf
- L&T Mapping.pdf

To respond to us regarding this application, please use **DevConnect@melbournewater.com.au** quoting MWA-1188291 in the subject line.

This email is sent from a notification-only email address that does not accept incoming email.

For general development enquiries contact our Customer Service Centre on 131 722.

Regards,

Segujja Kakembo | Planner , Development Planning Services | Melbourne Water
T: 131 722 | 990 La Trobe Street, Docklands, VIC 3008 | PO Box 4342 Melbourne VIC 3001
| melbournewater.com.au

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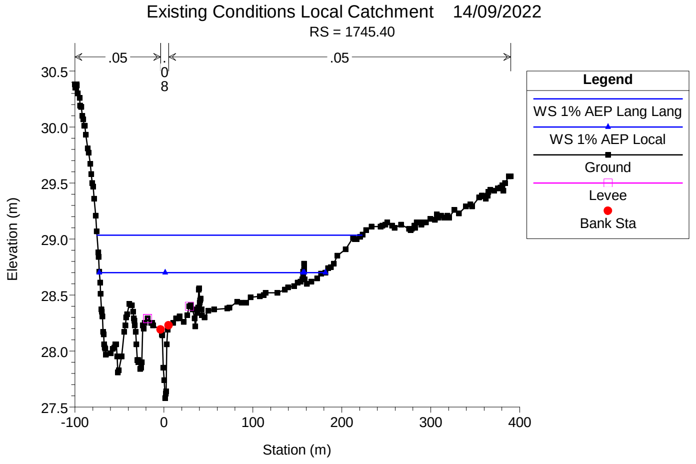
Appendix G:

Existing Conditions HEC-RAS Longitudinal Section and Cross Sections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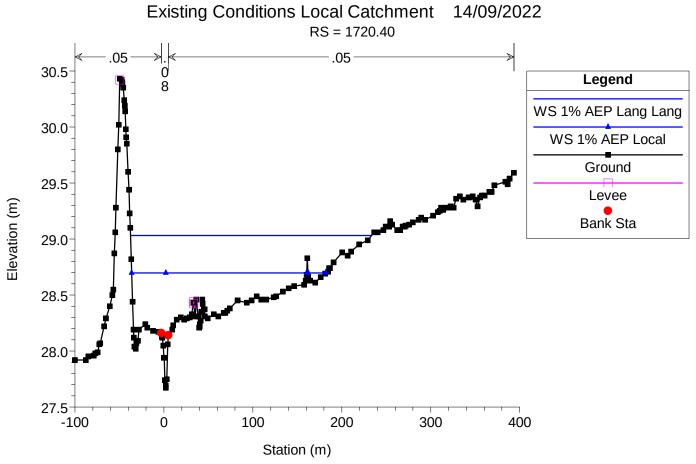
Ground
Levee
Bank Sta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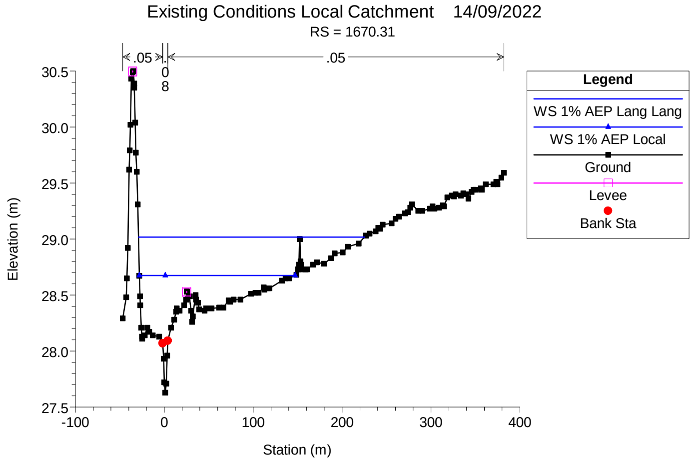
Bank Sta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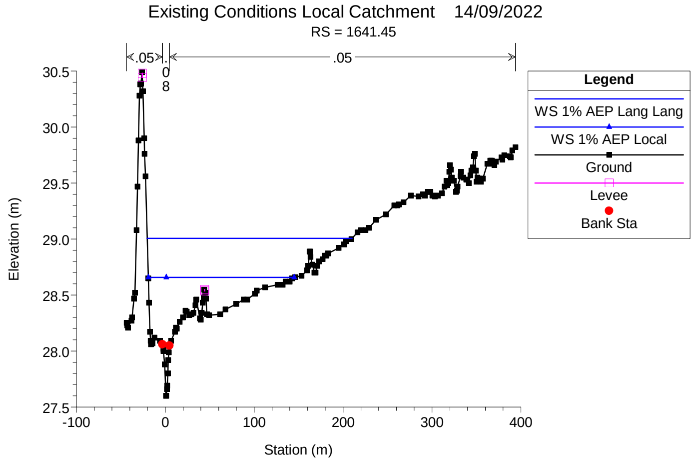
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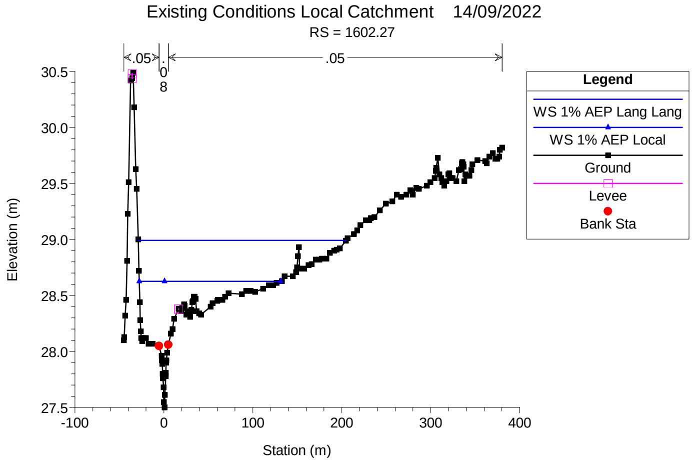
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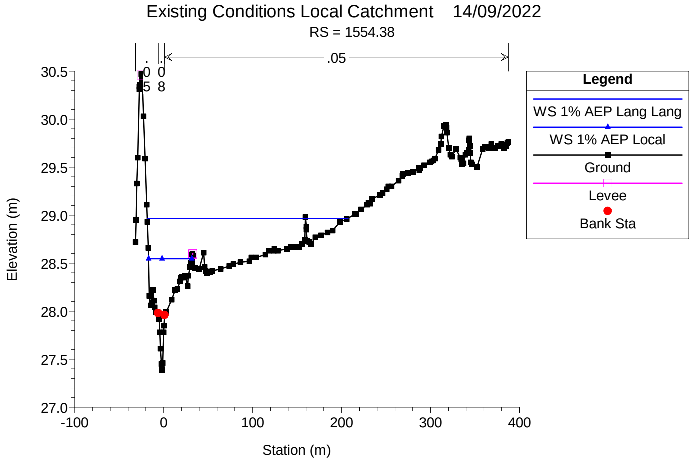
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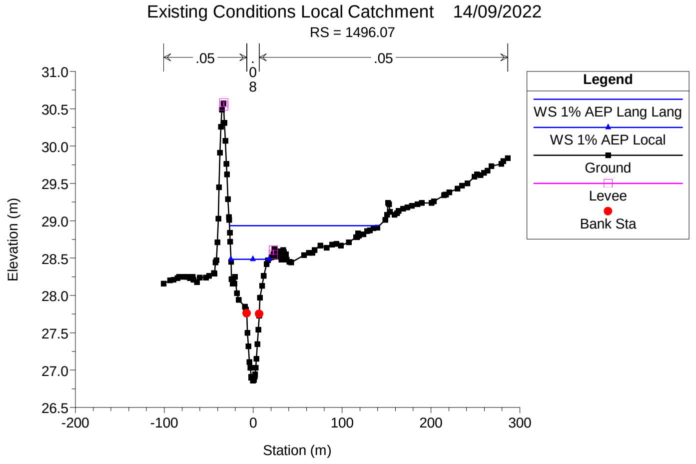
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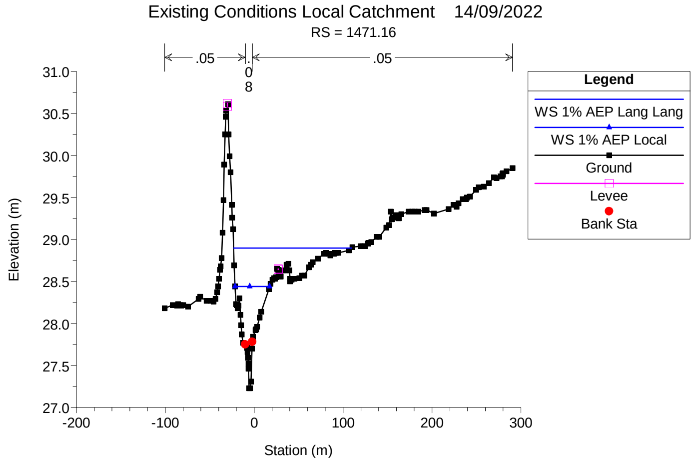
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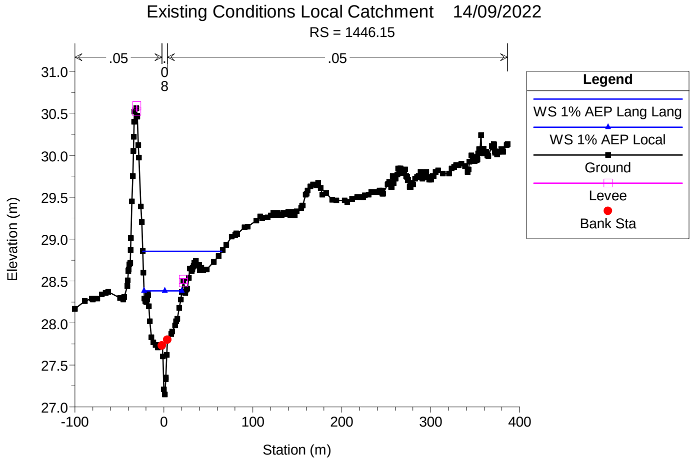
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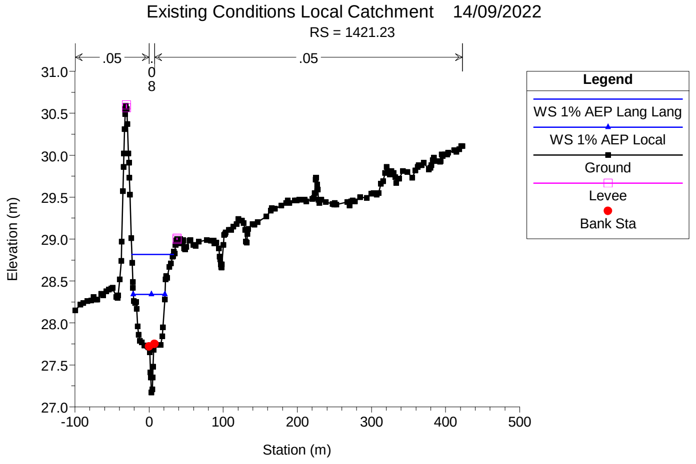
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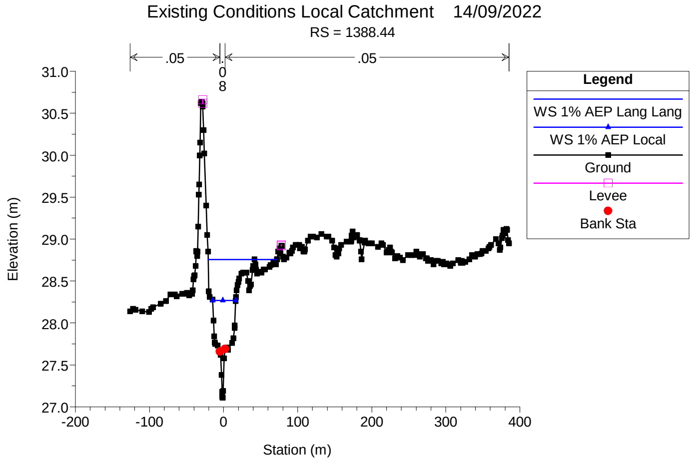
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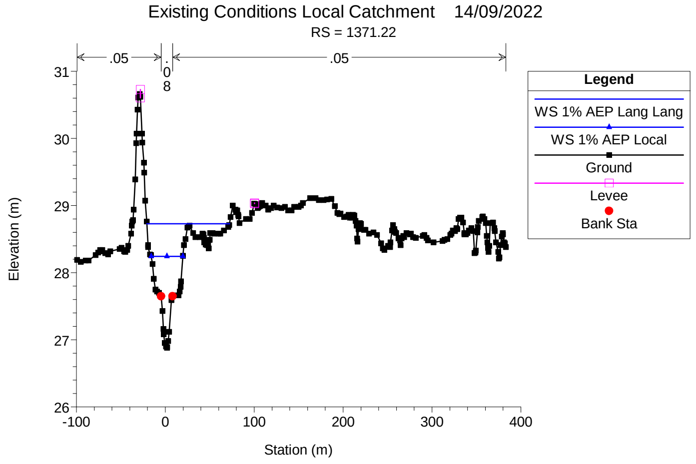
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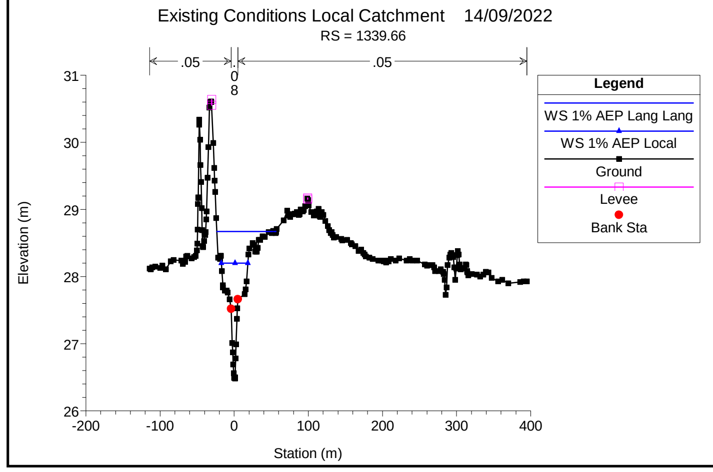
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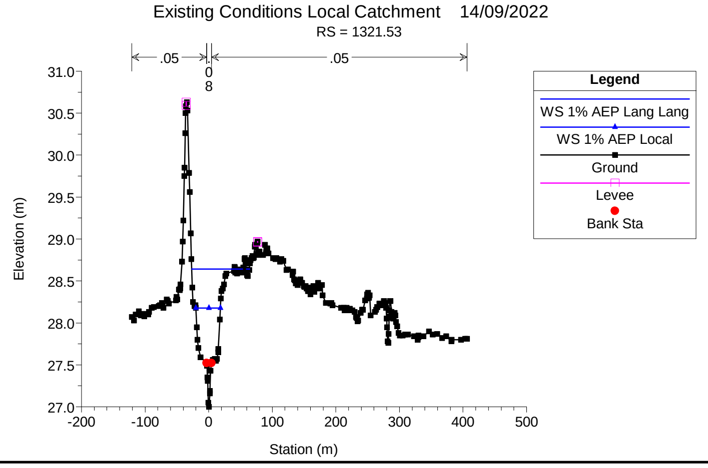
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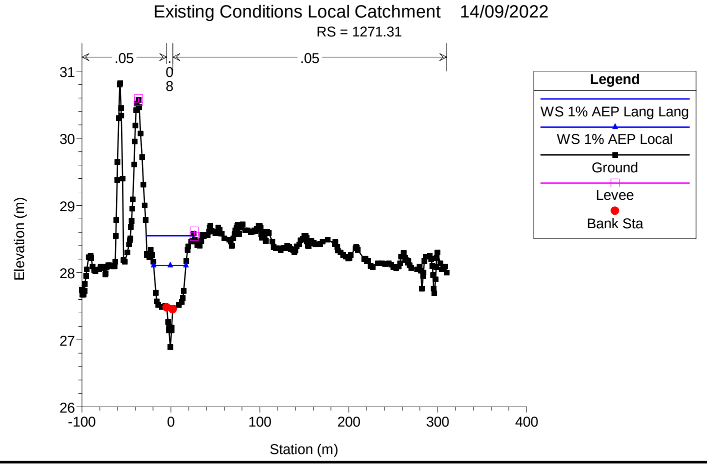
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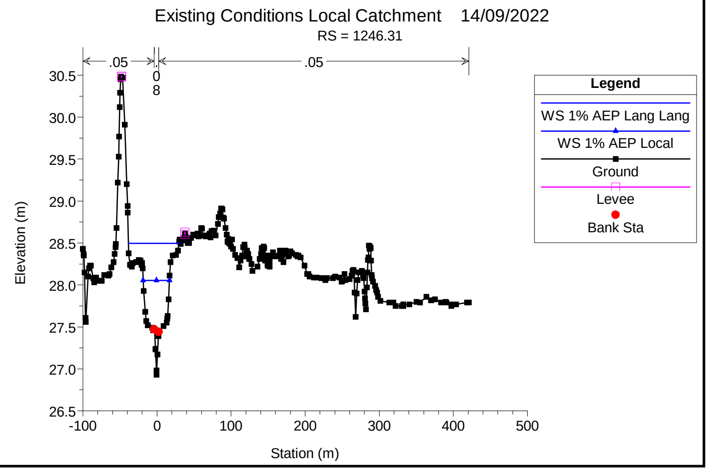
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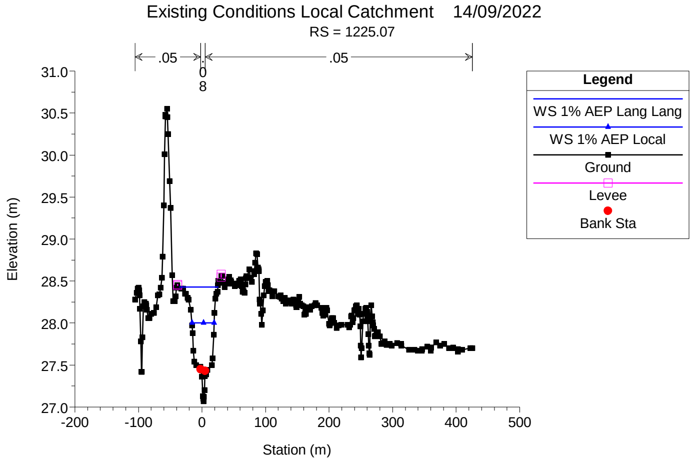
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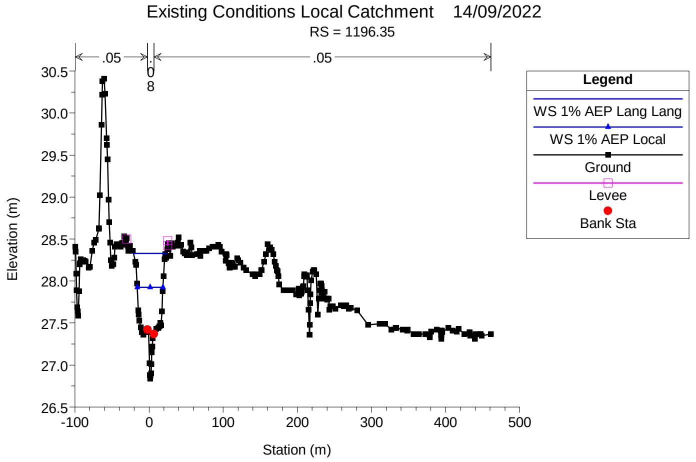
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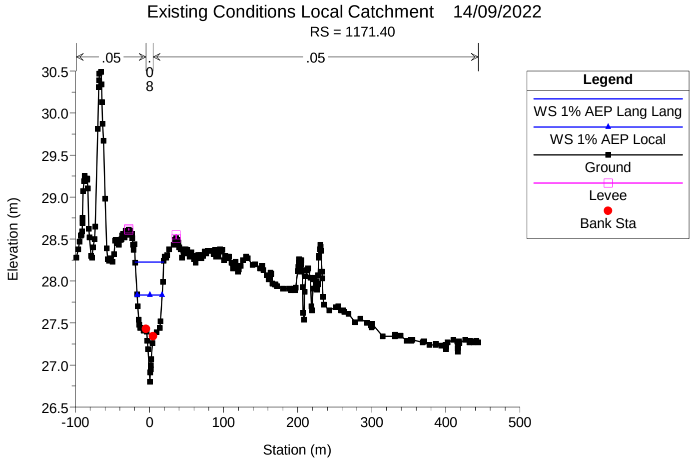
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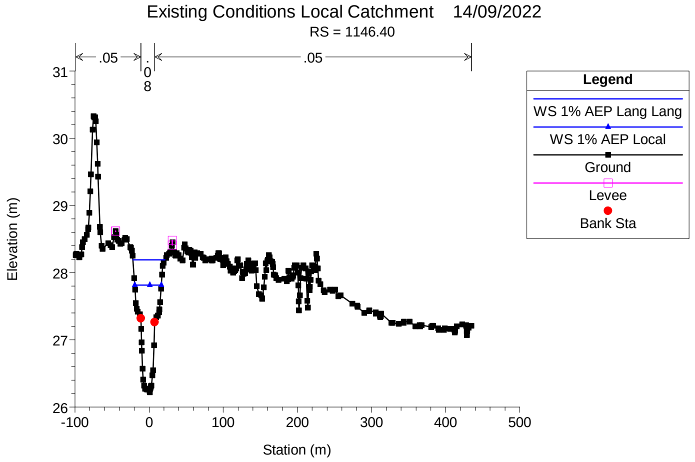
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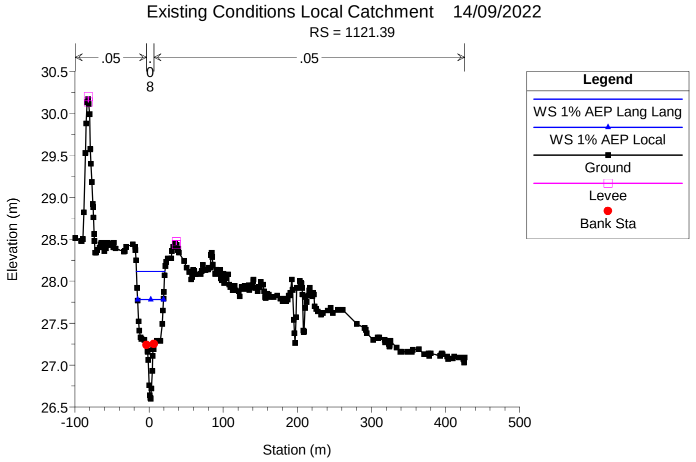
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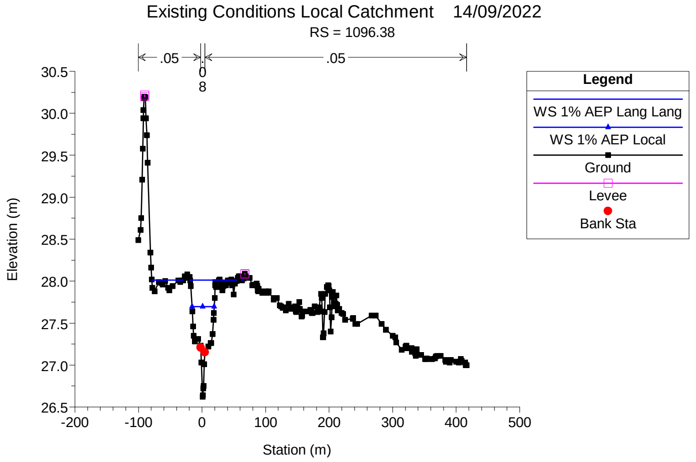
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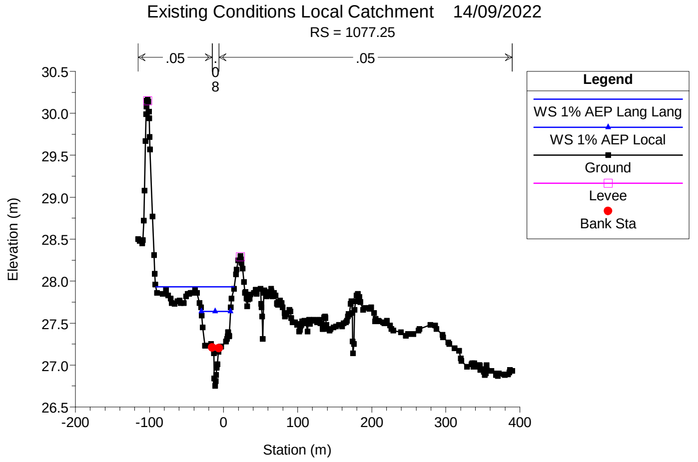
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Levee
Bank Sta
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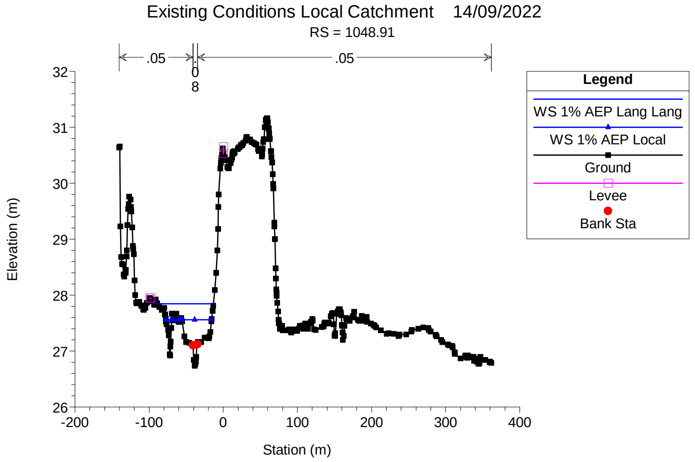
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Levee
Bank Sta
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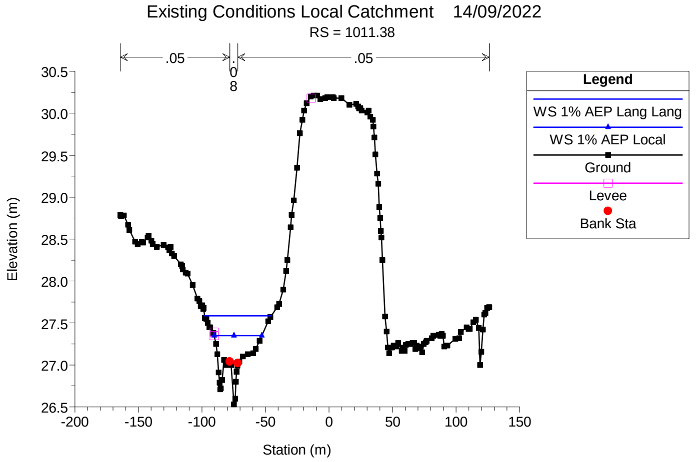
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Levee
Bank Sta
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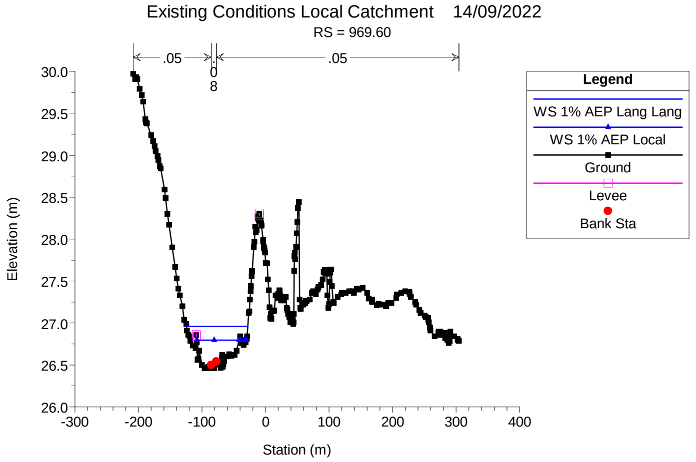
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Levee
Bank Sta
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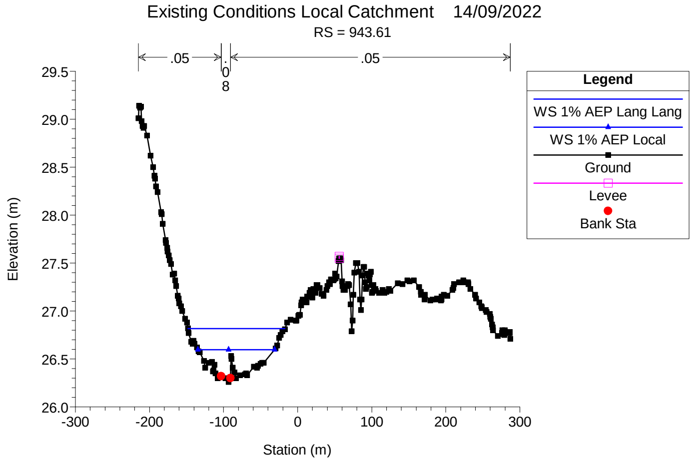
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Levee
Bank Sta
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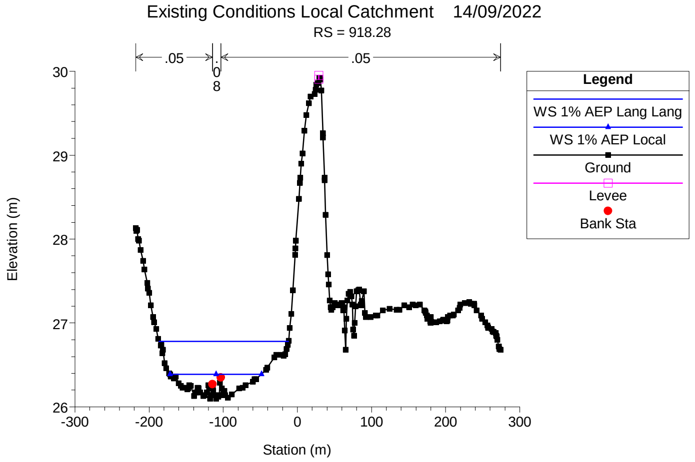
Station (m)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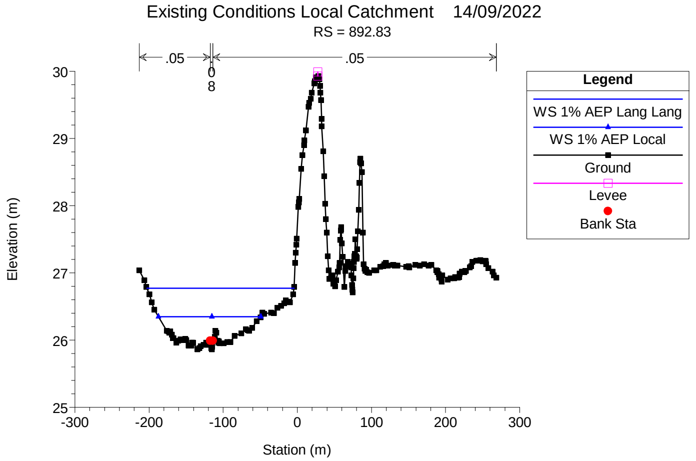
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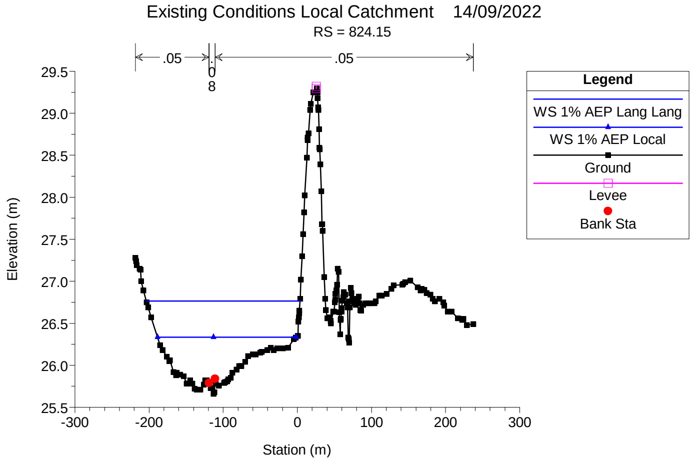
Station (m)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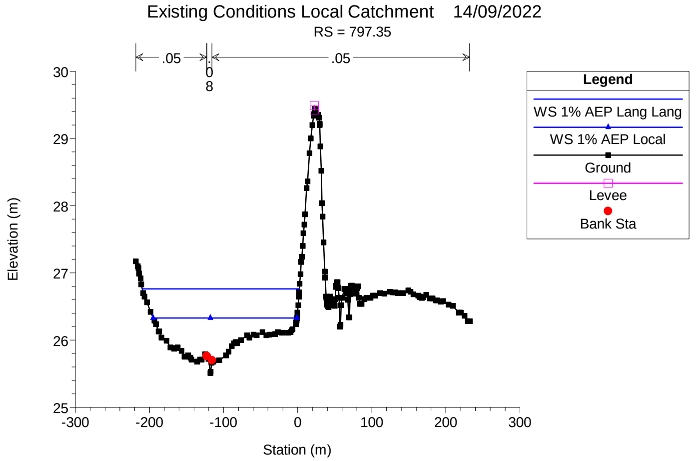
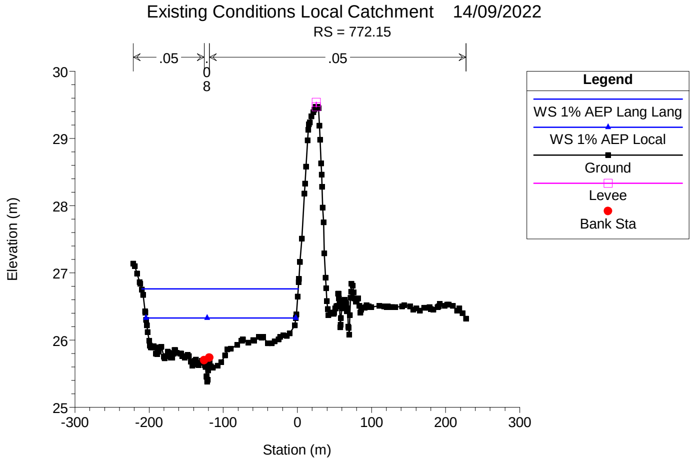
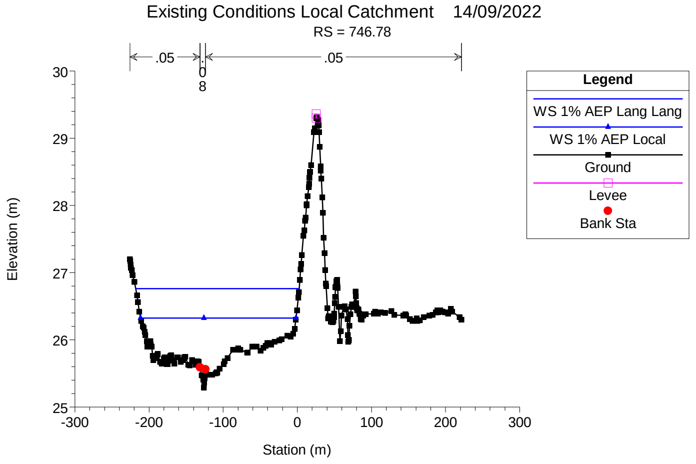
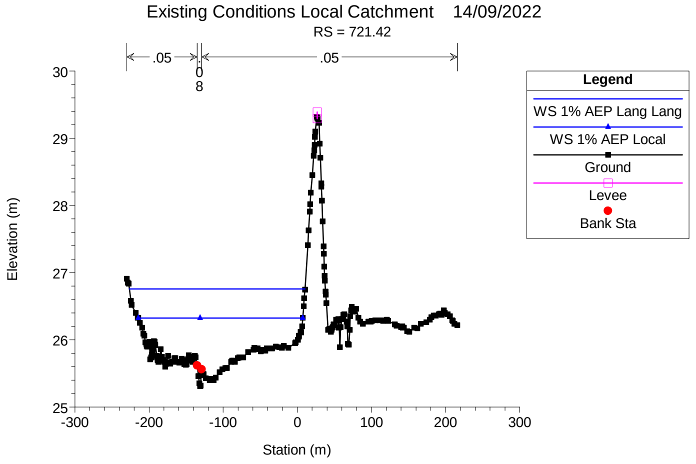
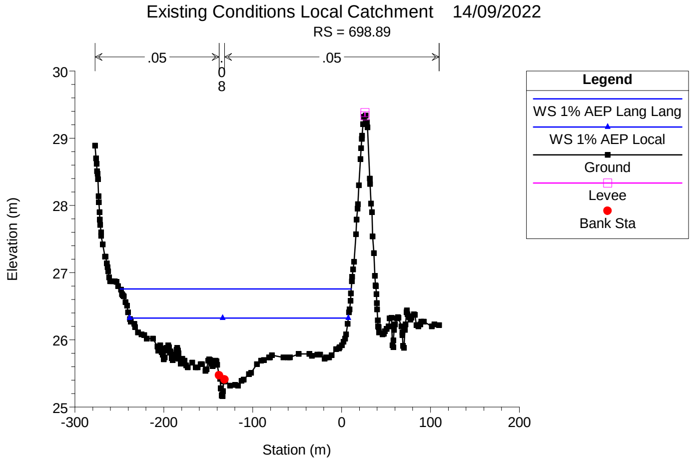
Ground
Levee
Bank Sta
Elevation (m)
29.5
29.0
28.5
28.0
27.5
27.0
26.5
26.0
25.5
-300
-200
-100
0
100
200
300
Station (m)

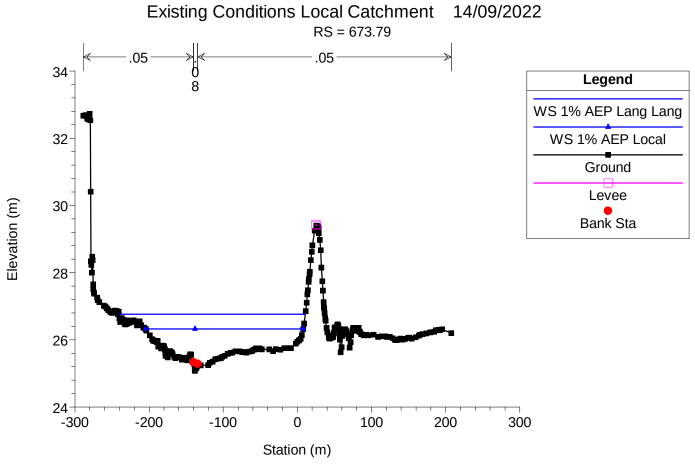

Existing Conditions Local Catchment 14/09/2022
RS = 797.35
.05
0
8
.05
Legend
WS 1% AEP Lang Lang
WS 1% AEP Local
Ground
Levee
Bank Sta
Elevation (m)
30
29
28
27
26
25
-300
-200
-100
0
100
200
300
Station (m)

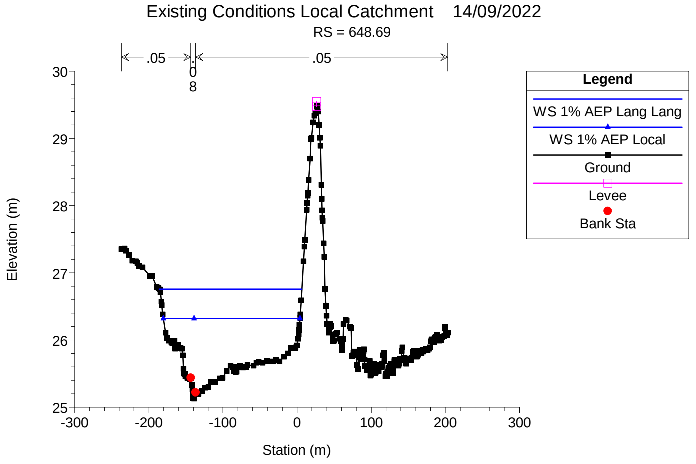

Existing Conditions Local Catchment 14/09/2022
RS = 772.15
.05
0
8
.05
Legend
WS 1% AEP Lang Lang
WS 1% AEP Local
Ground
Levee
Bank Sta
Elevation (m)
30
29
28
27
26
25
-300
-200
-100
0
100
200
300
Station (m)

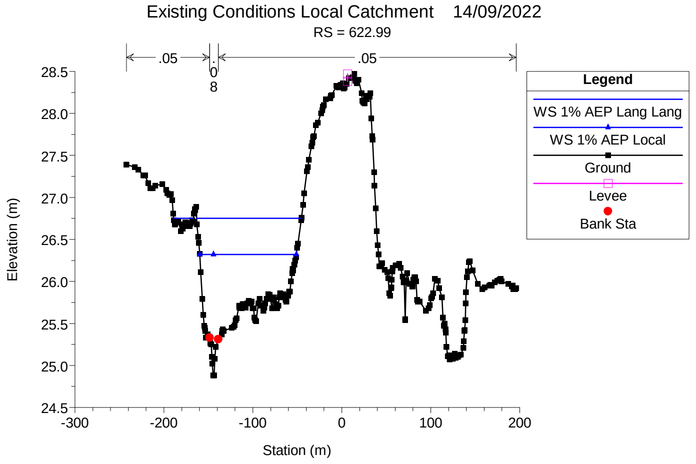

Existing Conditions Local Catchment 14/09/2022
RS = 746.78

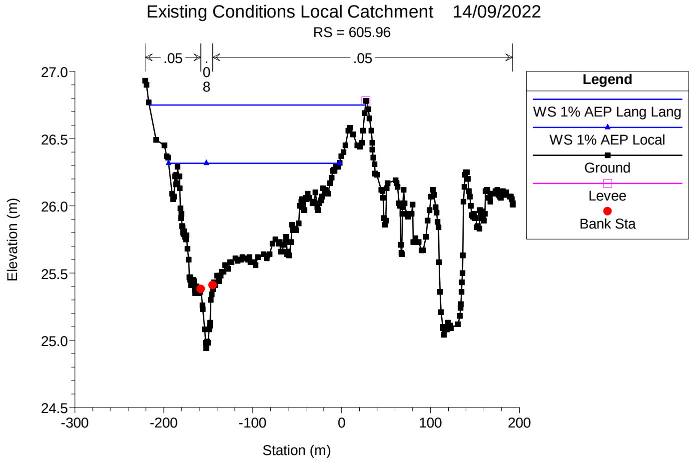

Existing Conditions Local Catchment 14/09/2022
RS = 721.42

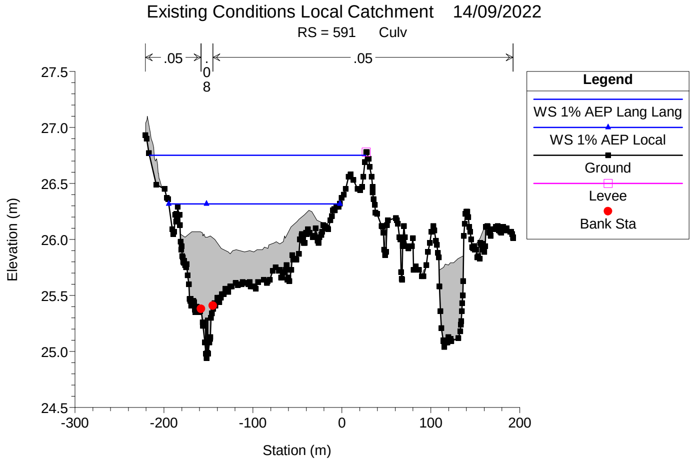

Existing Conditions Local Catchment 14/09/2022
RS = 698.89

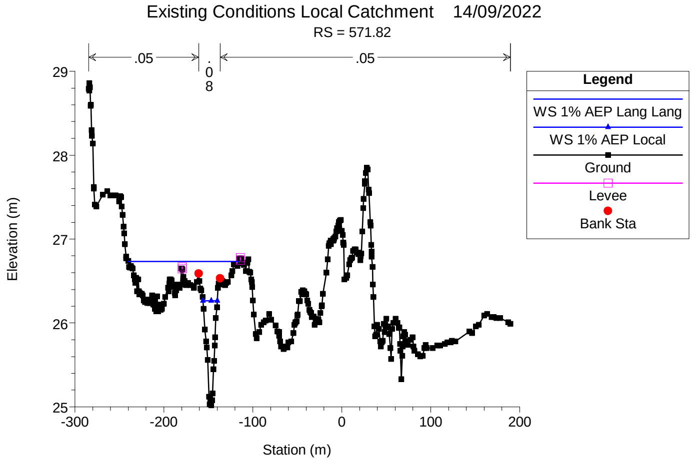

Existing Conditions Local Catchment 14/09/2022
RS = 673.79

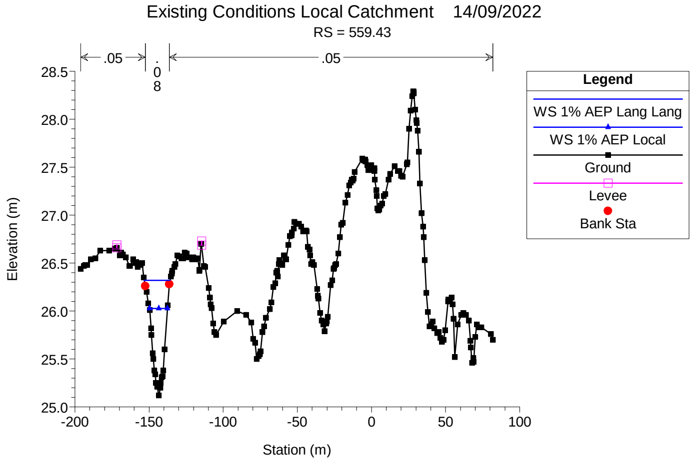

Existing Conditions Local Catchment 14/09/2022
RS = 648.69

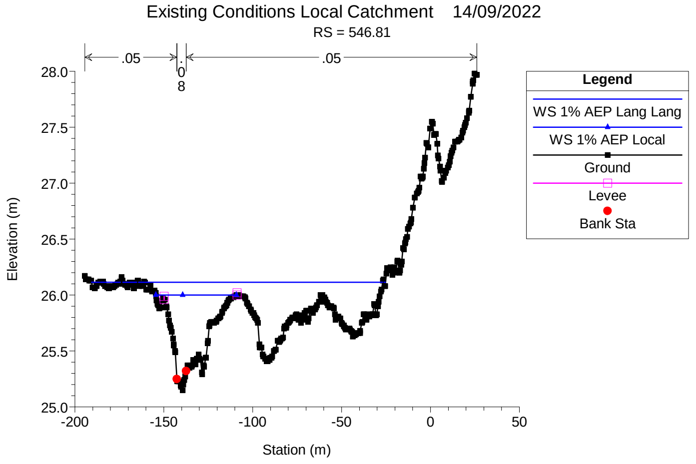

Existing Conditions Local Catchment 14/09/2022
RS = 622.99

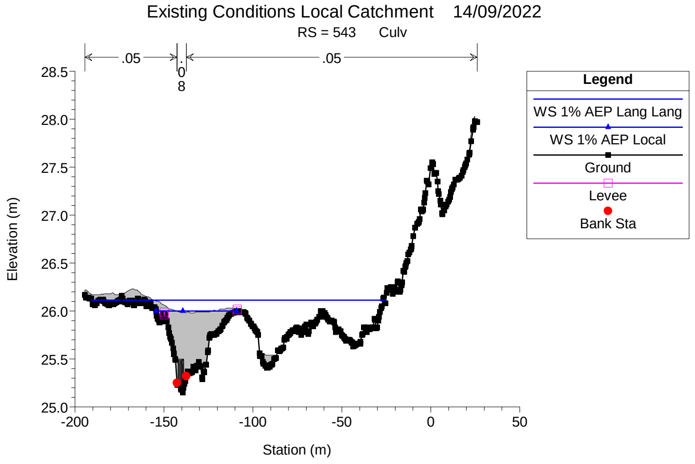

Existing Conditions Local Catchment 14/09/2022
RS = 605.96

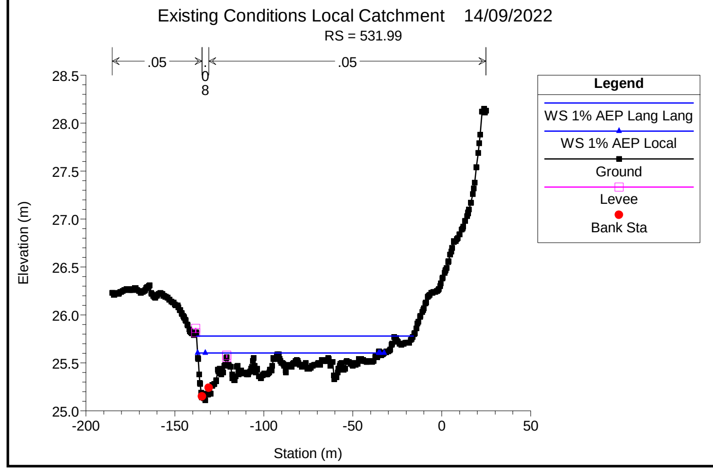

Existing Conditions Local Catchment 14/09/2022
RS = 591 Culv

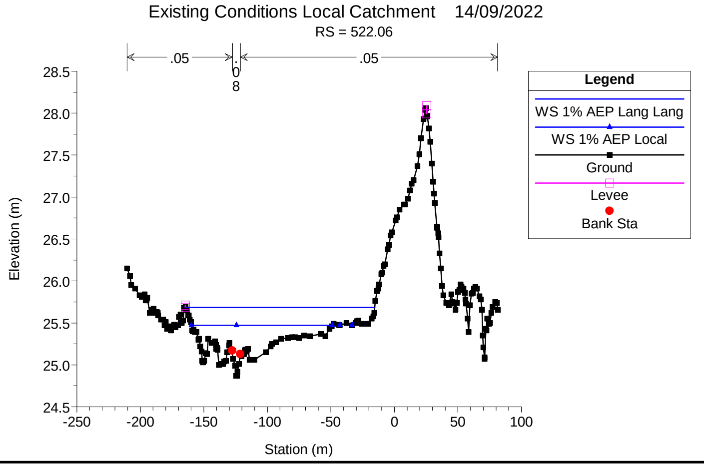

Existing Conditions Local Catchment 14/09/2022
RS = 571.82

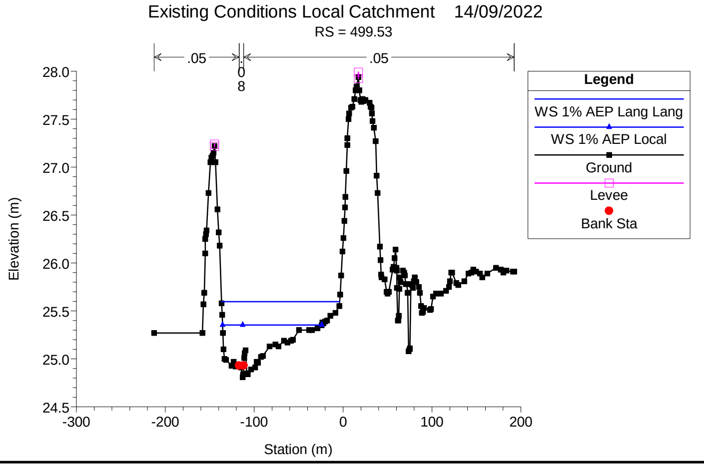

Existing Conditions Local Catchment 14/09/2022
RS = 559.43

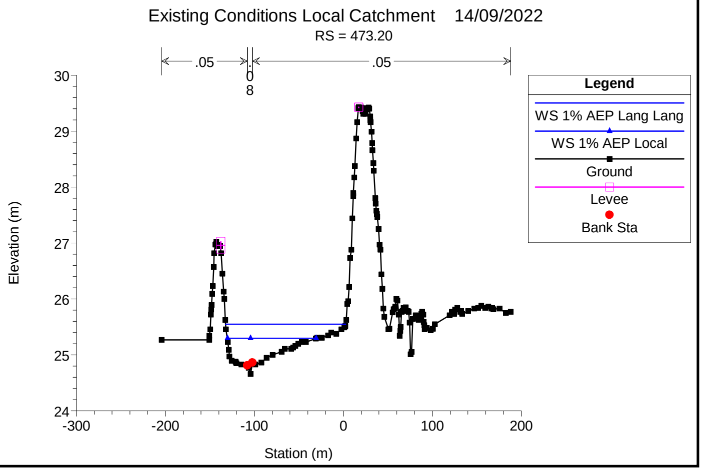

Existing Conditions Local Catchment 14/09/2022
RS = 546.81


Existing Conditions Local Catchment 14/09/2022
RS = 543 Culv

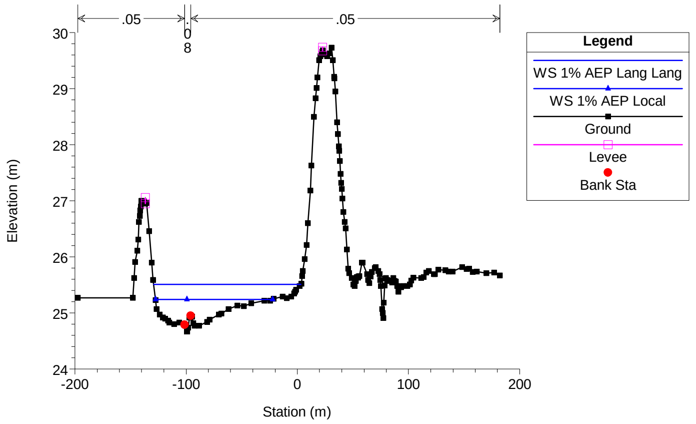

Existing Conditions Local Catchment 14/09/2022
RS = 531.99


Existing Conditions Local Catchment 14/09/2022
RS = 522.06

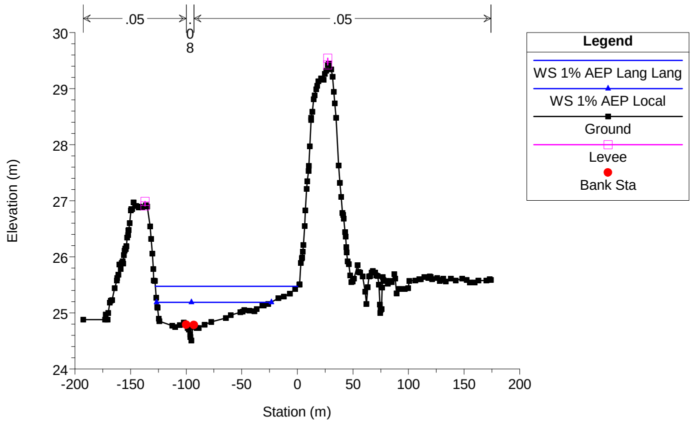

Existing Conditions Local Catchment 14/09/2022
RS = 499.53


Existing Conditions Local Catchment 14/09/2022
RS = 473.20

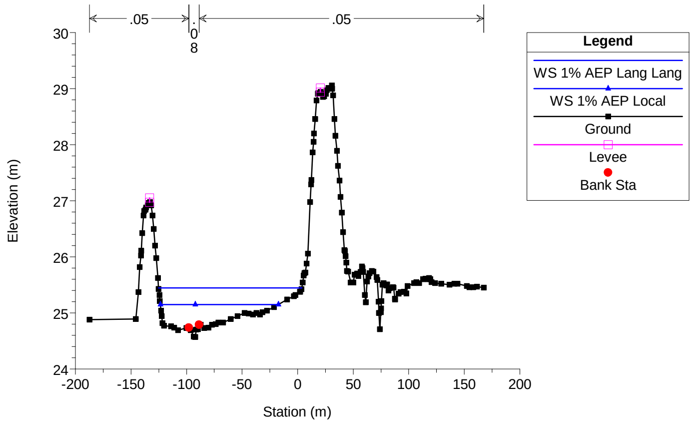
Existing Conditions Local Catchment 14/09/2022
RS = 447.18



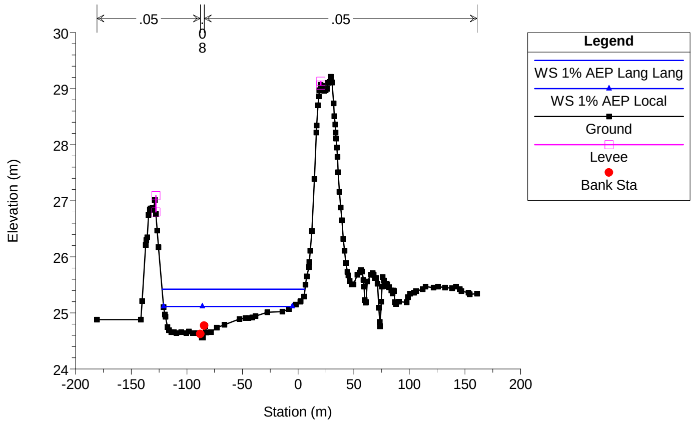
Existing Conditions Local Catchment 14/09/2022
RS = 421.71



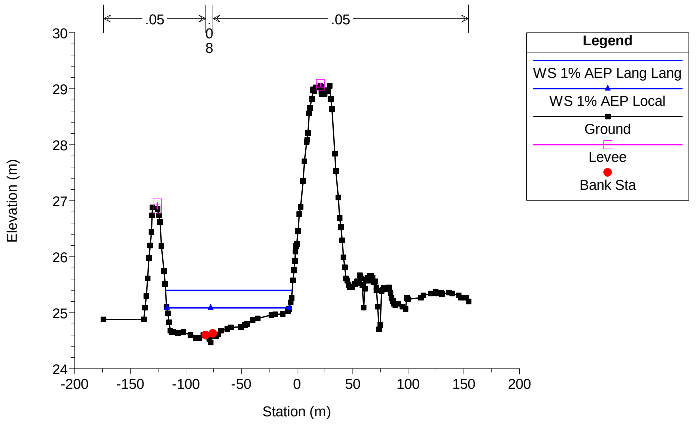
Existing Conditions Local Catchment 14/09/2022
RS = 396.79



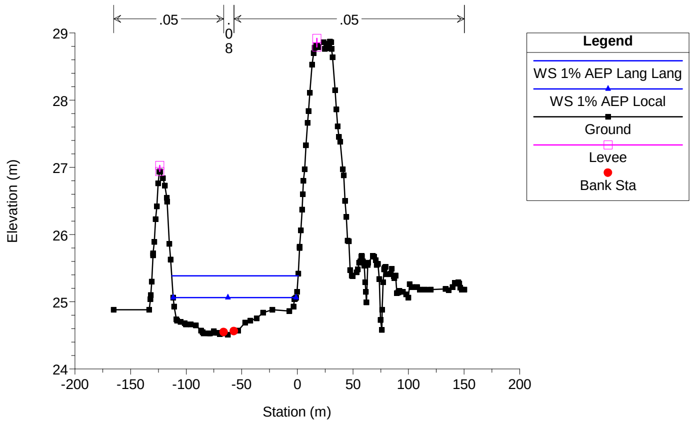
Existing Conditions Local Catchment 14/09/2022
RS = 370.99



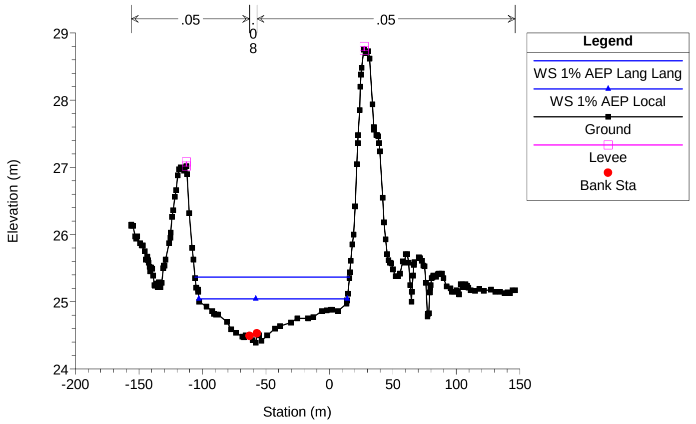
Existing Conditions Local Catchment 14/09/2022
RS = 345.10



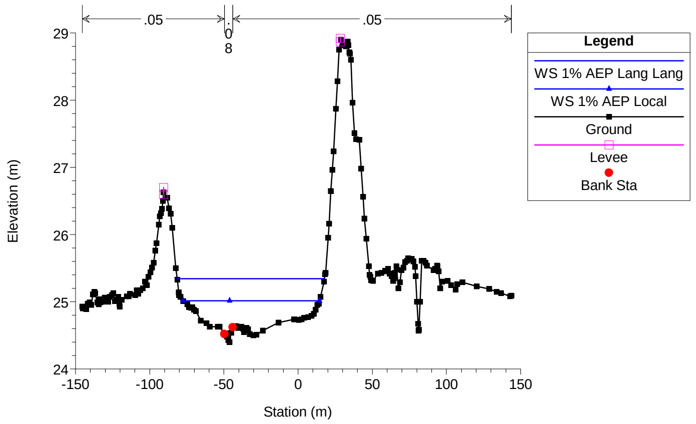
Existing Conditions Local Catchment 14/09/2022
RS = 318.50



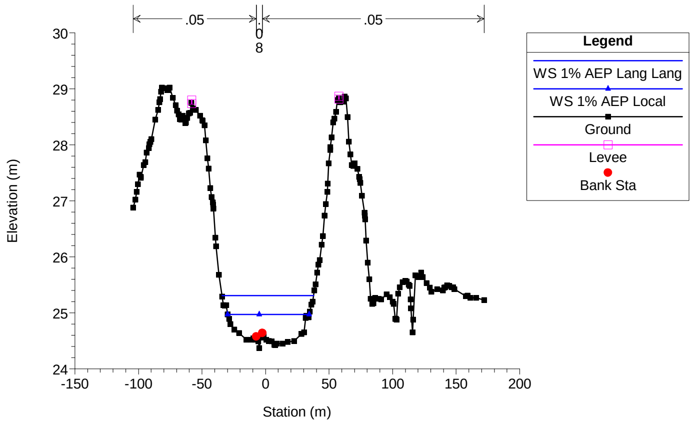
Existing Conditions Local Catchment 14/09/2022
RS = 291.91



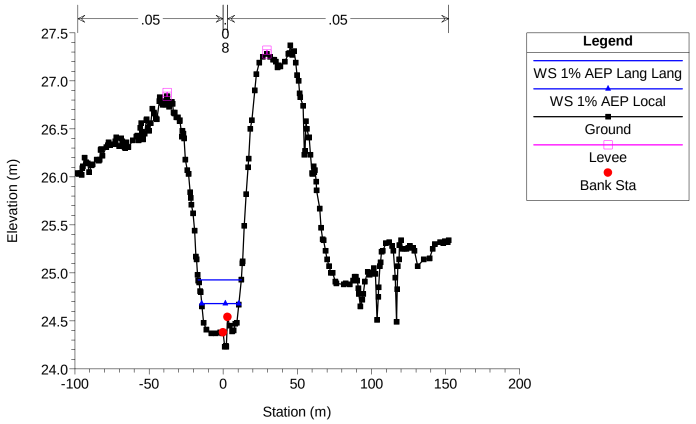
Existing Conditions Local Catchment 14/09/2022
RS = 264.67



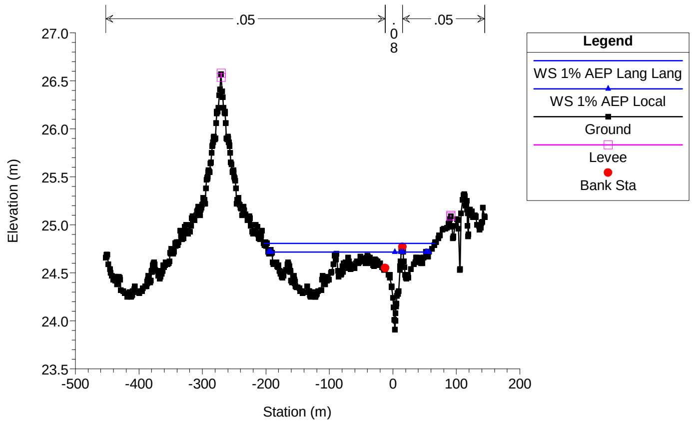
Existing Conditions Local Catchment 14/09/2022
RS = 214.45



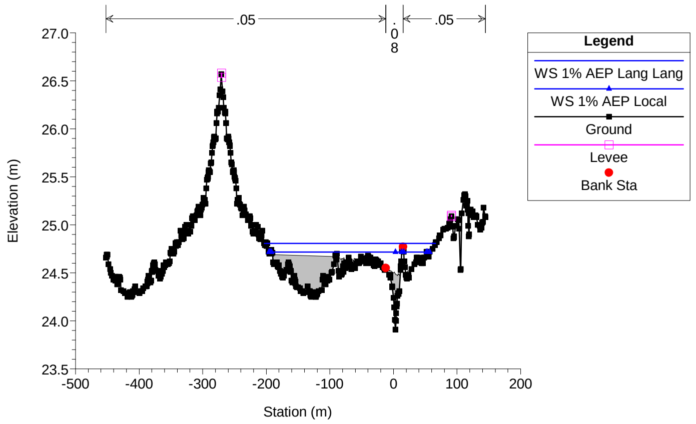
Existing Conditions Local Catchment 14/09/2022
RS = 178.92



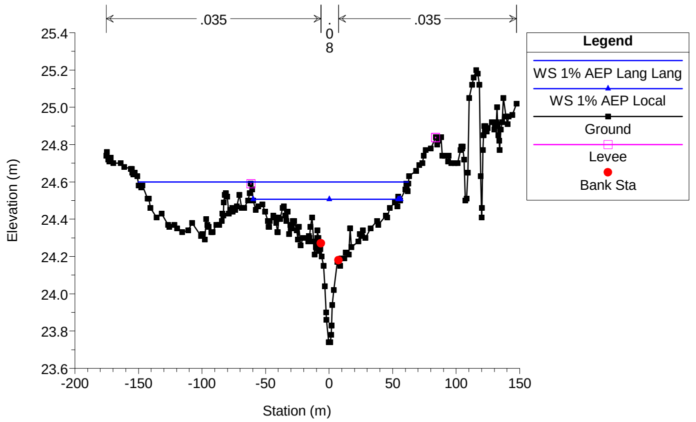
Existing Conditions Local Catchment 14/09/2022
RS = 166.16



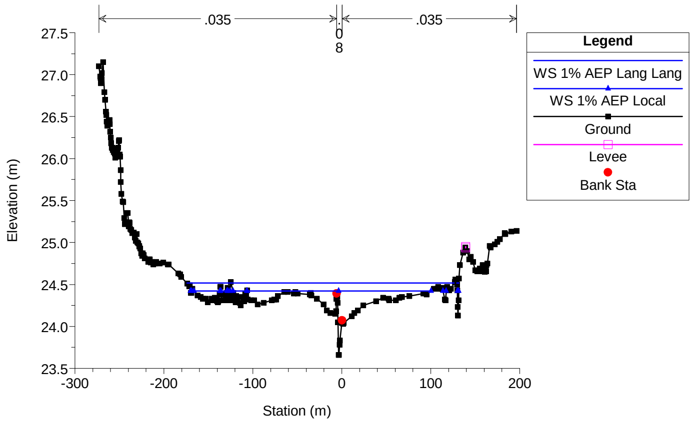
Existing Conditions Local Catchment 14/09/2022
RS = 165 Culv



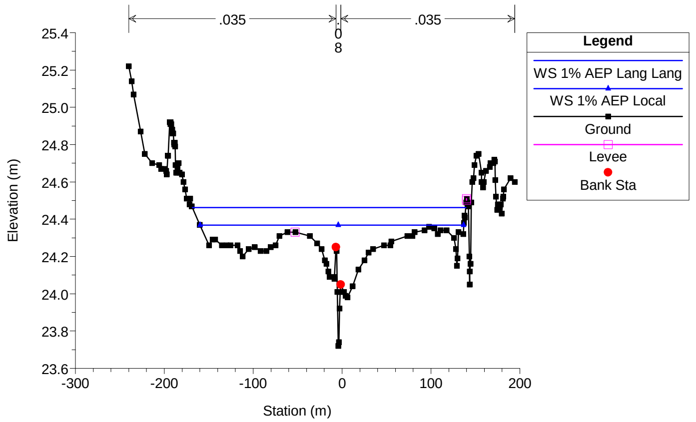
Existing Conditions Local Catchment 14/09/2022
RS = 140.12



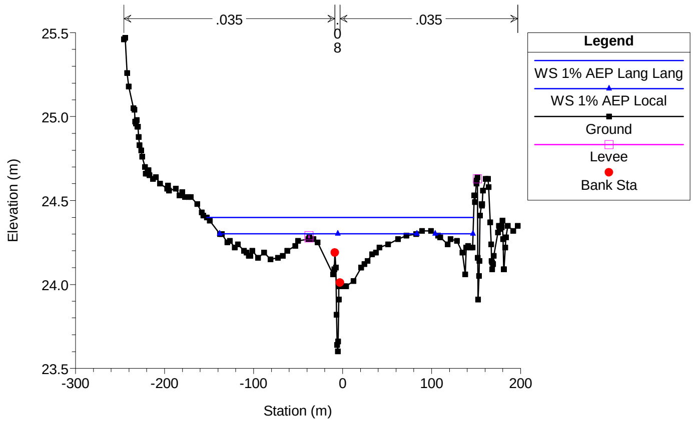
Existing Conditions Local Catchment 14/09/2022
RS = 109.40

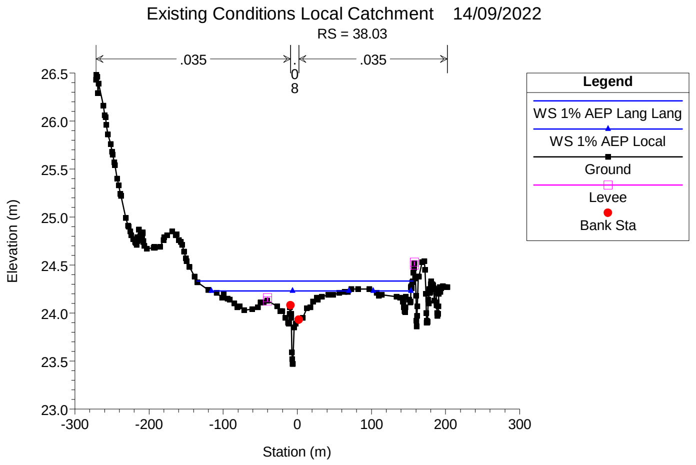


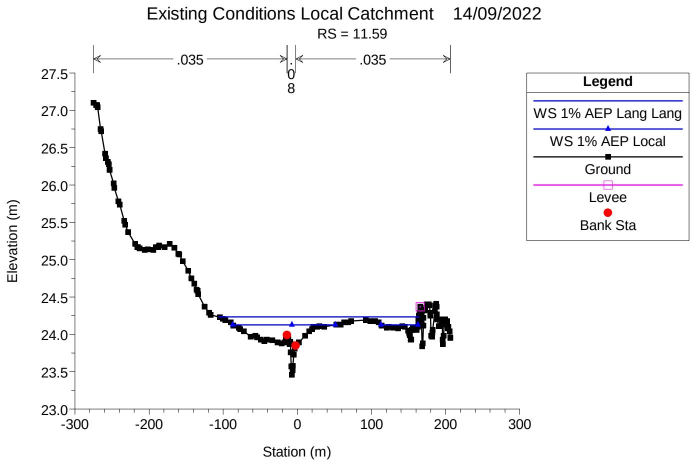
Existing Conditions Local Catchment 14/09/2022
RS = 86.03

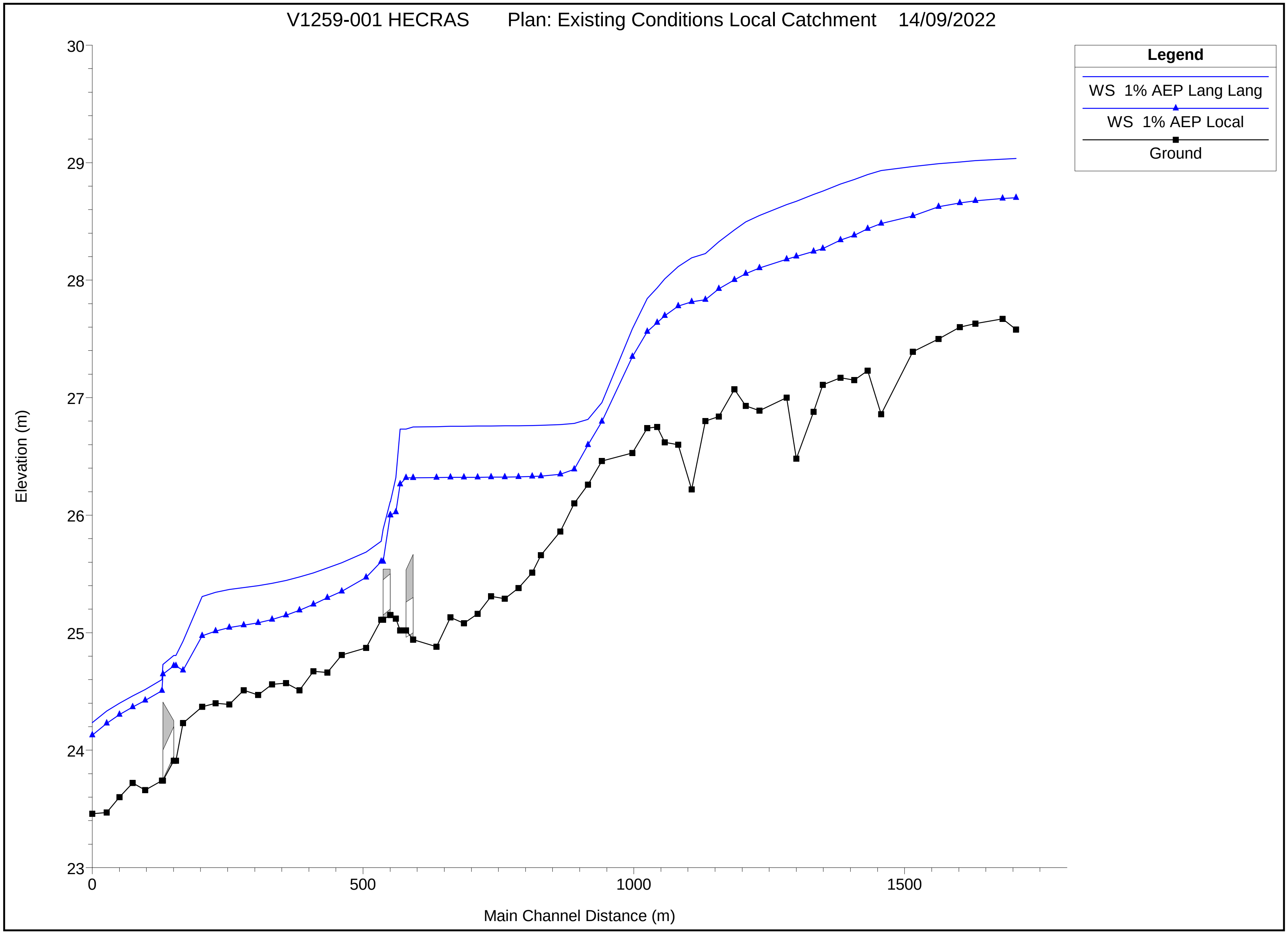


Existing Conditions Local Catchment 14/09/2022
RS = 61.86




Existing Conditions Local Catchment 14/09/2022
RS = 38.03
.035
0
8
.035
Legend
WS 1% AEP Lang Lang
WS 1% AEP Local
Ground
Levee
Bank Sta
Elevation (m)
26.5
26.0
25.5
25.0
24.5
24.0
23.5
23.0
-300
-200
-100
0
100
200
300
Station (m)

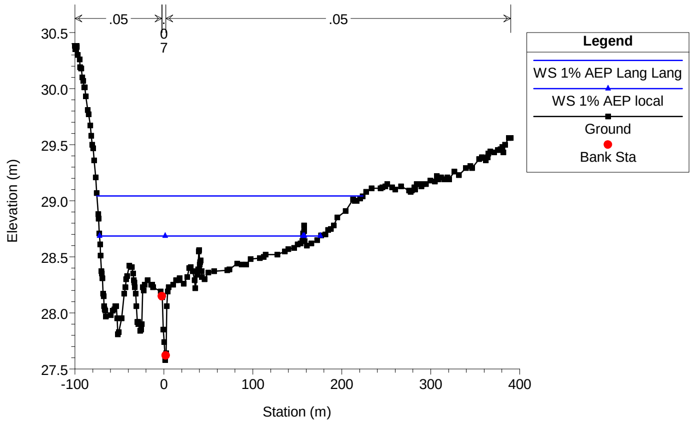

Existing Conditions Local Catchment 14/09/2022
RS = 11.59
.035
0
8
.035
Legend
WS 1% AEP Lang Lang
WS 1% AEP Local
Ground
Levee
Bank Sta
Elevation (m)
27.5
27.0
26.5
26.0
25.5
25.0
24.5
24.0
23.5
23.0
-300
-200
-100
0
100
200
300
Station (m)


V1259-001 HECRAS Plan: Existing Conditions Local Catchment 14/09/2022
Legend
WS 1% AEP Lang Lang
WS 1% AEP Local
Ground
Elevation (m)
30
29
28
27
26
25
24
23
0
500
1000
1500
Main Channel Distance (m)

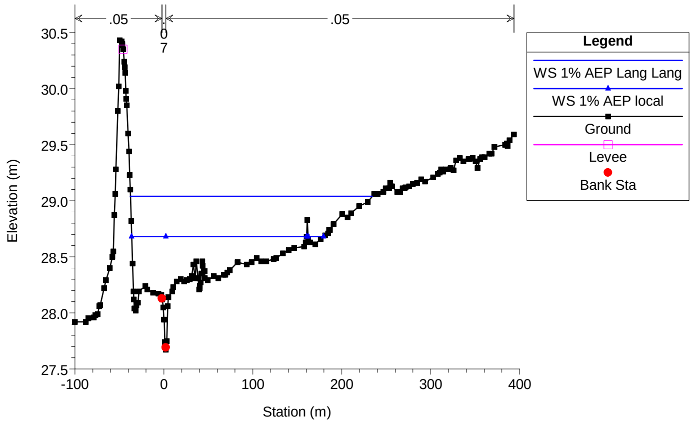
Appendix H:

Design Conditions HEC-RAS Longitudinal Section and Cross Sections

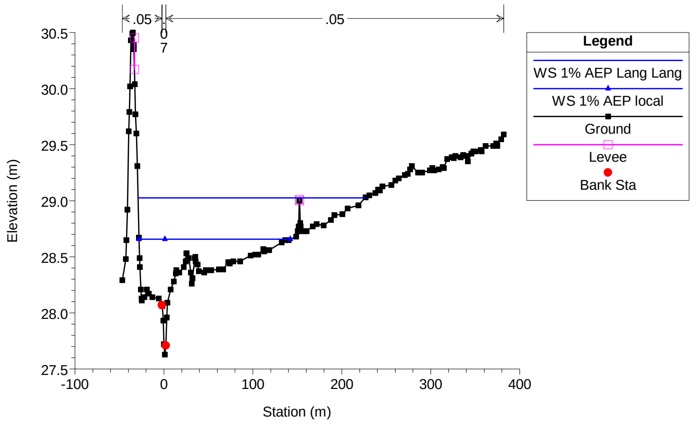
Design Conditions 14/09/2022
RS = 1745.25



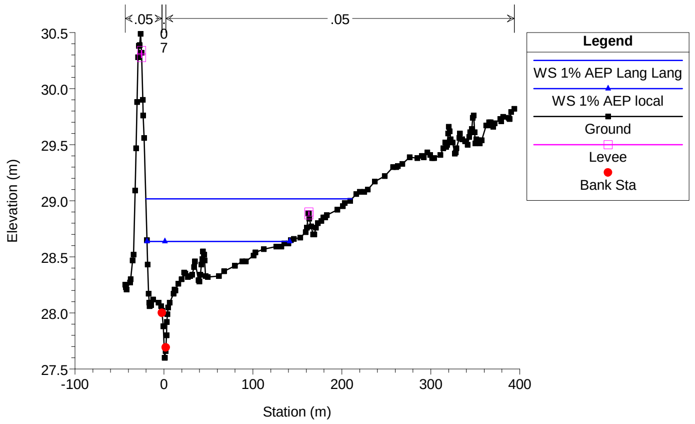
Design Conditions 14/09/2022
RS = 1720.24



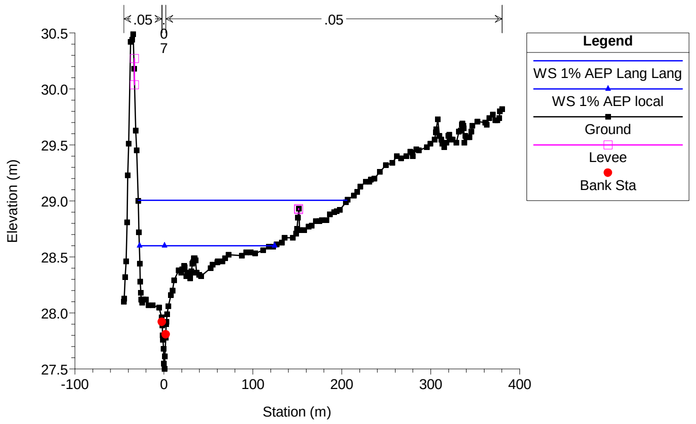
Design Conditions 14/09/2022
RS = 1670.16



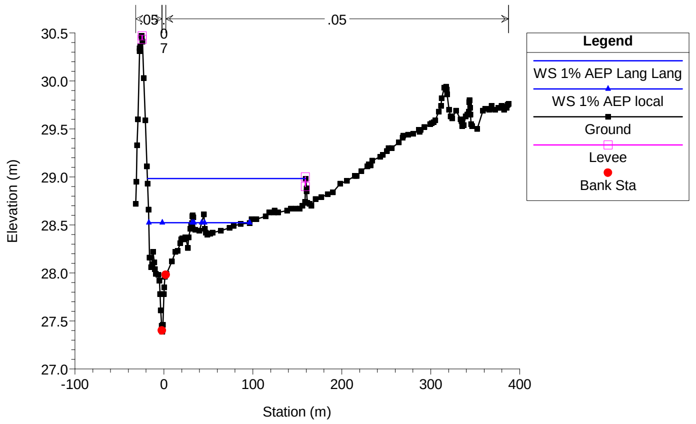
Design Conditions 14/09/2022
RS = 1641.30



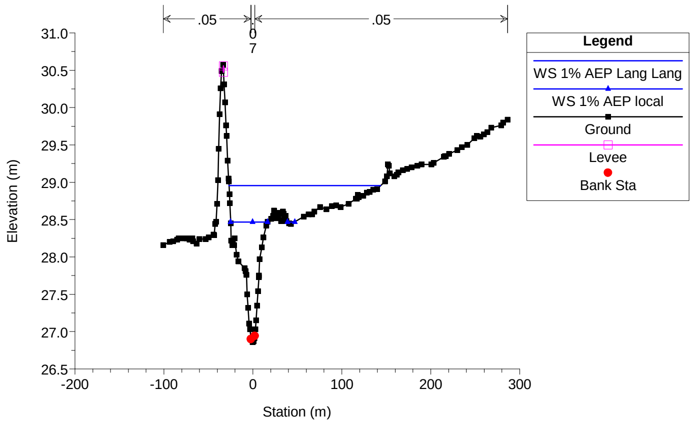
Design Conditions 14/09/2022
RS = 1602.12



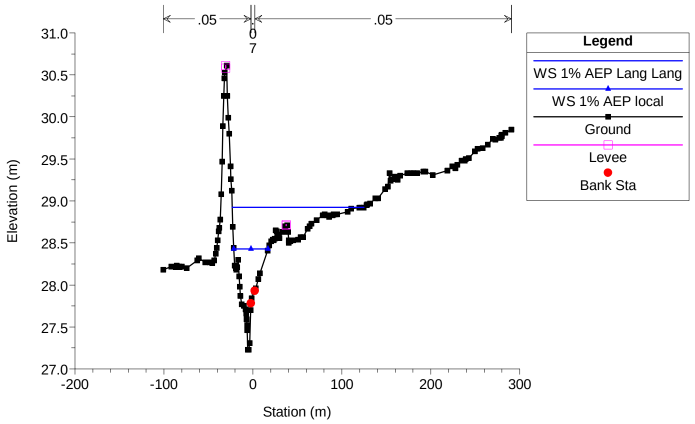
Design Conditions 14/09/2022
RS = 1554.23



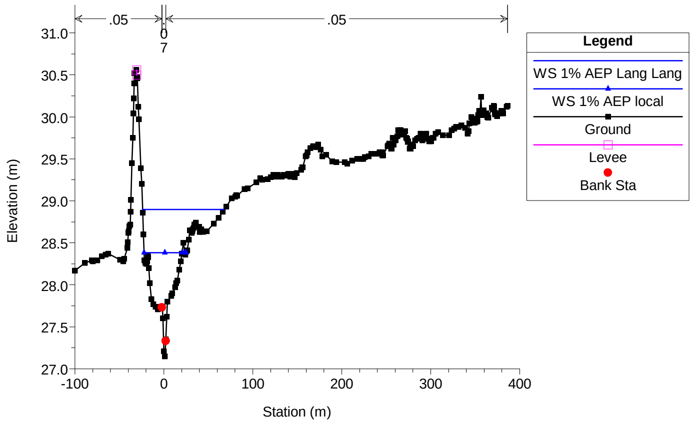
Design Conditions 14/09/2022
RS = 1495.92



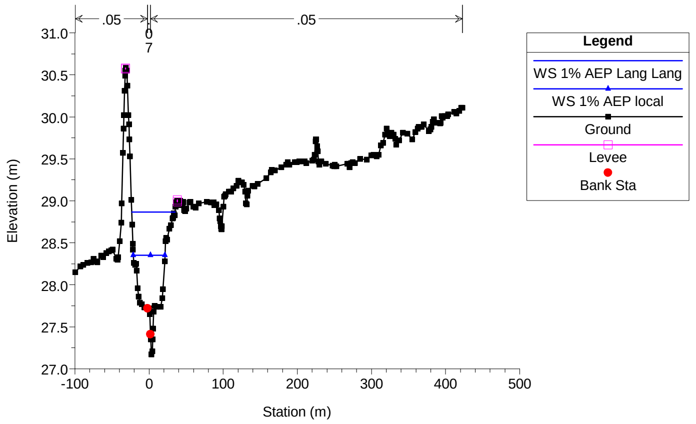
Design Conditions 14/09/2022
RS = 1471.01



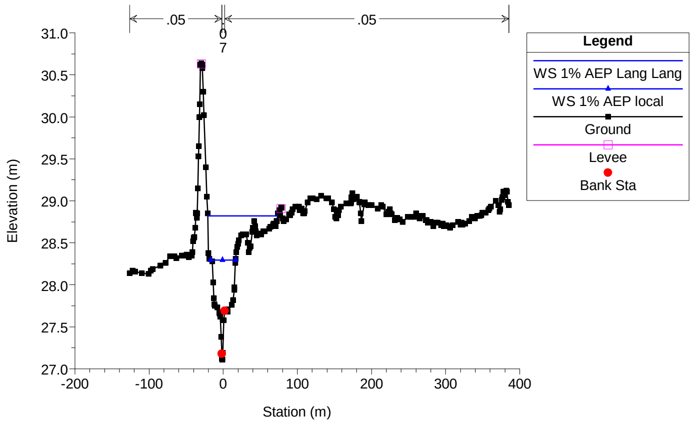
Design Conditions 14/09/2022
RS = 1446.00



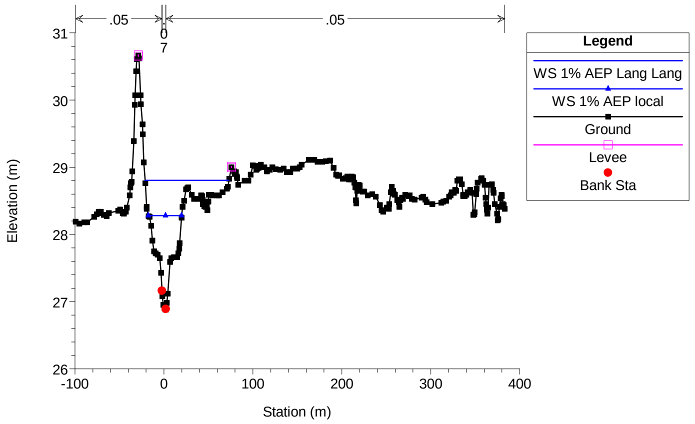
Design Conditions 14/09/2022
RS = 1421.07



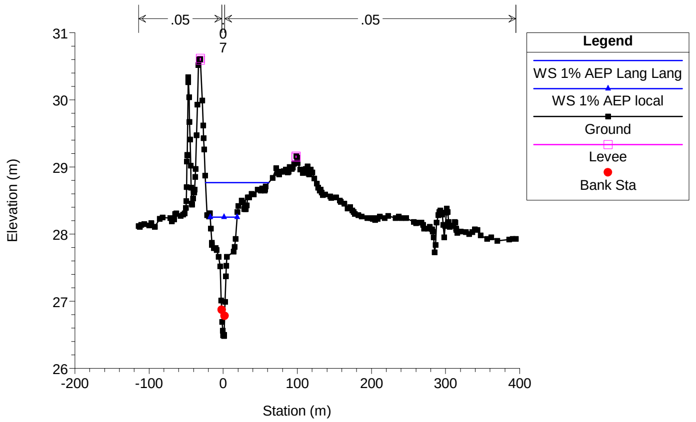
Design Conditions 14/09/2022
RS = 1388.28



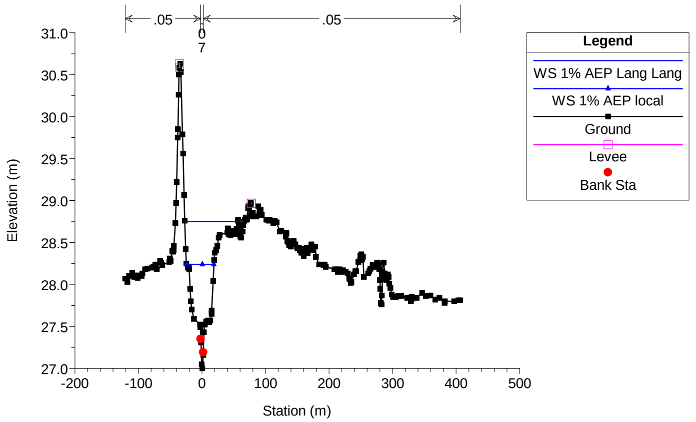
Design Conditions 14/09/2022
RS = 1371.07



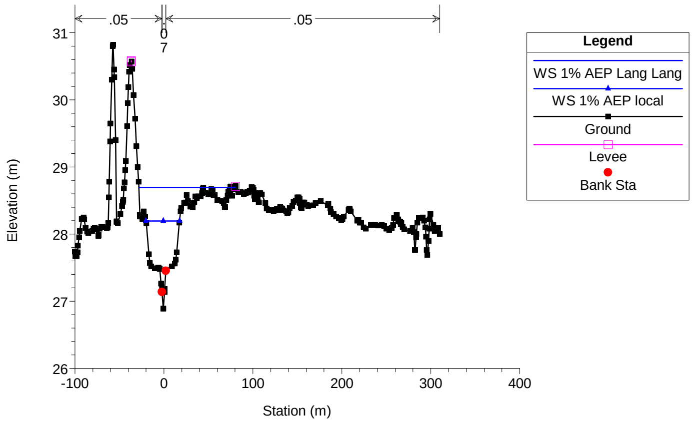
Design Conditions 14/09/2022
RS = 1339.51



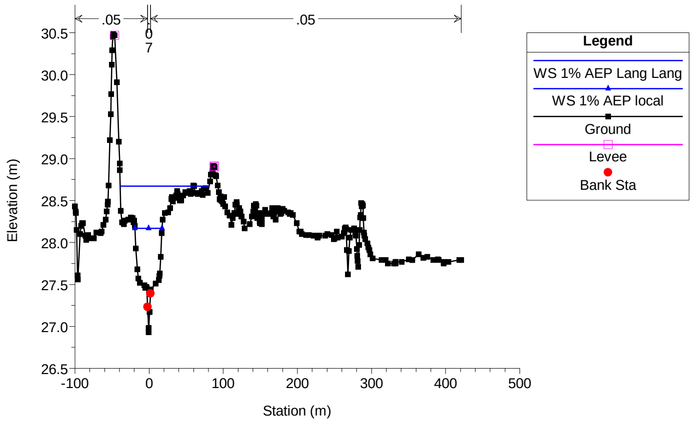
Design Conditions 14/09/2022
RS = 1321.38

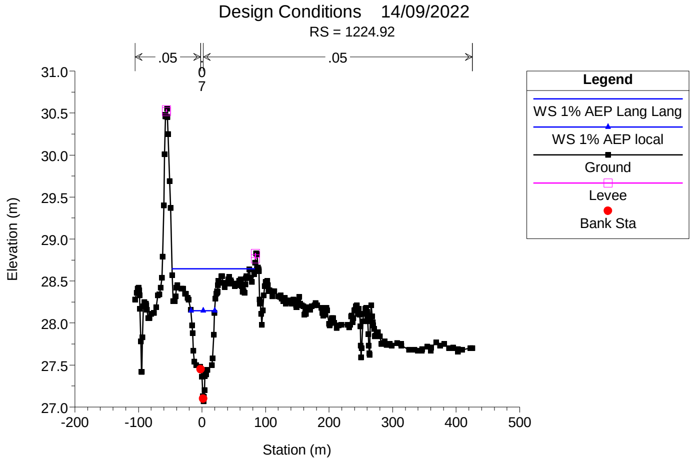


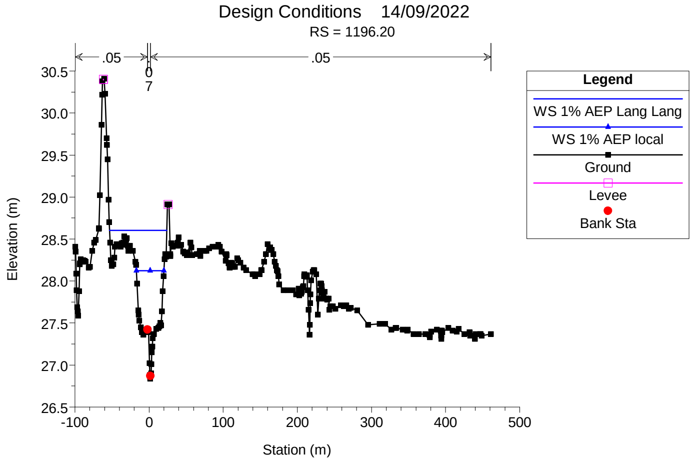
Design Conditions 14/09/2022
RS = 1271.16

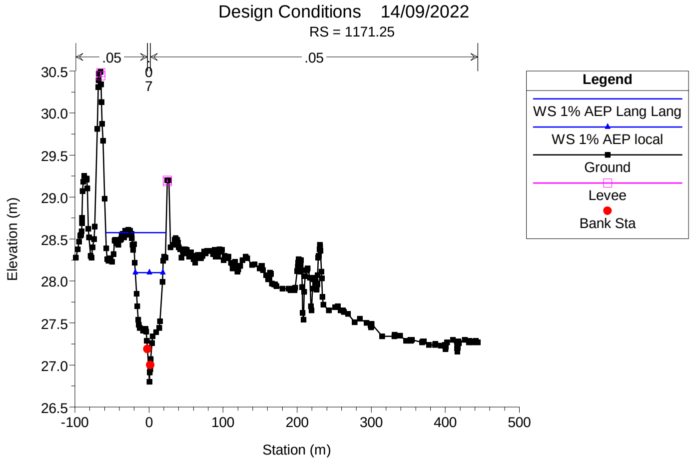


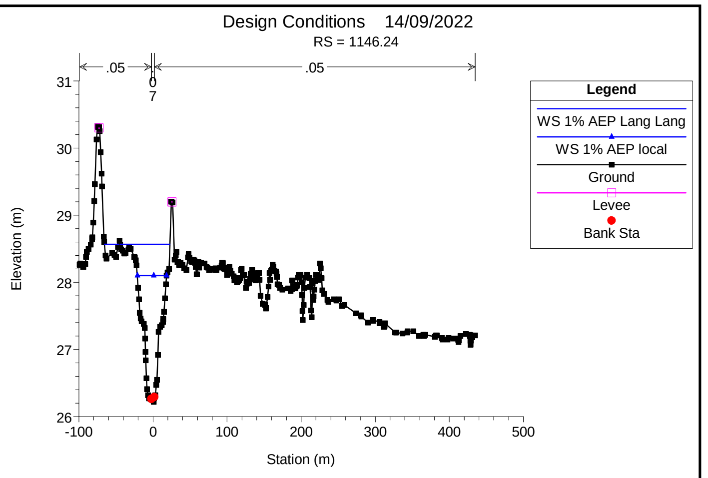
Design Conditions 14/09/2022
RS = 1246.16




Design Conditions 14/09/2022
RS = 1224.92
.05
0
7
.05
Elevation (m)
31.0
30.5
30.0
29.5
29.0
28.5
28.0
27.5
27.0
-200
-100
0
100
200
300
400
500
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
RS = 1196.20
.05
0
7
.05
Elevation (m)
30.5
30.0
29.5
29.0
28.5
28.0
27.5
27.0
26.5
-100
0
100
200
300
400
500
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
RS = 1171.25
.05
0
7
.05
Elevation (m)
30.5
30.0
29.5
29.0
28.5
28.0
27.5
27.0
26.5
-100
0
100
200
300
400
500
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
RS = 1146.24
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Elevation (m)
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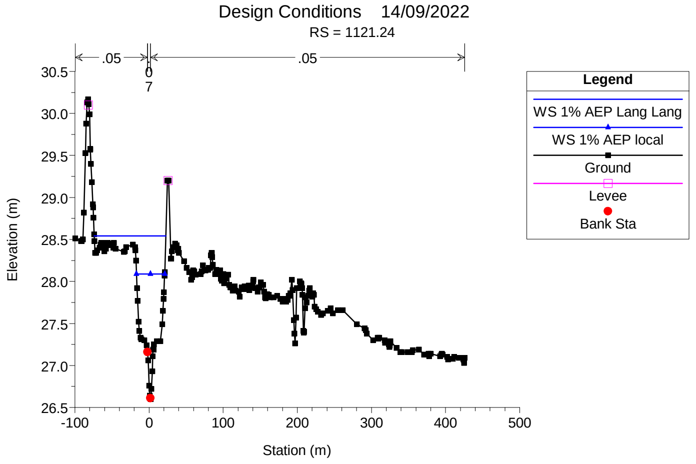
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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Elevation (m)
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29.5
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27.5
27.0
26.5
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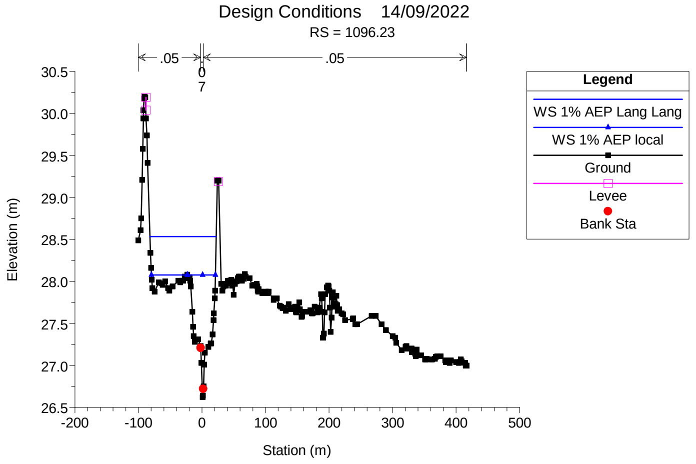
400
500
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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27.0
26.5
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300
400
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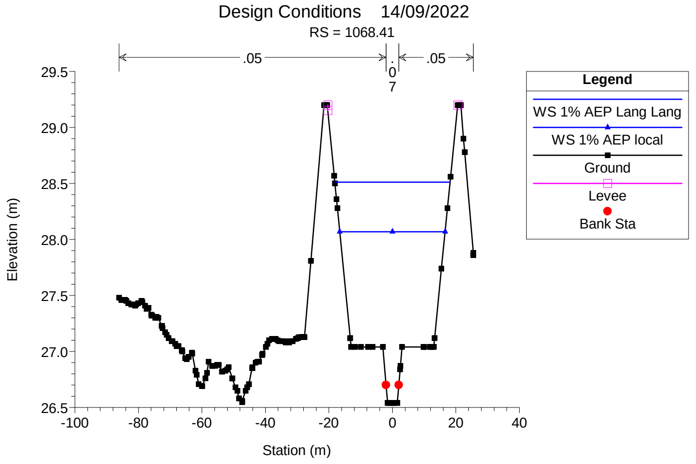
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta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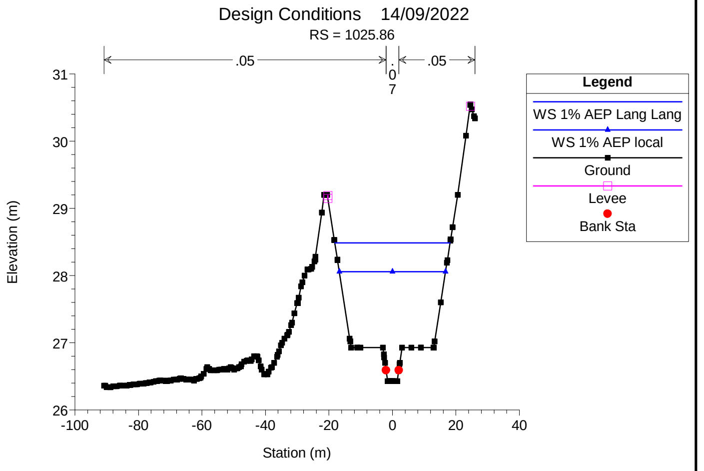
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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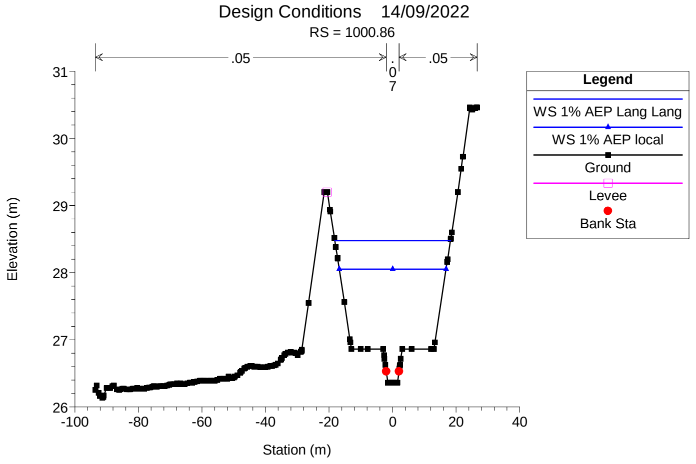
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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Elevation (m)
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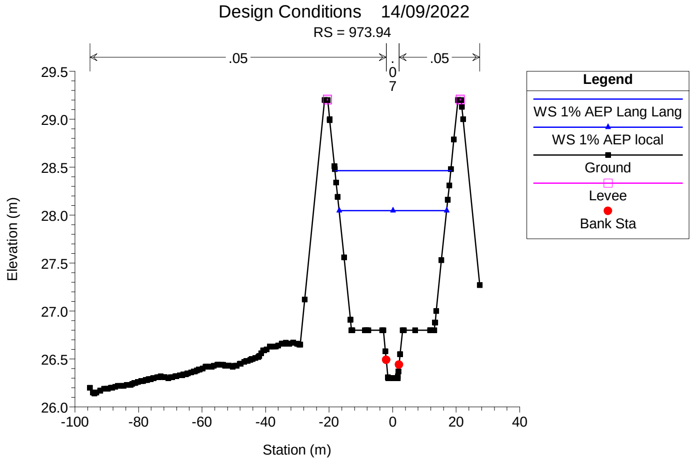
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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Elevation (m)
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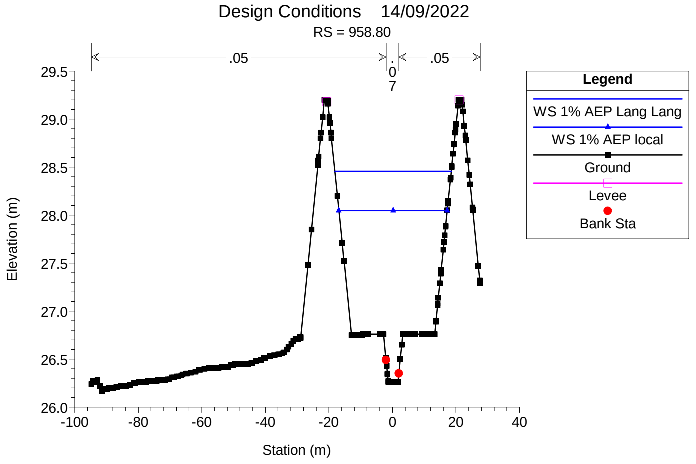
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta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-100
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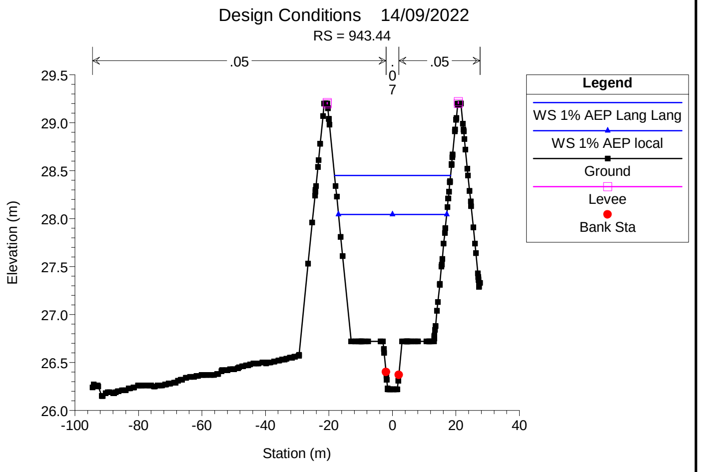
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
RS = 943.44
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26.5
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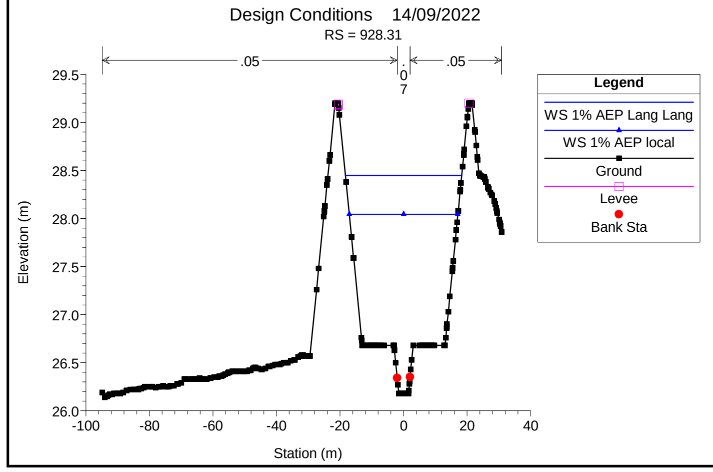
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta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27.0
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0
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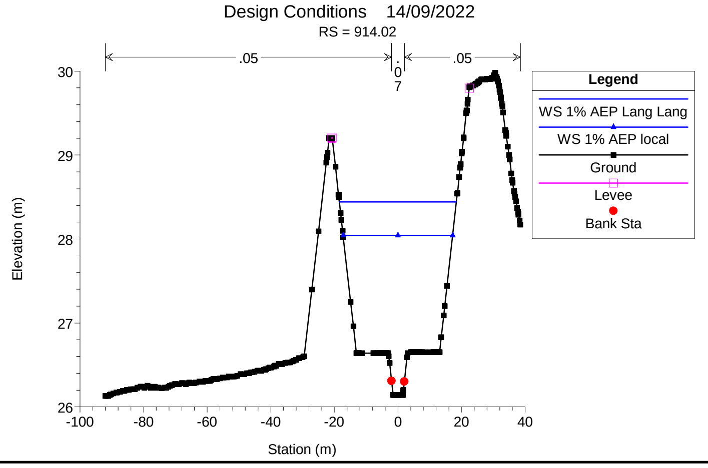
40
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
RS = 914.02
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Elevation (m)
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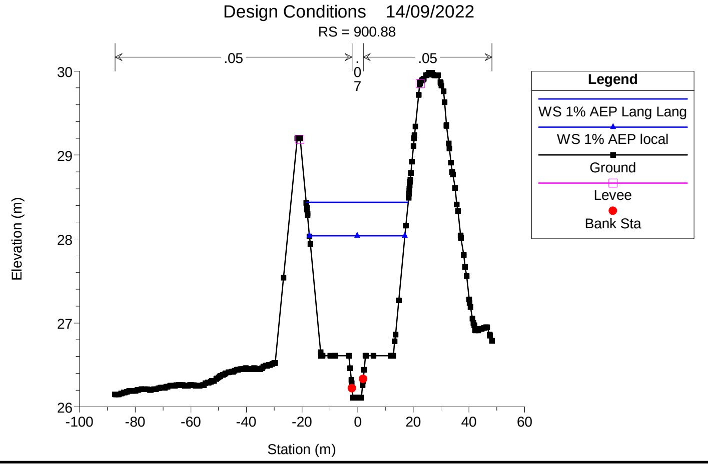
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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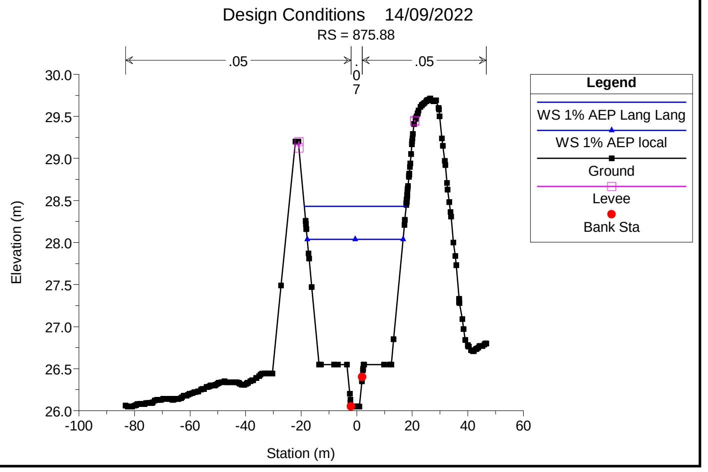
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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26.0
-100
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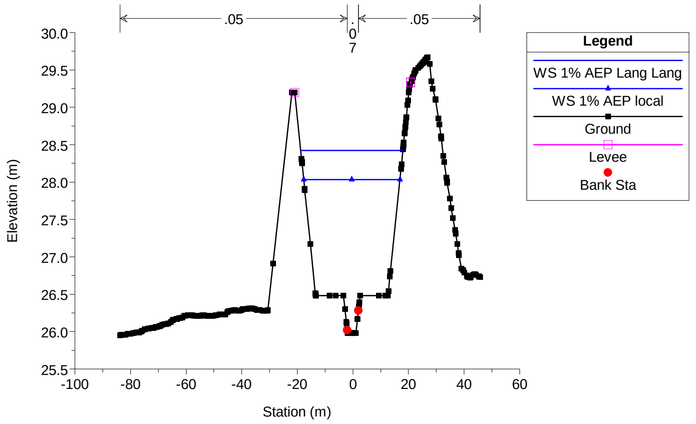
-40
-20
0
20
40
60
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta

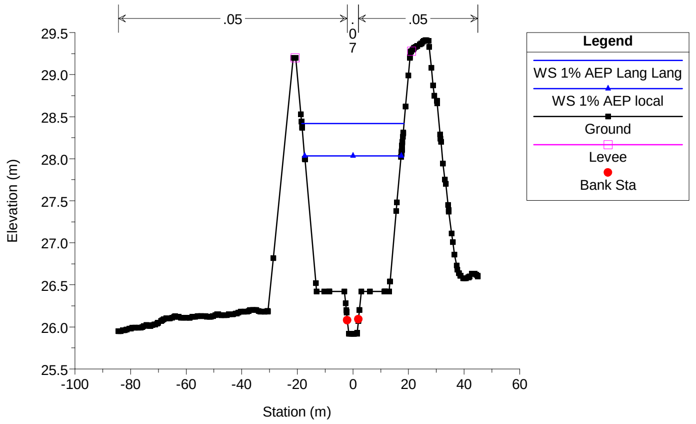
Design Conditions 14/09/2022

RS = 850.88



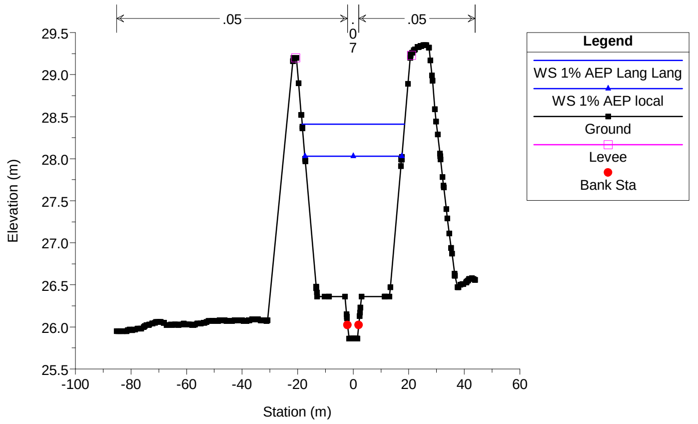
Design Conditions 14/09/2022

RS = 825.88



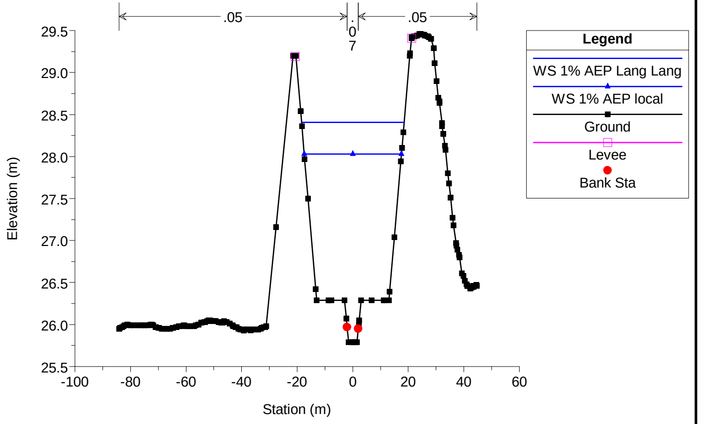
Design Conditions 14/09/2022

RS = 801.41



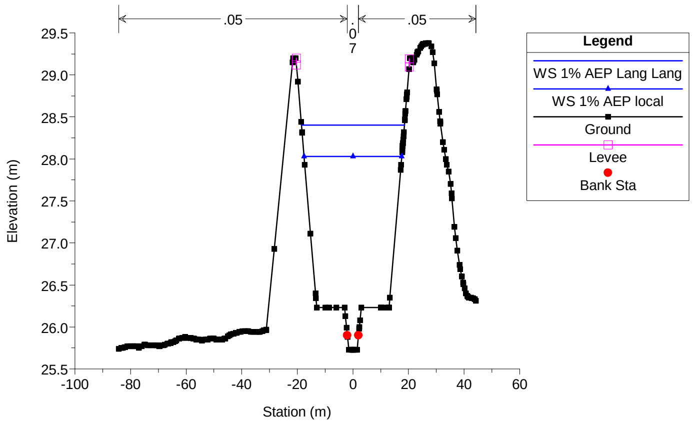
Design Conditions 14/09/2022

RS = 775.93



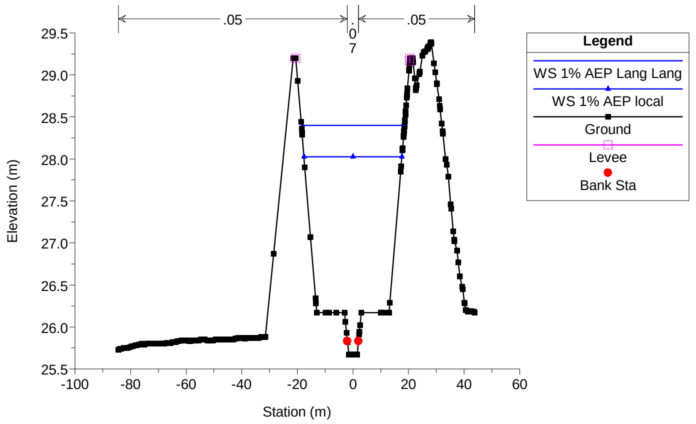
Design Conditions 14/09/2022

RS = 750.88



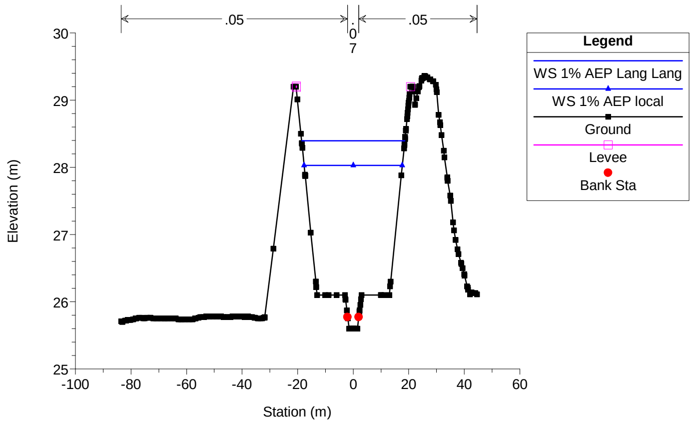
Design Conditions 14/09/2022

RS = 725.88



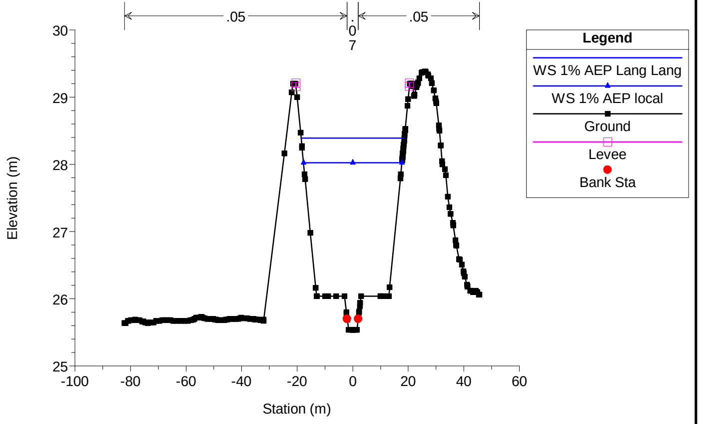
Design Conditions 14/09/2022

RS = 700.88



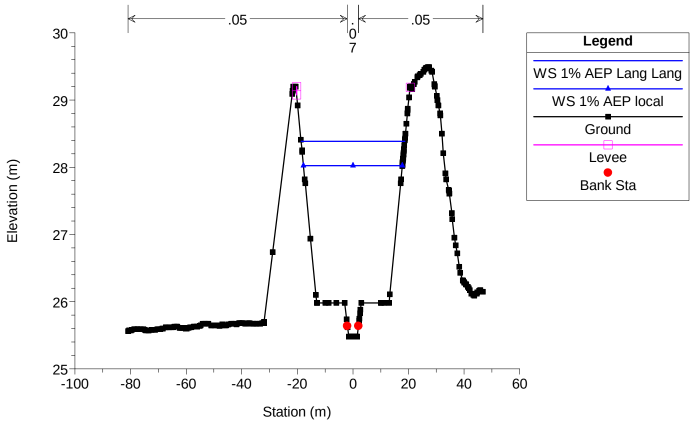
Design Conditions 14/09/2022

RS = 675.88



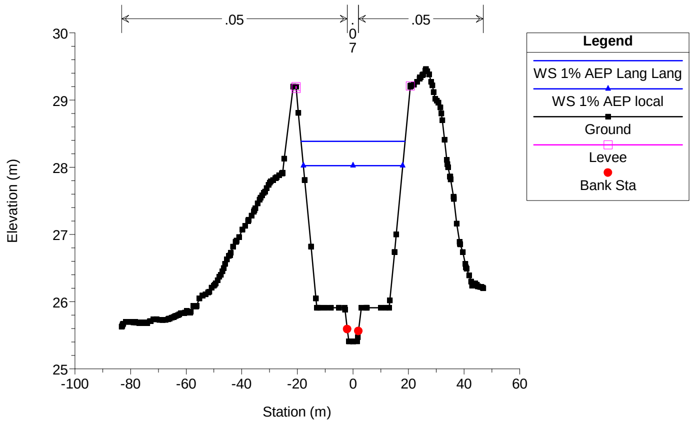
Design Conditions 14/09/2022

RS = 650.88



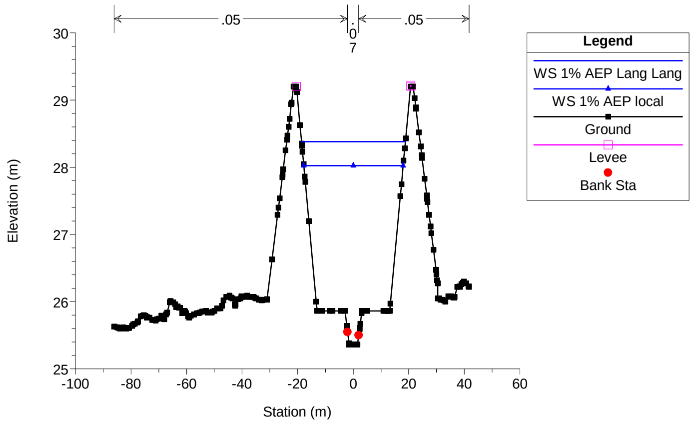
Design Conditions 14/09/2022

RS = 624.96



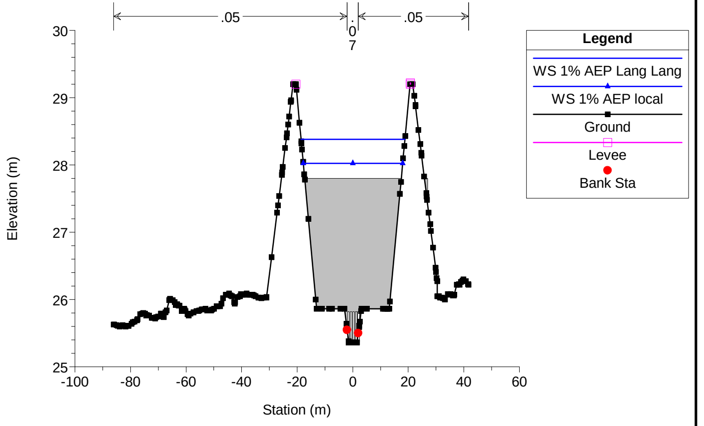
Design Conditions 14/09/2022

RS = 603.92



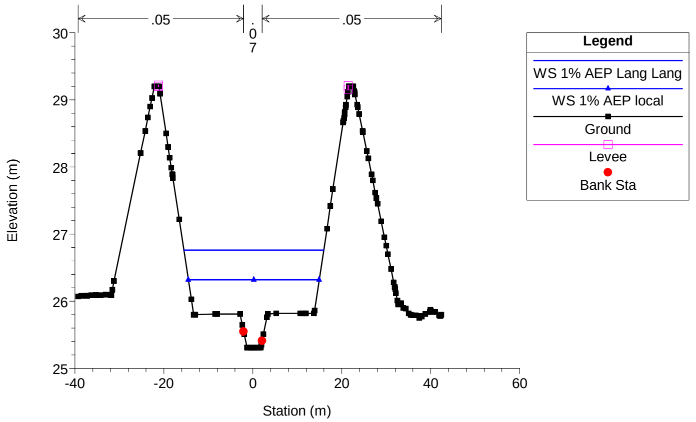
Design Conditions 14/09/2022

RS = 590 Culv



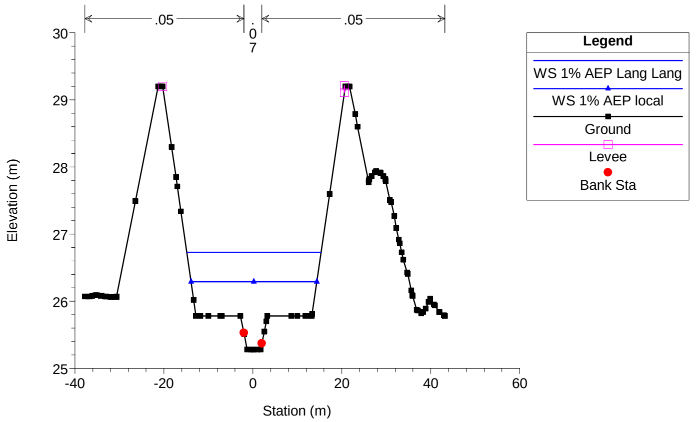
Design Conditions 14/09/2022

RS = 585.84



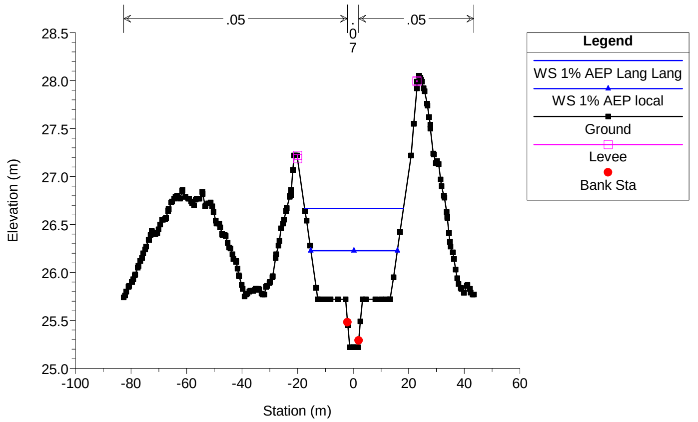
Design Conditions 14/09/2022

RS = 574.97



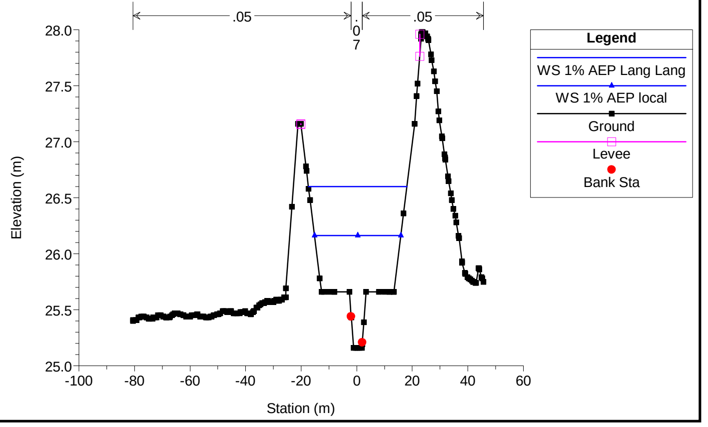
Design Conditions 14/09/2022

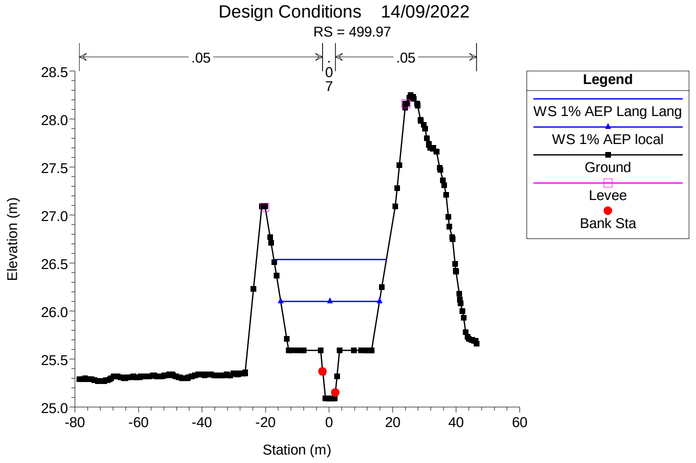
RS = 549.97



Design Conditions 14/09/2022

RS = 524.97




Design Conditions 14/09/2022
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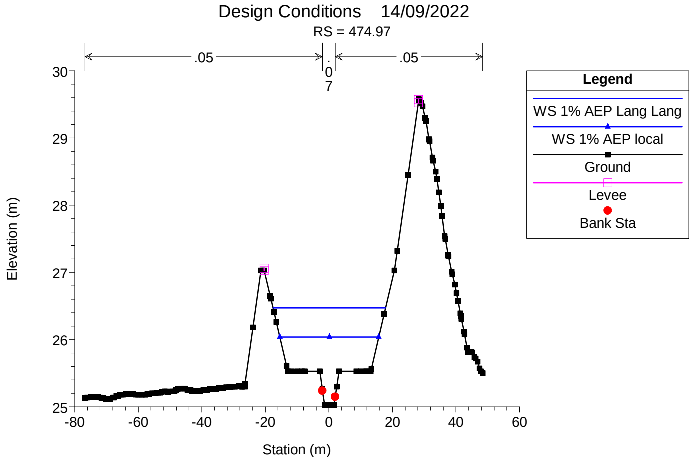
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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Elevation (m)
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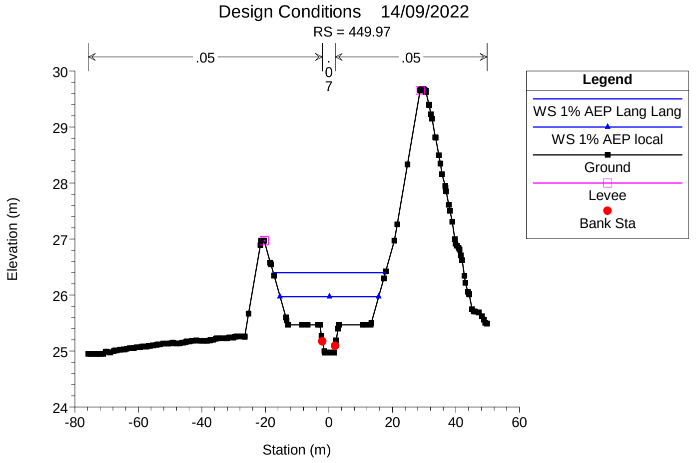
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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Elevation (m)
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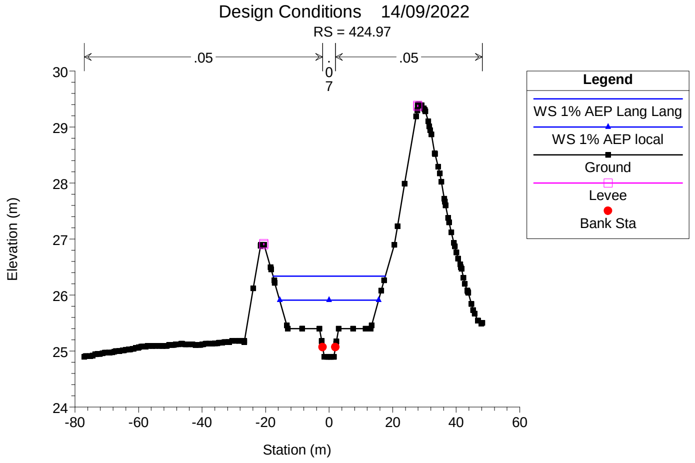
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta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Elevation (m)
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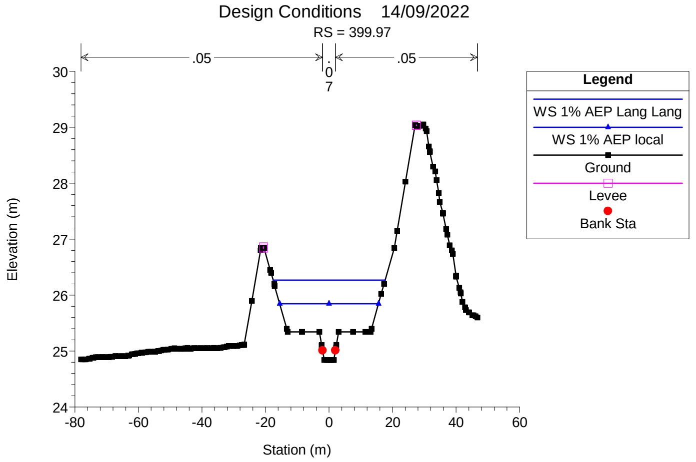
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta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Elevation (m)
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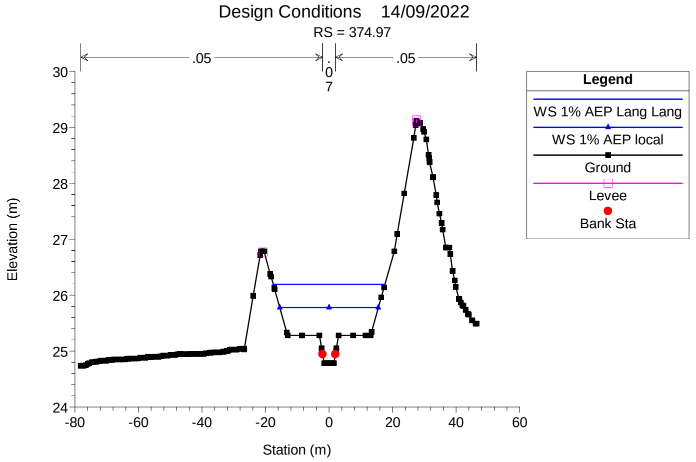
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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Elevation (m)
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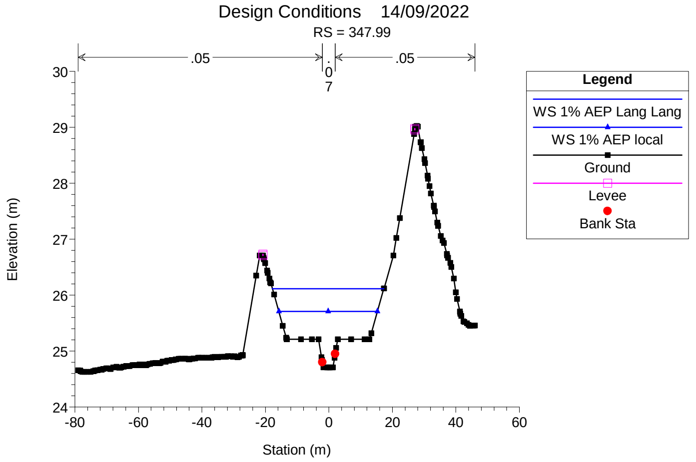
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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Elevation (m)
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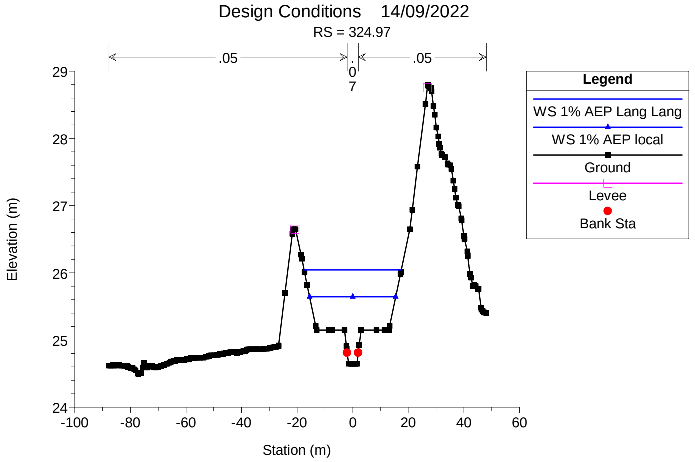
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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Elevation (m)
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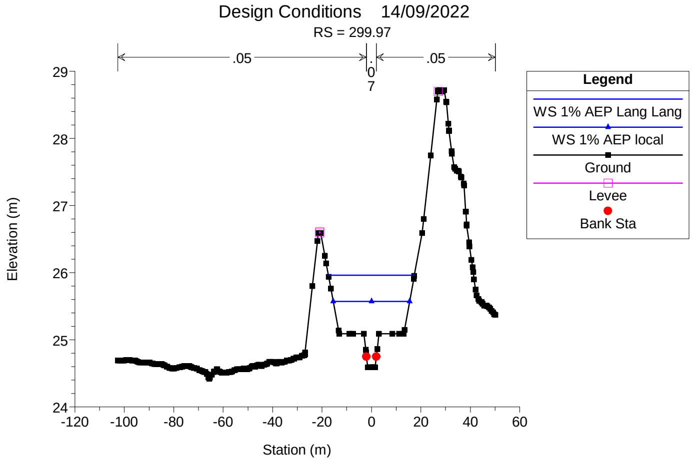
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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Elevation (m)
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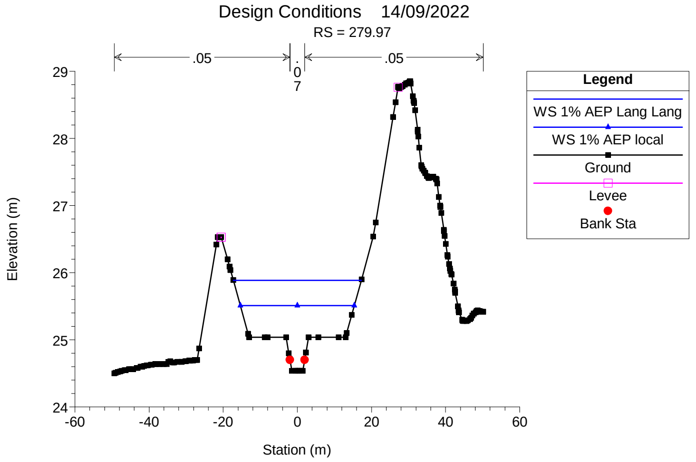
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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Elevation (m)
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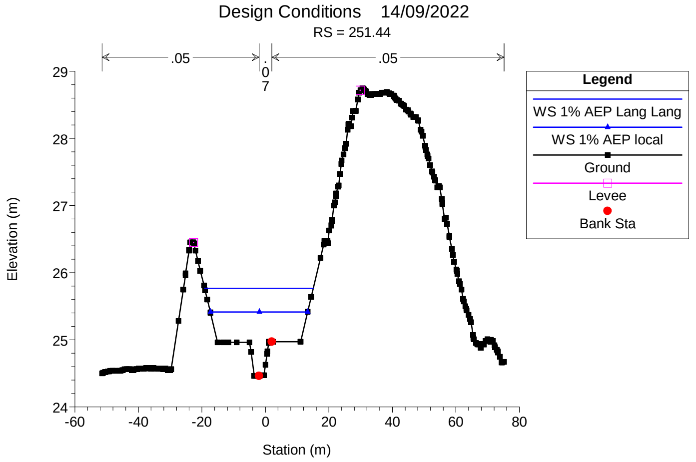
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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Elevation (m)
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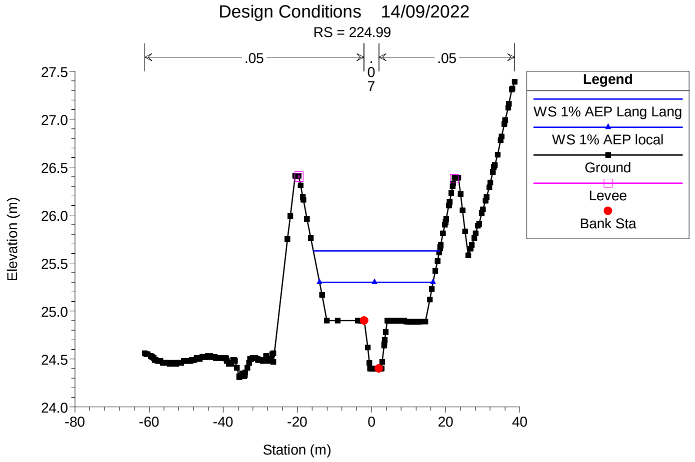
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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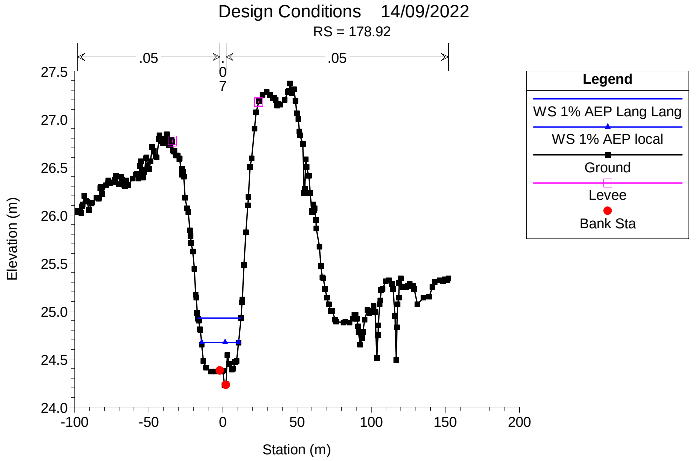
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta


Design Conditions 14/09/2022
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Elevation (m)
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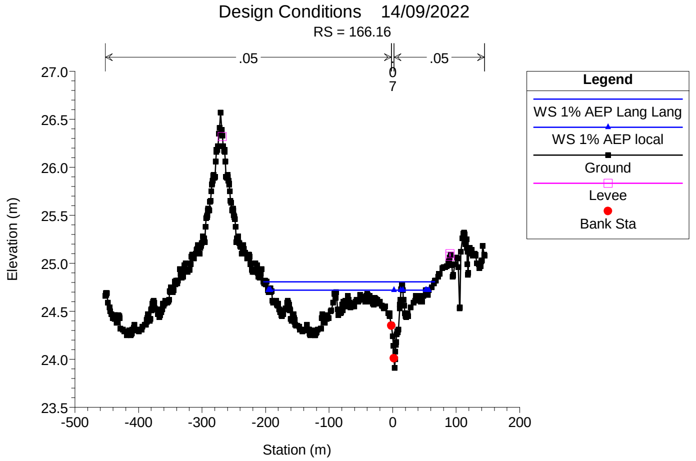
0
50
100
150
200
Station (m)
Legend
WS 1% AEP Lang Lang
WS 1% AEP local
Ground
Levee
Bank Sta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Levee
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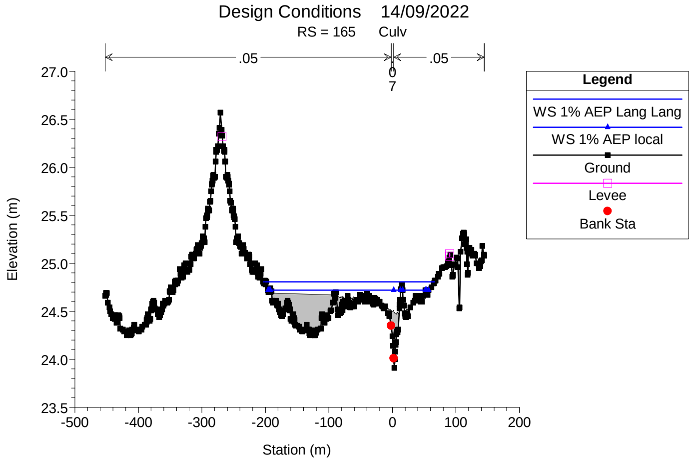
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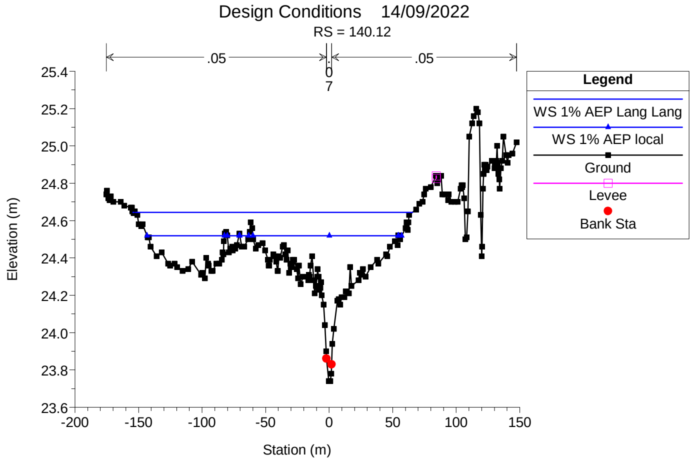
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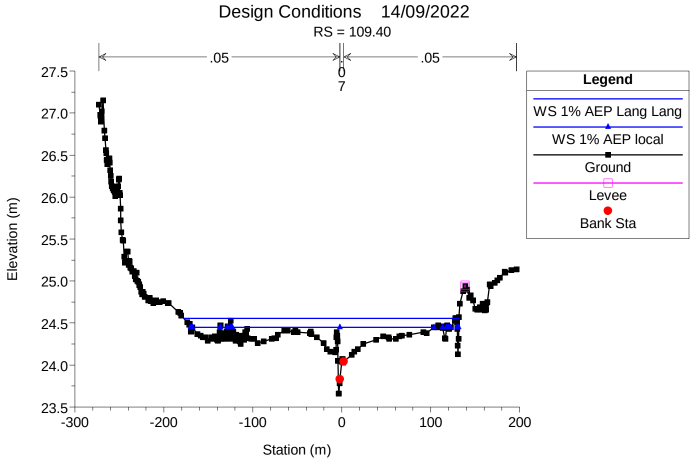

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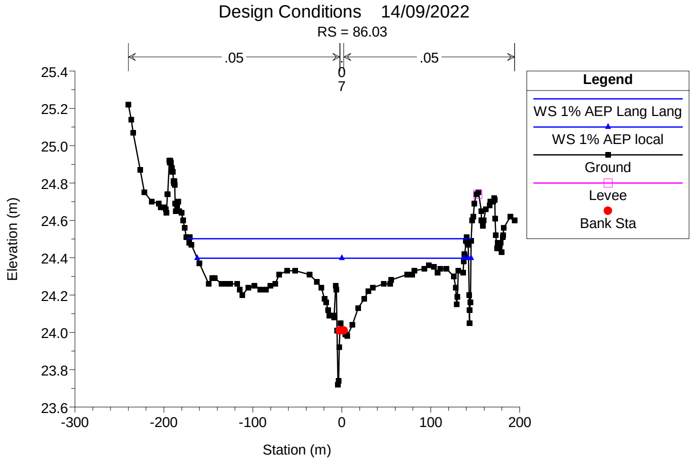

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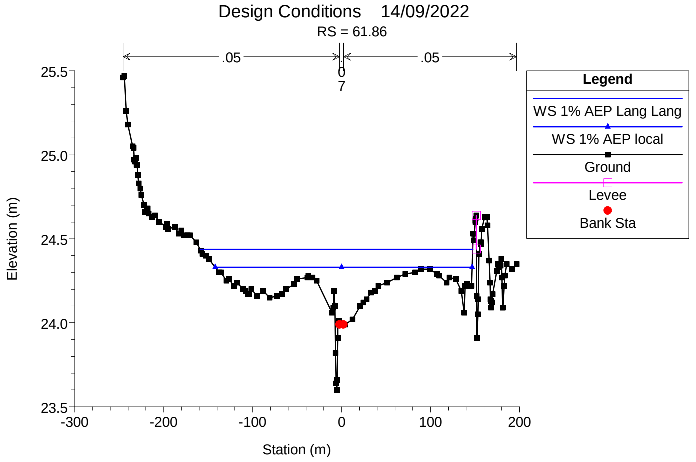

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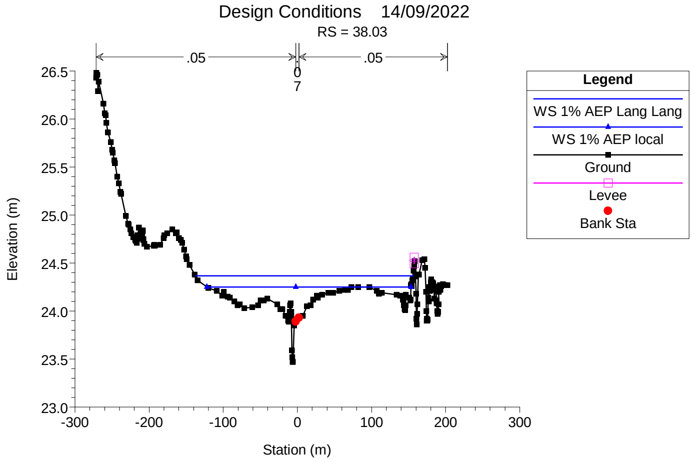

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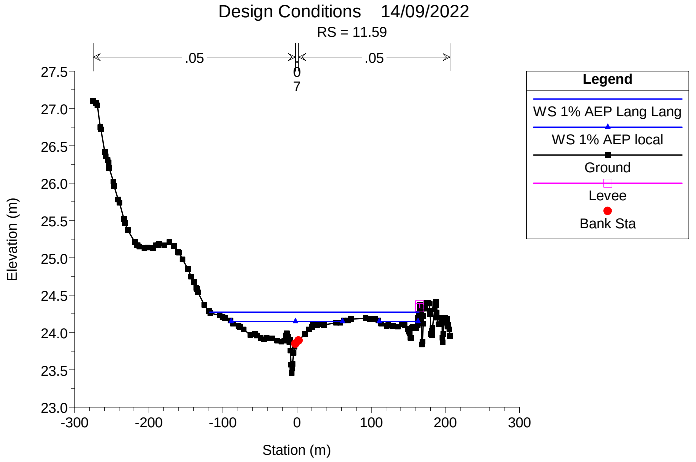

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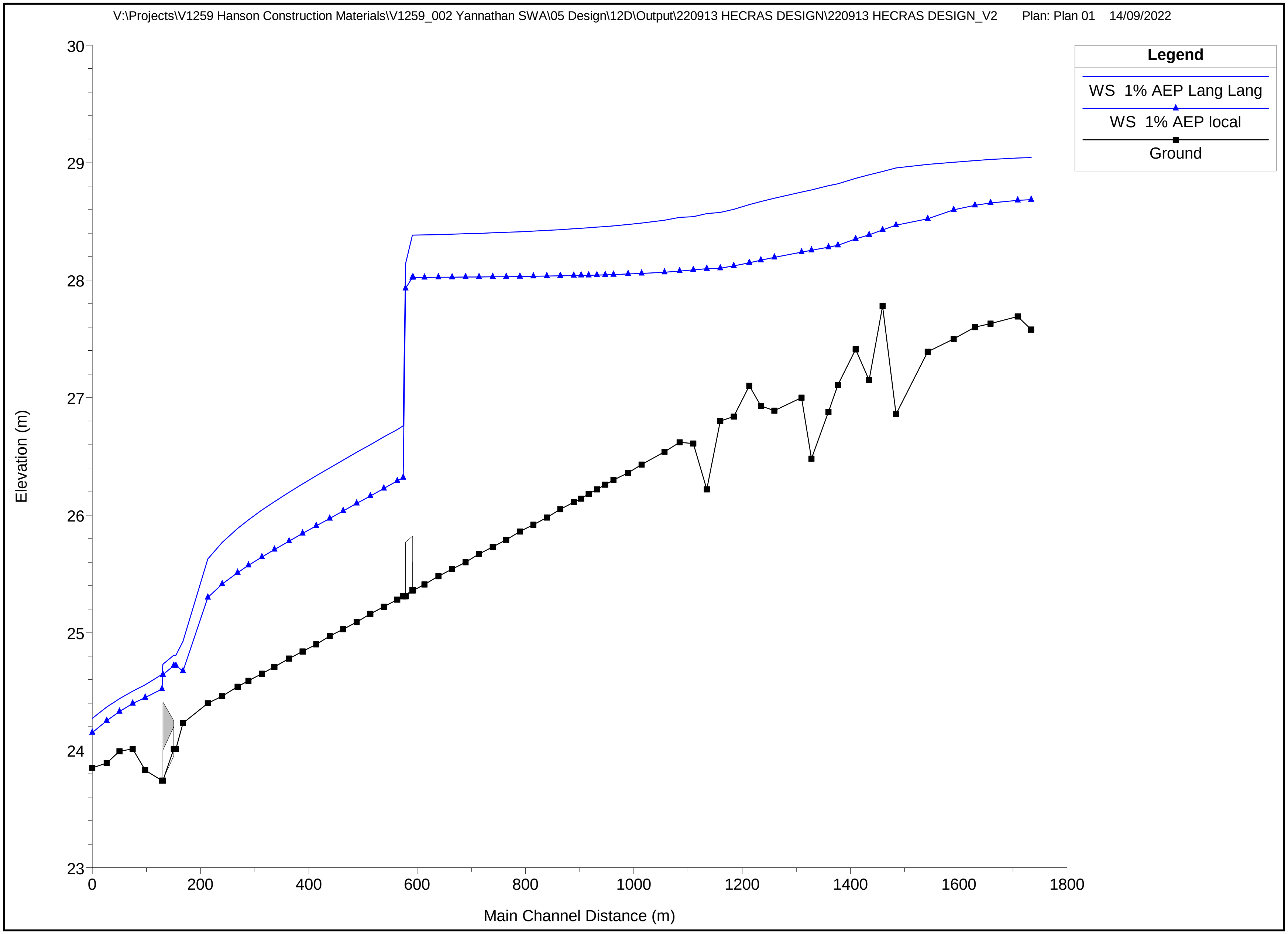
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Ground
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1400
1600
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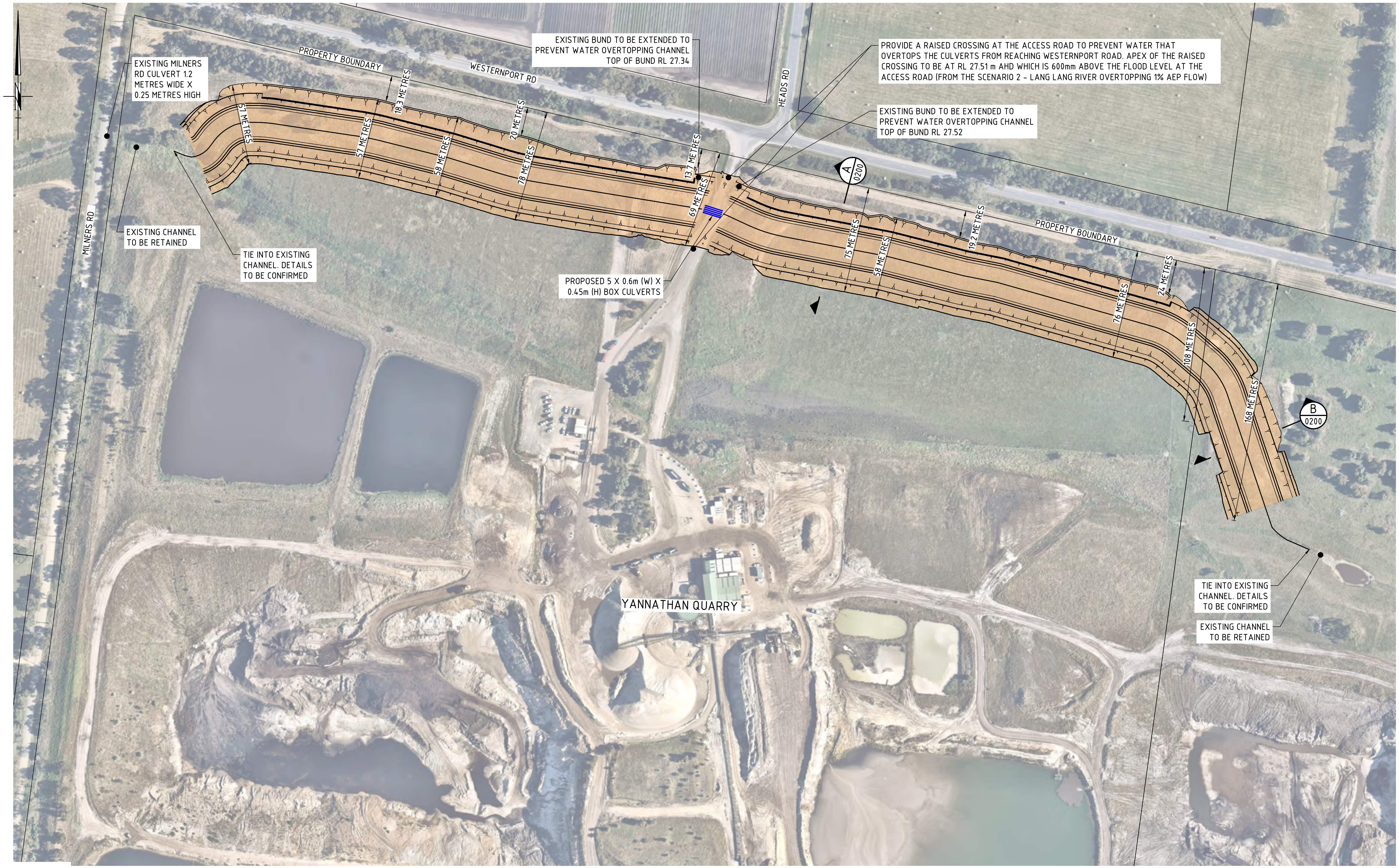
Main Channel Distance (m)

Appendix I:

Concept Design



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LAST MODIFIED:17/12/2021 12:33 PM

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A				
REV	BY	DATE	REVISION DESCRIPTION	PM APPD.

DOC. NUMBER	DOCUMENT TITLE
REFERENCE DOCUMENTS	

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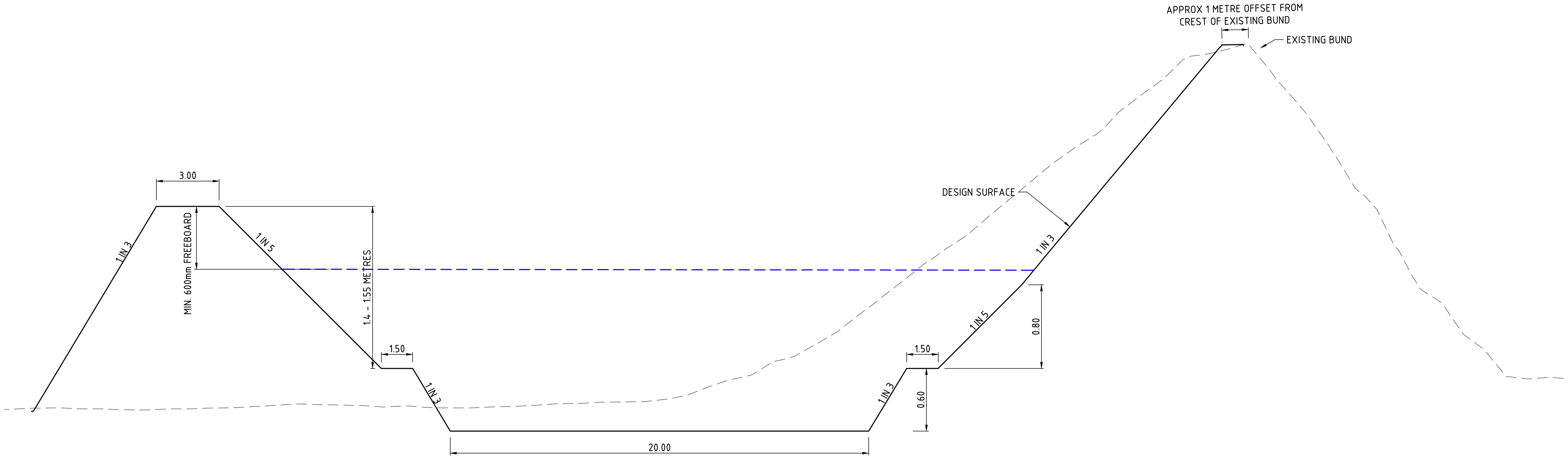
PM APPD.		PD APPD.	
CPENG		CPENG No.	

HANSON CONSTRUCTION MATERIALS

YANNATHAN SURFACE WATER ASSESSMENT
CONCEPT LAYOUT PLAN

ORIGINAL SIZE: A1
DWG NO.: V1259-002-DWG-0100
REV.: A



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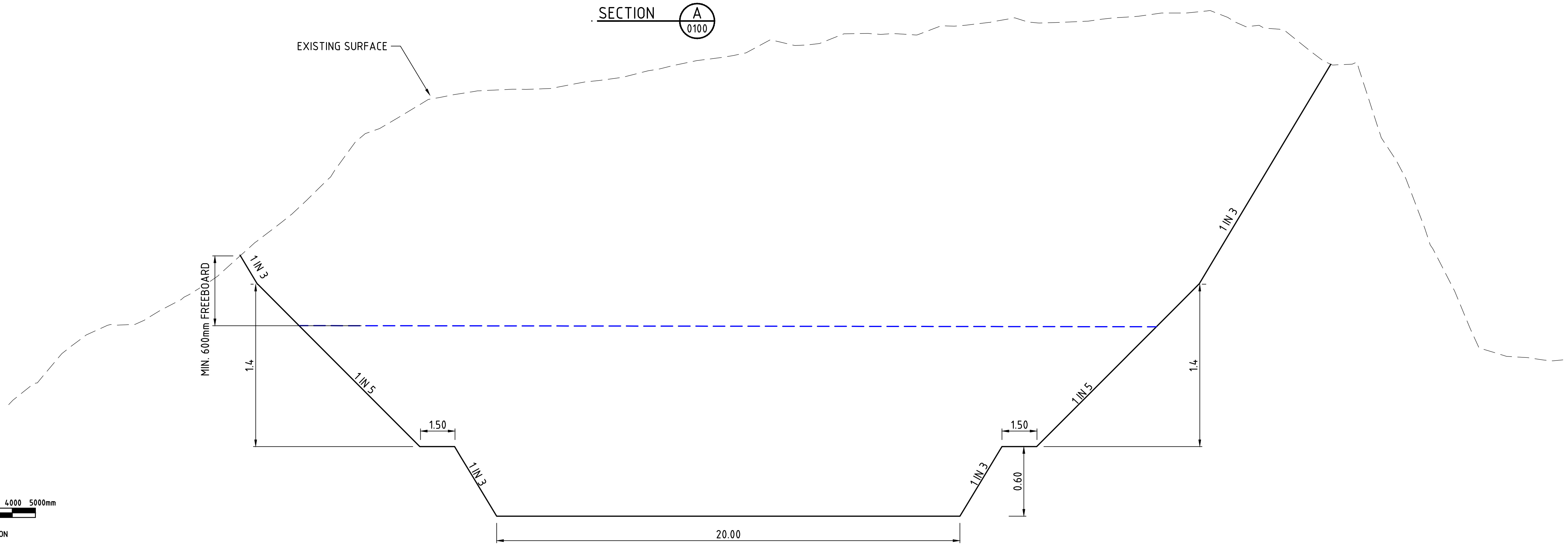

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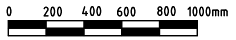

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DOC. NUMBER	DOCUMENT TITLE
REFERENCE DOCUMENTS	

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DESIGNED		CHECKED	
DRAWN		CHECKED	
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HANSON CONSTRUCTION MATERIALS

YANNATHAN SURFACE WATER ASSESSMENT
CONCEPT TYPICAL SECTION

ORIGINAL SIZE	DWG NO.	REV.
A1	V1259-002-DWG-0200	A

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YANNATHAN HYDROGEOLOGICAL ASSESSMENT

WA127

Client: Hanson Construction Materials

Ricardo ref. 30765

Issue:5

11/12/2023

Level 4, 3 Bowen Crescent, Melbourne, Victoria 3004, Australia
Registered office: Ricardo Energy, Environment & Planning Pty, Level 17, 383 Kent Street Sydney NSW 2000 ABN: 80 605 049 054

Customer: Hanson Construction Materials

Customer reference:
WA127

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Issue History			
Issue No	Date Issued	Document Status	Approved By
1	19/07/2019	Draft	Dave Adams
2	13/09/2022	Draft	Dave Adams
3	19/09/2022	Final	Dave Adams
4	5/05/2023	Final	Kathy Mac Innes
5	22/11/2023	Final	Jo Regel

Executive Summary

The Yannathan Sand Quarry has been owned and operated by Hanson Construction Materials (Hanson) and its predecessors since 1997 under Work Authority WA127. The reserves within the approved extraction area are nearly exhausted and Hanson is seeking to extend the area and depth of extraction.

The site is in an area of relatively high watertable so the hydrogeological aspects of the proposed expansion are critical. The site is currently permitted to extract to a depth of 9 mAHD which correlates to a horizon with a high organic content, sometimes even coal. Investigative drilling has confirmed that further sand resources exist beneath this organic-rich layer.

Despite excavation being below the watertable the site has been able to minimise lateral groundwater inflow by using clay overburden placed against the batters. This has allowed the quarry to continue to operate using dry quarry methods. Water that flows into the pit is pumped to worked out areas which return the groundwater to the aquifer.

The report has been prepared in support of a Work Plan Variation to extend the area and depth of the quarry. The option to use the current method of excavation has been explored in some depth. Although the outcomes of the groundwater modelling indicated the level of impact on surrounding groundwater users was acceptable, the modelling report informed a decision by Hanson to switch to dredging for the deeper sections of the pits for operational reasons. This has the added benefit of reducing the impact on neighbouring groundwater users and potential environmental values for the groundwater environment.

Additionally the switch to dredging means that there is sufficient storage available onsite for water extracted where dry quarrying operations are still occurring so that there is no need for an additional groundwater extraction licence.

CONTENTS

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Glossary

Acronym	Description
AHD	Australian Height Datum
AMRR	Accumulative monthly residual rainfall
EC	Electrical conductivity
EPA	Environment Protection Authority
EP Act	Environment Protection Act (2017)
ERR	Earth Resources Regulator
ERS	Environment Reference Standard
GDE	Groundwater Dependent Ecosystems
GME	Groundwater monitoring event
mbgl	Metres below ground level
mbTOC	Metres below top of casing
NHMRC	National Health and Medical Research Council
PolyDADMAC	2-Propen-1-aminium, N,N-dimethyl-N-2-propenyl-, chloride, homopolymer (organic coagulant)
RL	Reduced level
RWL	Reduced water level
SOBN	State Observation Bore Network
SEPP	State Environment protection Policy (now superseded by the ERS)
SRW	Southern Rural Water
SWL	Standing water level
TOC	Total organic carbon / top of casing
TDS	Total dissolved solids
TKN	Total Kjeldahl Nitrogen
WA	Work Authority
WMIS	Water Management Information System
WSPA	Water Supply Protection Area

1. INTRODUCTION

1.1 OBJECTIVES

Ricardo Energy Environment and Planning (Ricardo) has been engaged by Hanson Construction Materials (Hanson) to prepare a Work Plan Variation for the Yannathan quarry (the Site) to extend the area and depth of the extraction area within the current Work Authority area. The site is located at 870 -910 Westernport Road, Yannathan, approximately 6 km east-north-east of the township of Lang Lang, and 75 km south-east of the Melbourne CBD (**Figure 1-1).**

The Site supplies sand from two pits on the eastern and western sides of the site. Quarrying currently extends to RL: 9 mAHD, with the natural ground surface elevation varying between 26 and 30 mAHD. This application proposes an increase of the quarry depth to RL:-9 mAHD and to extend the area to the northern portion of the site.

Figure 1-1 Site location

1.2 REGULATORY CONTEXT

The site currently operates under Work Authority 127 (WA127) and Planning Permit T140140-1.

The Planning Permit was originally issued by the Shire of Cranbourne (No CW2959), now within the municipality of the Cardinia Shire Council. The Planning Permit allows sand extraction across the site. The Planning Permit was originally for a fifteen-year period, this was extended to 29/11/2015 in 2010 then was amended and reissued as permit No T140140-1 in April 2015, there is no time limit specified. A further amendment was approved on 31 August 2020 (via secondary consent) for the construction of a bund wall along the eastern boundary of the site. Relevant clauses of the Amended Planning Permit include:

- Condition 27 - there is to be no extraction below RL: 9mAHD.

- Condition 28 – All works must comply with Southern Rural Water's specific conditions of the endorsed Work Plan
- Condition 29 – The Work Authority holder shall implement controls to ensure that there is no polluted seepage from the work site into groundwater or surface water resource.
- Condition 31 – any significant variation in

  groundwater levels around the site boundary will need a detailed hydrogeological assessment report prepared and submitted to Southern Rural Water (SRW).

  Monitoring date *(sic)* for groundwater levels and any increase in groundwater extraction rates must be reported to SRW

  Monitoring date *(sic)* may require the applicant to submit a revised detailed hydrogeological assessment report addressing the potential impacts of declining groundwater levels and the impacts of increased dewatering activities
- Condition 35 – Prior to extraction works commencing in new areas, the applicant must submit a revised hydrogeological assessment which must takes *(sic)* into account historical groundwater monitoring data, potential increase in declining groundwater levels, any potential increase in extraction rates, potential impacts on the groundwater resources and existing users and the need for a revised groundwater monitoring program

Extractive Industry works originally commenced under Extractive Industry Licence LIC1266 which was granted to H.A and K.I Beluch in 1989. Hanson Construction Materials purchased the site in 1997 and the adjacent site in 1998.

The Work Authority originally limited extraction to defined areas within the property but was subsequently amended to include the entirety of the property in the 2013 Work Plan Variation. The amended Work Authority conditions include the following:

Condition 2.2 – No extraction shall take place below RL: 9 as shown on drawing no Q 944-YA.

Condition 3.1 – The Work Authority holder shall implement controls to ensure that there is no polluted seepage from the work site into groundwater or surface water resource.

Condition 3.3 - Any significant variation in groundwater levels around the site boundary will require the need for a detailed hydrogeological report to be prepared and forwarded to Southern Rural Water for assessment.

1.3 STAKEHOLDERS

The stakeholders relevant to increasing the area and depth of extraction at the site are outlined in **Table 1-1**.

Table 1-1 Stakeholders

Stakeholder	Area of concern
Southern Rural Water (SRW)	Southern Rural Water is a State Government agency responsible for the groundwater licensing framework that applies caps and restrictions on allocated water use. SRW is obligated to consult with other agencies (referral agencies) on matters such as licensing and water trading. SRW has identified a range of current and emerging issues according to the underlying aquifers in the region. These issues include seawater/saline intrusion, quarry dewatering, increasing demand and competition between users. Additionally, SRW was provided with a draft of this report (Version 3), and provided comments in letter dated 7 October 2022. This report has been updated to address SRW's comments.
Earth Resources Regulator (ERR)	ERR manages resources extracted from the ground, including the sand, which is mined at the Site, to balance the needs of the environment, community and Victorian economy.

Stakeholder	**Area of concern**
Environment Protection Authority (EPA)	No changes to noise or dust emissions are anticipated associated with application.
Shire of Cardinia	The Shire of Cardinia is responsible for implementing the Planning Scheme under the *Planning and Environment Act 1987.*
Neighbours	The nearest neighbours are located immediately east and west of the site.

1.4 LEGISLATIVE FRAMEWORK

Table 1-2 below outlines the primary legislative framework relevant to consideration of increased depth and area.

Table 1-2 Legislative framework

Legislation	**Description**
Water Act (1989)	The Water Act 1989 governs water entitlements and establishes the mechanisms for managing Victoria's water resources.
Mineral Resources (Sustainable Development) Act (1990)	This act provides a framework for the development and regulation of extractive industries such as sand extraction.
Planning and Environment Act (1987)	The Planning and Environment Act establishes a framework for planning the use, development and protection of land in Victoria.
Environment Protection Act (2017)	The EP Act provides the legal framework to protect the environment in Victoria. The EP Act applies to air, water, land and noise emissions in Victoria.

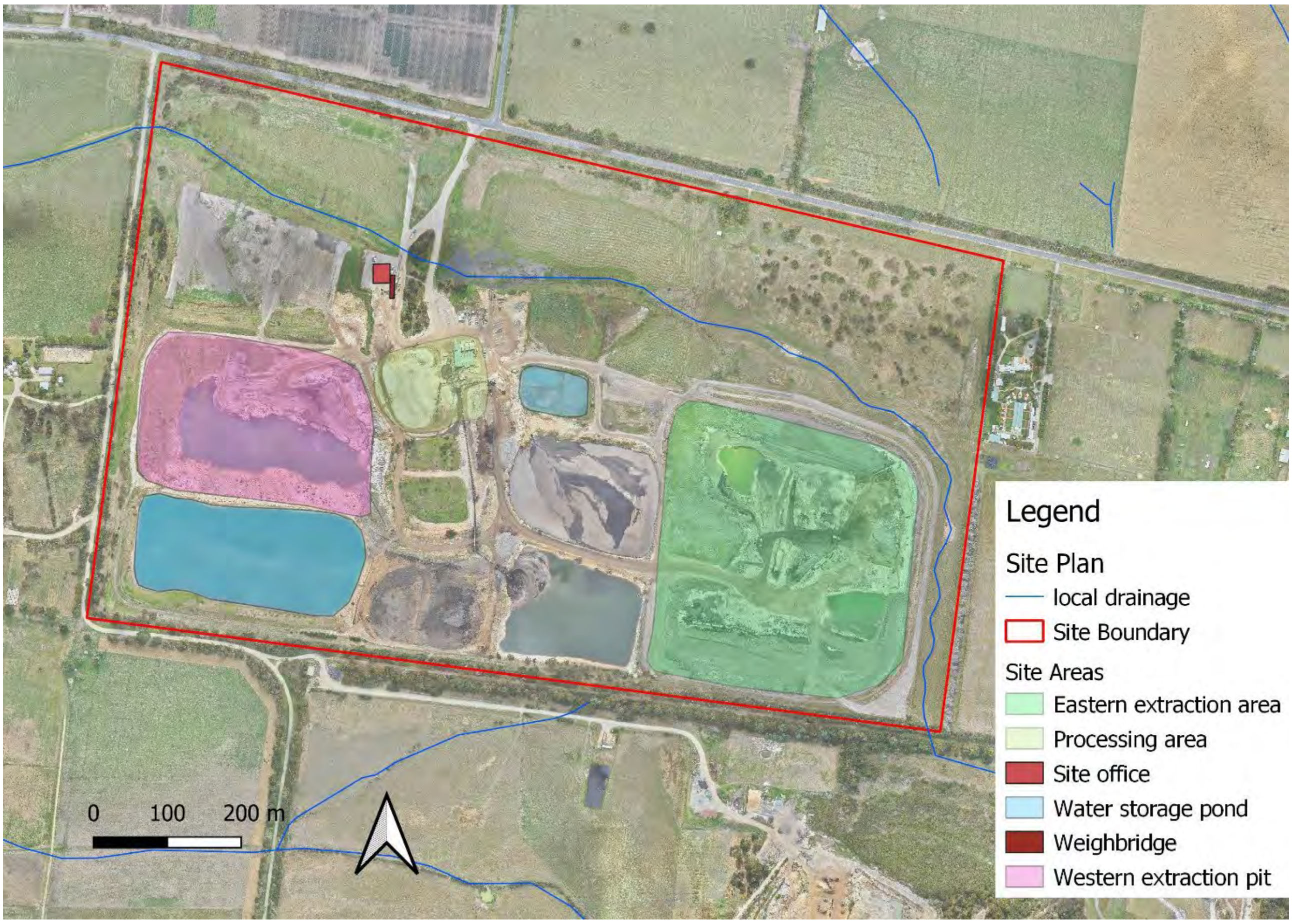
2. SITE DESCRIPTION

The site is located on Westernport Rd, Yannathan, approximately 6km east-north-east of Lang Lang, opposite the intersection with Heads Road. The Site is on a relatively flat alluvial plain approximately midway between the Lang Lang River to the north and the Little Lang Lang River to the south.

The existing pits, shown in **Figure 2-1**, are operated using dry quarrying means, with the inflowing water draining to the base of the pit. Water is pumped from the base of the pit to onsite storages for use in sand processing or water storage.

Groundwater extracted from the pits is retained on site. The site has a groundwater extraction licence for 19.5 ML to account for groundwater lost with exported wet product. The licence is by annual transfer since the Water Supply Protection Area (WSPA) is fully allocated and no new licences are available.

Figure 2-1 Site plan



2.1 CONTEXT

The township of Yannathan is located within the Shire of Cardinia and has a small population of 272 at the 2021 census[1]. Located on the edge of the former Koo Wee Rup Swamp, native vegetation was cleared, and a network of drains was constructed in the 1890's to drain the shallow groundwater. Land use in the Yannathan area has historically been used for farming and agricultural purposes and other extractive industry.

2.1.1 Surrounding land use

Surrounding land uses adjacent to the Site are described in **Table 2-1** below and shown in **Figure 2-2.**

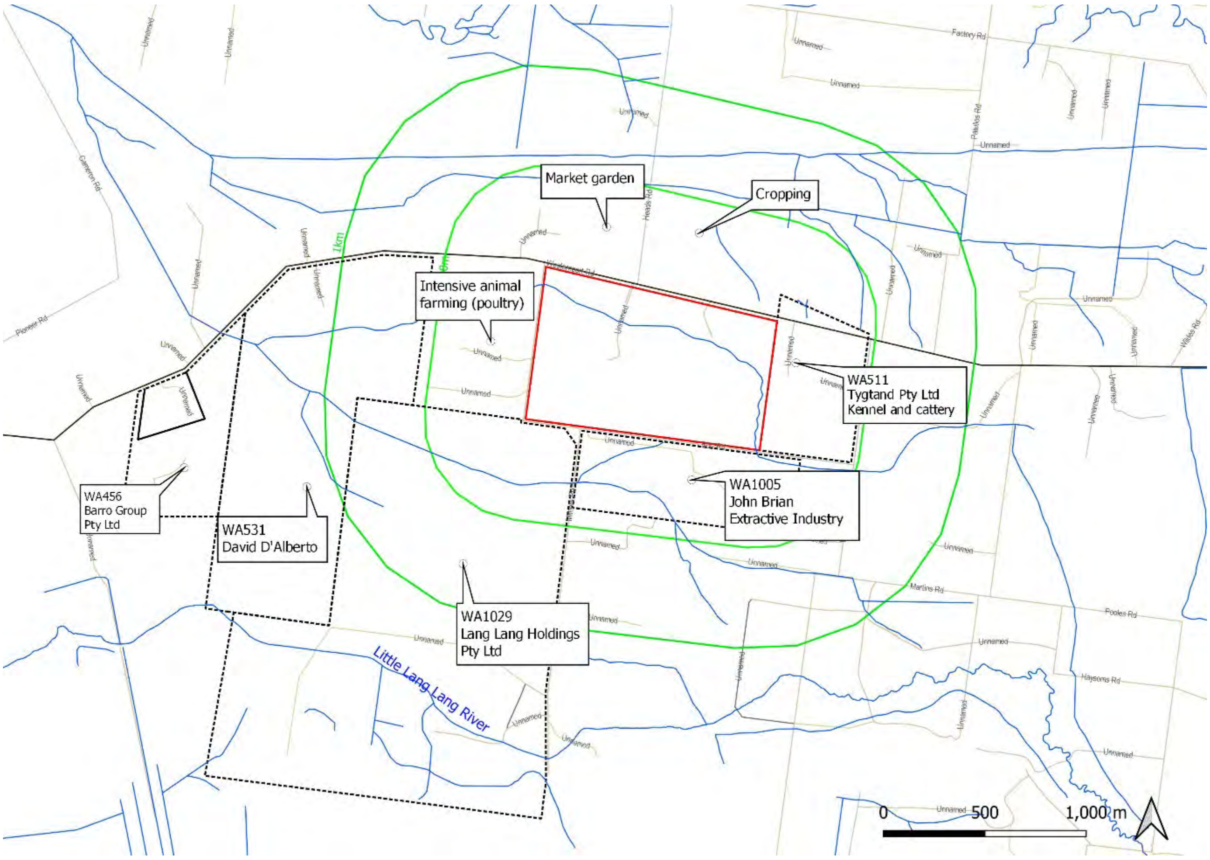
---

[1] 2021 Yannathan, Census All persons QuickStats | Australian Bureau of Statistics (abs.gov.au)

Table 2-1 Surrounding land use

Location	Description
North	Agricultural uses. A residential farmhouse is located approximately 740m from the north-western corner of the site. A former residential building to the north of the site is used as an office for the market garden, not a residence. However, it is understood that a caretaker stays overnight from time to time.
East	Land immediately east of the site is currently a kennel boarding and cattery facility and a farm with on-site residence. There is also a current work authority (WA511) over the property.
South	Current work authorities (WA1005 and WA1029) exist over the properties immediately south of the Site.
West	An intensive poultry farming facility with on-site residence exists immediately west of the site.

Figure 2-2 Surrounding land use



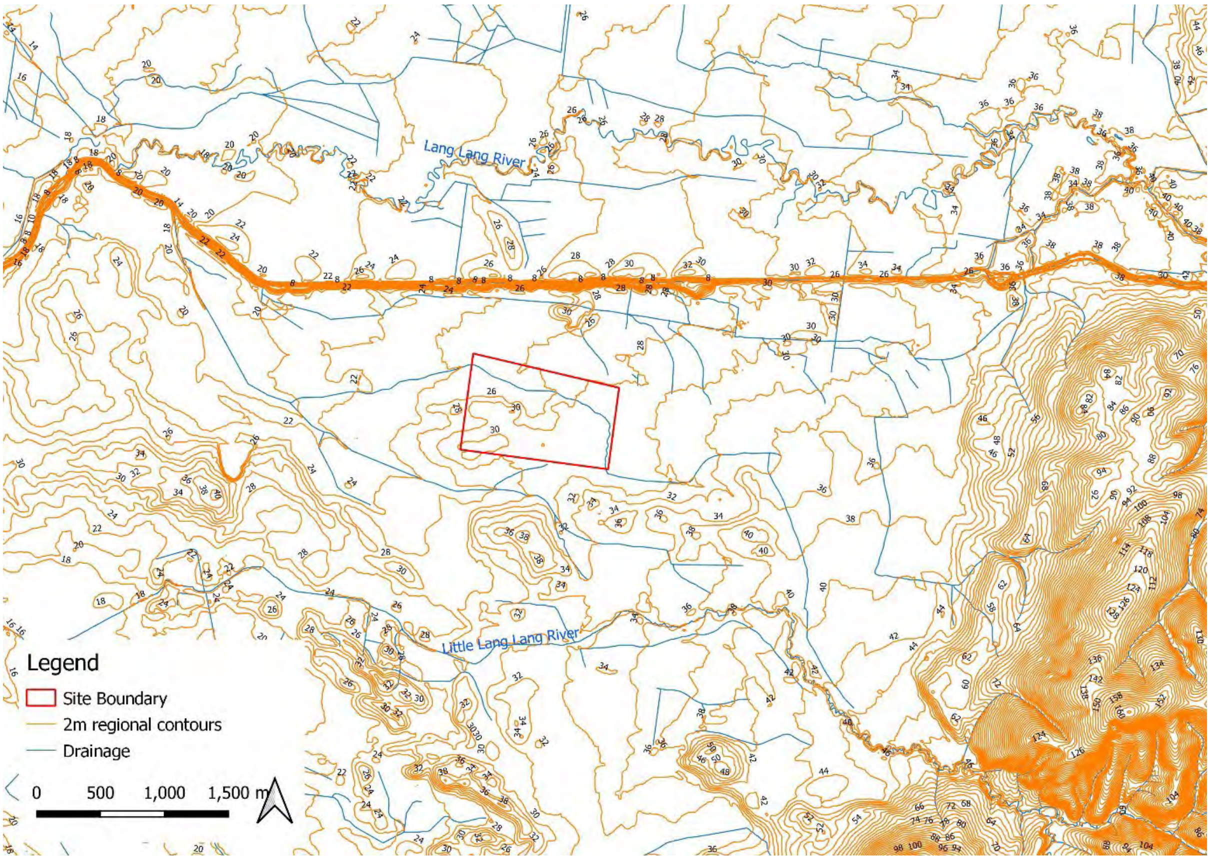
2.1.2 Topography and drainage

The pre-development topography and drainage surrounding the site are shown in **Figure 2-3.**

The site is set in a relatively flat area, grading from the south to northwest from 30 m AHD to 26 mAHD. The topography grades to the north to the Lang Lang River. East and southeast of the site the topography grades to approximately 70 mAHD approximately 3 km to the southeast.

The site is on the southern edge of the former Koo Wee Rup Swamp which was drained between 1889 and 1893[2] by the construction of a series of drains across the area. The nearest drain is an east west drain located approximately 550m north of the Site's northern boundary. Away from the drained areas drainage is anticipated to mirror the topography, assuming no external influences (such as pumping or features that may intersect the watertable). In the drained areas the drains will control the watertable.

Figure 2-3 Topography and drainage



2.1.3 Climate

Climate data for the site was accessed on SILO[3], an online climate database. Relevant climate data from 1970-2021 is presented in **Table 2-2** below.

Table 2-2 Climate data 1970-2021

Month	Average Maximum Temperature (°C)	Average Minimum Temperature (°C)	Average Rainfall (mm/day)	Average Evaporation (mm/day)	Average Morton Lake Evaporation (mm/day)
January	25.4	13.5	1.8	5.7	5.2
February	25.9	13.8	1.7	5.3	4.7
March	23.7	12.5	1.8	3.9	3.4
April	20.1	10.2	2.4	2.5	2.1
May	16.8	8.3	2.7	1.7	1.1

---

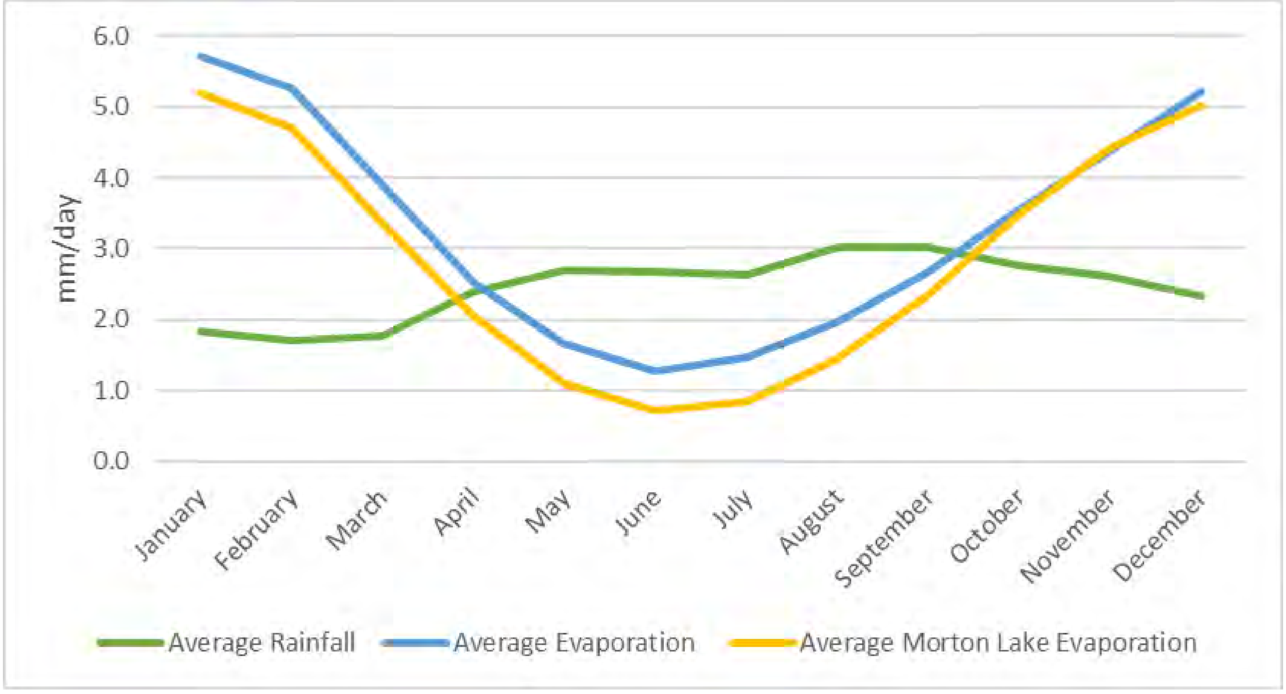
[2] Koo Wee Rup (victoriancollections.net.au)

[3] https://www.longpaddock.qld.gov.au/silo/gridded-data/

Month	Average Maximum Temperature (°C)	Average Minimum Temperature (°C)	Average Rainfall (mm/day)	Average Evaporation (mm/day)	Average Morton Lake Evaporation (mm/day)
June	14.1	6.3	2.7	1.3	0.7
July	13.5	5.8	2.6	1.5	0.8
August	14.6	6.3	3.0	2.0	1.4
September	16.6	7.5	3.0	2.7	2.4
October	18.9	8.8	2.8	3.5	3.5
November	21.1	10.5	2.6	4.4	4.4
December	23.3	12.0	2.3	5.2	5.0

Average daily rainfall, evaporation and Morton Lake evaporation between 1970 - 2021 are presented in **Figure 2-4** below.

Figure 2-4 Climate averages 1970-2021

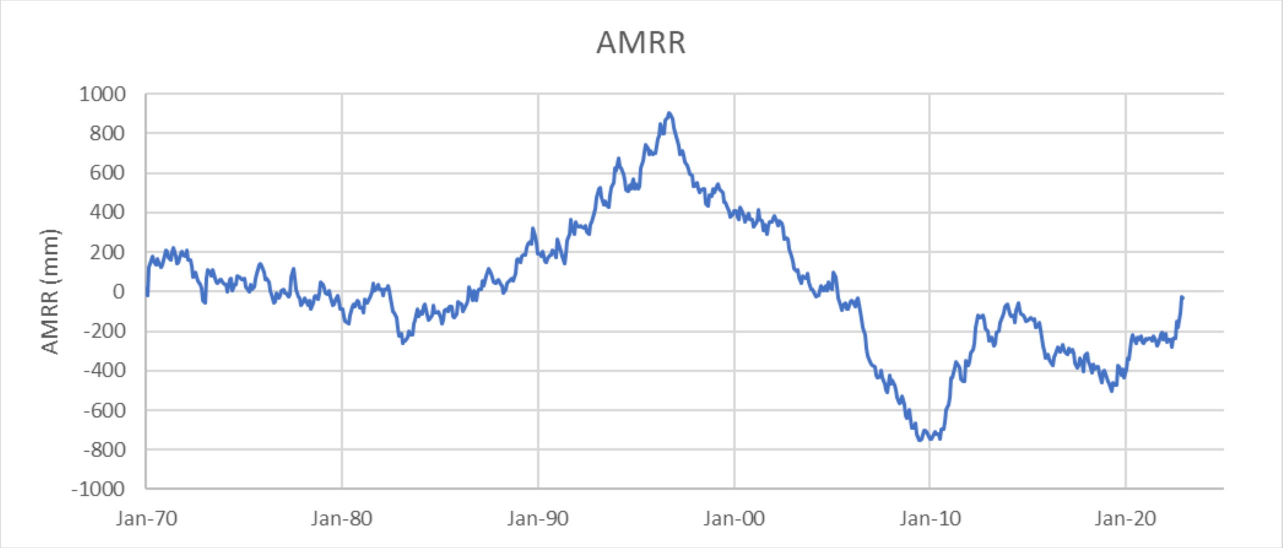


Morton Lake evaporation is a modelled value specifically designed for ponds and waterbodies incorporating subsurface heat storage in the waterbody.

Climatic fluctuations between 1970 – 2021 are presented in an accumulative monthly residual rainfall (AMRR) plot in **Figure 2-5** below. A negative trend in the data indicates below average rainfall, and a positive trend indicates above average rainfall. Groundwater systems generally reflect these water availability trends, assuming there are no external influences.

The plot shows an extended period of above average rainfall between 1984 and 1997. The millennial drought extended from 1997 to 2009. Since 2009 the extremes appear to be returning to a more normal pattern similar to that experienced prior to 1984.

Figure 2-5 AMRR plot



2.2 QUARRY HISTORY AND PROPOSED DEVELOPMENT

The site was undeveloped prior to January 2004. The approved quarry area comprises of 18 Stages, which have been divided into 5 Phases. The timing for completion of each Phase is as follows:

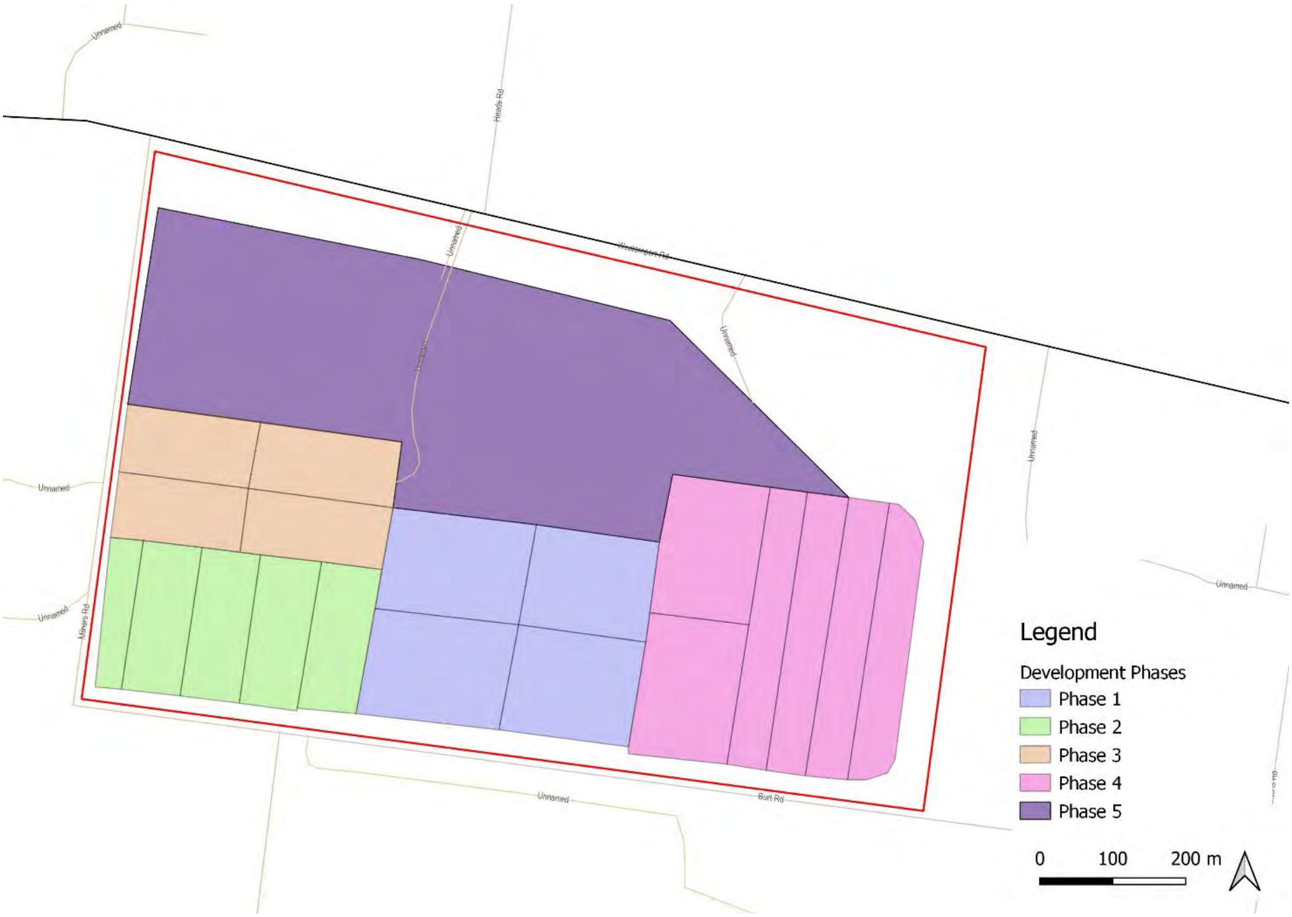
- Phase 1: January 2009.
- Phase 2: January 2014.
- Phase 3 and 4: Commenced 2014, ongoing.
- Phase 5: Future development at completion of Phase 3 and 4, including additional northern expansion and rehabilitation.

The proposed development of the site during Phase 5 involves extraction in the northern section and diversion of the watercourse on-site to the north.

A summary of the development, including figures for each development phase is provided in **Appendix A**.

The areas of each development phase are shown in **Figure 2-6**.

Figure 2-6 Development phases

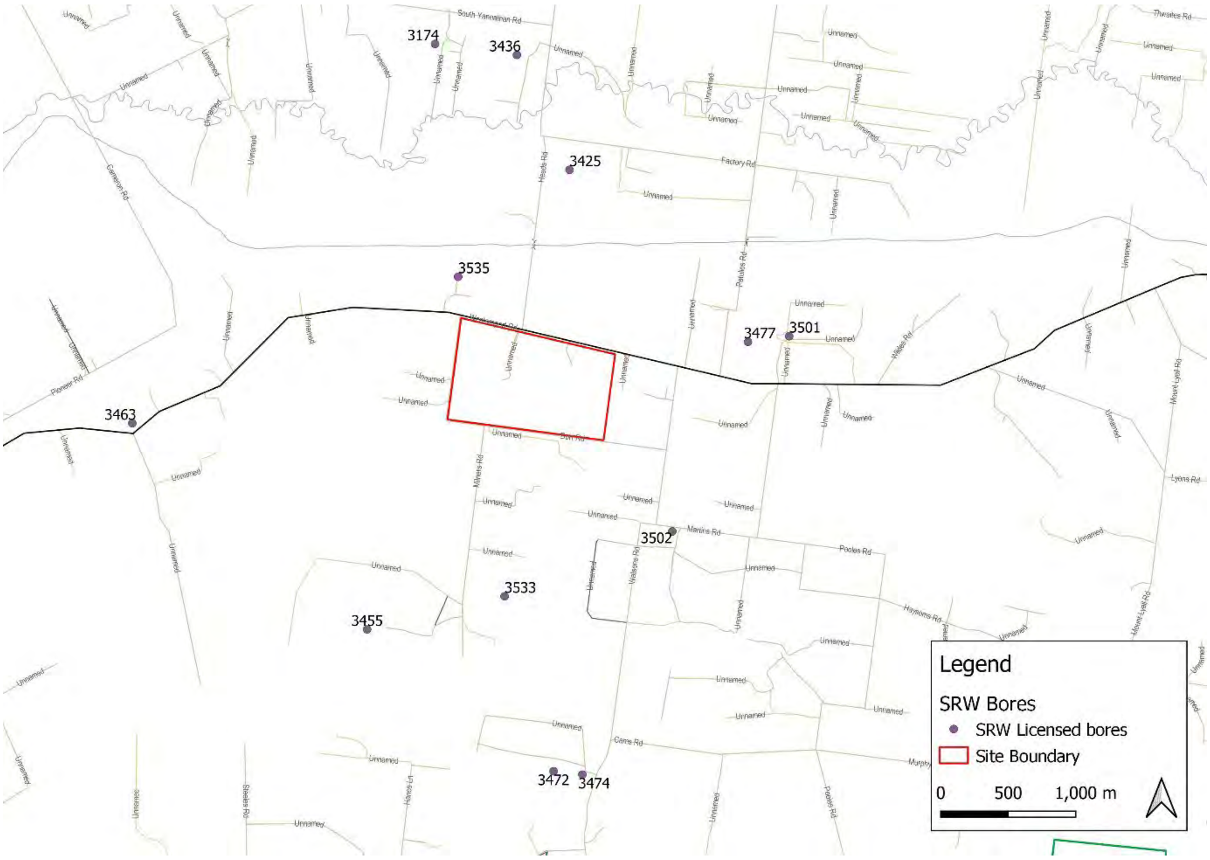


2.3 POTENTIAL RECEPTORS

2.3.1 SRW Licensed bores

The bores licensed by Southern Rural Water are presented in **Figure 2-7**.

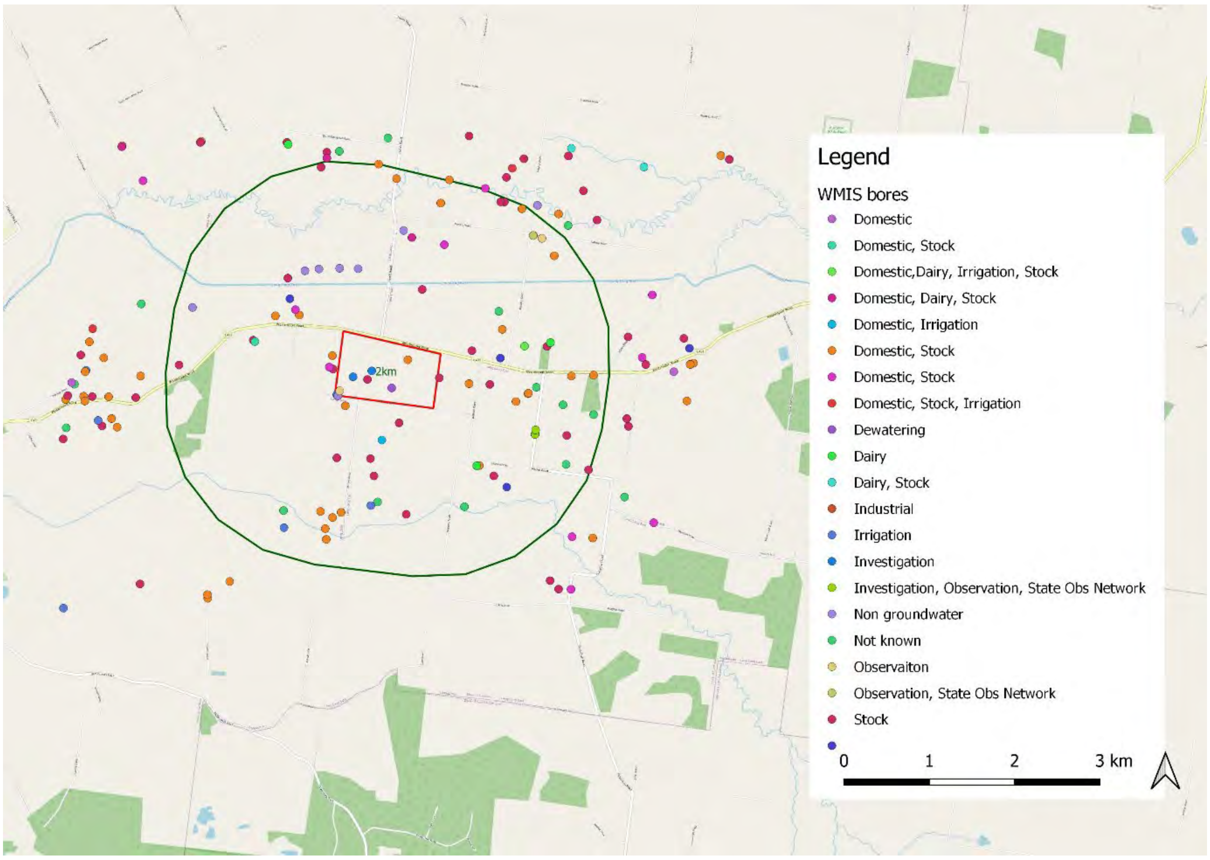
Figure 2-7 SRW licensed bores



2.3.2 Bore search

A bore search was conducted of bores on the Water Management Information System (WMIS) within a 2km buffer of the site. A total of 84 bores were revealed to exist within 2km of the site, their primary recorded use is shown in **Figure 2-8** below. The majority of bores are used for domestic or stock purposes. However, 87% of these wells were installed prior to 2000, and may no longer be in use. The closest two receptor bores are WRK975049 (chicken farm to the west) and WRK110562 ("Ming's" irrigation well to the north).

Figure 2-8 WMIS bore search



3. GEOLOGY AND HYDROGEOLOGY

3.1 GEOLOGY

3.1.1 Regional setting

The Site is located on the north-eastern edge of the Westernport Basin. The Westernport Basin is described as a ‘complexly faulted and eroded basin that is largely underlain by shallow basement covered by a thin veneer of early Lower Cretaceous Strzelecki Group and Tertiary sediments and volcanics” (Lakey and Tickell 1980). Regional flow lines detailed in the 1:100,000 Westernport hydrogeological map show the regional groundwater flowing to the northwest (**Figure 3-1**).

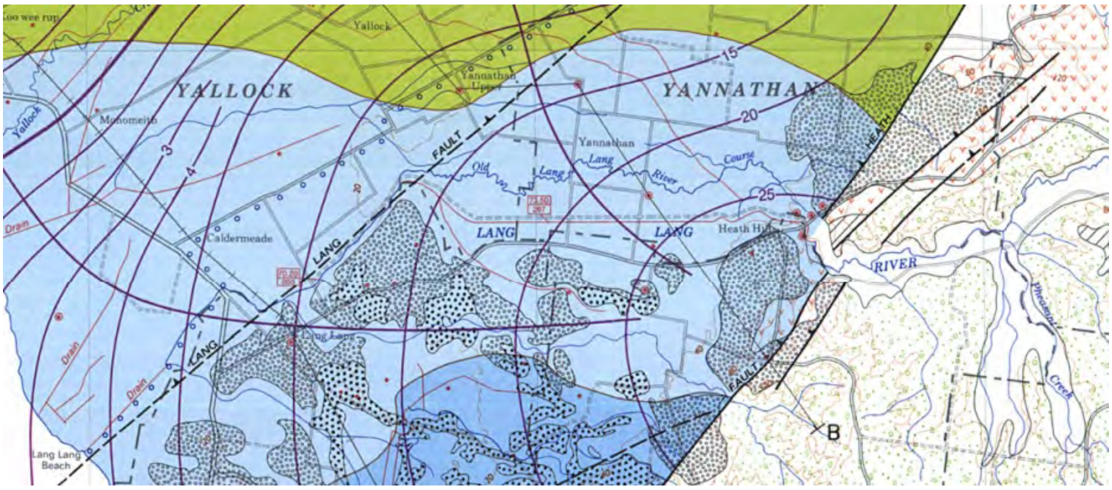
The site is on the downthrown side of the Heath Hill Fault which is a northeast to southwest trending fault approximately 4 km southeast of the site. The site is on the upthrown side of the inferred Lang Lang Fault which parallels the Heath Hill Fault approximately 3 km north-west of the Site.

Bedrock in this area comprises Cretaceous-aged Strzelecki Group at a depth of approximately 150m. A regional cross section on the hydrogeological mapsheet runs a short distance north of the site. This is reproduced in **Figure 3-2**. The stratigraphic sequence at the site from the top down comprises:

- Quaternary aged quartzose aeolian deposits (discontinuous).
- Oligocene aged Yallock Formation – sand, medium to coarse quartzose; gravel, high organic content; minor lignite; fluvial and paludal deposition.
- Eocene aged Older Volcanics – basalt.
- Early Eocene aged Childers Formation – sand, coarse quartzose; gravel; high organic content, numerous lignite and hard organic clay beds, fluvial and paludal deposition.

The sand resource in the Yallock Formation (now classified as part of the Sandringham Sandstone) extends to a depth of approximately 100m.

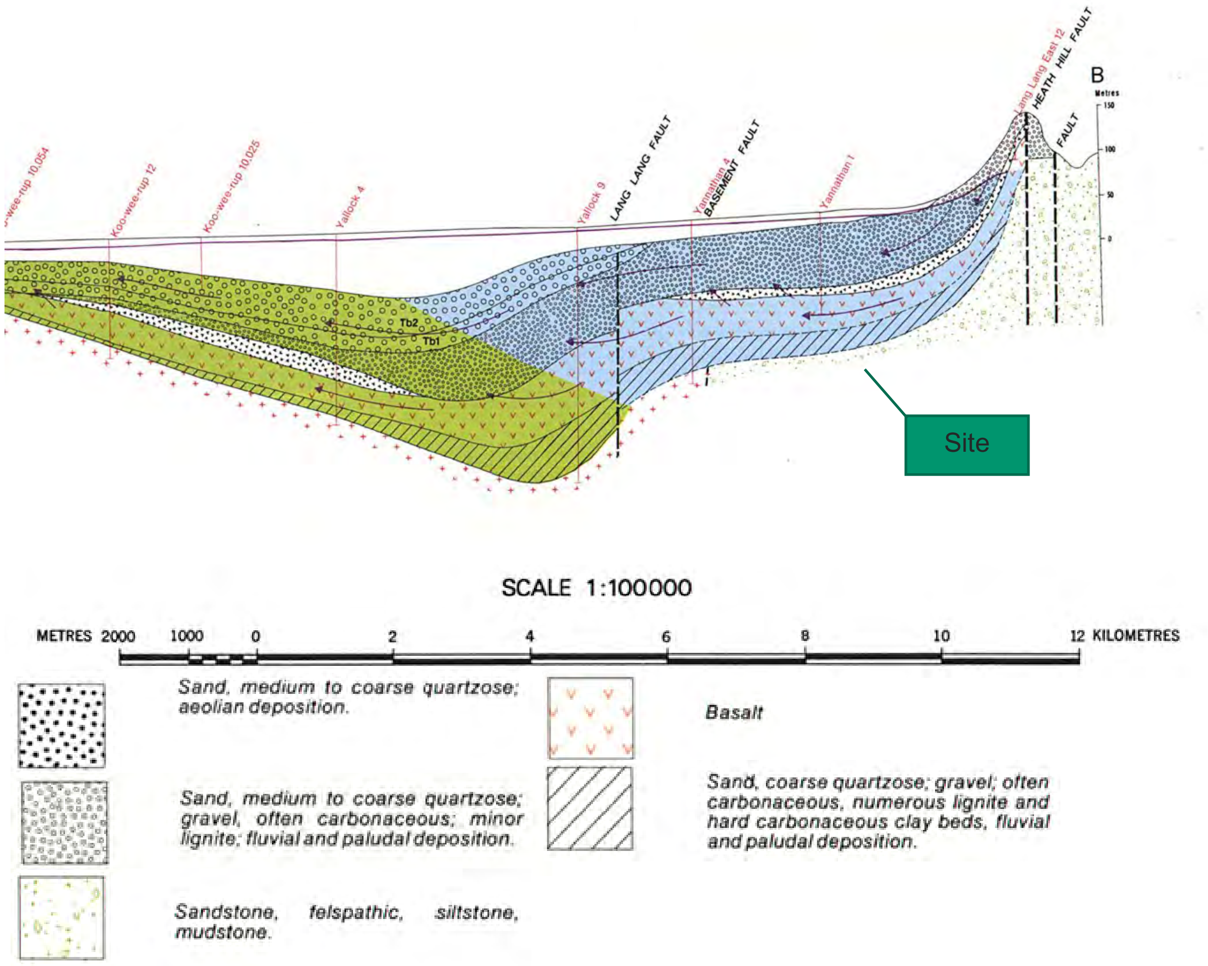
Figure 3-1 Extract from 1:100,000 Westernport Hydrogeological Map-Regional



Potentiometric surface (metres AHD) Feb. 1978	—3—
Flow line	→
Recharge/discharge zone	
Surface water divide	● ● ● ●
Groundwater Conservation Area boundary	○ ○ ○
Northern limit of Tertiary aquifer	
Government observation bore	●
Irrigation bore	•
Stream gauging station	Annual discharge Catchment area
Geological boundary	
Geological boundary, position approximate	
Monocline	
Fault	
Fault inferred	
Salinity/yield zone boundary	
Watercourse	
Low water mark	
High water mark	
Bathymetric contour (metres below AHD)	
Dredged channel	
Drain	
Water pipeline	
Aqueduct	
Highway	
Main connecting road	
Other road	
Railway line	
Parish boundary	
Parish name	NAR
Topographic contour	180 200 120

QUATERNARY					⁘	Sand, medium to coarse quartzose; aeolian deposition
					☐	Clay, minor felspathic sand and gravel; fluvial deposition.
				Unconformity		
	Early Late		Baxter Formation	Tb2	○	Sand, medium to coarse, quartzose, gravel, often carbonaceous, numerous lignite and carbonaceous clay beds; fluvial and paludal deposition.
	MIOCENE		WESTERN PORT GROUP	Tb1	○	Sand, fine; transitional from littoral marine to fluvial deposition.
		Middle	Sherwood Formation	Tm	⁚	Sand, fine to medium, calcareous, often silty; minor limestone; shallow marine deposition.
		Early		Tml	⁚	Calcarenite with sand, silt and clay matrix; shallow marine deposition.
TERTIARY	OLIGOCENE		Yallock Formation	Ty	▨	Sand, medium to coarse quartzose; gravel, often carbonaceous; minor lignite; fluvial and paludal deposition.
				Unconformity		

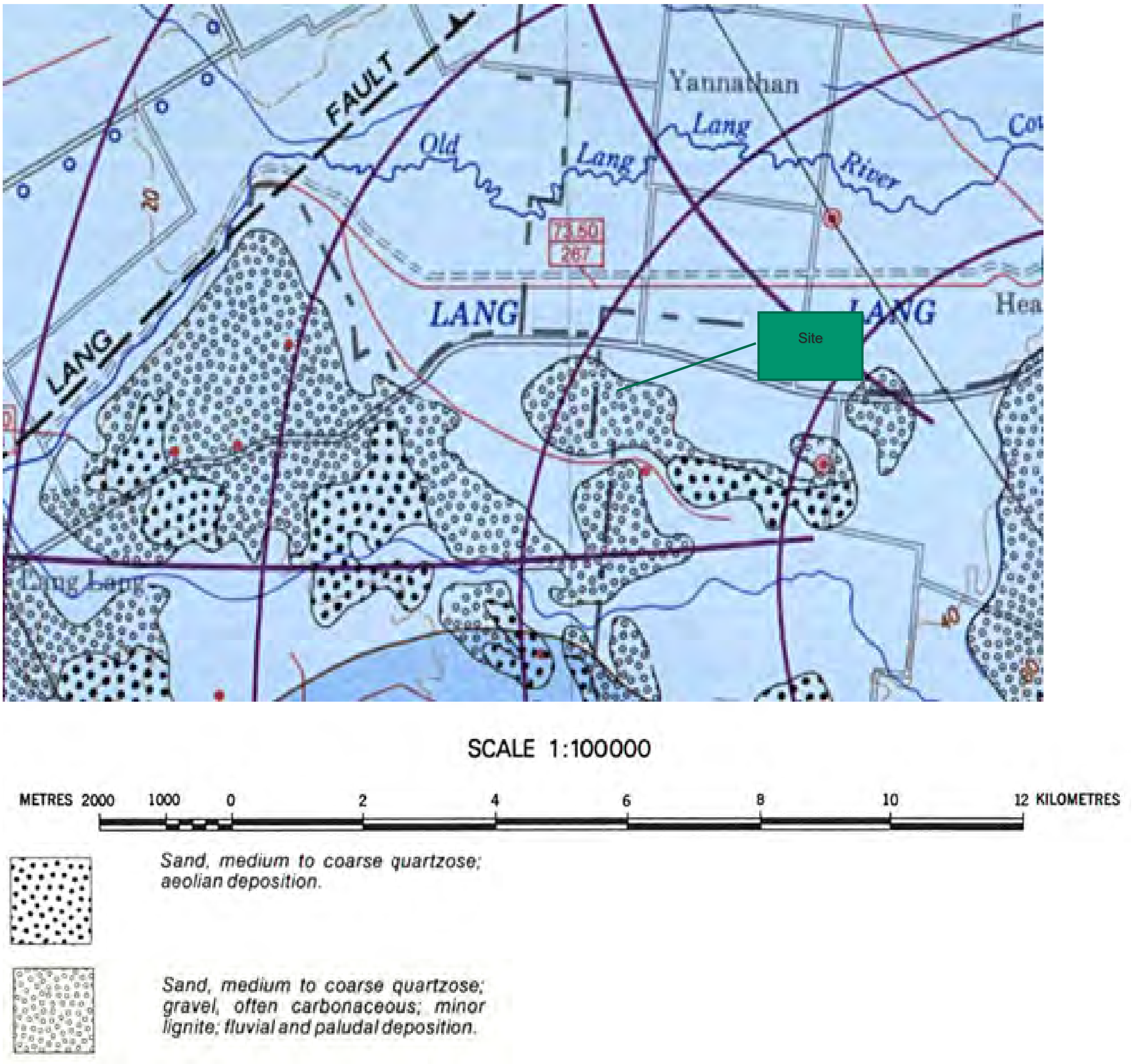
Figure 3-2 Cross section from 1:100,000 Westernport Hydrogeological Map



3.1.2 Local geology

Generally, the geology underlying the site includes a layer of clean sands, underlain by black sands which are further underlain by clean sands. Historically, Hanson extracted the upper level of clean sands to approximately RL: 9 mAHD (top of black sands layer). The black sands layer below contains a high proportion of organic matter, and in some places lignite. Recently, a use has been identified for the black sands layer in alternative products, triggering the increased depth application. Black sands are currently being quarried from the western pit (above RL 9mAHD), and recent drilling has shown a significant thickness of clean sand beneath. **Figure 3-3** below shows the sands at site are fluvial and paludal in deposition.

Figure 3-3 1:100,000 Westernport Hydrogeological Map - local

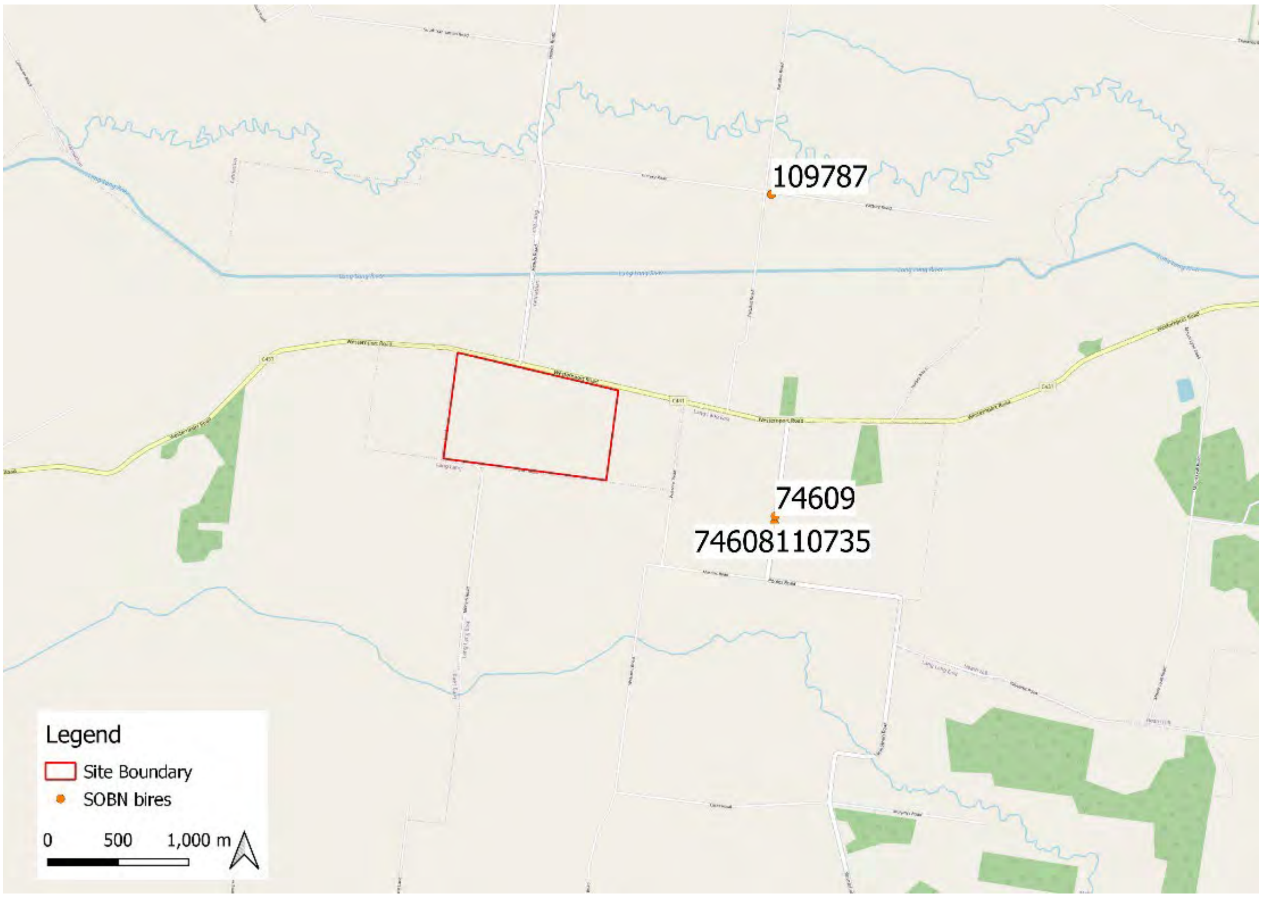


3.2 HYDROGEOLOGY

3.2.1 Regional hydrogeology

Four SOBN bores (109787, 110735, 74608 and 74609) are within a 2km radius of the site and are shown in **Figure 3-4.**

Figure 3-4 SOBN bores



The standing water levels (SWLs) for the SOBN bores are presented in **Figure 3-5** to **Figure 3-8**.

Figure 3-5 SWL Bore 109787 (mbTOC)

Figure 3-6 SWL Bore 110735 (mbTOC)

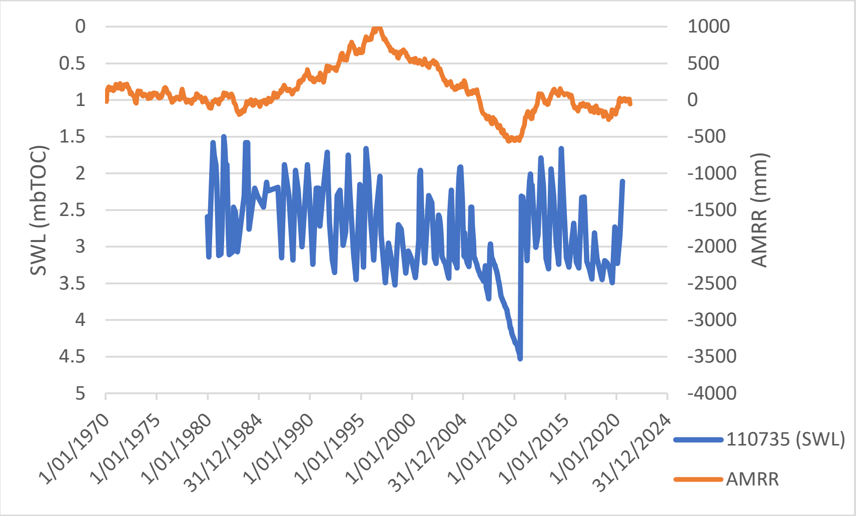


Figure 3-7 SWL Bore 74608 (mbTOC)

Figure 3-8 SWL Bore 74609 (mbTOC)

Bore 109787 has data from 1970-2009, to the end of the millennium drought. Standing water level at 109787 fluctuates between approximately 6.0 mbTOC and 10.0 mbTOC. Groundwater levels are relatively consistent indicating an absence of local extraction and broadly mirror the AMRR. In this area groundwater levels reflect climatic variability.

Standing water level at 110735 fluctuates between approximately 1.5 mbTOC to 3.5 mbTOC reflecting local groundwater extraction. Water levels do not show a response to the drought or preceding wet period. Groundwater levels are therefore controlled by irrigation activity.

Groundwater levels in Bores 74608 (screened from 45.25 – 117 mbgl) and 74609 (screened from 20-30 mbgl) both reflect climatic variability and good hydraulic connection at depth. Heads in the shallower screened bore are higher than in the deeper bore indicating downwards hydraulic gradients. Salinities are also higher in the lower aquifer (598 and 645 mg/l reported in 1983) compared to the shallow aquifer (varying between 88 and 198 mg/L between 1983a and 2019 with lower TDS concentrations in recent readings).

3.2.2 Local hydrogeology

The groundwater monitoring network is shown in **Figure 3-9.** The current monitoring network comprises of bores: LL8, LL9, LL13, LL15, LL16, LL19, and LL20. BH6 is still present but is now dry and considered inactive. Water levels have been measured at approximately monthly intervals and are shown in **Table 3-1** below. Bore logs, where available, are contained in **Appendix B**.

Figure 3-9 Site monitoring bores

Table 3-1 Bore information

Bore	Easting	Northing	Status	Depth (m)	Top of black sand	Base of black sand	Comment
BH3			Inactive / Decommissioned	3.00			
BH6			Inactive / Decommissioned				No bore log
BH7			Inactive / Decommissioned				No bore log
LL1	380556	5765196	Inactive / Decommissioned	19.25	2.125	2.875	
LL2	380790	5765184	Inactive / Decommissioned	19.00			Coal at 18.5m
LL3	380775	5764966	Inactive / Decommissioned	14.75	0.500	1.125	Black clay
LL4	380634	5765117	Inactive / Decommissioned	15.00			Coal at 14.875m
LL5	380238	5765018	Inactive / Decommissioned	23.63	18.875	>23.625	Black sand recorded as 'black silt'
LL6	380171	5765162	Inactive / Decommissioned	18.00	16.625	>18	
LL7	380310	5765167	Inactive / Decommissioned	14.75			Black sand not encountered
LL8	380226	5764844	Active	14.00	13.125	>14	Ends in coal layer
LL9	381267	5765203	Active	13.00			Black sand not encountered
LL10	381088	5765251	Inactive / Decommissioned	15.00	14.000	>15	
LL11	381056	5765102	Inactive / Decommissioned	15.00	2.000	3.250	
LL12	380940	5765157	Inactive / Decommissioned	18.00	0.250	7.750	Layer of yellow brown clay at 2-2.625
LL13			Active	15.50			Black sand not encountered
LL14	380790	5765184	Inactive / Decommissioned	30.00	11.000	>30	Black sands assumed to be same as 'brown coal' layer
LL15			Active				No bore log
LL16			Active				No bore log
LL17			Inactive / Decommissioned				No bore log
LL18			Inactive / Decommissioned				No bore log
LL19			Active				No bore log
LL20			Active				No bore log

3.2.2.1 Groundwater level

The 2020 Monitoring Report (P. Larkin, 2020) and an October 2022 Groundwater Monitoring Event (Ricardo, 2022) provide the most recent groundwater level data for the site. Bores have been grouped into clusters representing different areas of the site. These clusters are shown in **Figure 3-10 to Figure 3-13** below. The AMRR is also shown on each figure as a comparison to groundwater level trends. Groundwater levels that reflect the AMRR are more likely to be influenced by rainfall, assuming no external interaction.

The eastern bores shown in **Figure 3-10** generally reflect the AMRR. The “flat-topping” of the trend in LL8 and LL9 suggests groundwater is close to the surface. Bore LL12 is more centrally located in the site and is showing impacts from extraction from 2005 which showed good recovery until impacted by other site works. Water levels at LL9 are also showing the effects of extraction in the eastern pit.

BH6 in the south-western area shown in **Figure 3-11** initially reflects the AMRR but drops approximately 5m to approximately 20mAHD.while quarrying activity was occurring in that part of the site. Phase 2 of extraction (south west corner) was completed in 2014, water levels have remained at this level since, noting that extracting in the western pit to the north of this location is currently at 9 mAHD.

Bores in the central part of the site (**Figure 3-12**) generally reflect the AMRR to around 2015, since then water levels have been impacted by site works.

North-western bores shown in **Figure 3-13** reflect the impact of the western pit, levels in Bore LL13 indicate these impacts are quite localised to the pit.

This shows that the impact on the watertable from extraction is localised, and that the watertable commences rebound as soon as activity moves to another part of the site.

Figure 3-10 Eastern area bores RWL

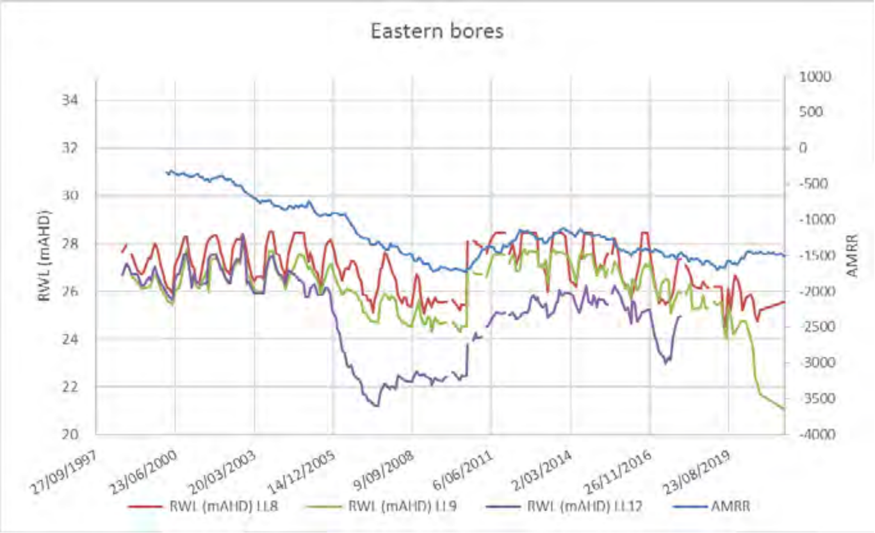


Figure 3-11 Southwestern area bores RWL

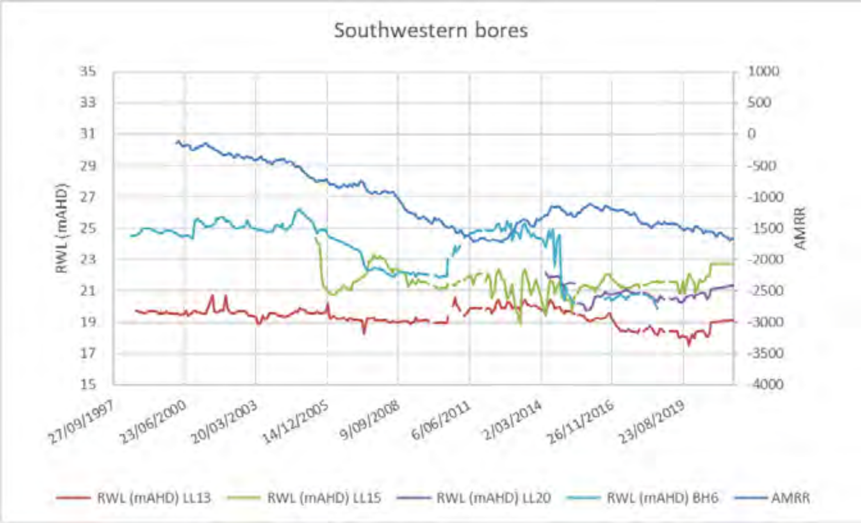


Figure 3-12 Bores near processing area RWL

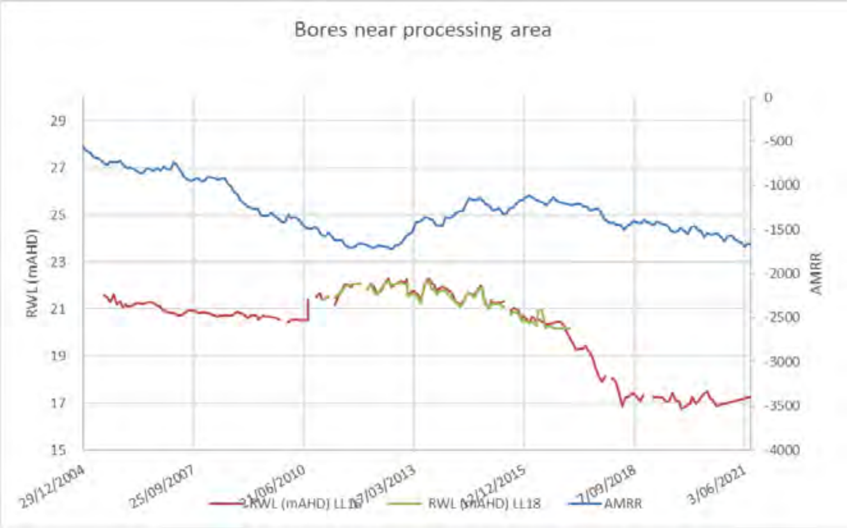
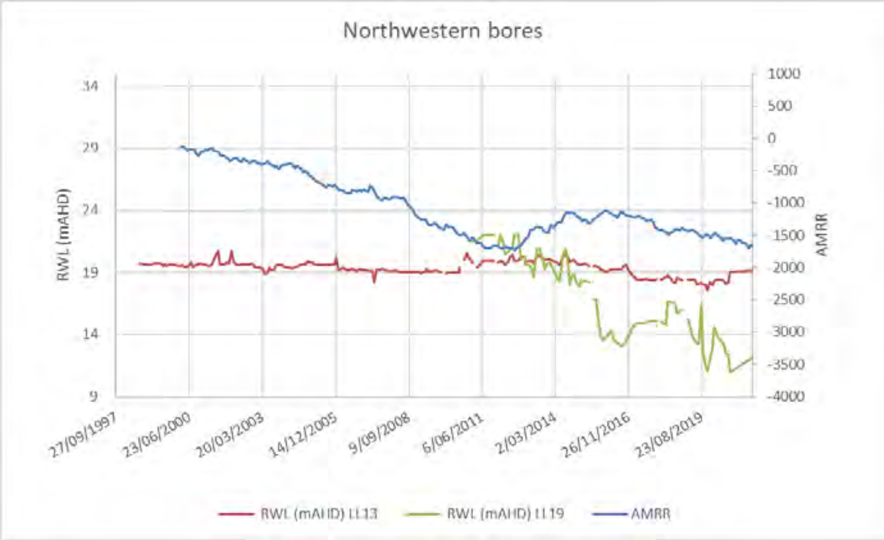


Figure 3-13 North western bores RWL



3.2.2.2 *Aquifer properties*

Hydraulic conductivity has been tested twice at the site. The 1997 Dames & Moore report estimated the range of hydraulic conductivities of the sand aquifer. These estimates were based on a limited number of rising head tests and grain size data from possibly selective sampling. The 1999 Dames & Moore indicates that these samples introduced a level of bias and resulted in relatively high preliminary estimates of 2×10^{-4} m/s to 4×10^{-4} m/s for the site.

In 1999 rising head tests were conducted in LL2, LL8, LL12 and LL13 and hydraulic conductivity were calculated using Hvorslev's equation for an isotropic, unconfined aquifer. Table 3-2 below shows the results which range from 2.2×10^{-8} m/s to 3.8×10^{-6} m/s. The average K value is 1.418×10^{-6} m/s.

Table 3-2 Hydraulic conductivity

Bore	Hydraulic conductivity m/s
LL2	3.8×10^{-6}
LL8	3.9×10^{-7}
LL12	2.2×10^{-6}
LL13	3.2×10^{-8}
LL14	6.7×10^{-7}

3.2.2.3 *Groundwater flow*

Groundwater flow is shown in Figure 3-14 below. The flow was interpreted from October 2022 water levels and is shown as approximately 26 mAHD in the south-eastern corner of the site and flows north-westerly. The two pits on the site are shown to be having a localised impact on groundwater flow.

Figure 3-14 Groundwater flow Oct 2022

3.2.2.4 *Groundwater chemistry*

Data obtained in 30/07/98, prior to quarrying activities, shows that the background pH is slightly acidic with average field pH readings of 5.7 pH units (Table 3-3). No major ion analyses have been undertaken since this time, but pH and electrical conductivity are monitored when water levels are recorded.

Table 3-3 Groundwater chemistry 1999

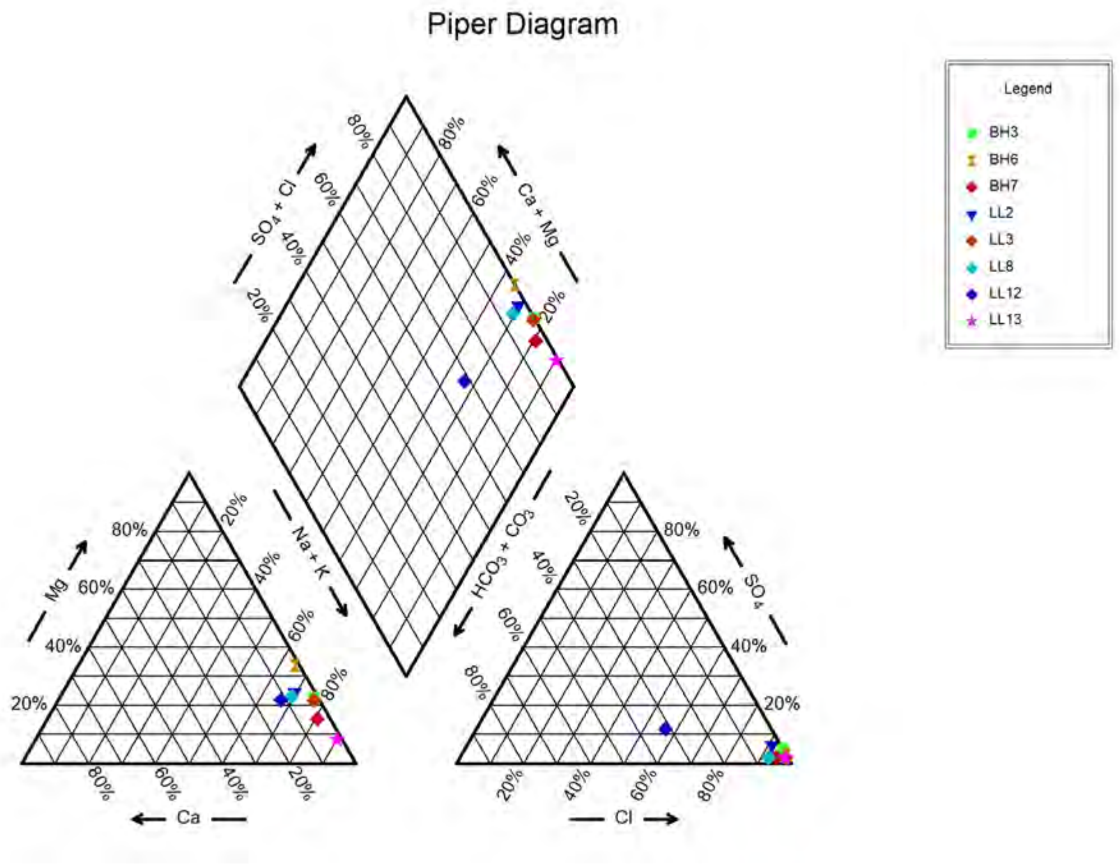
Analyte	BH3	BH6	BH7	LL2	LL3	LL8	LL12	LL13
Redox (mV)	32.0	265.0	-102.0	-168.0	-97.0	-194.0	-101.0	-157.0
Conductivity (uS/cm)	283.0	208.0	304.0	397.0	1,294.0	337.0	282.0	1,051.0
Field pH (units)	4.56	4.67	5.95	5.81	5.86	6.04	6.91	5.80
Lab pH (units)	4.02	4.32	5.83	5.29	4.90	5.58	6.16	5.47
TDS	220	150	200	1,400	850	370	730	820
Chloride	86	56	150	100	430	98	40	340
Sulphate (SO_4)	5.8	2.1	3.8	8.8	10.0	2.5	11.0	7.7
Bicarbonate (as CO_3)	<0.05	<0.05	33.0	22.0	17.0	32.0	49.0	22.0
Carbonate (as $CaCO_3$)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Calcium (Ca)	0.50	0.36	1.4	3.5	3.3	3.6	4.6	2.2
Magnesium (Mg)	5.3	5.8	3.2	8.3	24.0	6.5	5.3	7.2

Analyte	BH3	BH6	BH7	LL2	LL3	LL8	LL12	LL13
Potassium (K)	0.61	0.25	4.4	5.4	3.7	0.63	15.0	7.5
Sodium (Na)	34	21	30	42	160	37	22	150
Phosphate total (as P)	<0.05	<0.05	3.3	0.1	0.1	<0.05	1.4	0.4
Total Nitrogen (N)	0.4	1.6	49.0	4.0	7.8	1.5	5.8	2.2

A Piper plot of the only available major ion data is presented in **Figure 3-15**.

The local groundwater conditions at the Site are sodium chloride dominant with relatively low bicarbonate levels, however a relatively high bicarbonate concentration and relatively low chloride concentration were reported at LL12. This is reflected in the Piper Plot. Reducing conditions were reported at all locations except for BH3 and BH6. LL12 is close to the original flow path of the waterway so the bicarbonate concentrations reported in this bore prior to quarrying are likely to reflect recharge from the creek which is naturally high in bicarbonate.

Figure 3-15 Piper plot 1999



The pH results in groundwater are shown in **Figure 3-16** to **Figure 3-19.** The conductivity results in groundwater are shown in **Figure 3-20** to **Figure 3-23**.

pH generally ranges between 5 to 6 at the Site consistent with pre-quarrying conditions, however some wells on the eastern and western boundary reported pH values below 4. The GME (Ricardo 2022) noted that inferred groundwater flows in these wells were towards the pits, so reduced pH was likely due to off-site sources.

Conductivity generally ranges between approximately 500 µS/cm to 1000 µS/cm at the Site. However, a spike of over 18,000 µS/cm at LL9 in 2016 was reported. This bore is located on the north-eastern boundary and up-gradient to the Site adjacent to the kennels/cattery. The high conductivity concentration may relate to offsite sources.

The water in the southwestern pit is hydraulically connected with the groundwater. Salinity as indicated by the electrical conductivity is showing an increasing trend..

3.2.3 Conceptualisation

The local geology is shown on a series of cross sections located as shown in **Figure 3-24** to **Figure 3-26**.

Figure 3-16 Eastern area bores - pH

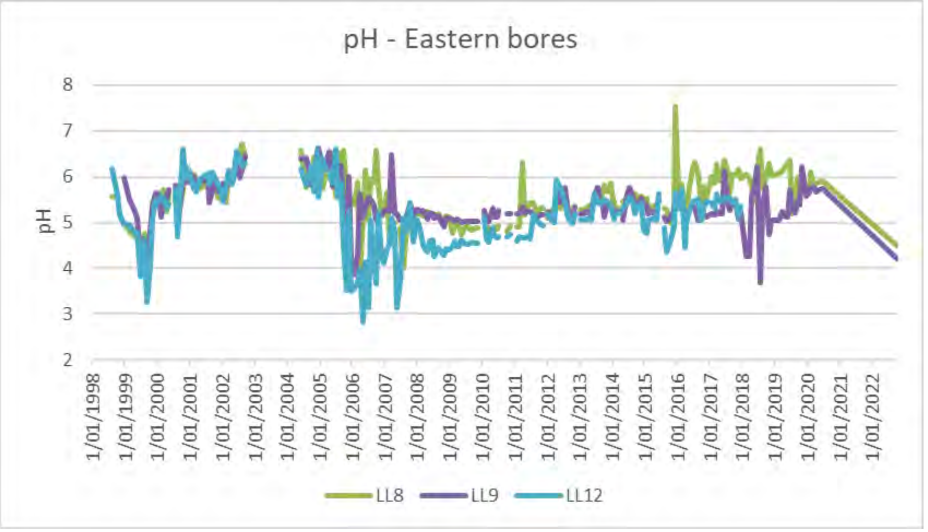


Figure 3-17 South-western area bores - pH

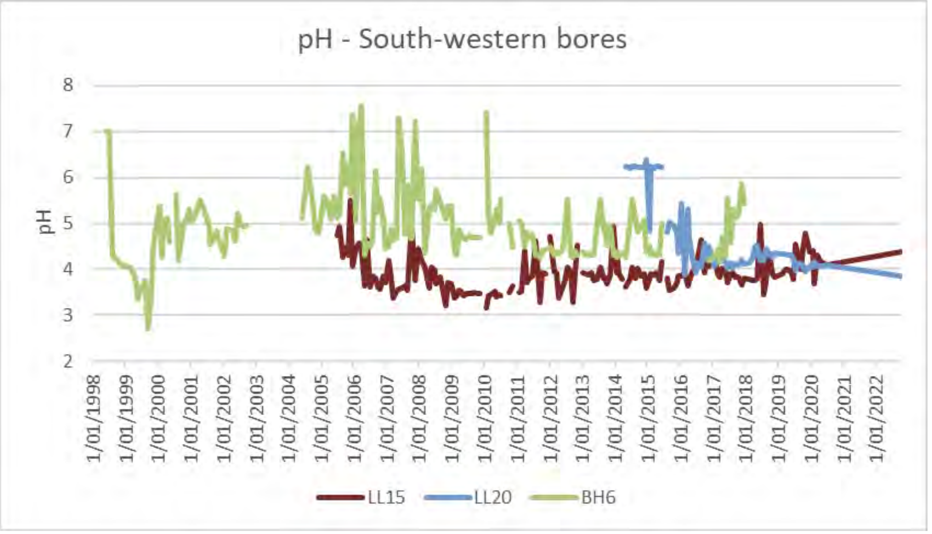


Figure 3-18 Bores near processing plant - pH

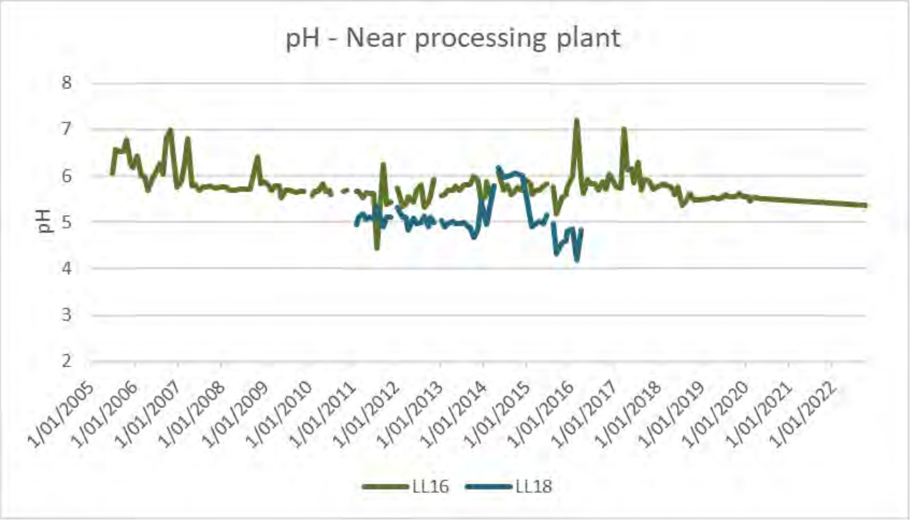


Figure 3-19 North-western bores - pH

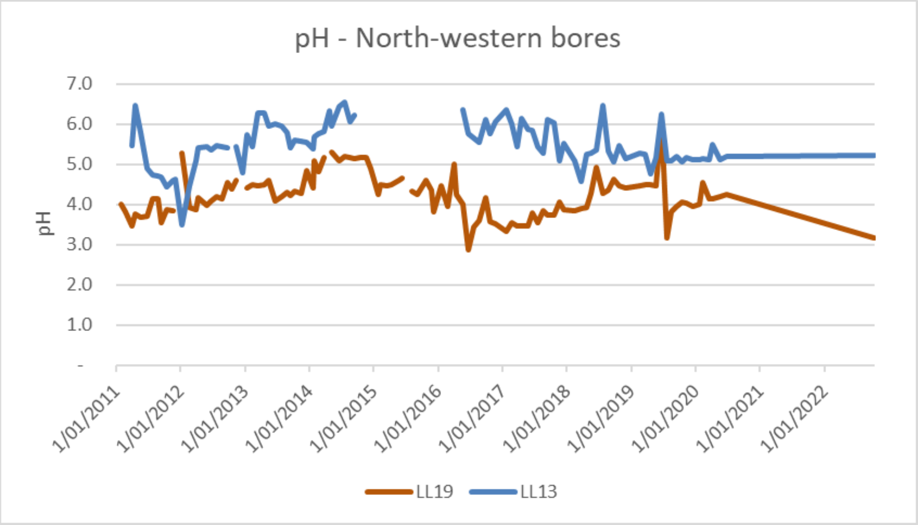


Figure 3-20 Eastern area bores - EC

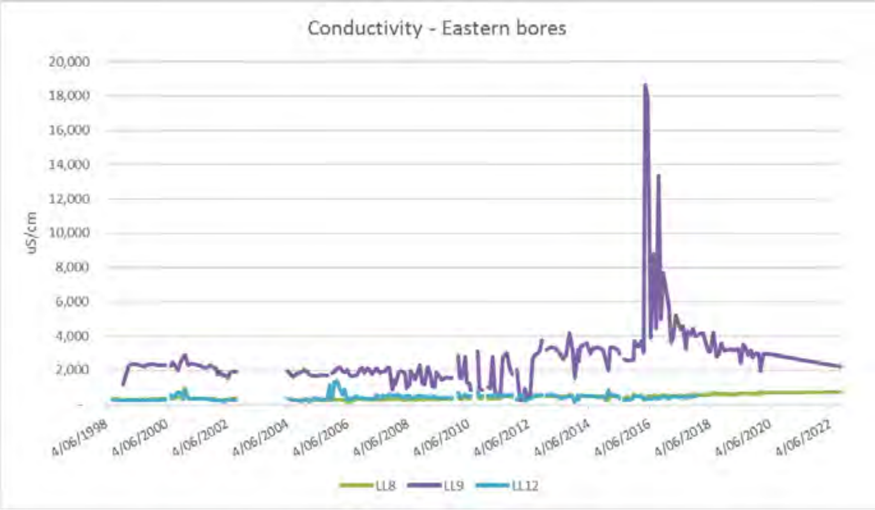


Figure 3-21 South-western area bores - EC

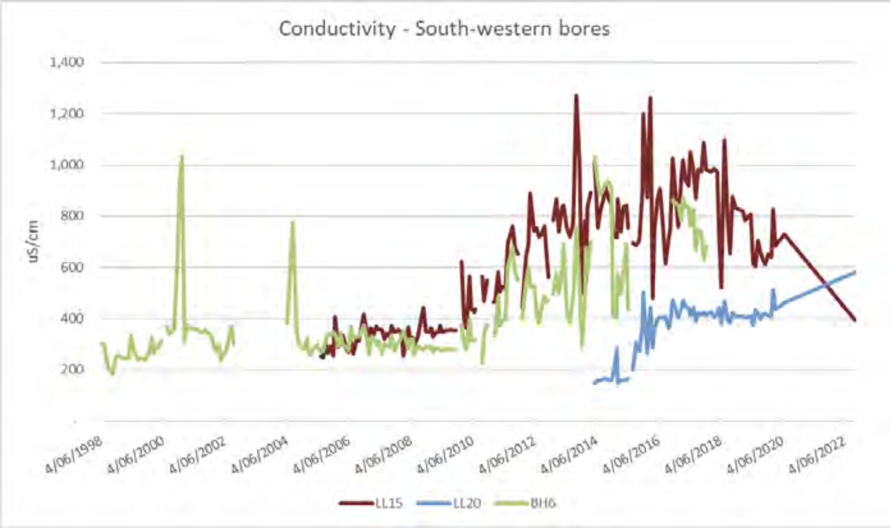


Figure 3-22 Bores near processing plant - EC

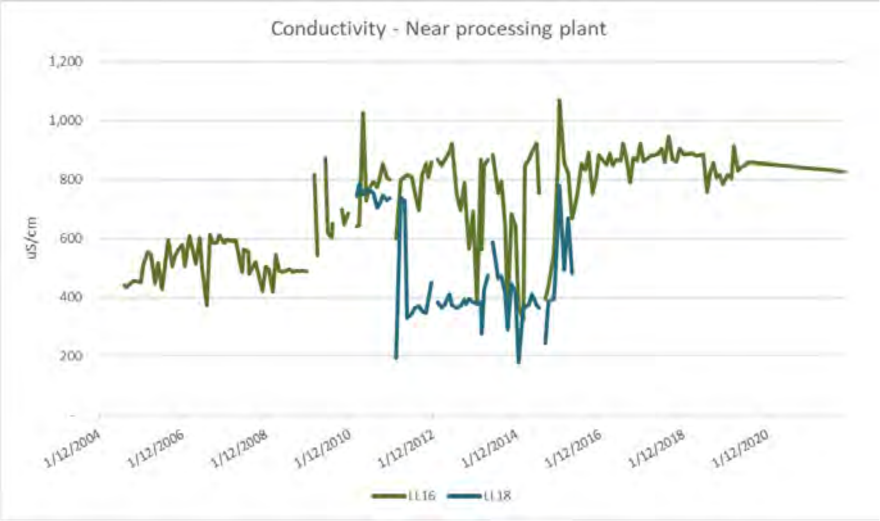


Figure 3-23 North-western bores - EC

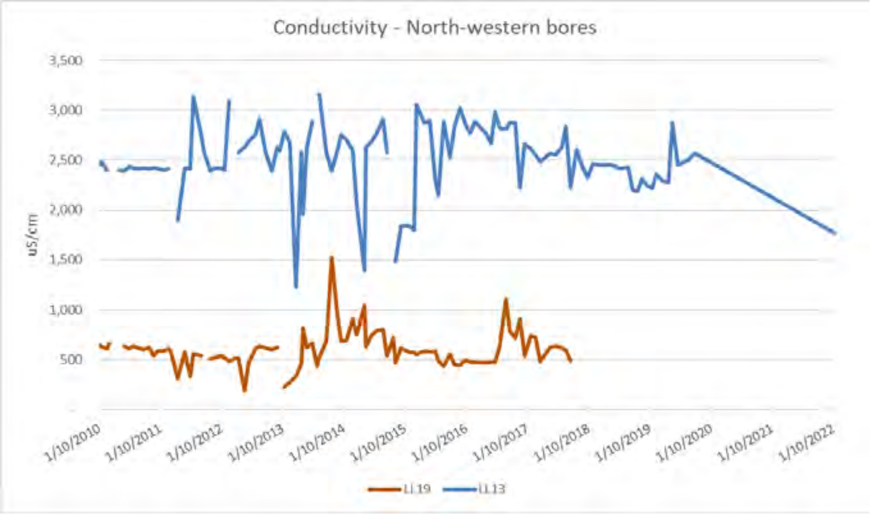


Figure 3-24 Sections A and B

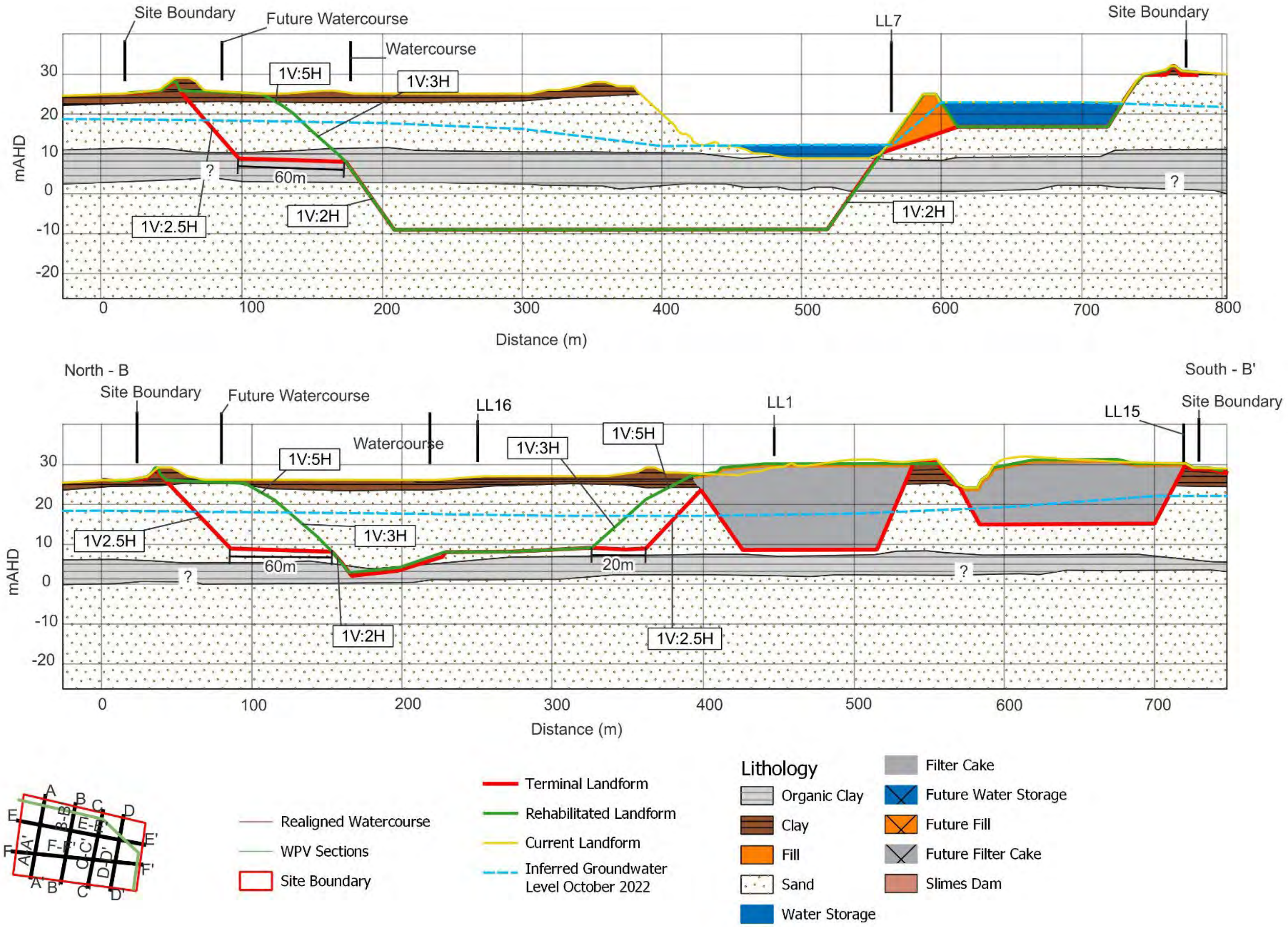


Figure 3-25 Sections C and D

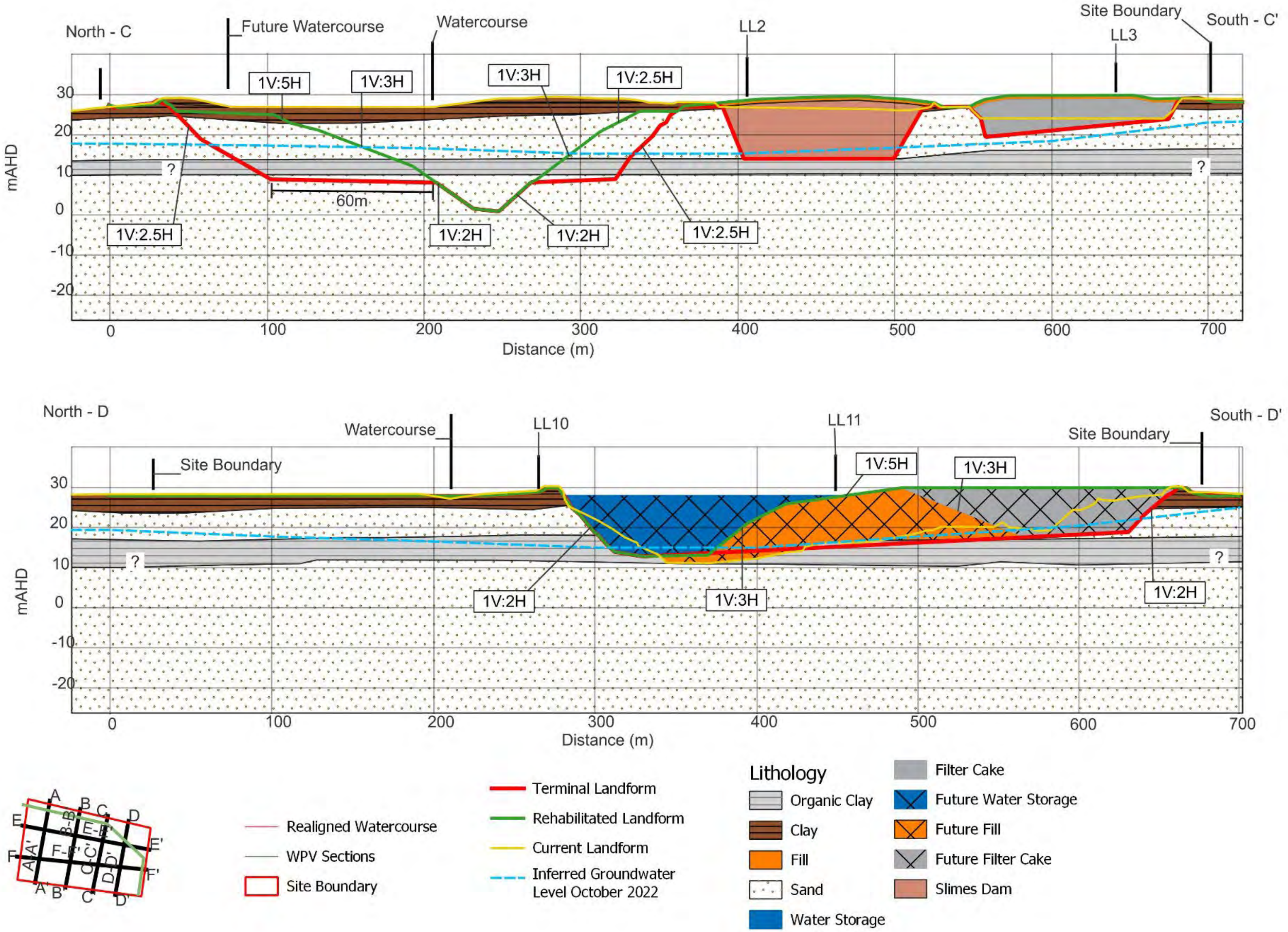
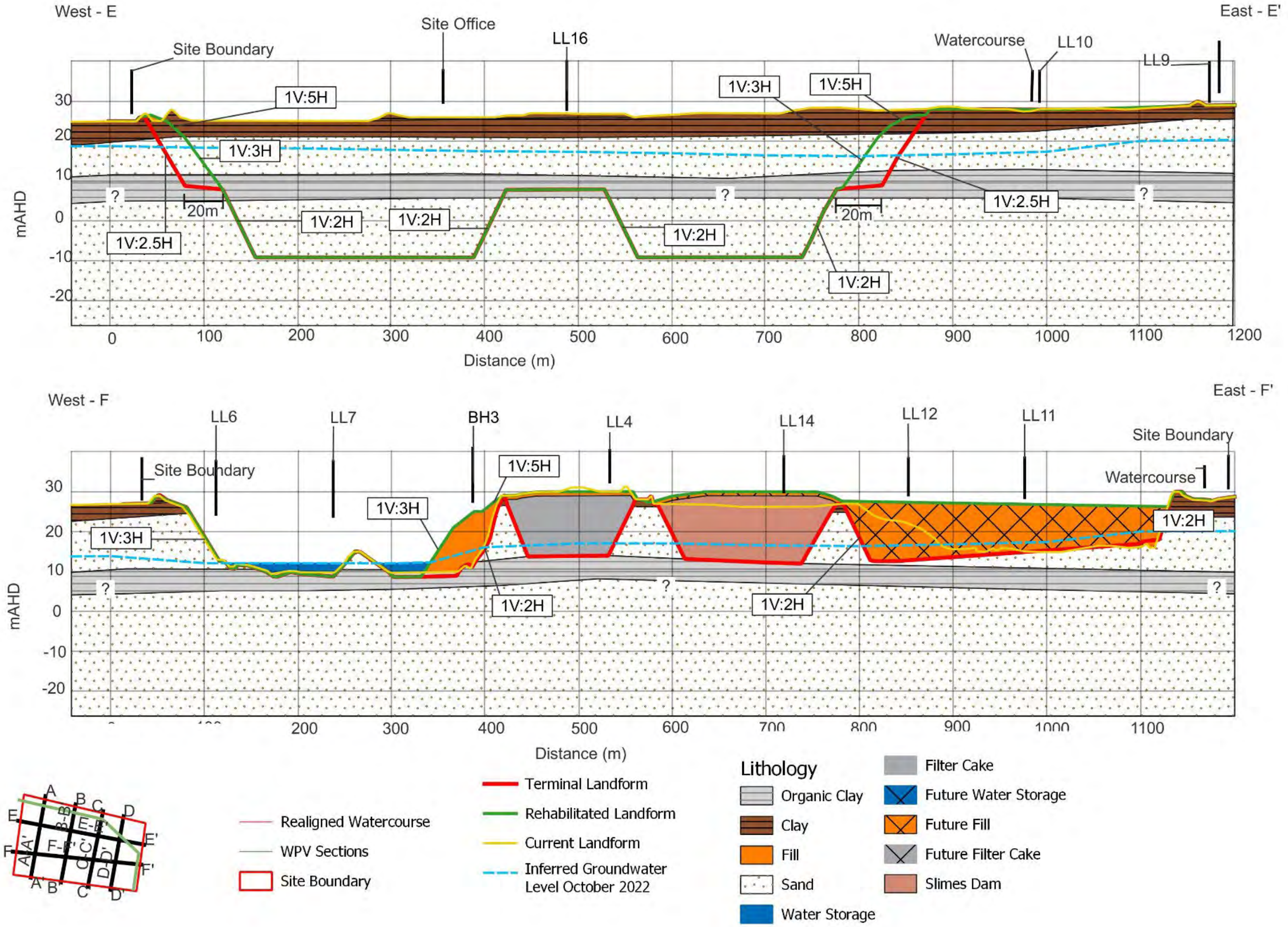


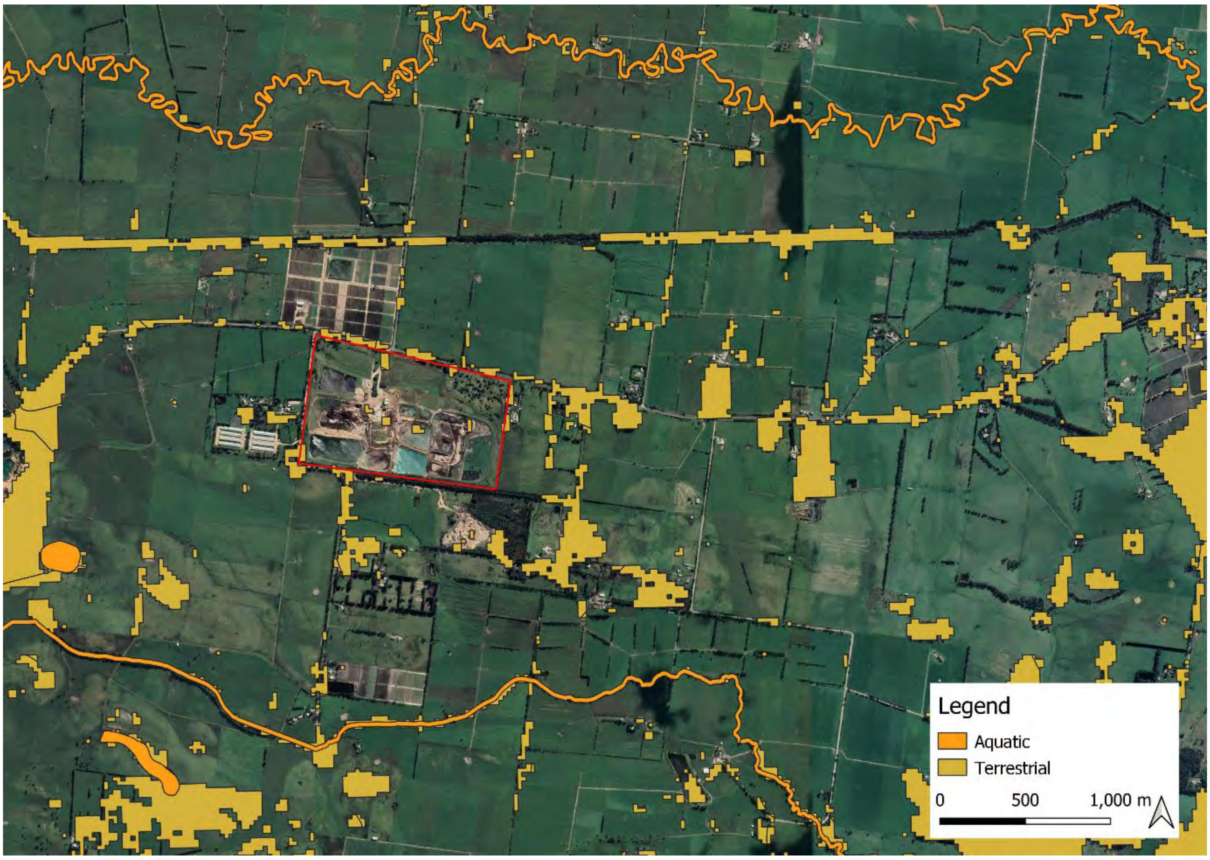
Figure 3-26 Sections E and F



3.2.4 Groundwater dependent ecosystems

Groundwater dependant ecosystems in the vicinity of the site are shown in **Figure 3-27**. Vegetation surrounding the site is dependent on groundwater, as well as vegetation along the Lang Lang River to the north of the site.

Figure 3-27 Groundwater dependent ecosystems



3.3 CHEMICALS USED AT THE SITE

An assessment of chemicals used at the site, and potential impacts to groundwater, are provided in the October 2022 Groundwater Monitoring Event (**Appendix C**). Fuels and workshop chemicals stored at the site are bunded or in a bunded store respectively. Risks from these sources is considered low.

The following coagulants and flocculants are used on site in the processing plant:

- Flocculant “Magnafloc® 5250”, (polyacrylamide).
- Coagulant “Magnafloc® 1425”, 2-Propen-1-aminium, N,N-dimethyl-N-2-propenyl-, chloride, homopolymer (“poly DADMAC”).

Polyacrylamide and polyDADMAC are widely used as coagulants / flocculants for effluent treatment, in paper manufacture and water purification. Both chemicals are endorsed by the National Health and Medical Research Council (NHMRC) for use in drinking water treatment (NHMRC, 2011). Polyacrylamide may also be used as a soil conditioner in agriculture, and as a surfactant in herbicides (Reber et al, 2007). At the Yannathan site they are used as coagulants / flocculants to assist in the removal of undersized material (“fines”) to produce a filter cake. The filter cake is currently used to fill extracted pits / ponds in addition to oversize material. Currently, the filter cake (including residual coagulant / flocculant) is disposed by conveyor to the pond south of the processing plant.

In 2021, the following quantities were used at the site:

Polyacrylamide	59,201kg
PolyDADMAC	173,880L (10%-50% w/w solution)

The October 2022 GME included analysis of potential degradation products in groundwater wells, and water accumulating in the cell to which filter cake was being deposited. This includes:

- Total Organic Carbon (TOC).
- Total Kjeldahl Nitrogen (TKN).
- Nitrogen containing non-organic compounds (nitrate, nitrite, ammonia).
- Acrylamide
- Chloride

The report concluded that that coagulants and flocculants used in processing were not unacceptably impacting cell water or groundwater.

3.4 IMPACT ASSESSMENT

Groundwater Solutions was engaged to conduct a numerical groundwater modelling study to assess the potential for hydrogeological impact resulting from the expanded excavation. The modelling report assumes excavation to a depth of -9m AHD by dry excavation**.**

The model was conducted in accordance with the Australian Groundwater Modelling Guidelines. The model was calibrated against transient observation dataset at sixteen measurement locations from 2004 to 2020. The values of the model hydraulic properties and boundary conditions influencing the simulation results were adjusted from the initial values, so the model was able to reproduce available groundwater observations.

Hydraulic parameter values that were adjusted during model calibration included:

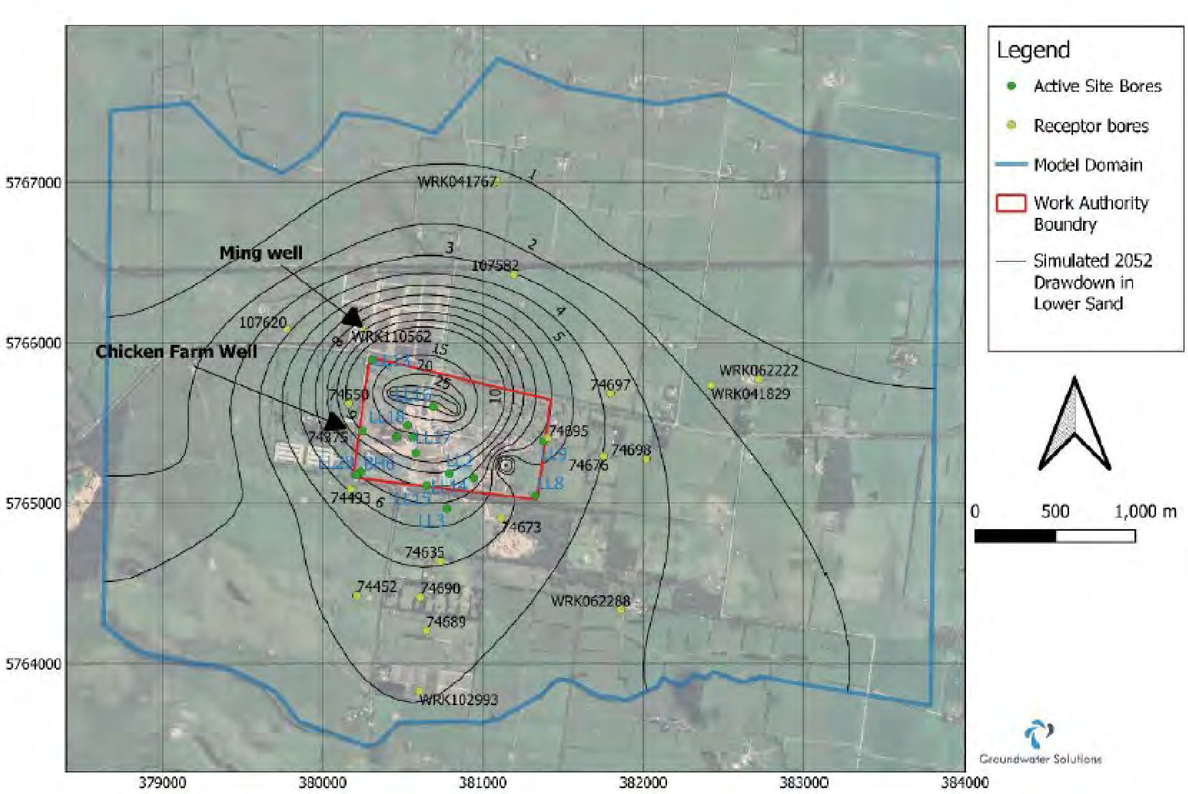
- Horizontal hydraulic conductivity.
- Vertical hydraulic conductivity.
- Specific storage.
- Recharge.
- Conductance of head dependent flux boundaries.

Following calibration, the model simulated steady state head acceptably matched the measured hydraulic head, with an average residual of -0.33m.

A maximum drawdown of greater than 5m is predicted two receptor bores (WRK975049 - chicken farm to the west and WRK110562 - Ming’s irrigation well to the north). The maximum predicted drawdown at WRK975049 does not exceed 50% of the available head and the maximum predicted drawdown at WRK110562 does not exceed 20% of the available head.

Simulated drawdown in 2052 is provided in **Figure 3-28**.

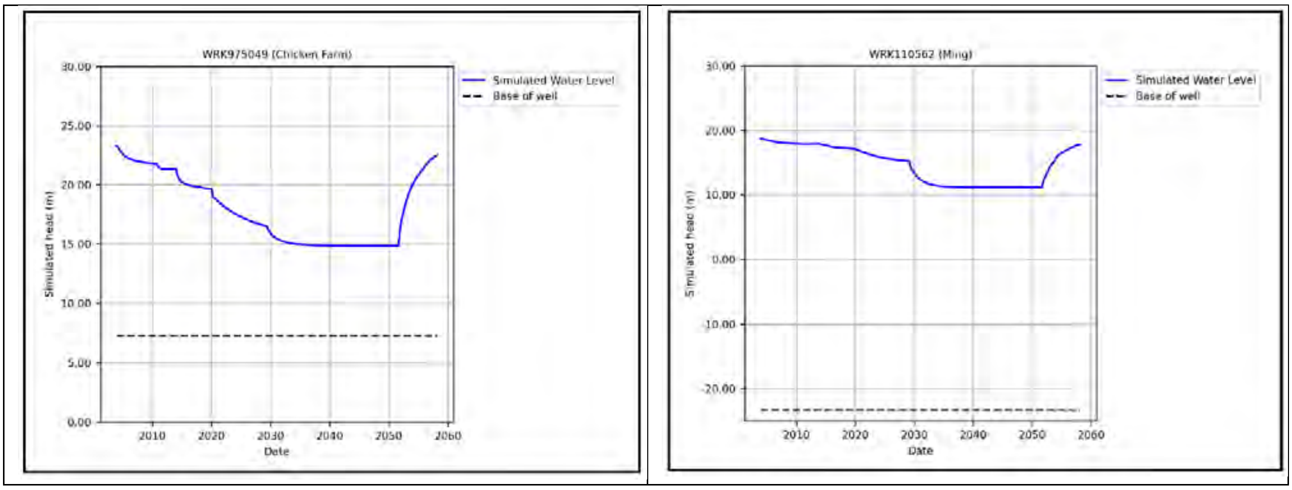
Figure 3-28 Simulated drawdown



Source: Groundwater Solutions 2021

Time series plots showing predictive water levels are shown below.

Figure 3-29 Potential impacts at closest receptors



Source: Groundwater Solutions 2021

It is noted that there is a rapid rebound of the watertable at the conclusion of quarrying.

3.4.1 Conclusions

The groundwater modelling suggested that the impact to neighbouring groundwater bores would be acceptable even with dewatering to -9mAHD. However, the volumes to be extracted would be difficult to manage, and would require a large increase in the extraction licence, for which it may be difficult to obtain a sufficient allocation. For this reason, it was decided to dry excavate only to 9mAHD (the current depth limit) and recover material from 9mAHD to -9mAHD by dredging.

Dredging below 9mAHD will require less groundwater extraction than dry excavation, and impacts are expected to be similar to current dry excavation operations. To further limit local groundwater impacts, the current practice of using clay overburden to batter excavated slopes to reduce groundwater ingress will continue.

4. WATER BALANCE

The objective of the water balance is to evaluate whether onsite storage will be sufficient to manage water onsite without offsite discharge.

An indicative staging plan was prepared to confirm operational considerations. It is possible that market demands and resource variability may change the order of extraction and for this reason has not been presented in detail. The indicative staging plan was used as the basis for the water balance and clearly demonstrates there is adequate onsite storage for water management through to final rehabilitation.

The current site has 18 defined stages, so the future stages modelled extend from Stage 19 to Stage 24 and Final Rehabilitation. Areas are quarried initially by dry extraction techniques as is the current practice. Following the initial extraction clay is placed against the perimeter walls to minimise groundwater inflows into the excavation. Excavation to deeper levels then occurs by wet extraction techniques through use of a dredge.

The final area to be extracted will be the processing plant area. The plant will be removed and this area will be quarried using dry extraction techniques with quarried materials trucked to an offsite processing facility.

The water balance evaluates the change in storage for the dams. The dams that are available for storage change through the extractive sequence. For each stage the individual inflows and outflows are calculated so that the nett change in storage can be determined.

The following are inflows to onsite waterbodies:

- Incident rainfall to dams
- Lateral inflows from the upper sands during the dry excavation stage
- Upwards Inflow through the organic layer while clay fill is placed against the walls
- Lateral inflow from the lower sands during the dredging stages

Note water pumped to the processing plant during dredging is returned to ponds so there is no nett change in storage.

The following are outflows for the onsite waterbodies:

- Evaporation from dams
- Outflow from water storages to aquifer
- Processing usage
- Dust suppression

4.1 WATER BALANCE DATA SOURCES

4.1.1 Areas and Staging

Pond areas are provided in **Table 5-1**.

Table 4-1 Stage areas

Area Name	Area (m^2)	Approximate Capacity (m^3)
South west dam	47,433	62,4000
South east dam	26,409	304,200
West Pit	64,729	1,627,500
East Pit	45386	960,000
Ext NE	52,493	
Ext SE	62,460	1,024,000

Area Name	Area (m^2)	Approximate Capacity (m^3)
Ext NW	38,540	
Ext SW	95,555	1,650,000
Processing area	19,091	221,000

4.1.2 Weather data

Average monthly rainfall between 1980 – 2022 is provided in **Table 5-2.** A wet scenario is also presented with rainfall increased by 10% for each year, and evaporation decreased by 5%. This data, in addition to the dam areas above form the basis for calculations of rainfall to and evaporation from dams.

Table 4-2 Average monthly rainfall Jan 1970- Jun 2022

Month	Average rainfall (mm/month)	Ave Rainfall + 10%	Morton Lake Evaporation (mm/month)	Morton Lake Evaporation – 5%
January	57.2	69.2	161.2	153.3
February	46.1	51.8	130.3	125.4
March	54.4	59.9	104.1	99.5
April	72.3	79.5	61.8	59.0
May	81.1	89.3	34.0	32.4
June	85.6	94.1	21.3	20.3
July	82.3	90.5	25.7	24.5
August	93.1	102.4	43.4	42.7
September	89.1	98	71.1	67.3
October	85.8	94.4	109.4	104.2
November	78.1	85.9	133.1	126.8
December	73.4	80.7	154.9	147.3

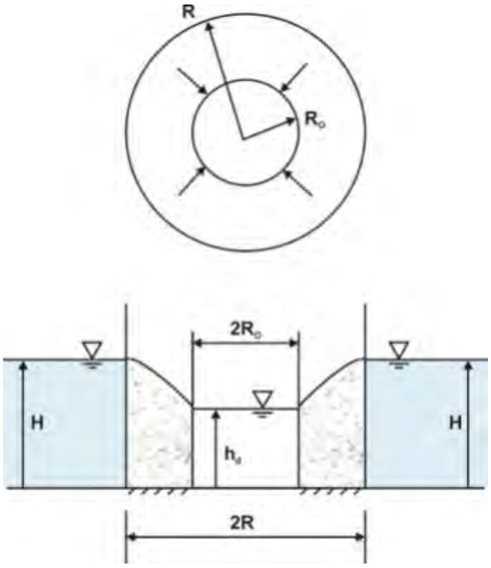
4.1.3 Groundwater inflow

4.1.3.1 Unconfined inflows

Inflows from the upper sand (unconfined aquifer) occur during the initial dry excavation stage. Inflows to the pit are pumped to onsite dams. The inflows have been determined using an analytical solution spreadsheet. The sum of the dam areas for each stage was calculated. For the purposes of the water balance calculation this is assumed to be circular in area.

The conceptualisation is as follows:

Figure 4-1 Conceptualisation - radial unconfined flow into a circular excavation



The inputs to this calculation are as follows:

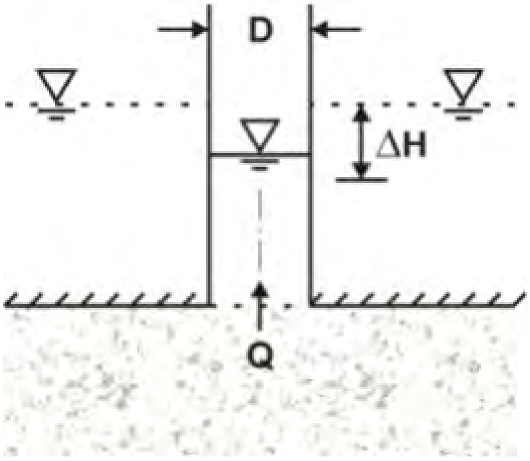
- Hydraulic conductivity – obtained from the calibrated groundwater model prepared by GWS
- Elevation of the base of aquifer – from drilling data
- Distance from the centre of excavation to constant head boundary – site water level data and model outputs
- Distance from centre to boundary of excavation – calculated from total area
- Head at the constant head boundary – Water level monitoring data
- Head in the excavation – required operating water levels

4.1.3.2 Inflows from the base

This scenario occurs when the clay has been placed against the perimeter walls permitting inflow from the base only through the organic layer.

The conceptualisation is as follows:

Figure 4-2 Conceptualisation - flow into the base of a circular excavation



The inputs to this calculation are as follows:

- Hydraulic conductivity – obtained from the calibrated groundwater model prepared by GWS
- Elevation of the base of aquifer – from drilling data
- Diameter of the excavation – calculated from total area

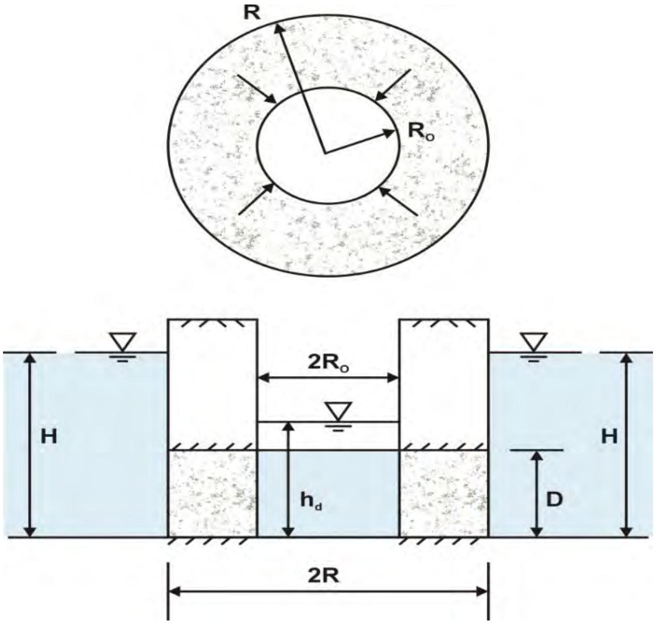
- Head at the constant head boundary – Water level monitoring data
- Head in the excavation – required operating water levels

4.1.3.3 Inflows during dredging

The water levels in the dredge ponds will be lower than the potentiometric surface in the confined aquifer. Groundwater extraction will be needed so that the suction pump on the dredge can reach to the base of the excavation.

The hydrogeological conceptualisation is as follows:

Figure 4-3 Conceptualisation - radial confined flow into a circular excavation



The inputs to this calculation are as follows:

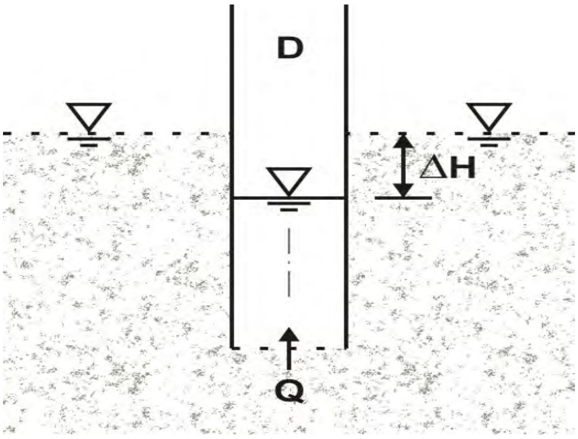
- Hydraulic conductivity – obtained from the calibrated groundwater model prepared by GWS
- Elevation of the base of aquifer – from drilling data
- Thickness of the aquifer where confined – assumed to be at RL-20 mAHD
- Distance from the centre of excavation to constant head boundary – site water level data and model outputs
- Distance from centre to boundary of excavation – calculated from total area
- Head at the constant head boundary – Water level monitoring data
- Head in the excavation – required operating water levels

4.1.4 Groundwater outflows

Water levels in storage dams are maintained at a higher level than the groundwater level to drive groundwater recharge to return extracted groundwater to the aquifer.

The hydrogeological conceptualisation is as follows:

Figure 4-4 Conceptualisation - flow into/out of the base of a circular excavation



Note: this illustrates the parameters for flow where the water level is below groundwater (flow into an excavation). The quantum of the flow is the same (but direction is reversed) if the head is above the groundwater level. Flow is primarily through the base because the perimeter walls are clay lined.

The inputs to this calculation are as follows:

- Hydraulic conductivity – obtained from the calibrated groundwater model prepared by GWS
- Elevation of the base of aquifer – from drilling data
- Diameter of the excavation – calculated from total area
- Head at the constant head boundary – Water level monitoring data
- Head in the excavation – required operating water levels

4.1.5 Dust suppression

Dust suppression has been assumed to be required from December through to March inclusive, with approximately one 27 m^3 tanker per day. This equates to approximately 3ML per year.

4.1.6 Processing

Hanson maintains a 19.5ML groundwater extraction licence to cover water lost with processed sand sold. This volume is dispersed evenly across the year.

Water is drawn from the ponds which also receives incident rainfall. The percentage of total inflow that is derived from rainfall varies from 30 to 100% averaging 50% over the life of the operation (assuming average rainfall).

The moisture content of sand sold is typically 3 - 7% by weight (Pers Comm, Quarry Manager). The anticipated tonnage is 400,000 tonnes/year so the mass of the water sold with product is 12,000 to 28,000 tonnes. 1 ML of water weighs 1000 tonnes so this equates to 28ML of which 50% is groundwater. Therefore, groundwater exported in product ranges from 6,000 – 14,000 tonnes per year (6 to 14 ML/year).

Similarly, of the 3ML/year used in dust suppression, 1.5ML/year will be from groundwater.

There is no irrigation and vehicle/plant washdowns are minimal. It is therefore considered that the consumption of groundwater will remain within the existing licence.

Therefore, moisture in product derived from groundwater includes:

6 to 14 ML/year exported in product.

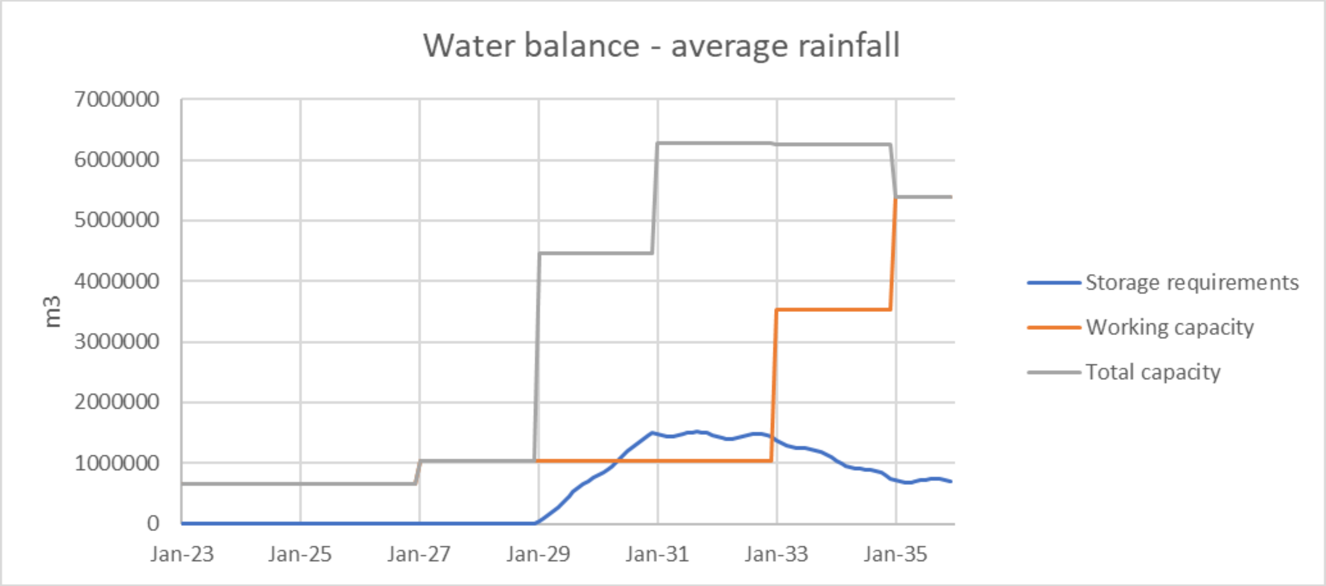
1.5ML/year used for dust suppression.

Overall, groundwater use is expected to be within the groundwater extraction licence limits of 19.5ML/year.

4.2 WATER BALANCE RESULTS

The resulting water balance is provided in **Appendix D**. The following figure illustrates the outcomes of the water balance calculations for average rainfall conditions each year.

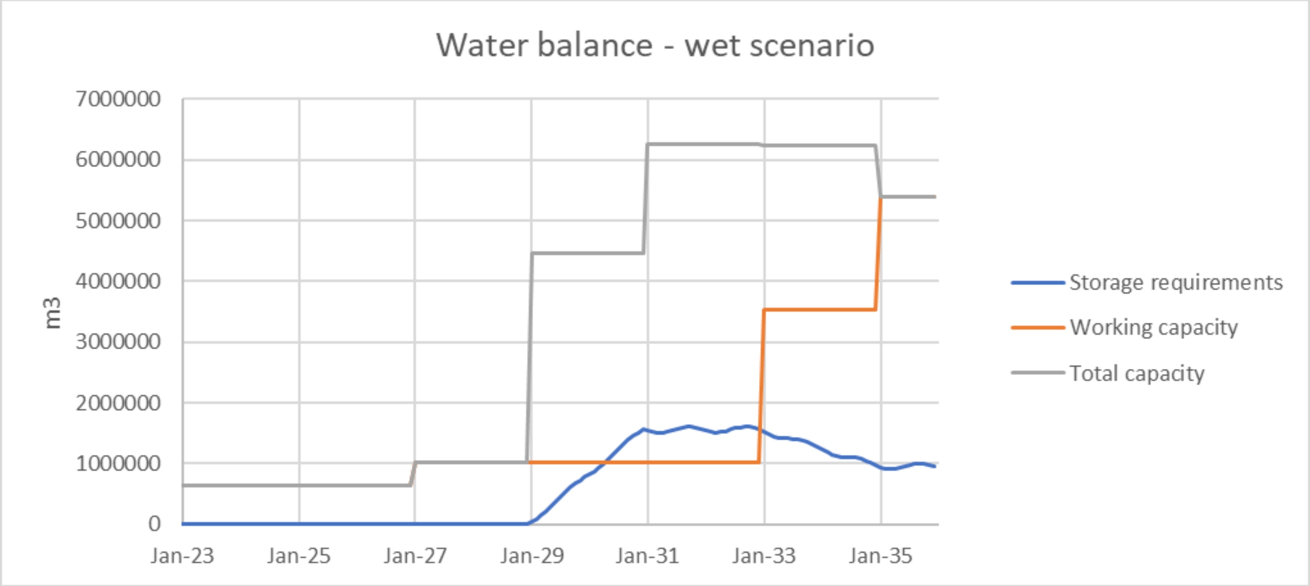
Figure 4-5 Water balance - average rainfall



It has been assumed each stage will have a duration of two years. The results show that the water storage requirements for the duration of the operation is able to be managed within the working capacity of the dams. During Stage 21 (2027-2028) this is close to the available working capacity. If capacity became an issue Hanson has additional capacity available in the dredge pond.

To test the sensitivity of the water balance model a wet scenario was also modelled. In this scenario rainfall was increased by 10% and evaporation decreased by 5% for each month of the entire model from 2023 to 2035. This is a highly improbable situation however does serve to demonstrate the capacity of the system to handle extreme events and potential climate change extremes.

Figure 4-6 Water balance - wet scenario

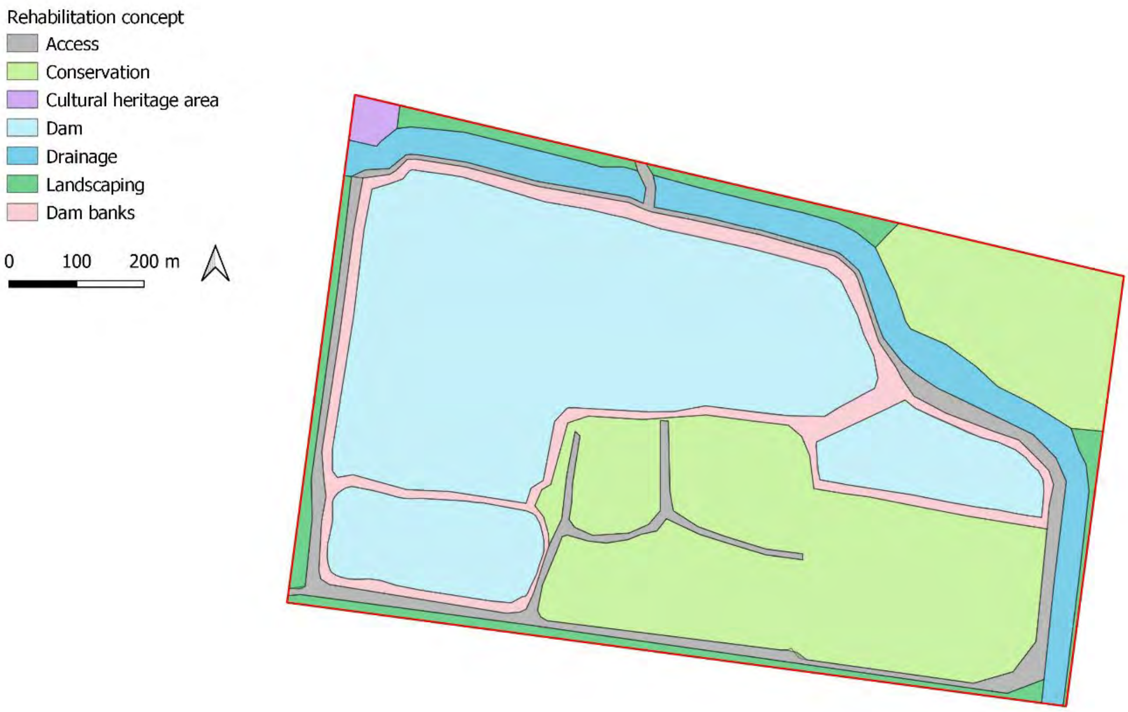


It is therefore concluded that no additional groundwater extraction allocations will be needed and that there is ample storage onsite such that offsite disposal will not be required.

4.3 POST CLOSURE WATER BALANCE

Following completion of rehabilitation works the watertable will be allowed to recover. The post closure site layout is shown in **Figure 4-7**.

Figure 4-7 Post closure site layout



The post-closure rehabilitation scenario assumes recovery of the water level. The volume of groundwater lost therefore equates to evaporation losses offset by rainfall incident to the ponds. The area of the ponds post closure for the above scenario is 31.87 ha. The annual water balance is tabulated below.

Table 4-3 Post-closure water balance

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rainfall (mm)	57.2	47.1	54.4	72.3	81.1	85.6	82.3	93.1	89.1	85.8	78.1	73.4	
Evaporation (mm)	161.0	131.4	104.1	61.8	34.0	21.2	25.7	44.8	70.7	109.4	133.1	154.8	
Volume of incident rainfall (m^3)	18238.4	15009.4	17343.7	23044.1	25864.0	27282.0	26228.6	29670.3	28396.1	27346.5	24899.7	23384.1	
Evaporative losses (m^3)	51305.4	41897.8	33181.9	19686.1	10832.3	6761.9	8199.5	14286.8	22547.0	34872.0	42437.0	49352.4	
Groundwater losses (m^3)	33067.0	26888.4	15838.2	-3358.0	-15031.7	-20520.1	-18029.1	-15383.5	-5849.1	7525.5	17537.3	25968.3	
Groundwater losses (ML)	33.1	26.9	15.8	-3.4	-15.0	-20.5	-18.0	-15.4	-5.8	7.5	17.5	26.0	48.7

5. RISK ASSESSMENT

The hydrogeological hazards, risks and controls based on the proposed works have been identified in accordance with the *Preparation of Work Plans and Work Plan Variations* (State of Victoria, Department of Jobs, Precincts and Regions 2020).

5.1 HAZARD IDENTIFICATION

The hydrogeological hazards identified as a result of the proposed works include:

- Greater groundwater inflow than anticipated necessitating offsite discharge impacting surface water and ecosystems.
- Increased drawdown impacting neighbouring groundwater users and ecosystems.
- Impact to natural groundwater chemistry conditions impacting groundwater and ecosystems.

5.2 ASSESSMENT FRAMEWORK

Risk is assessed by comparing likelihood of an event and the consequences of the event occurring.

The likelihood assessment descriptions outlined are provided below in **Table 5-1**.

Table 5-1 Likelihood assessment framework

Likelihood	Description	Probability of event occurring
Almost certain	The risk event is expected to occur in most circumstances	> 90%
Likely	The risk event is expected to occur in some common circumstances	70-90%
Possible	The risk event might occur in some circumstances	30-70%
Unlikely	The risk event could occur in some uncommon circumstances, as this is known to occur at comparable sites	5-30%
Rare	Highly unlikely, but the risk event may occur in exceptional circumstances, as may have occurred at comparable sites	< 5%

ERR consequence descriptions are outlined in *Preparation of Work Plans and Work Plan Variations,* there are four consequences classifications relevant to groundwater including:

- Land and land use – land, property and infrastructure beyond the boundary of the licence or work authority area.
- Environmental contamination event
- Native vegetation, flora species or fauna species
- Surface water or groundwater

Each classification contains sub-categories that provide specific descriptions for each consequence outlined. The relevant consequence descriptions are provided in **Table 5-2.**

Table 5-2 ERR consequence descriptions

	Consequence	Critical	Major	Moderate	Minor	Insignificant
Consequences for “ land, property and infrastructure “ *beyond the boundary of the licence or work authority area*	**Land and land uses** Loss of production from primary production land or loss of annual-seasonal primary production. Environmental damage to National Park, other conservation reserve or other public land.	Permanent loss of production from primary production land >10 ha. Loss of annual-seasonal primary production from >100 ha of land. Irreversible or long-term environmental damage (with rehabilitation taking years or longer) to >1 ha of National Park or other conservation reserve.	Permanent loss of production from primary production land <10 ha. Loss of annual-seasonal primary production from 10-100 ha of land. Irreversible or long-term environmental damage to <1 ha of National Park or other conservation reserve or to ≥10 ha of other public land. Reversible damage to ≥1 ha of National Park or other conservation reserve or to ≥10 ha of other public land.	Loss of annual-seasonal primary production from <10 ha of land. Short-term (days-weeks). Disruption to 10-100 ha of primary production land. Reversible damage to <1 ha of National Park or other conservation reserve or to <10 ha of other public land.	Minor damage to agricultural land or public land not requiring active rehabilitation. Temporary and small-scale disruption to agricultural production (days, 1-10 ha)	Total damage to private or public property or infrastructure <$1k. .
Consequences for “ the environment” – air, water, soil, vegetation, flora and fauna species *other than for planned and approved disturbances within the licence or work authority area.*	**Environmental contamination event** Environmental contamination event (of air, soil-land and/or water)	A State-level incident response is required. Incident response, clean-up and rehabilitation expected to run for years and/or cost ≥$10 million.	A regional emergency management incident response required. Clean-up and rehabilitation expected to run for months and/or cost $1-10 million.	Clean-up and rehabilitation expected to run for weeks and cost $10k-$1 million.	Clean-up and rehabilitation may be required but can be completed within days.	Hazard event with minimal environmental impact and no noticeable effect beyond the immediate occurrence or expression of the hazard.
	Native vegetation, flora species or fauna species Environmental contamination event or other form of environmental damage that impacts native vegetation, flora or fauna species	Damage leading to bioregional, State or national extinction of listed threatened species of native flora or fauna or vegetation community. Irreversible or long-term (years) damage or environment harm to ≥10 ha of native vegetation (not listed threatened vegetation community) or to ≥1 ha listed threatened native vegetation community. Deaths of hundreds (or more) of listed native flora or fauna species or native mammals. Contamination or other environmental damage leading to deaths of native fauna well beyond (>1 km) the boundaries of the operation.	Damage leading to local extinction of listed threatened species of native flora or fauna or vegetation community. Deaths of up to ~100 listed threatened flora or fauna species or native mammals. Major damage or environment harm to 1-10 ha of native vegetation (not listed threatened vegetation community) or to <1 ha listed threatened native vegetation community that will be irreversible or take years to recover from.	Damage leading to deaths of a small number of listed threatened flora or fauna species or native mammals. Reversible damage or environmental harm to <10 ha of non-listed native vegetation community or <1 ha of listed native vegetation community.	Damage to <1 ha of native vegetation (not listed threatened vegetation community) that can be recovered in weeks to months. Damage that affects native fauna populations but does not kill individuals or disrupt breeding or other important ecological processes.	Hazard event with minimal environmental impact and no noticeable effect beyond the immediate occurrence or expression of the hazard.
	Surface water or groundwater Contamination of surface water/groundwater aquifer	Contamination leading to disruption of beneficial uses as defined by SEPP (Waters) for more than a year.	Contamination leading to disruption of beneficial uses as defined by SEPP (Waters) for up to one year.	Localised contamination leading to disruption of beneficial uses as defined by SEPP (Waters) for weeks to months.	Contamination of natural waterway or wetland occurs, but water quality remains within applicable EPA or ANZECC guidelines for existing beneficial uses. Water extraction or diversion reduces surface water flows or groundwater available for environmental uses, but with no detectable effect on dependent species or ecosystems and carried out within terms of water licence.	Hazard event with minimal environmental impact and no noticeable effect beyond the immediate occurrence or expression of the hazard.

Note SEPP (Waters) has been superseded by the ERS, ANZECC guidelines have been superseded by the ANZG.

The risk matrix used to assess risk level is provided in **Table 5-3**.

Table 5-3 Risk assessment matrix

		Consequence				
		Insignificant	**Minor**	**Moderate**	**Major**	**Critical**
Likelihood	**Almost Certain**	Medium	High	Very High	Very High	Very High
	Likely	Medium	Medium	High	Very High	Very High
	Possible	Low	Medium	Medium	High	Very High
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Medium	Medium	High
	Eliminated	Eliminated				

Risk level descriptions are provided in **Table 5-4.**

Table 5-4 Risk level descriptions

Risk level	Description
Very High	Totally unacceptable level of risk. Control measures must be put in place to reduce the risk to lower levels.
High	Generally unacceptable level of risk. Control measures must be put in place to reduce the risk to lower levels or seek specific guidance from ERR.
Medium	May be acceptable provided the risk has been minimised as far as reasonably practicable.
Low	Acceptable level of risk provided the risk cannot be eliminated.
Eliminated	The risk is eliminated.

The risk register is presented in **Appendix E**.

5.3 RISK TREATMENT PLAN

5.3.1 Scope

This risk treatment plan is for the control of potential adverse impacts arising from groundwater management associated with the proposed quarry extension with increased depth.

5.3.2 Sensitive receptors

Sensitive receptors are the environment, any member of the public or land, property or infrastructure in the vicinity of a quarry that may be put at risk by the hazard associated with the quarrying or rehabilitation activity.

The sensitive receptors associated with this hazard are presented in **Table 5-5.**

Table 5-5 Sensitive receptors

#	Details of the Sensitive Receptor	Location and proximity to site	How hazard may harm or damage Sensitive Receptor	Evidence to support assessment
1	Ecological receptors (Lang Lang River)	650m N to nearest ecological receptor (Lang Lang River)	Reduced local groundwater availability, likely induce increased recharge from river	Groundwater modelling, WMIS and SRW data, GDE datasets, site monitoring data

#	Details of the Sensitive Receptor	Location and proximity to site	How hazard may harm or damage Sensitive Receptor	Evidence to support assessment
2	Surrounding groundwater users	~50m W to nearest GW user	Reduced local groundwater availability, potentially dry bores	Groundwater modelling, WMIS and SRW data, site monitoring data
3	Surface water – onsite waterway	Onsite	Groundwater discharges may impact water quality.	SW monitoring and site inspections
4	Ecological receptors – onsite waterway	Onsite	Groundwater discharges may impact water quality.	SW monitoring and site inspections
5	Groundwater quality	Site and immediate surrounds	Salinity increase from evaporative concentration of salts	Monitoring of groundwater quality

5.3.3 Inherent Risk

These are the risks associated with the hazard to the sensitive receptors. The inherent risk rating is the risk before control measures have been applied. The residual risk rating is the risk level after the control measures have been applied.

The project phase options include set up/construction, operations/production and rehabilitation, or a combination.

Table 5-6 Inherent risks

#	Details of the Risk	Project Phase	Likelihood	Consequence	Risk
S21Q	Contamination of groundwater from filtercake during quarrying phase	Operations/ Production	Unlikely	Minor	Low
S39Q	Water management activities lowering the watertable beyond the reach of plant roots	Operations/ Production	Possible	Minor	Medium
S40Q	Water management activities impacting on the watertable and increasing salinity which affects groundwater conditions	Operations/ Production	Possible	Minor	Medium
S41Q	Water management activities impacting on the watertable and increasing salinity which affects plant growth	Operations/ Production	Possible	Moderate	Medium
S58Q	Water management activities creating Increased groundwater drawdown	Operations/ Production	Possible	Minor	Medium
S59Q	Greater groundwater inflow than anticipated impacting surface water quality necessitating off-site discharge	Operations/ Production	Rare	Minor	Low
S60Q	Greater groundwater inflow than anticipated surface water ecosystems necessitating off-site discharge	Operations/ Production	Rare	Minor	Low

5.3.4 Control measures to address hazard

The control measures are to be designed to eliminate or minimise, as far as reasonably practicable, the identified inherent risks. The numbers of the risks being managed by each control should be recorded against the control.

The control measures for this risk treatment plan are presented in **Table 5-7**.

Table 5-7 Control measures

#	Details of control measures being used	Risks being managed (from Inherent Risk Assessment)	Performance standards
W14	Implement targeted monitoring where impact is suspected	S21Q	Monitoring program in place
W01	If the activity to return the water discharge to a waterway involves construction of any works on a designated waterway, ensure an appropriate "Works on Waterways" permit is obtained from a CMA.	S60Q	Permits for works on waterway obtained as required.
W02	Any discharge of treated or process water to the environment will be subject to EPA licencing.	S59Q, S60Q	Any discharge of treated or process water to the environment is licenced.
W03	If the works to return the water to the environment do not involve works on a designated waterway, stabilise the area with rock rip rap or other materials to prevent erosion.	S59Q, S60Q	Any point of water discharge has been stabilised with appropriate materials.
W04	Develop and implement an inspection and maintenance program for sediment and erosion control features developed for the return of water to the environment.	S59Q, S60Q	Inspection and maintenance program developed and being implemented.
W05	Retain daily records of the volume and quality of water returned to the environment from the Work Authority area.	S59Q, S60Q	Daily records of volume and quality of water returned to the environment have been maintained.
W06	Monitor groundwater levels	S39Q, S58Q	Monitoring records are available
W07	Monitor vegetation health	S39Q, S41Q, S60Q	Site inspection records are available
W09	Monitoring of water quality in waterway	S59Q, S60Q	Monitoring records are available
W10	If necessary, time discharges to coincide with higher flows	S59Q	Daily records of volume and quality of water returned to the environment have been maintained.
W11	Monitor groundwater quality	S40Q, S41Q	Monitoring records are available
W12	Monitor water quality in ponds	S40Q, S41Q	Monitoring records are available
W13	Installation of clay lining on perimeter bunds	S39Q, S40Q, S41Q, S58Q	Clay liner installed

5.3.5 Residual risk assessment

Considering the control measures being put in place the assessment of the residual risk associated with the risk events identified for this hazard is shown in **Table 5-8**.

Table 5-8 Residual risk assessment

#	Details of the Risk	Project Phase	Likelihood	Consequence	Risk
S21Q	Contamination of groundwater from filtercake during quarrying phase	Operations/ Production	Unlikely	Minor	Low
S39Q	Water management activities lowering the watertable beyond the reach of plant roots	Operations/ Production	Unlikely	Minor	Low
S40Q	Water management activities impacting on the watertable and increasing salinity which affects groundwater conditions	Operations/ Production	Unlikely	Minor	Low
S41Q	Water management activities impacting on the watertable and increasing salinity which affects plant growth	Operations/ Production	Unlikely	Minor	Low
S58Q	Water management activities creating Increased groundwater drawdown	Operations/ Production	Unlikely	Minor	Low
S59Q	Greater groundwater inflow than anticipated impacting surface water quality necessitating off-site discharge	Operations/ Production	Rare	Minor	Low
S60Q	Greater groundwater inflow than anticipated surface water ecosystems necessitating off-site discharge	Operations/ Production	Rare	Minor	Low

5.3.6 Compliance standards

Compliance standards relevant to this risk treatment plan are provided in **Table 5-9**.

Table 5-9 Compliance standards

Compliance Standards
The Environmental Reference Standard (Environmental Protection Authority Victoria)

5.3.7 Monitoring and management

Monitoring and ongoing management relevant to this risk treatment plan are provided in **Table 5-10**.

Table 5-10 Monitoring and management

#	Aspect to be monitored/managed	Details of monitoring and ongoing management
1	Inflow rate to pit	Weekly
2	Bore water levels	Weeky
3	Groundwater field chemistry parameters	Annually

#	Aspect to be monitored/managed	Details of monitoring and ongoing management
4	Groundwater and pond water quality	Laboratory analysis annually
5	Vegetation health (onsite and offsite)	Visual inspections
6	Surface water quality in onsite watercourse*	Major ions by laboratory analysis annually

* when water is flowing in the drainage line

5.3.8 Relevant industry publications

The relevant industry publications are provided in **Table 5-11.**

Table 5-11 Relevant industry publications

#	Document	Source (e.g. URL, appendix number)
1	Preparation of Work Plans and Work Plan Variations, Earth Resources Victoria	https://earthresources.vic.gov.au/legislation-and-regulations/guidelines-and-codes-of-practice/work-plan-guidelines-for-mining-licences
2	The Environmental Reference Standard (Environmental Protection Authority Victoria)	https://www.epa.vic.gov.au/about-epa/laws/epa-tools-and-powers/environment-reference-standard

5.3.9 Operator's reference documents

The relevant operator's reference documents are provided in **Table 5-12**.

Table 5-12 Operator's reference documents

#	Document	Location (e.g. work plan appendix number)
1	Site plan	30765 Yannathan Hydrogeology Report

5.4 RISK ASSESSMENT CONCLUSIONS

Following the implementation of controls, the hazards outlined have been determined to have a low residual risk rating.

- Use of flocculants and coagulants in sand processing impacting groundwater
- Water management activities lowering the watertable beyond the reach of plant roots
- Water management activities impacting on the watertable and increasing salinity which affects groundwater conditions
- Water management activities impacting on the watertable and increasing salinity which affects plant growth
- Water management activities creating Increased groundwater drawdown
- Greater groundwater inflow than anticipated necessitating off-site discharge
- Greater groundwater inflow than anticipated necessitating off-site discharge

6. CONCLUSIONS AND RECOMMENDATIONS

The following is concluded from this assessment:

- Extraction will be by dry excavation and placement of clay batters along terminal faces to a depth of 9mAHD. This is consistent with current site operations. From 9mAHD to -9mAHD, materials will be recovered by dredging.
- The proposed extension and increase in depth will not unacceptably impact groundwater levels at neighbouring properties.
- Offsite groundwater discharge will not be required, existing licenses are adequate.
- Following implementation of controls the residual risks associated with the proposed works have a low risk rating.

It is recommended:

- The Water Monitoring Program should be implemented to include:
  - A full gauging and sampling round for major ions and nutrients and TOC to provide an understanding of any changes to groundwater chemistry conditions at the Site.
  - Additional groundwater wells be installed and included in the monitoring program to confirm there are no unacceptable impacts to deeper aquifers from dredging. This should include:
  - An additional well in the vicinity of current well LL8 (hydraulically upgradient).
  - Additional wells in the vicinity of LL13 and LL19 respectively (hydraulically downgradient).
  - Additional wells on the northern boundary (2) as recommended in the geotechnical report contained as an Appendix to **Part 1 Summary Report.**
  - Triggers for groundwater quality should be based on the groundwater assessment criteria (Section 4) of the 2022 Groundwater Monitoring Event (**Appendix C**). Should any groundwater assessment criteria be exceeded, the probable cause should be investigated and actions recommended (if required).
- It is recommended that excess water purged during development to be stored on-Site and used for dust suppression and water provision to neighbours during dry months. If needed remaining excess water can be discharged to the surface water channel. Discharges to the surface water channel would require EPA licensing.

7. REFERENCES

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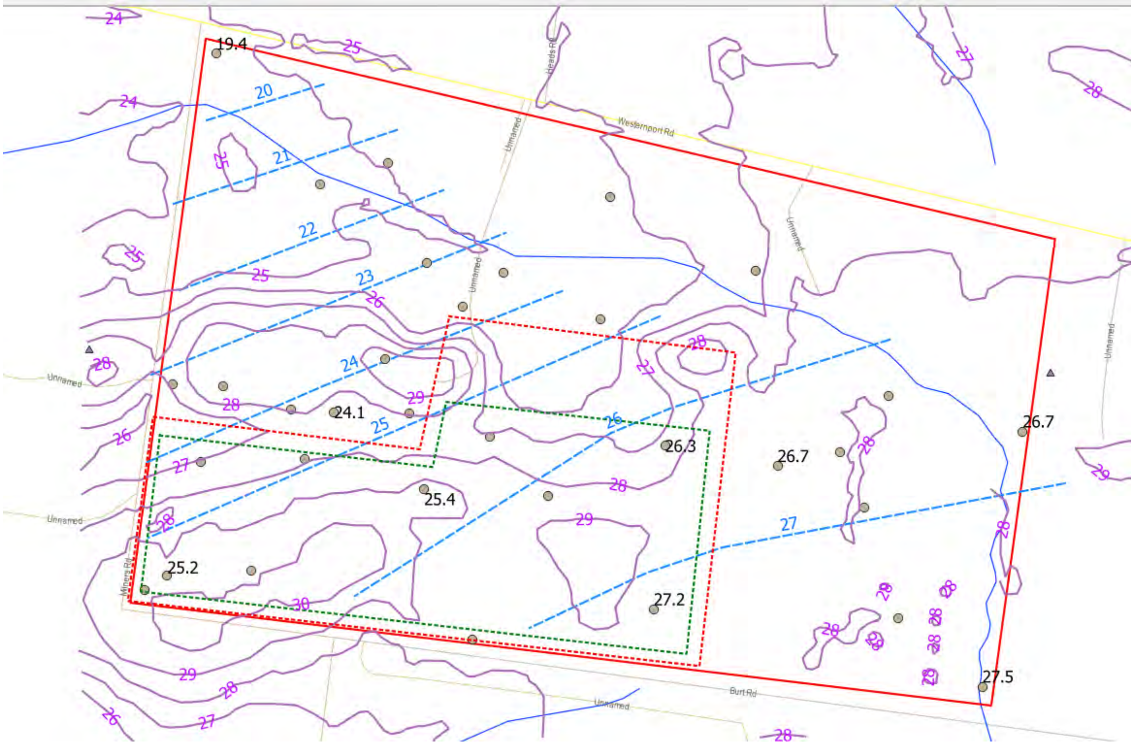
Appendix A Summary of development history

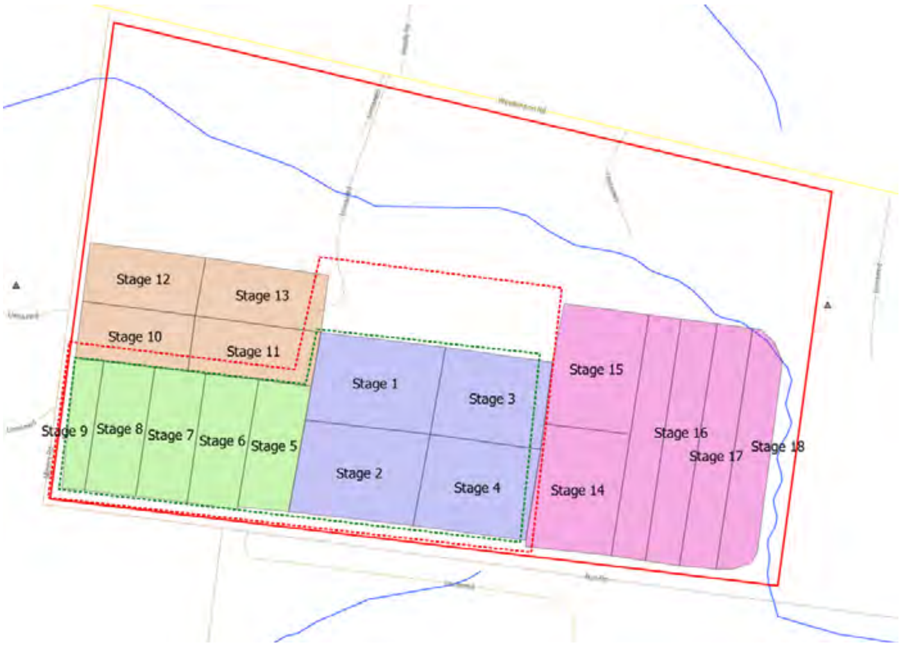
Prior to January 2004 the site was not developed. **Figure A-1** shows the original surface topography, together with the original Work Authority and Extraction Boundaries (dotted). The groundwater levels and inferred initial water levels from January 2004 are also presented.

Figure A-1 Pre-development January 2004



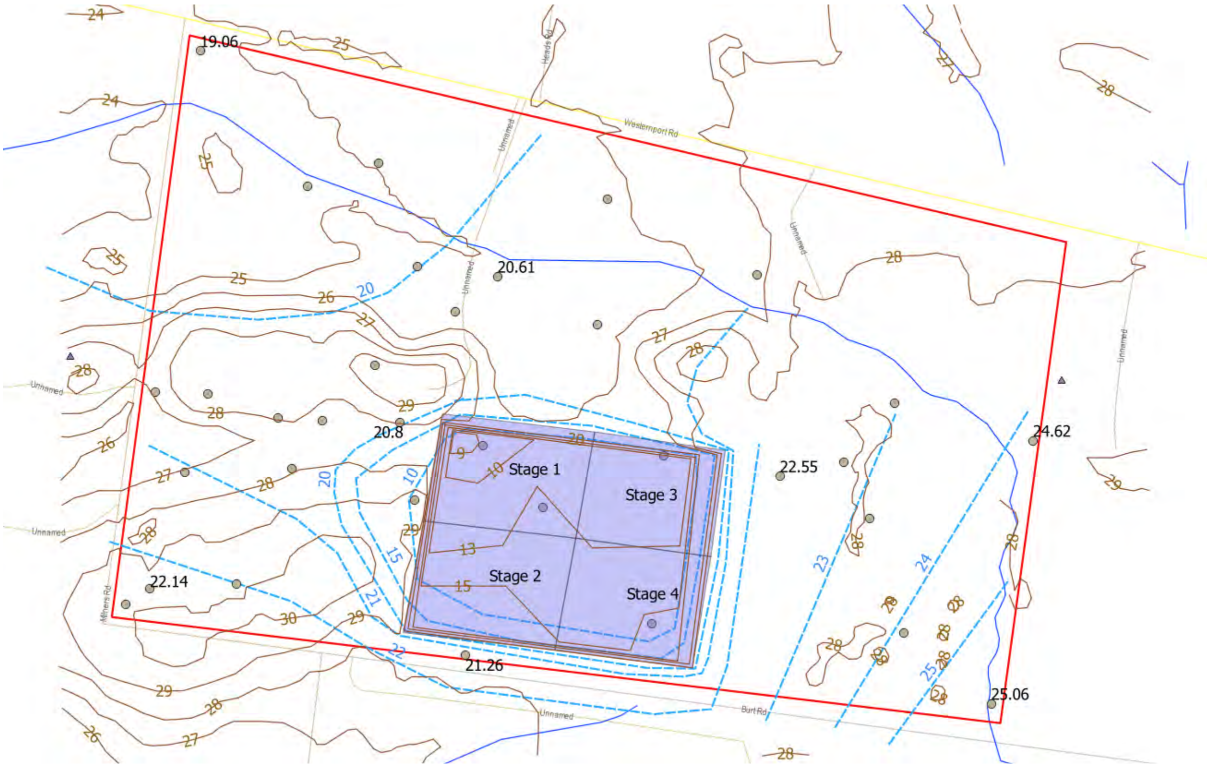
The approved quarry area comprises of 18 Stages, which have been divided into 4 Phases. The Stages and Phases of development are shown in **Figure A-2**.

Figure A-2 Development Stages and Phases



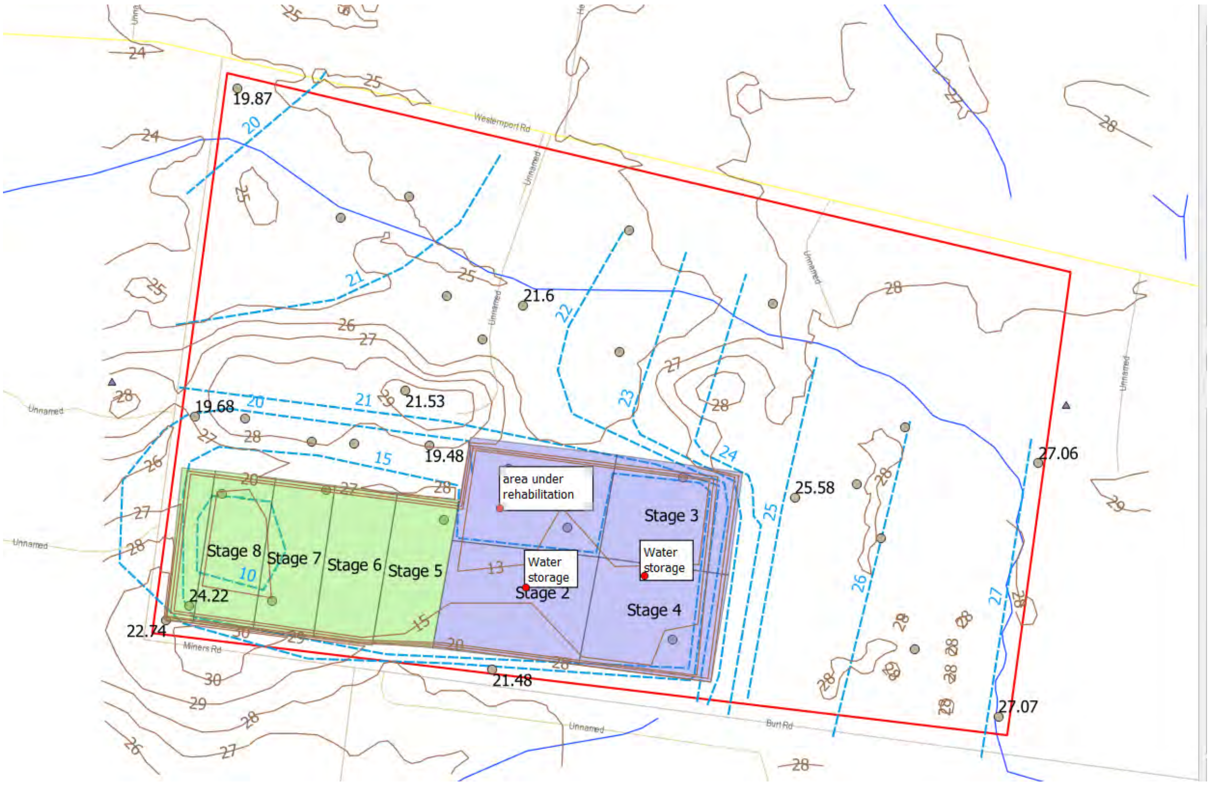
Phase 1 was completed by January 2009. **Figure A 3** illustrates an approximation of what would have been the situation at the end of Phase 1. The groundwater levels do show a developing cone of depression around the pit.

Figure A 3 End Phase 1 January 2009



Following the completion of Phase 1 quarrying extended to the west – southwestern corner of the site in Phase 2. Quarrying of this area was completed in 2014. **Figure A-4** shows the layout of the site following the completion of Phase 2 in 2014.

Figure A-4 End Phase 2 January 2014



Extraction in the Phase 3 area (Stages 10-13 inclusive) commenced in 2014 and is still proceeding. Extraction commenced in the Eastern Pit in 2017 and is still continuing. It is expected the Eastern and Western Pits will be exhausted within 2 years.

The turkey nest dams north of Phase 3 were installed between January 2015 and July 2015. These would have eliminated recharge in this area. These are now removed.

Figure A-5 shows the development of Phase 3 and 4 as of February 2018 and **Figure A-6** shows the development at the site as of September 2020. Note the turkey nest dams north of the West Pit have been removed.

Figure A-5 Phases 3 and 4 February 2018

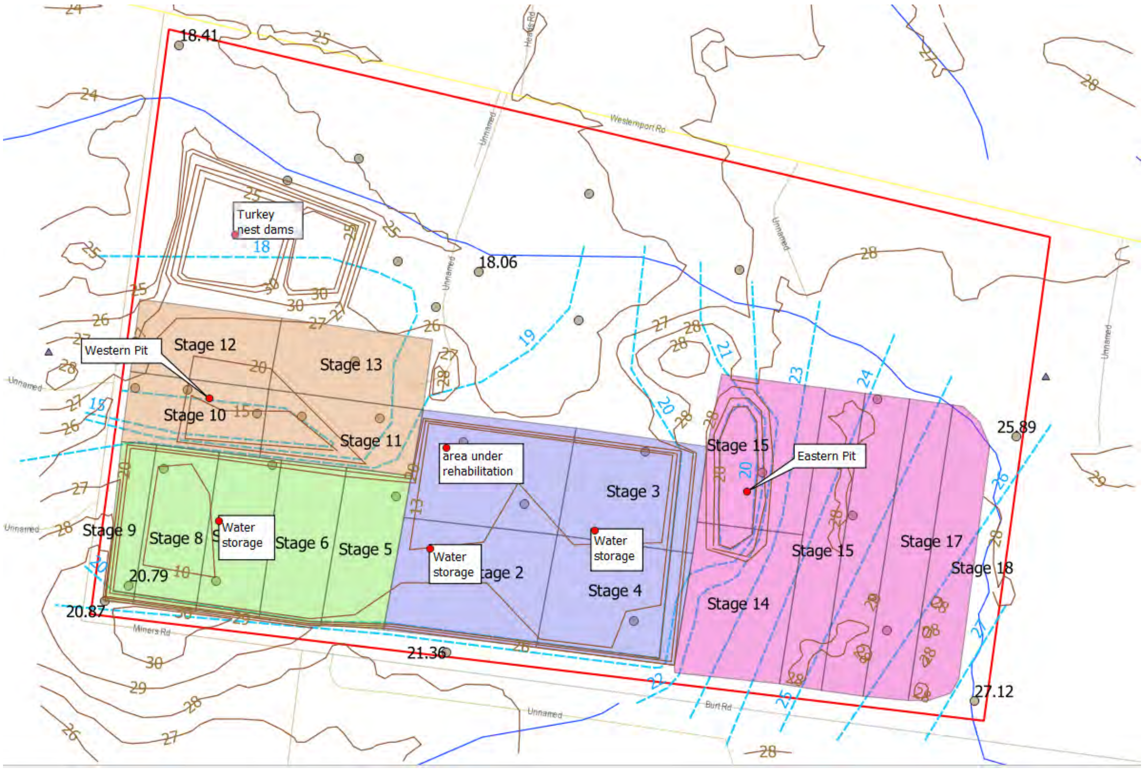


Figure A-6 Phase 3 and 4 September 2020

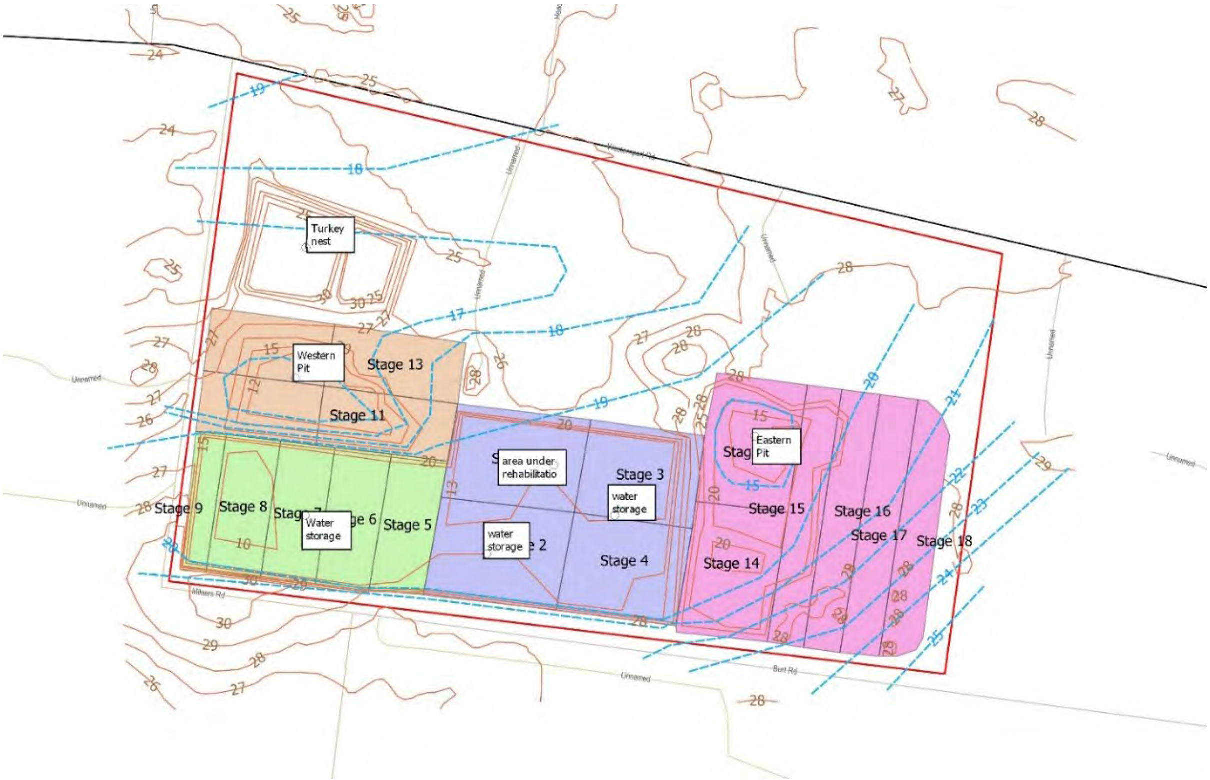
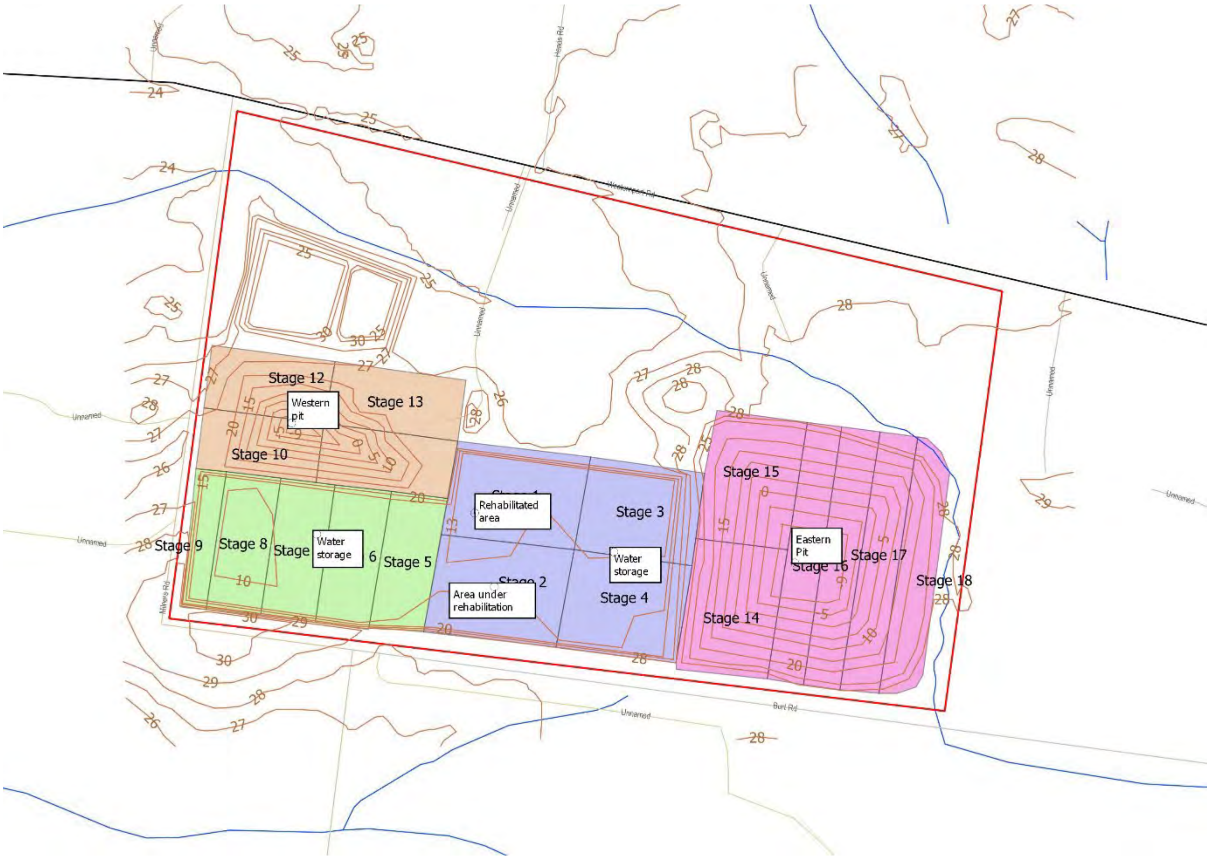


Figure A-7 presents the anticipated site arrangement at the end of Stage 18 (Phase 4). Quarrying extends down to -9 mAHD. As this is a future scenario only annotated topography is presented. It is anticipated this situation will occur late 2022.

Figure A-7 End of Stage 18



Extraction in the proposed extension area considers:

- Extraction of accessible resource to the north of the site, and reinstatement of this area prior to relocation of the current waterway.
- Relocation of the internal Access Road from the site entrance to the process area and associated power lines to enable extraction of sand from beneath the current alignment.

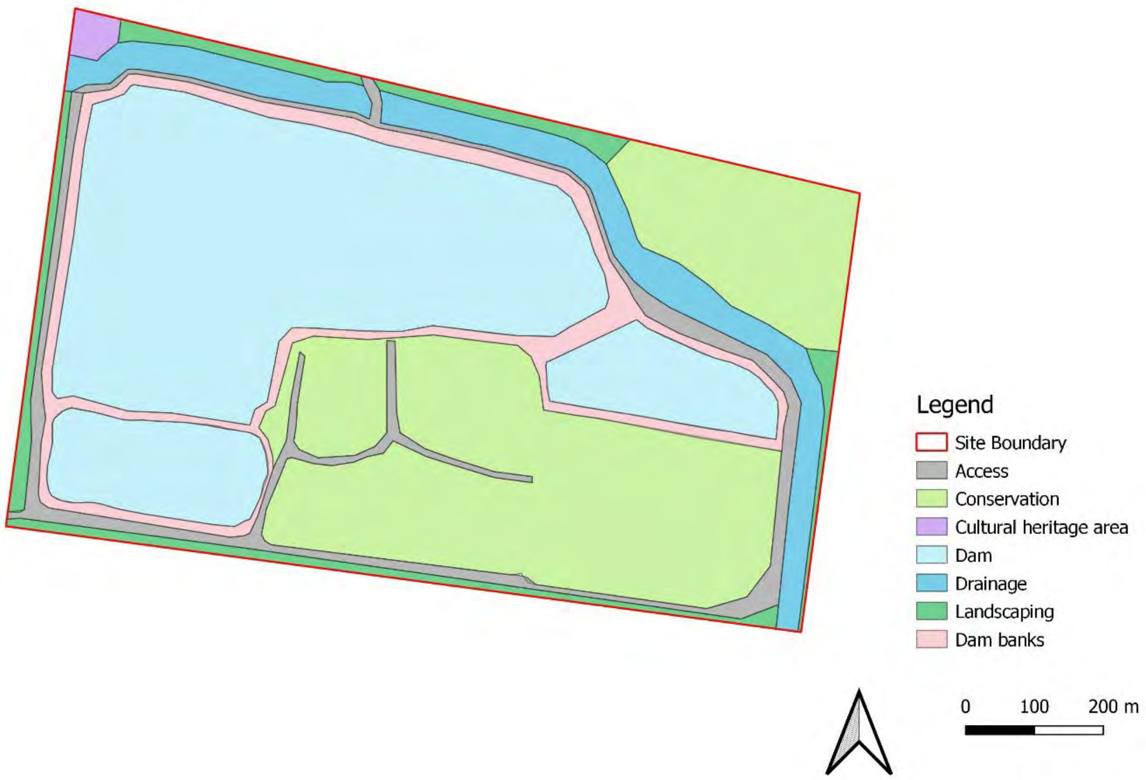
The phasing will be as follows:

- The current underground power supply will be relocated to align with the current Access Road. Thereafter the area north of the existing waterway and east of the existing Access Road will be excavated. At the same time, the existing eastern and western extraction area will extend north and / or to increased depths.
- The excavated area north of the existing waterway and east of the current Access Road will be reinstated to the agreed geotechnical specification, and the Access Road / power lines relocated to the east over the reinstated area.
- The area to the north of the existing waterway and west of the relocated Access Road will be excavated and reinstated to the agreed geotechnical specification. Excavations from the existing eastern and western extraction areas will continue to extend north and / or to increased depths.
- When the proposed area for the realigned waterway has been completed, the new waterway will be constructed, and the existing waterway diverted to the proposed alignment. Extraction from the eastern and western areas will then proceed to the final extent and depths.
- Concurrent with the above, the northern wall of the current western pit (shown as Stages 10-13 in **Figure A-7**) will be reinstated and this dam used for the storage of fines. If required, the dam to the south of this (shown as stages 5 to 9 on **Figure A-6** will also be used for storage of fines. The final form of these two dams (reinstated or pit lakes) will be subject to the amount of fines recovered.
- The final extraction stage will include removal of the existing processing plant, and excavation of this area with off-site processing. This will be to nominally 9mAHD using dry excavation techniques.

The extent of excavation (terminal landform) and rehabilitation concepts are shown in **Figure A-8, A-9.**

Figure A-8 Terminal Landform

Figure A-9 Rehabilitation Concept



Appendix B Bore logs

Sect 2/

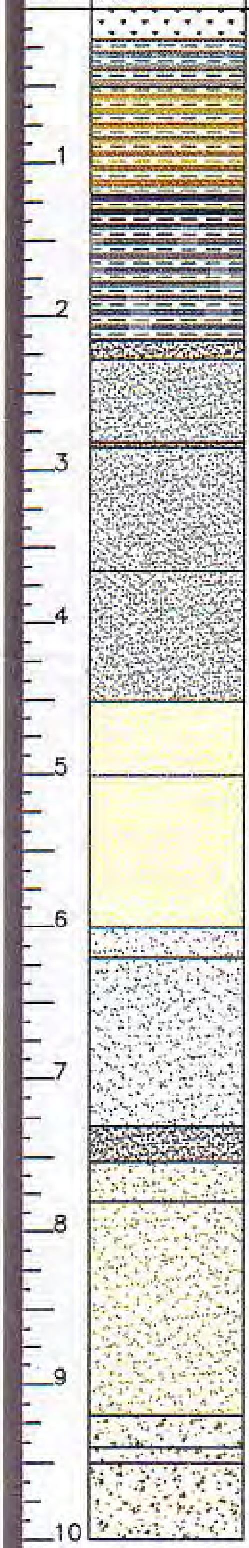
PIONEER CONCRETE (VIC) PTY LTD

GRAPHIC DRILL LOG

HOLE: LL1
PROJECT: BULACH SAND

LOCATION: 380556,5765196
DRILLED: STATEWIDE DRILLING
LOGGED: P BROWNE 15/5/97

DPH LOG DESCRIPTION



BLACK SUB SOIL

LIGHT GREY CLAY

YELLOW BROWN SANDY CLAY

GREY CLAY

DARK GREY CLAY

GREY AND BROWN CLAY

BLACK & CHOC BROWN VERY FINE SAND

GREY CLAY & VERY FINE SAND

BLACK VERY FINE SAND

GREY CLAY & VERY FINE SAND

GREY VERY FINE SAND

WHITE AND YELLOW BROWN FINE SAND CONSOLIDATED

WHITE & YELLOW FINE SAND CONSOLIDATED

DARK GREY FINE SAND

VERY DARK GREY FINE SAND

WHITE VERY FINE SAND

GREY AND BROWN FINE SAND

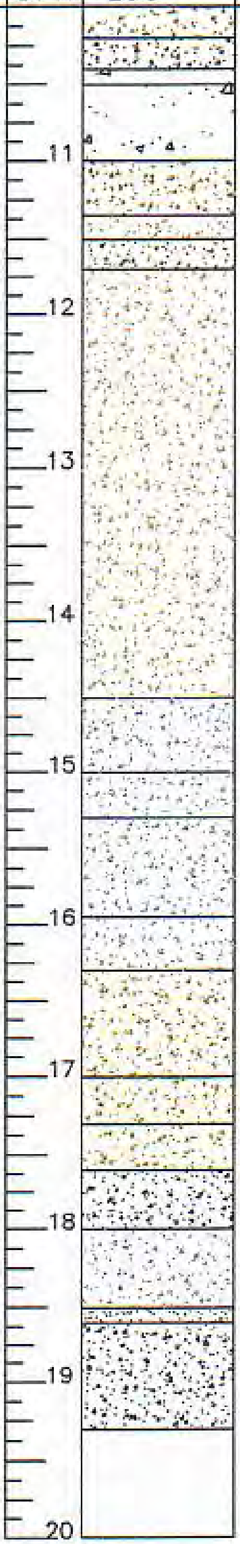
DARK BROWN FINE SAND CONSOLIDATED

DARK CHOC BROWN MEDIUM SAND

DARK CHOCOLATE BROWN MEDIUM SAND

DARK CHOC BROWN MEDIUM TO COARSE SAND UNCONSOLIDATED

DPH LOG DESCRIPTION



BROWN MEDIUM TO COARSE SAND

LIGHT BROWN MEDIUM SAND

BLACK AND WHITE MEDIUM TO COARSE SAND

WHITE MEDIUM TO COARSE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

RED BROWN MEDIUM SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

LIGHT BROWN MEDIUM SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

DARK BROWN MEDIUM SAND UNCONSOLIDATED WITH ROUNDED QUARTZ VERY WET

LIGHT BROWN MEDIUM TO FINE SAND LOOSELY CONSOLIDATED WITH LITTLE FINES

OFF WHITE MEDIUM SAND LOOSLY CONSOLIDATED

OFF WHITE MEDIUM SAND LOOSLY CONSOLIDATED WITH ROUNDED QUARTZ

OFF WHITE MEDIUM SAND UNCONSOLIDATED

OFF WHITE MEDIUM SAND LOOSLY CONSOLIDATED WITH ROUNDED QUARTZ

BROWN & OFF WHITE MEDIUM SAND CONSOLIDATED WITH ROUNDED QUARTZ

BROWN & OFF WHITE MEDIUM SAND LOOSLY CONSOLIDATED ROUNDED QUARTZ

BROWN & OFF WHITE MEDIUM TO COARSE SAND LOOSLY CONSOLIDATED ROUNDED QUARTZ

WHITE MEDUIM SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

OFF WHITE MEDIUM SAND LOOSLY CONSOLIDATED

BLACK OILY FINE SAND WITH ROUNDED QUARTZ

WHITE UNCONSOLIDATED MEDIUM TO FINE SAND

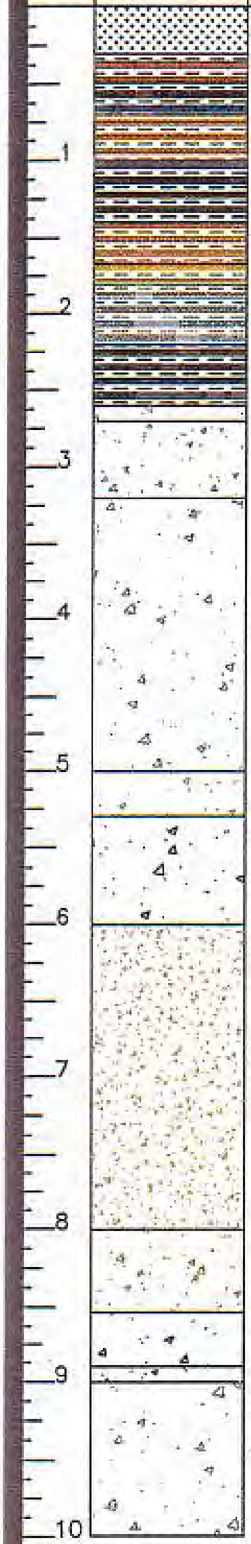
PIONEER CONCRETE (VIC) PTY LTD

GRAPHIC DRILL LOG

HOLE: LL2
PROJECT: BULACH SAND

LOCATION: 380790,5765184
DRILLED: STATEWIDE DRILLING
LOGGED: P BROWNE 15/5/97

DPH LOG DESCRIPTION



BLACK SUB SOIL

RED BROWN COARSE SAND & CLAY
DARK BROWN COARSE SAND & CLAY
WHITE BROWN CLAY AND MEDIUM SAND

WHITE & LIGHT BROWN CLAY

WHITE CLAYEY FINE SAND

BROWN CLAYEY FINE SAND

YELLOW – BROWN CLAYEY FINE SAND

OFF WHITE CLAY & FINE SAND

WHITE CLAY AND FINE SAND

OFF WHITE UNCONSOLIDATED ROUNDED COARSE SAND

OFF WHITE UNCONSOLIDATED MEDIUM TO COARSE ROUNDED SAND

OFF WHITE COARSE SAND WITH ROUNDED QUARTZ GRIANS TO 4 MM

WHITE & BROWN MEDIUM TO COARSE SAND UNCONSOLIDATED 10MM ROUNDED QUARTZ

OFF WHITE COARSE SAND WITH ROUNDED GRAINS TO 10MM UNCONSOLIDATED

BROWN AND WHITE MEDIUM SAND GRAINS UP TO 2MM AND ROUNDED

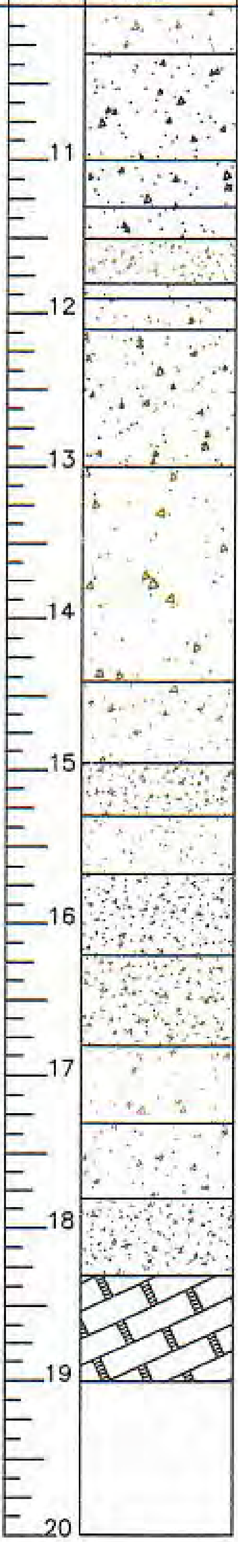
LIGHT BROWN MEDIUM TO COARSE SAND UNCONSOLIDATED WITH ROUNDED GRAINS TO 4MM

WHITE COARSE SAND UNCONSOLIDATED SUB ANGULAR QUARTZ

OFF WHITE MEDIUM TO COARSE SAND UNCONSOLIDATED SUB ANGULAR TO ROUNDED QUARTZ TO 3MM

OFF WHITE ROUNDED COARSE SAND

DPH LOG DESCRIPTION



CHOCOLATE BROWN MEDIUM TO COARSE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

WHITE MEDIUM TO COARSE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

WHITE MEDIUM TO COARSE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

WHITE MEDIUM TO COARSE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ
LIGHT BROWN COARSE TO FINE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ
OFF WHITE COARSE SAND UNCONSOLIDATED ROUNDED QUARTZ
DARK BROWN MEDIUM TO COARSE SAND UNCONSOLIDATED ROUNDED QUARTZ

DARK BROWN MEDIUM TO COARSE SAND UNCONSOLIDATED ROUNDED QUARTZ TO 2.5 mm

RED BROWN COARSE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ TO 3mm

LIGHT BROWN COARSE TO MEDIUM SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

LIGHT BROWN MEDIUM TO FINE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

LIGHT BROWN FINE SAND

OFF WHITE MEDIUM TO FINE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ TO 1.5mm

LIGHT BROWN MEDIUM TO FINE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

DARK BROWN MEDIUM TO COARSE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ TO 2mm

OFF WHITE MEDIUM TO COARSE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ TO 2.5mm

OFF WHITE MEDIUM SAND UNCONSOLIDATED WITH ROUNDED QUARTZ TO 2mm

COAL

PIONEER CONCRETE (VIC) PTY LTD

GRAPHIC DRILL LOG

HOLE: LL3
PROJECT: BULACH SAND

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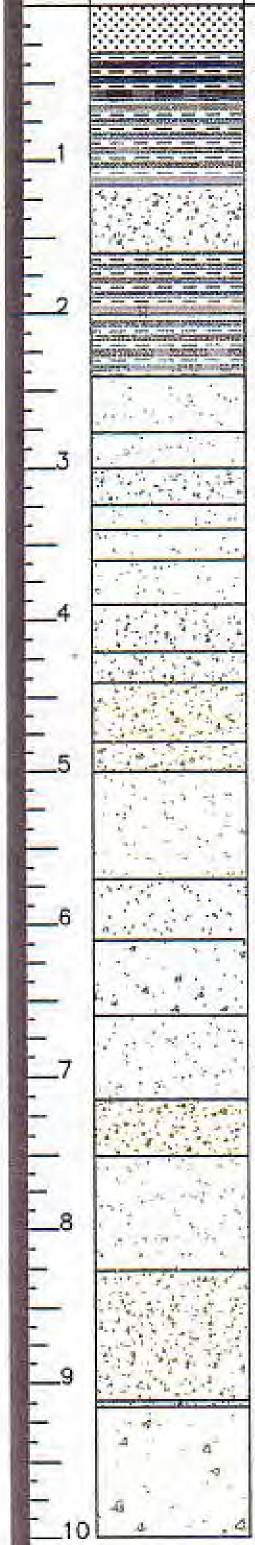
DRILLED: STATEWIDE DRILLING
LOGGED: P BROWNE 20/5/97

DPH | LOG | DESCRIPTION



BLACK SUB SOIL

BLACK CLAY

GREY CLAY

GREY CLAY

GREY CONSOLIDATED MEDIUM SAND ROUNDED QUARTZ

GREY CLAY & MEDIUM CONSOLIDATED SAND

GREY CLAY & FINE TO MEDIUM SAND

GREY CONSOLIDATED FINE SAND

GREY LOOSLEY CONSOLIDATED FINE SAND

GREY LOOSLEY CONSOLIDATED MEDIUM TO COARSE SAND

GREY CONSOLIDATED FINE ROUNDED SAND

GREY CONSOLIDATED FINE TO COARSE ROUNDED SAND

GREY CONSOLIDATED FINE ROUNDED SAND

GREY FINE TO MEDIUM SAND AND CLAY WITH ROUNDED QUARTZ GRAINS

GREY CLAYEY FINE SAND

YELLOW BROWN MEDUIM SAND UNCONSOLIDATED ROUNDED QUARTZ TO 2mm

LIGHT BROWN MEDIUM SAND UNCONSOLIDATED

LIGHT YELLOW/ BROWN FINE SAND UNCONSOLIDATED ROUNDED QUARTZ

OFF WHITE FINE SAND WITH ROUNDED GRAINS UNCONSOLIDATED

GREY MEDIUM TO COARSE SAND WITH ROUNDED GRAINS TO 2mm UNCONSOLIDATED

GREY FINE TO MEDIUM SAND UNCONSOLIDATED

YELLOW/BROWN MEDIUM SAND UNCONSOLIDATED ROUNDED QUARTZ TO 1.8mm

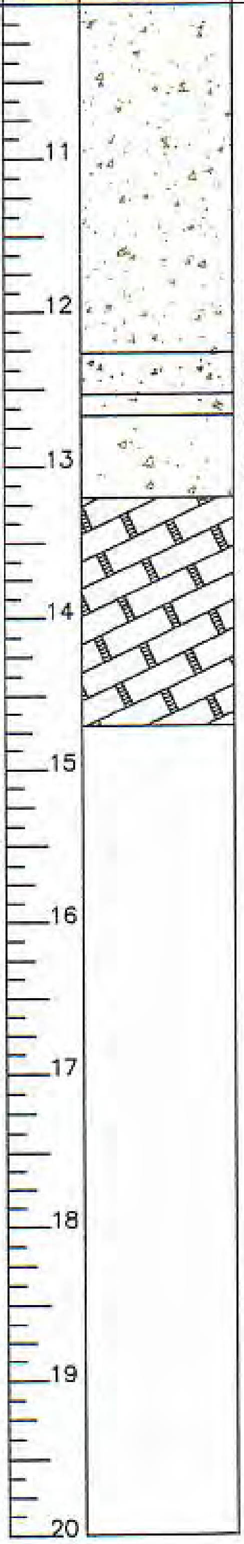
LIGHT BROWN FINE SAND UNCONSOLIDATED

LIGHT BROWN FINE TO MEDIUM SAND UNCONSOLIDATED

LIGHT BROWN MEDIUM SAND UNCONSOLIDATED

WET LIGHT BROWN COARSE SAND UNCONSOLIDATED ROUNDED QUARTZ TO 3mm

DPH | LOG | DESCRIPTION



LIGHT BROWN MEDIUM TO COARSE SAND UNCONSOLIDATED WITH ROUNDED WHITE QUARTZ TO 3mm

DARK BROWN COARSE TO MEDIUM SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

LIGHT BROWN COARSE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ TO 2mm

LIGHT BROWN MEDIUM TO COARSE SAND CONSOLIDATED WITH ROUNDED QUARTZ

COAL

PIONEER CONCRETE (VIC) PTY LTD

GRAPHIC DRILL LOG

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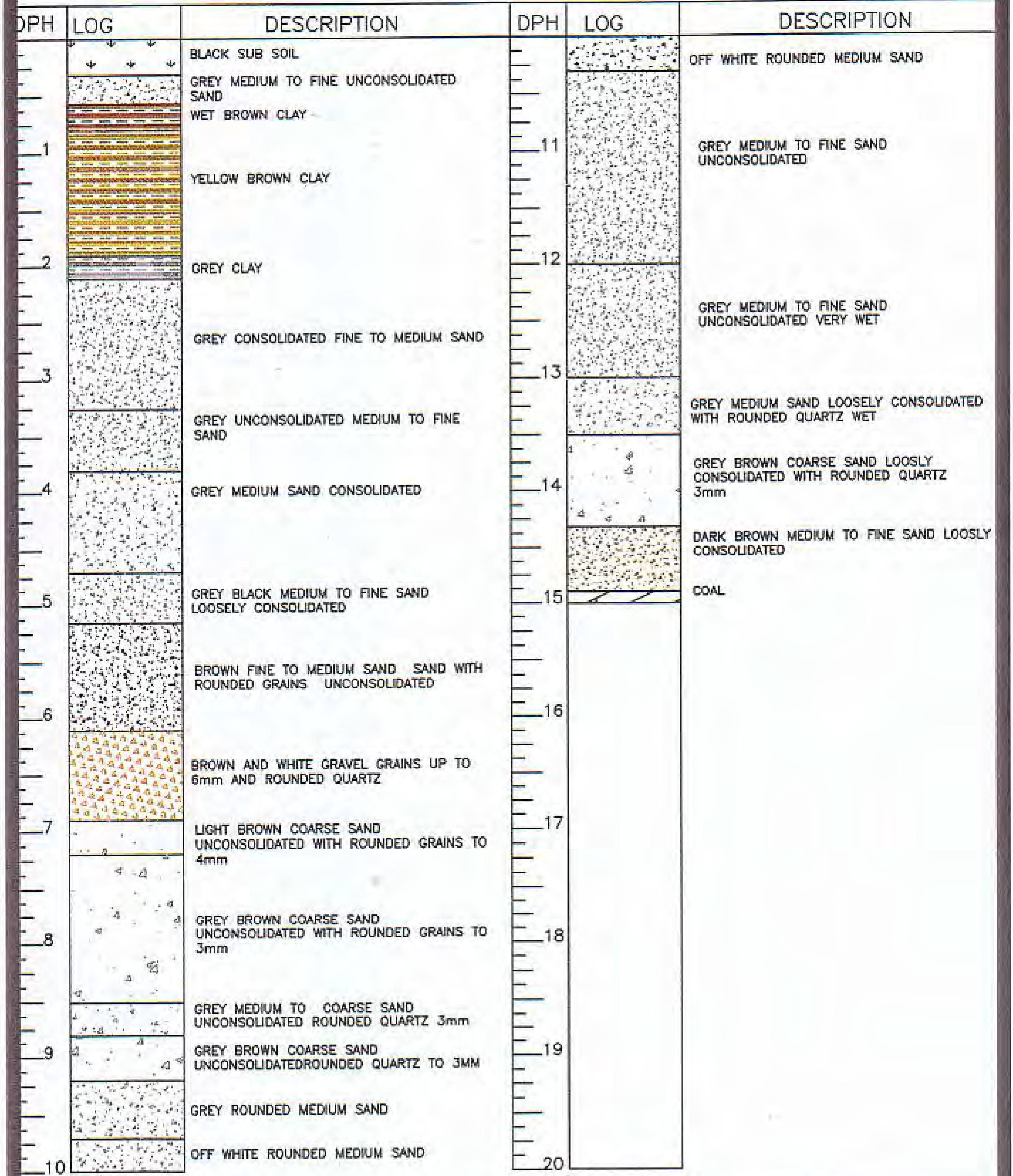
PROJECT: BULACH SAND
LOCATION: 380634,5765117
DRILLED: STATEWIDE DRILLING
LOGGED: P BROWNE 20/5/97



DESCRIPTION

BLACK SUB SOIL

GREY MEDIUM TO FINE UNCONSOLIDATED SAND

WET BROWN CLAY

YELLOW BROWN CLAY

GREY CLAY

GREY CONSOLIDATED FINE TO MEDIUM SAND

GREY UNCONSOLIDATED MEDIUM TO FINE SAND

GREY MEDIUM SAND CONSOLIDATED

GREY BLACK MEDIUM TO FINE SAND LOOSELY CONSOLIDATED

BROWN FINE TO MEDIUM SAND SAND WITH ROUNDED GRAINS UNCONSOLIDATED

BROWN AND WHITE GRAVEL GRAINS UP TO 6mm AND ROUNDED QUARTZ

LIGHT BROWN COARSE SAND UNCONSOLIDATED WITH ROUNDED GRAINS TO 4mm

GREY BROWN COARSE SAND UNCONSOLIDATED WITH ROUNDED GRAINS TO 3mm

GREY MEDIUM TO COARSE SAND UNCONSOLIDATED ROUNDED QUARTZ 3mm

GREY BROWN COARSE SAND UNCONSOLIDATEDROUNDED QUARTZ TO 3MM

GREY ROUNDED MEDIUM SAND

OFF WHITE ROUNDED MEDIUM SAND

DESCRIPTION

OFF WHITE ROUNDED MEDIUM SAND

GREY MEDIUM TO FINE SAND UNCONSOLIDATED

GREY MEDIUM TO FINE SAND UNCONSOLIDATED VERY WET

GREY MEDIUM SAND LOOSELY CONSOLIDATED WITH ROUNDED QUARTZ WET

GREY BROWN COARSE SAND LOOSLY CONSOLIDATED WITH ROUNDED QUARTZ 3mm

DARK BROWN MEDIUM TO FINE SAND LOOSLY CONSOLIDATED

COAL

PIONEER CONCRETE (VIC) PTY LTD

GRAPHIC DRILL LOG

HOLE: LL5
PROJECT: BULACH SAND
PAGE 1 OF 2

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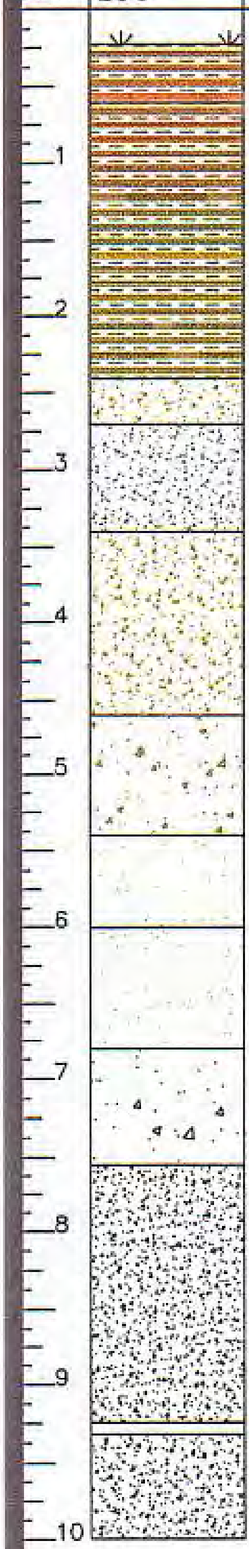
LOGGED: P BROWNE 27/5/97

DPH	LOG	DESCRIPTION



BLACK SUB SOIL

BROWN CLAY

CHOCOLATE BROWN CLAY

BROWN CLAY

GREY AND RED/ BROWN CLAY & COARSE SAND

YELLOW/BROWN CONSOLIDATED ROUNDED MEDIUM SAND

OFF WHITE LOOSLEY CONSOLIDATED MEDIUM TO FINE ROUNDED SAND

YELLOW/BROWN MEDIUM SAND WITH ROUNDED QUARTZ

RED/BROWN MEDIUM SAND LOOSLEY CONSOLIDATED ROUNDED QUARTZ

CREAM CONSOLIDATED FINE SAND

CREAM AND OFF WHITE FINE SAND CONSOLIDATED

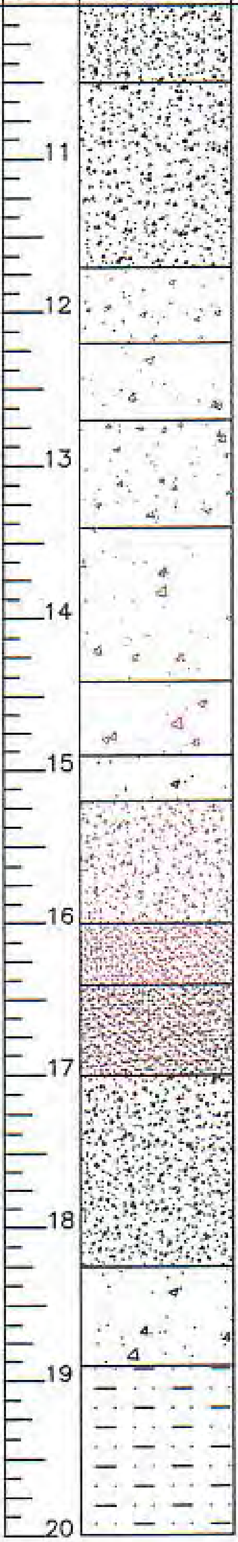
WHITE MEDIUM COARSE SAND GRAINS UP TO 2MM AND ROUNDED

WHITE FINE TO MEDIUM SAND UNCONSOLIDATED ROUNDED QUARTZ

RED/BROWN UNCONSOLIDATED FINE TO MEDIUM SAND

WHITE UNCONSOLIDATED FINE TO MEDIUM SAND

DPH	LOG	DESCRIPTION



WHITE UNCONSOLIDATED FINE TO MEDIUM SAND

WHITE MEDIUM SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

OFF WHITE MEDIUM TO COARSE SAND UNCONSOLIDATED WITH ROUNDED WHITE QUARTZ

OFF WHITE COARSE TO FINE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

OFF WHITE MEDIUM TO COARSE SAND LOOSELY CONSOLIDATED WITH ROUNDED QUARTZ

LIGHT BROWN COARSE SAND LOOSLY CONSOLIDATED WITH ROUNDED QUARTZ

LIGHT VOILET COARSE SAND LOOSLY CONSOLIDATED WITH ROUNDED QUARTZ

YELLOW BROWN COARSE SAND LOOSLY CONSOLIDATED WITH SUB ANGULAR QUARTZ

LIGHT VOLILET FINE TO MEDIUM SAND WITH ROUNDED QUARTZ

LIGHT VOILET VERY FINE SAND WET

BLACK AND VOILET VERY FINE SAND WET

TWO SIZED SAND FINE AND COARSE PARTLY CONSOLIDATED WITH ROUNDED QUARTZ

OFF WHITE COARSE SAND LOOSLY CONSOLIDATED WITH ROUNDED QUARTZ

BLACK SILT

PIONEER CONCRETE (VIC) PTY LTD

GRAPHIC DRILL LOG

HOLE: LL5
PROJECT: BULACH SAND
PAGE 2 OF 2

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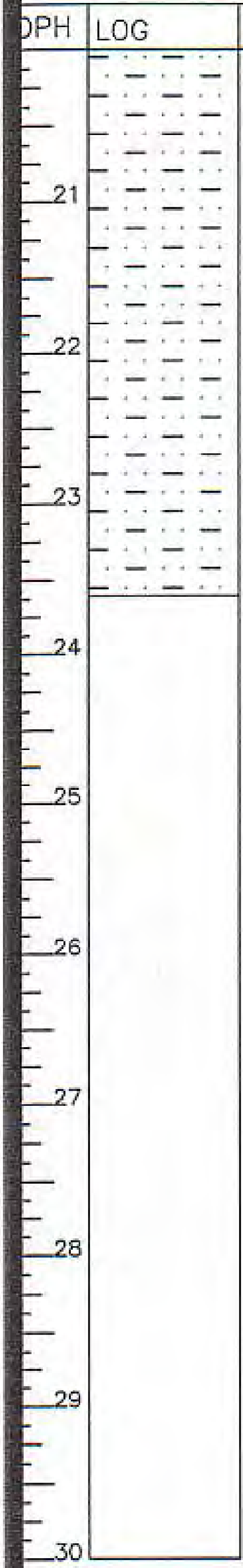
DRILLED: STATEWIDE DRILLING
LOGGED: P BROWNE 20/5/97

DPH | LOG | DESCRIPTION



BLACK SILT

DPH | LOG | DESCRIPTION

31
32
33
34
35
36
37
38
39
40

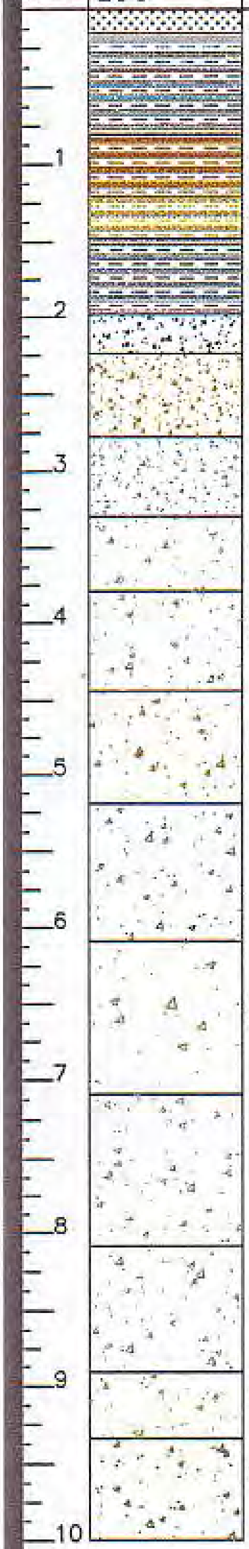
PIONEER CONCRETE (VIC) PTY LTD

GRAPHIC DRILL LOG

HOLE: LL6
PROJECT: BULACH SAND

LOCATION 380171,5765162
DRILLED: STATEWIDE DRILLING
LOGGED: P BROWNE 27/5/97

PH LOG DESCRIPTION



BLACK SUB SOIL

GREY COARSE SAND & CLAY

BROWN CLAY AND MEDIUM SAND

YELLOW BROWN CLAYEY MEDIUM SAND

GREY CLAY

WHITE CONSOLIDATED MEDIUM SAND

RED BROWN LOOSELY CONSOLIDATED MEDIUM SAND

OFF WHITE UNCONSOLIDATED MEDIUM ROUNDED SAND

OFF WHITE CONSOLIDATED ROUNDED FINE TO MEDIUM SAND

OFF WHITE FINE TO MEDIUM SAND WITH ROUNDED QUARTZ

BROWN MEDIUM SAND UNCONSOLIDATED

OFF WHITE MEDIUM SAND WITH ROUNDED GRAINS UNCONSOLIDATED

BROWN AND OFF WHITE MEDIUM TO COARSE SAND GRAINS UP TO 2MM AND ROUNDED

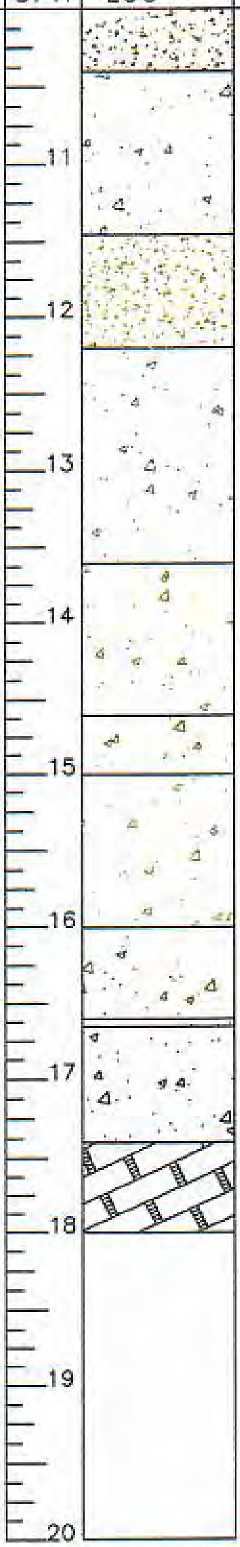
OFF WHITE MEDIUM TO COARSE SAND UNCONSOLIDATED

OFF WHITE MEDIUM TO COARSE SAND UNCONSOLIDATED ROUNDED QUARTZ

OLIVE BROWN MEDIUM TO COARSE SAND UNCONSOLIDATED ROUNDED QUARTZ

DARK BROWN ROUNDED MEDIUM SAND

DPH LOG DESCRIPTION



DARK BROWN ROUNDED MEDIUM SAND

DARK OFF WHITE MEDIUM TO FINE SAND UNCONSOLIDATED WITH ROUNDED WHITE QUARTZ

TAN MEDIUM TO FINE SAND UNCONSOLIDATED WITH ROUNDED WHITE QUARTZ

OFF WHITE COARSE TO MEDIUM SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

LIGHT BROWN COARSE SAND LOOSLY CONSOLIDATED WITH ROUNDED QUARTZ TO 4mm

BROWN COARSE SAND LOOSLY CONSOLIDATED WITH ROUNDED QUARTZ

BROWN AND OFF WHITE COARSE SAND WITH ROUNDED QUARTZ

DARK BROWN COARSE SAND LOOSLY CONSOLIDATED WITH ROUNDED QUARTZ OILY

BLACK OILY FINE SAND

BLACK OILY COARSE SAND LOOSLY CONSOLIDATED WITH ROUNDED QUARTZ

BLACK SILT

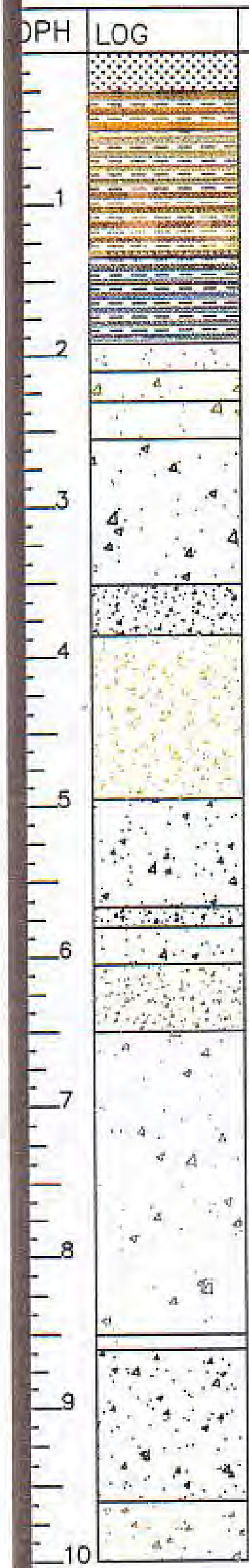
PIONEER CONCRETE (VIC) PTY LTD

GRAPHIC DRILL LOG

HOLE: LL7
PROJECT: BULACH SAND

LOCATION: 380310,5765167
DRILLED: STATEWIDE DRILLING
LOGGED: P BROWNE 27/5/97

DPH | LOG | DESCRIPTION



BLACK SUB SOIL

RED BROWN CLAYEY FINE SAND

BROWN CLAY

GREY CLAY

CHOCOLATE BROWN CLAYEY CONSOLIDATED FINE SAND

YELLOW BROWN CONSOLIDATED COARSE SAND

RED BROWN CONSOLIDATED ROUNDED COARSE SAND

OFF WHITE CONSOLIDATED COARSE ROUNDED SAND

OFF WHITE FINE TO MEDIUM SAND WITH ROUNDED QUARTZ

CREAM MEDIUM TO FINE SAND CONSOLIDATED WITH ROUNDED QUARTZ

OFF WHITE MEDIUM TO COARSE SAND UNCONSOLIDATED ROUNDED QUARTZ

YELLOW BROWN MEDIUM SAND WITH ROUNDED GRAINS UNCONSOLIDATED

OFF WHITE MEDIUM TO COARSE SAND LOOSLEY CONSOLIDATED

YELLOW BROWN MEDIUM SAND ROUNDED

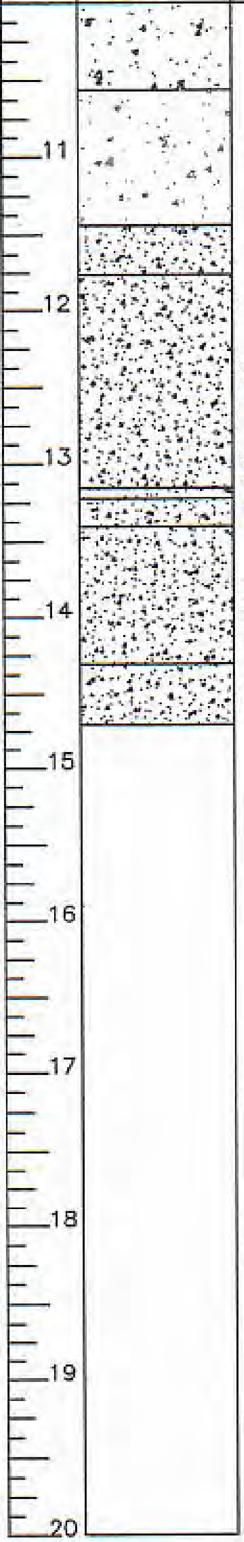
OFF WHITE COARSE SAND UNCONSOLIDATED WITH ROUNDED GRAINS

YELLOW BROWN COARSE SAND UNCONSOLIDATED ROUNDED QUARTZ

OFF WHITE MEDIUM TO COARSE SAND UNCONSOLIDATED ROUNDED QUARTZ TO 3mm

WHITE & BROWN MEDIUM TO COARSE SAND UNCONSOLIDATED WITH ROUNDED WHITE QUARTZ

DPH | LOG | DESCRIPTION



WHITE & BROWN MEDIUM TO COARSE SAND UNCONSOLIDATED WITH ROUNDED WHITE QUARTZ

OFF WHITE MEDIUM TO COARSE SAND UNCONSOLIDATED WITH ROUNDED WHITE QUARTZ TO 2mm

WHITE MEDIUM SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

OFF WHITE MEDIUM SAND UNCONSOLIDATED WITH ROUNDED QUARTZ TO 2mm

OFF WHITE MEDIUM SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

YELLOW & OFF WHITE MEDIUM SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

OFF WHITE MEDIUM SAND LOOSELY CONSOLIDATED WITH ROUNDED QUARTZ

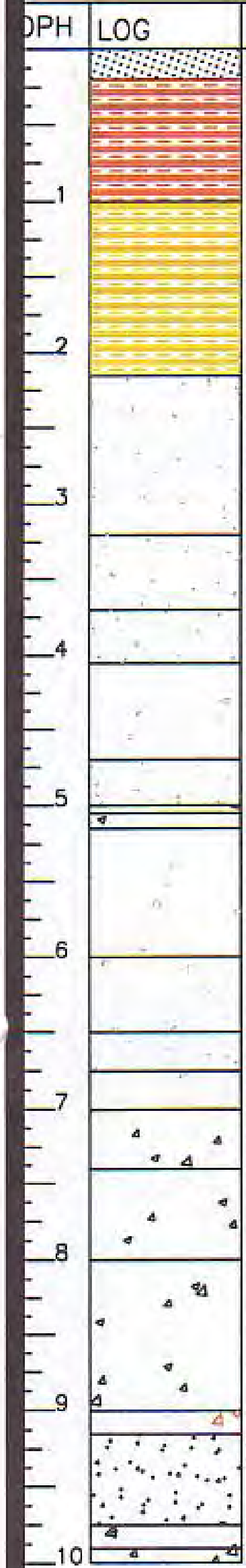
YELLOW BROWN MEDIUM SAND LOOSLY CONSOLIDATED WITH ROUNDED QUARTZ

PIONEER CONCRETE (VIC) PTY LTD

GRAPHIC DRILL LOG

HOLE: LL8
PROJECT: YANNATHAN

LOCATION: 380226,5764844
DRILLED: STATEWIDE DRILLING
LOGGED: P BROWNE 17/7/98



DESCRIPTION

BLACK TOP SOIL

DARK BROWN CLAY

GREY BROWN CLAY

GREY CLAYEY ROUNDED CONSOLIDATED MEDIUM FINE SAND

GREY CLAYEY FINE TO MEDIUM SAND WITH ROUNDED QUARTZ

GREY WET MEDIUM SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

GREY MEDIUM TO COARSE SAND UNCONSOLIDATED ROUNDED QUARTZ

GREY MEDIUM CONSOLIDATED CLAYEY SAND ROUNDED

OFF WHITE CLAYEY COARSE SAND

WHITE CONSOLIDATED COARSE SAND WITH CLAY

OFF WHITE COARSE SAND WITH ROUNDED GRAINS CONSOLIDATED & CLAY

GREY BROWN MEDIUM TO COARSE SAND LOOSLEY CONSOLIDATED, CLAYEY

GREY MEDIUM SAND CONSOLIDATED WITH ROUNDED GRAINS

GREY COARSE SAND SEMI-CONSOLIDATED ROUNDED QUARTZ

WHITE COARSE SAND UNCONSOLIDATED ROUNDED QUARTZ TO 2mm

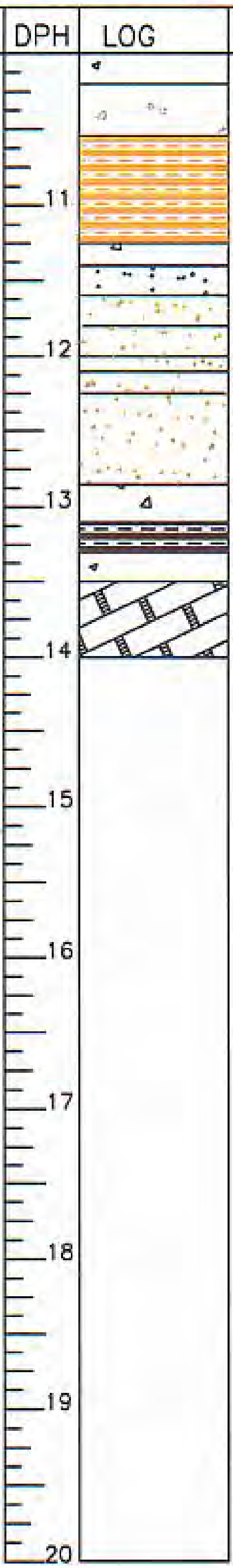
WHITE & RED COARSE SAND UNCONSOLIDATED WITH ROUNDED WHITE QUARTZ

OFF WHITE & RED COARSE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

RED/BROWN COARSE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

WHITE MEDIUM TO COARSE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

DARK GREY VERY COARSE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ



DESCRIPTION

WET WHITE & BROWN VERY COARSE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

GREY/BROWN COARSE SAND UNCONSOLIDATED WITH ROUNDED WHITE QUARTZ TO 3mm

BROWN CLAY

GREY BROWN MEDIUM TO COARSE SAND UNCONSOLIDATED

OFF WHITE MEDIUM SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

DARK BROWN MEDIUM SAND CONSOLIDATED

DARK BROWN MEDIUM SAND SEMI-CONSOLIDATED

DARK BROWN MEDIUM SAND CONSOLIDATED

GREY BROWN MEDIUM SAND UNCONSOLIDATED

DARK BROWN MEDIUM SAND SEMI-CONSOLIDATED

BROWN COARSE SAND CONSOLIDATED

BLACK CLAY

DARK BROWN CONSOLIDATED FINE SAND

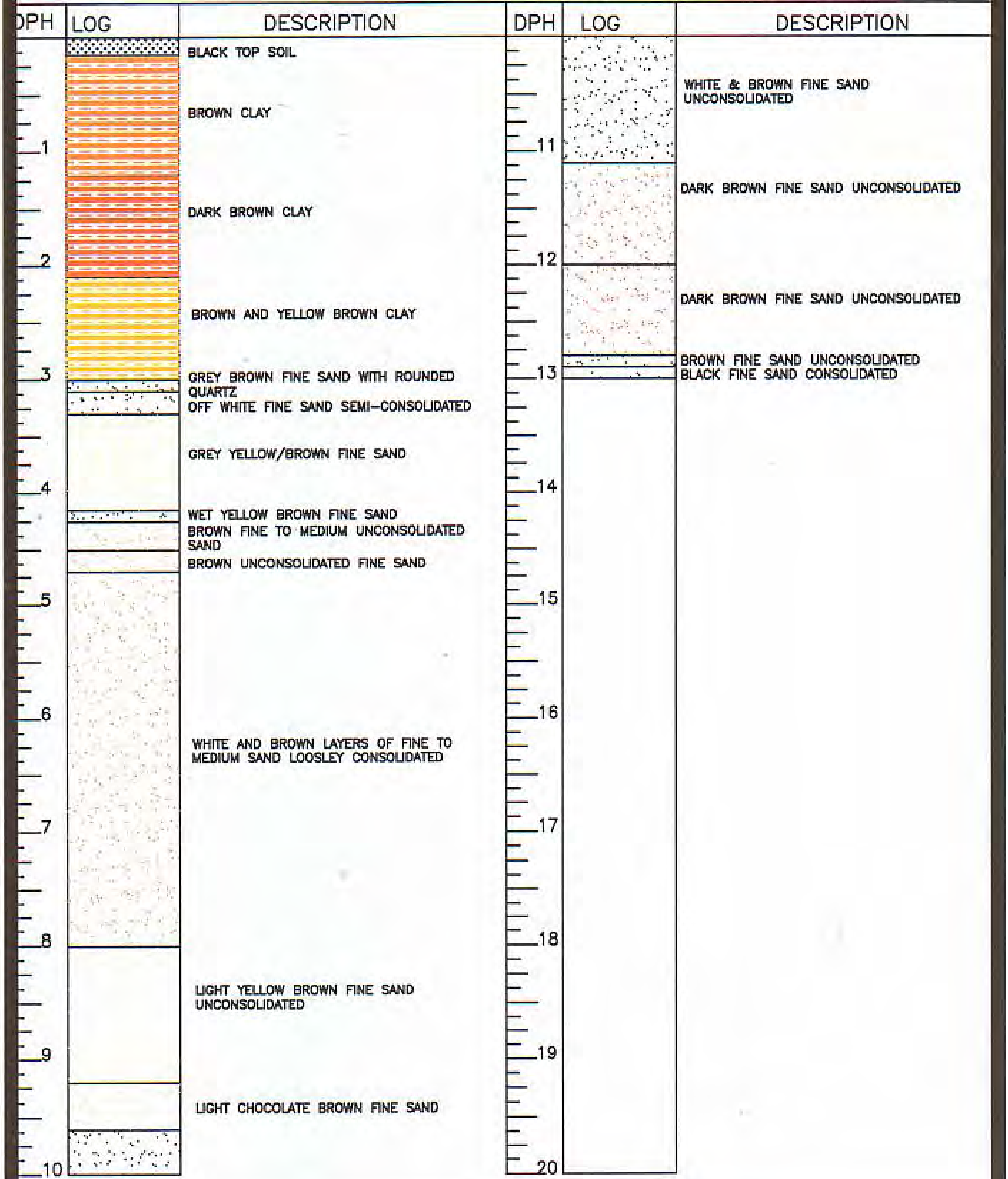
COAL

PIONEER CONCRETE (VIC) PTY LTD

GRAPHIC DRILL LOG

HOLE: LL9
PROJECT: YANNATHAN

LOCATION: 381267,5765203
DRILLED: STATEWIDE DRILLING
LOGGED: P BROWNE 17/7/98



BLACK TOP SOIL

BROWN CLAY

DARK BROWN CLAY

BROWN AND YELLOW BROWN CLAY

GREY BROWN FINE SAND WITH ROUNDED QUARTZ

OFF WHITE FINE SAND SEMI-CONSOLIDATED

GREY YELLOW/BROWN FINE SAND

WET YELLOW BROWN FINE SAND

BROWN FINE TO MEDIUM UNCONSOLIDATED SAND

BROWN UNCONSOLIDATED FINE SAND

WHITE AND BROWN LAYERS OF FINE TO MEDIUM SAND LOOSLEY CONSOLIDATED

LIGHT YELLOW BROWN FINE SAND UNCONSOLIDATED

LIGHT CHOCOLATE BROWN FINE SAND

WHITE & BROWN FINE SAND UNCONSOLIDATED

DARK BROWN FINE SAND UNCONSOLIDATED

DARK BROWN FINE SAND UNCONSOLIDATED

BROWN FINE SAND UNCONSOLIDATED

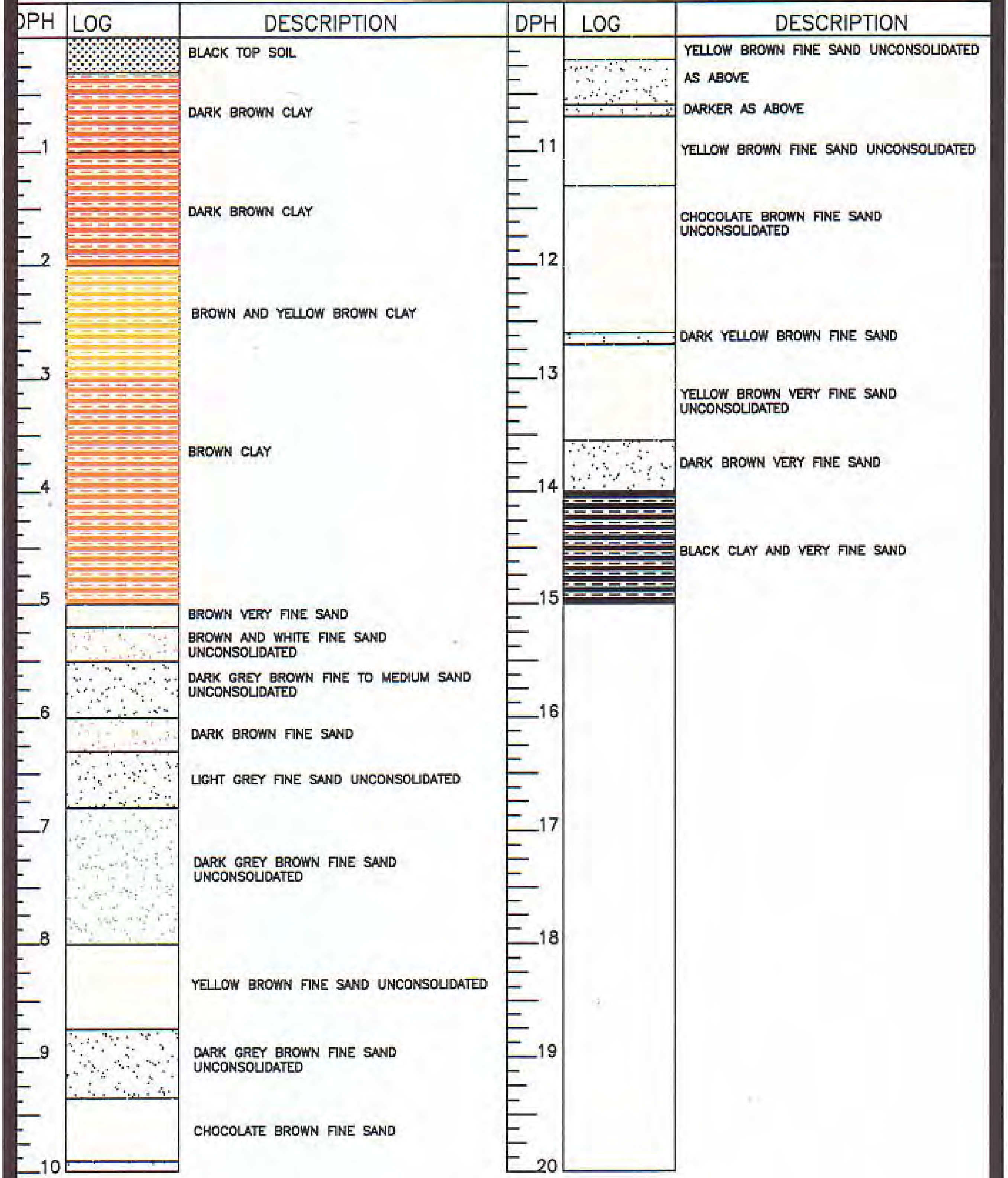
BLACK FINE SAND CONSOLIDATED

PIONEER CONCRETE (VIC) PTY LTD

GRAPHIC DRILL LOG

HOLE: LL10
PROJECT: YANNATHAN

LOCATION: 381088,5765251
DRILLED: STATEWIDE DRILLING
LOGGED: P BROWNE 17/7/98



BLACK TOP SOIL
DARK BROWN CLAY
DARK BROWN CLAY
BROWN AND YELLOW BROWN CLAY
BROWN CLAY
BROWN VERY FINE SAND
BROWN AND WHITE FINE SAND UNCONSOLIDATED
DARK GREY BROWN FINE TO MEDIUM SAND UNCONSOLIDATED
DARK BROWN FINE SAND
LIGHT GREY FINE SAND UNCONSOLIDATED
DARK GREY BROWN FINE SAND UNCONSOLIDATED
YELLOW BROWN FINE SAND UNCONSOLIDATED
DARK GREY BROWN FINE SAND UNCONSOLIDATED
CHOCOLATE BROWN FINE SAND

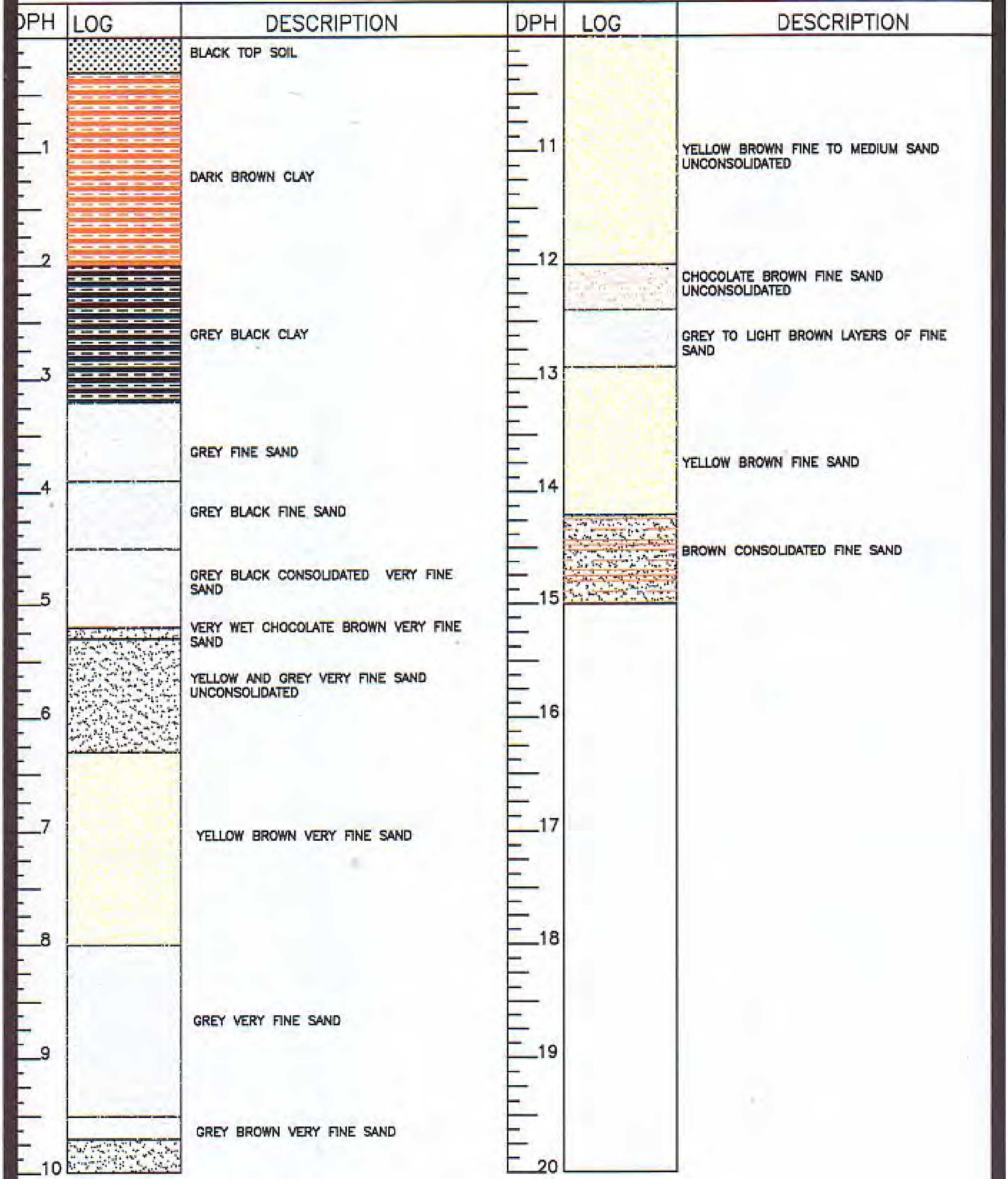
YELLOW BROWN FINE SAND UNCONSOLIDATED
AS ABOVE
DARKER AS ABOVE
YELLOW BROWN FINE SAND UNCONSOLIDATED
CHOCOLATE BROWN FINE SAND UNCONSOLIDATED
DARK YELLOW BROWN FINE SAND
YELLOW BROWN VERY FINE SAND UNCONSOLIDATED
DARK BROWN VERY FINE SAND
BLACK CLAY AND VERY FINE SAND

PIONEER CONCRETE (VIC) PTY LTD

GRAPHIC DRILL LOG

HOLE: LL11
PROJECT: YANNATHAN

LOCATION: 381056,5765102
DRILLED: STATEWIDE DRILLING
LOGGED: P BROWNE 17/7/98

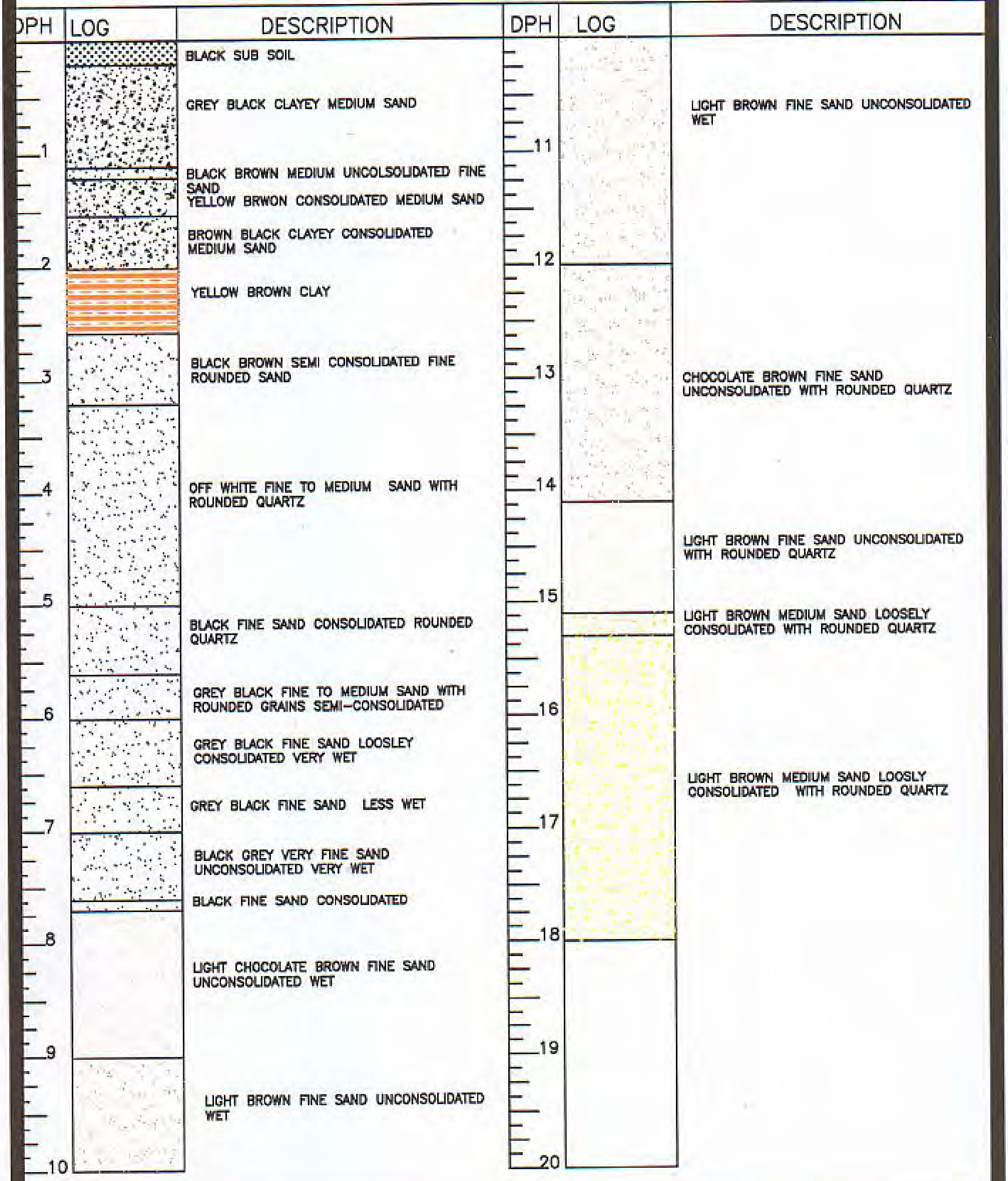


PIONEER CONCRETE (VIC) PTY LTD

GRAPHIC DRILL LOG

HOLE: LL12
PROJECT: YANNATHAN

LOCATION: 380940,5765157
DRILLED: STATEWIDE DRILLING
LOGGED: P BROWNE 27/7/98



BLACK SUB SOIL

GREY BLACK CLAYEY MEDIUM SAND

BLACK BROWN MEDIUM UNCOLSOLIDATED FINE SAND

YELLOW BRWON CONSOLIDATED MEDIUM SAND

BROWN BLACK CLAYEY CONSOLIDATED MEDIUM SAND

YELLOW BROWN CLAY

BLACK BROWN SEMI CONSOLIDATED FINE ROUNDED SAND

OFF WHITE FINE TO MEDIUM SAND WITH ROUNDED QUARTZ

BLACK FINE SAND CONSOLIDATED ROUNDED QUARTZ

GREY BLACK FINE TO MEDIUM SAND WITH ROUNDED GRAINS SEMI-CONSOLIDATED

GREY BLACK FINE SAND LOOSLEY CONSOLIDATED VERY WET

GREY BLACK FINE SAND LESS WET

BLACK GREY VERY FINE SAND UNCONSOLIDATED VERY WET

BLACK FINE SAND CONSOLIDATED

LIGHT CHOCOLATE BROWN FINE SAND UNCONSOLIDATED WET

LIGHT BROWN FINE SAND UNCONSOLIDATED WET

LIGHT BROWN FINE SAND UNCONSOLIDATED WET

CHOCOLATE BROWN FINE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

LIGHT BROWN FINE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

LIGHT BROWN MEDIUM SAND LOOSELY CONSOLIDATED WITH ROUNDED QUARTZ

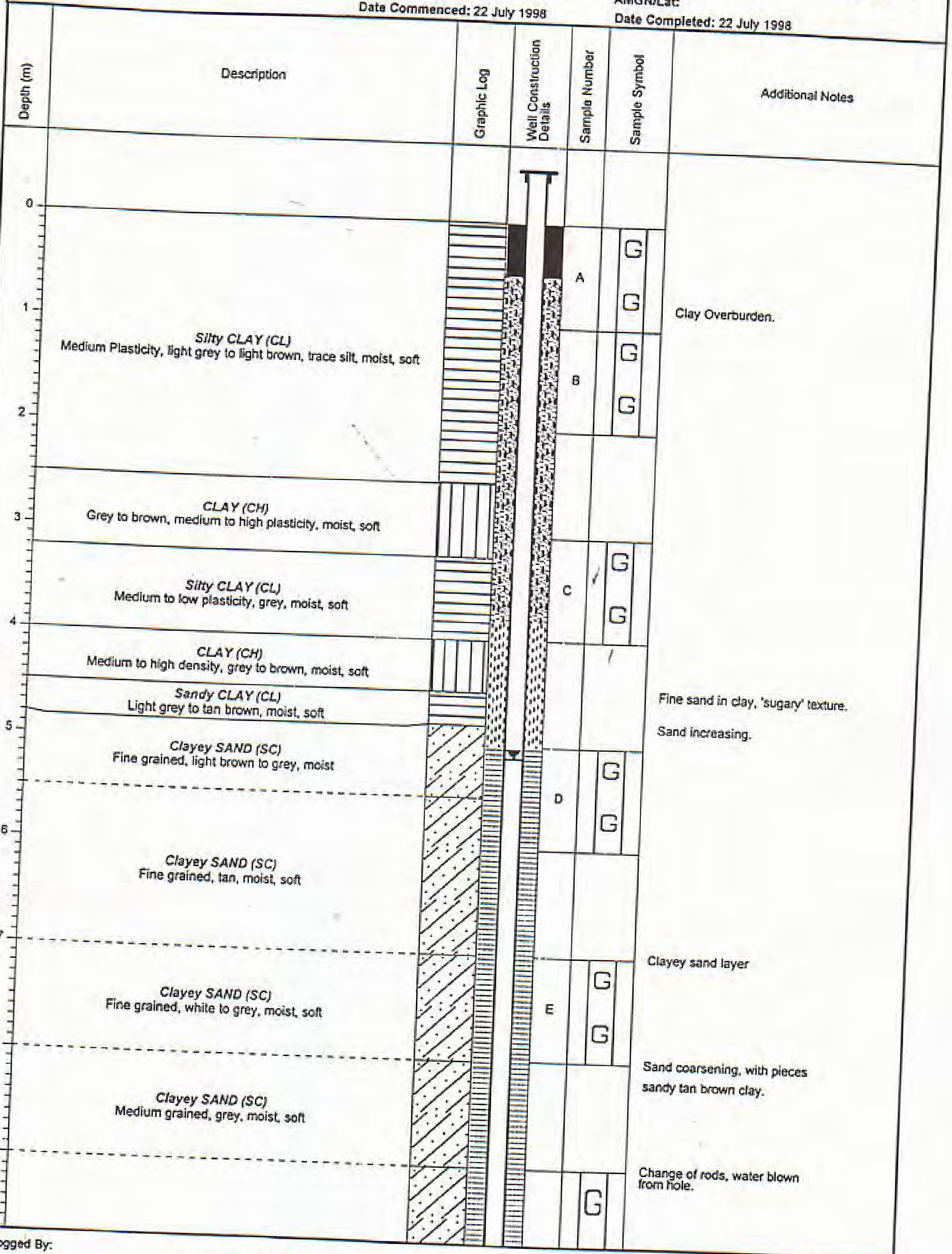
LIGHT BROWN MEDIUM SAND LOOSLY CONSOLIDATED WITH ROUNDED QUARTZ
]

Project Name: Proposed Quarry, Yannathan
Project No: 14890-031-072
Client: Pioneer Concrete Pty Ltd

Location: Yannathan, Victoria
RL Collar:
AMGE/Long:
Date Commenced: 22 July 1998

Bore Location: North west corner of site
RL Surface:
AMGN/Lat:
Date Completed: 22 July 1998

Bore: LL13



Silty CLAY (CL)
Medium Plasticity, light grey to light brown, trace silt, moist, soft

CLAY (CH)
Grey to brown, medium to high plasticity, moist, soft

Silty CLAY (CL)
Medium to low plasticity, grey, moist, soft

CLAY (CH)
Medium to high density, grey to brown, moist, soft

Sandy CLAY (CL)
Light grey to tan brown, moist, soft

Clayey SAND (SC)
Fine grained, light brown to grey, moist

Clayey SAND (SC)
Fine grained, tan, moist, soft

Clayey SAND (SC)
Fine grained, white to grey, moist, soft

Clayey SAND (SC)
Medium grained, grey, moist, soft

Clay Overburden.

Fine sand in clay, 'sugary' texture.

Sand increasing.

Clayey sand layer

Sand coarsening, with pieces sandy tan brown clay.

Change of rods, water blown from hole.

Logged By:
Approved By:
Drawn By:
Ref:

Company:
Drilling Rig:
Drilling Method:

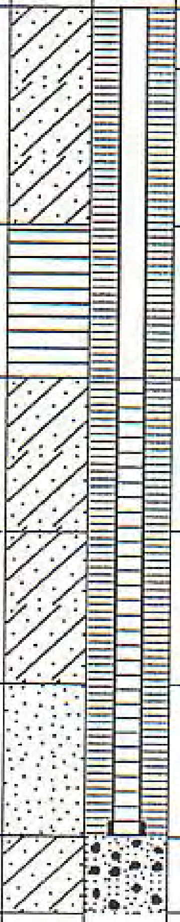
DAMES & MOORE PTY LTD

Project Name: Proposed Quarry, Yannathan
Project No: 14890-031-072
Client: Pioneer Concrete Pty Ltd

Location: Yannathan, Victoria
RL Collar:
AMGE/Long:
Date Commenced: 22 July 1998

Bore Location: North west corner of site
RL Surface:
AMGN/Lat:
Date Completed: 22 July 1998

Bore: LL13



Depth (m)	Description	Sample Number	Sample Symbol	Additional Notes
10	*Clayey SAND (SC)* Medium grained, light grey, moist to wet, soft	F	G	
11	*Sandy CLAY (CL)* Medium grained sand, light grey, wet (saturated)	G	G G	
12	*Clayey SAND (SC)* Medium to fine grained, light grey, saturated	H	G G	
13	*Clayey SAND (SC)* Medium grained, light grey to light brown, saturated			Sand increasing.
14	*SAND (SP)* Medium to fine grained, light grey to light brown, saturated	I	G G	Sand only, rounded quartz grains. With carbon (black to brown.
15	*Clayey SAND (SC)* Dark Brown, with carbonaceous material	J	G	Carbonaceous layer at 15m.
	END OF BOREHOLE			
16				
17				
18				
19				

Logged By:
Approved By:
Drawn By:
Ref:

Company:
Drilling Rig:
Drilling Method:

DAMES & MOORE PTY LTD
A DAMES & MOORE COMPANY

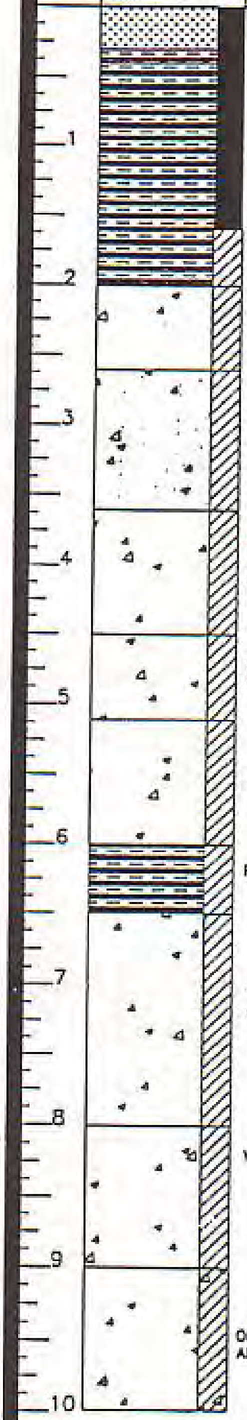
PIONEER CONCRETE (VIC) PTY LTD

GRAPHIC DRILL LOG

HOLE: LL14
PROJECT: YANNATHAN SAND
PAGE 1 OF 2

LOCATION: 380790,5765184
DRILLED: NORTH WEST DRILLING
LOGGED: P BROWNE 16/11/98

DPH LOG DESCRIPTION



BLACK SUB SOIL

RED CLAY SOME LIMONITE

BROWN CLAY

WATER PRESENT

BROWN CLAY

WHITE CLAYEY COARSE SAND ROUNDED QUARTZ

RED COARSE SAND WET WITH ROUNDED QUARTZ TO 2mm CLAYEY IN PARTS

BROWN COARSE SAND SEMI CONSOLIDATED WITH ROUNDED OUZRTZ TO 2mm

GREY COARSE SAND VERY WET MINOR CLAY GRAINS TO 2mm ROUNDED AND ELONGATE

LIGHT BROWN CLAYEY COARSE SAND WITH ROUNDED, ELONGATE QUARTZ

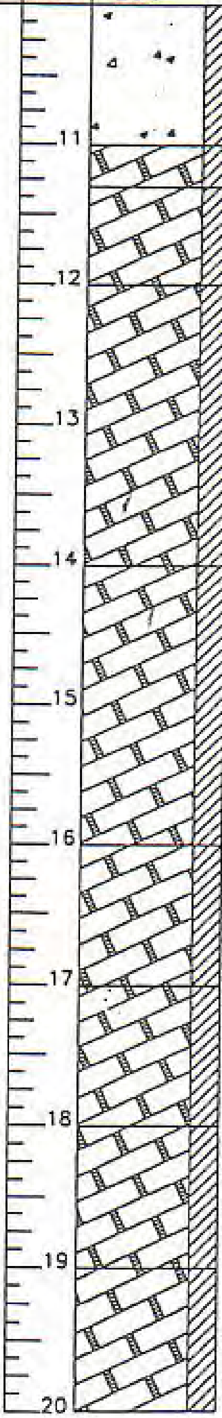
RED CLAY

WHITE COARSE SAND TO 2mm WITH MINOR CLAY.

WHITE VERY FINE SAND UNCONSOLIDATED

OFF WHITE VERY COARSE SAND, ROUNDED AND ELONGATE

DPH LOG DESCRIPTION



WHITE MEDIUM TO COARSE SAND UNCONSOLIDATED WITH ROUNDED QUARTZ

BROWN COAL

BROWN COAL WITH VEGETATION PRESENT

BROWN CHOCOLATE COAL

BROWN COAL WITH MINOR COARSE GRAVEL LAYERS

BROWN COAL WITH MINOR COARSE SAND LAYERS, SAND TO 2mm

BROWN COAL WITH MINOR COARSE SAND LAYERS, SAND TO 2mm

COAL WITH VEGETATION FRAGMENTS AND GRAVEL LAYERS GARINS ROUNDED AND UP TO 2mm

COAL WITH MINOR GRAVEL LAYERS

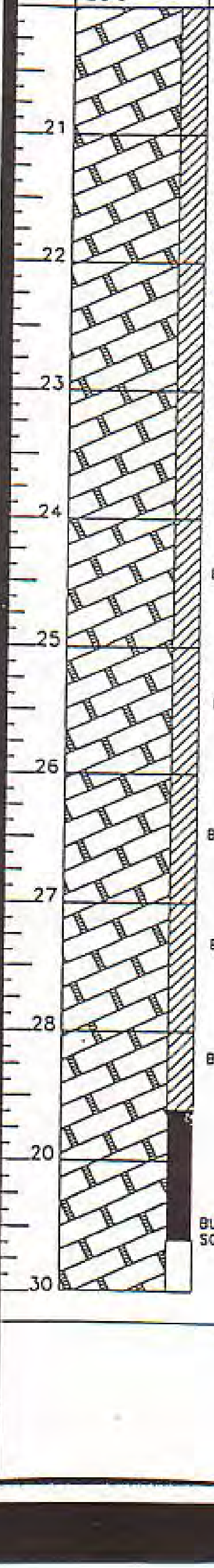
PIONEER CONCRETE (VIC) PTY LTD

GRAPHIC DRILL LOG

HOLE: LL14
PROJECT: YANNATHAN SAND
PAGE 2 OF 2

LOCATION: 380790,5765184
DRILLED: NORTH WEST DRILLING
LOGGED: P BROWNE 16/11/98

DPH | LOG | DESCRIPTION



BROWN COAL WITH COARSE SAND LAYERS

BROWN COAL WITH MEDIUMSAND LAYERS, MINOR

BROWN COAL WITH VERY FIENSAND LAYERS, LOST WATER CIRCULATION

BLACK SILTY COAL WITH MINOR COARSE SAND LAYERS

BLACK SILTY COAL

BLACK SILTY COAL

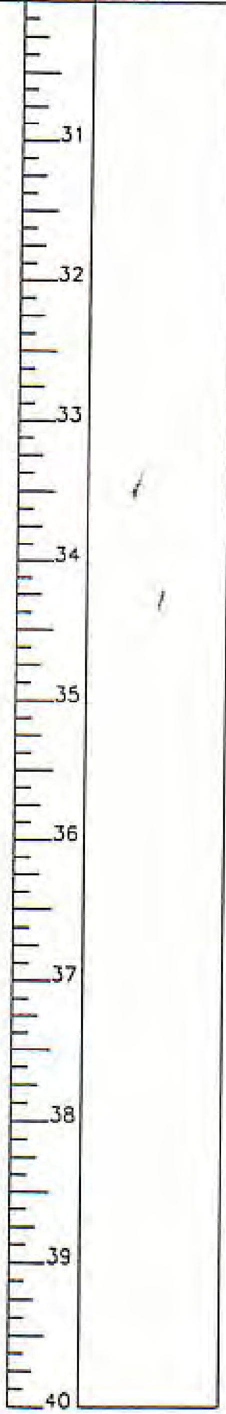
BLACK SILTY COAL

BLACK SILTY COAL

BLACK SILTY COAL

BLACK COAL WITH MINOR COARSE SAND AND SOME FINE SAND LAYERS

DPH | LOG | DESCRIPTION



Appendix C Groundwater Monitoring Event, October 2022

GROUNDWATER MONITORING EVENT

Yannathan

Client: Hanson Construction Materials

Ricardo ref. 30765

Issue: 2

16/12/2022

Customer: Hanson Construction Materials

Customer reference:
WA127

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Ricardo reference:
30765

Contact:
Kathy Mac Innes, Level 4, 3 Bowen Crescent, Melbourne, Victoria 3004, Australia

Registered office:
Ricardo Energy, Environment & Planning Pty
Level 17, 383 Kent Street Sydney NSW 2000

T: + 61 (0) 3 9978 7823
E: plc.admin@ricardo.com
E: kathy.macinnes@ricardo.com

Author:
Josh Bicknell / Dave Adams

Ricardo is certified to ISO9001, ISO14001, ISO27001 and ISO45001.

Issue History			
Issue No	Date Issued	Document Status	Approved By
1	22/11/2022	Draft	Kathy Mac Innes
2	16/12/2022	Final	Kathy Mac Innes

EXECUTIVE SUMMARY

Hanson Construction Materials (Hanson) operates the Yannathan extraction and processing operations at 870 and 910 Westernport Road, Yannathan, VIC 3981 (the Site). The Site is operated under the existing Work Authority (WA127).

A Work Plan Variation for the site submitted to the Earth Resources Regulation (ERR) branch of Department of Jobs, Precincts and Regions (DJPR), included a Hydrogeological Assessment with was reviewed by Southern Rural Water (SRW). SRW provided comments on the Hydrogeological Assessment, including a recommendation for a risk assessment to include chemicals used in the processing of aggregates, and disturbance caused by the extraction activities.

Ricardo has reviewed chemicals used on-Site to process aggregates. These include:

- Flocculant “Magnafloc® 5250”, (polyacrylamide).
- Coagulant “Magnafloc® 1425”, 2-Propen-1-aminium, N,N-dimethyl-N-2-propenyl-, chloride, homopolymer (“poly DADMAC”).

Polyacrylamide and polyDADMAC are widely used as coagulants / flocculants for effluent treatment, in paper manufacture and water purification. Both chemicals are endorsed by the National Health and Medical Research Council (NHMRC) for use in drinking water treatment (NHMRC, 2011).

The structures of the above coagulants / flocculants were reviewed for likely degradation products, and Constituent of Potential Concern (CoPCs) that may become evident in groundwater. Identified CoPCs included: Total Organic Carbon (TOC); Total Kjeldahl Nitrogen (TKN); nitrogen containing non-organic compounds (nitrate, nitrite, ammonia); acrylamide and chloride.

Further to the above, water levels at seven monitoring wells across the site were gauged and sampled for the identified CoPCs. A water sample was also collected from a cell into which filter cake containing coagulants / flocculants is deposited. Laboratory results were compared to groundwater assessment criteria consistent with local and national guidelines.

Overall, with the exception of slightly reduced pH, no impacts above assessment criteria were reported in the cell receiving filter cake with residual coagulants / flocculants. Some impacts above assessment criteria were observed in groundwater for chloride, nitrate and Total Kjeldahl Nitrogen. However, these were observed in hydraulically upgradient wells to the east of the site, or to the west of the site. Groundwater contours indicate that extract activities in the west pit may be drawing groundwater towards the site, so impacts in the west may also be from off-site sources.

From sampling of the cell into which filter cake is deposited, it is concluded that coagulants and flocculants used in processing are not unacceptably impacting cell water or groundwater. Groundwater impacts observed in some monitoring wells included reduced pH across the site, including hydraulically upgradient wells, which is likely a regional issue due to the site geology. Other localised impacts (pH, elevated electrical conductivity / TDS, chloride, nitrate and TKN) are hydraulically upgradient of site operations, noting that pit dewatering activities may be drawing groundwater on-site to the west. These localised impacts are consistent with off-site sources rather than site activities. Therefore, risks to groundwater quality from chemicals used in processing aggregates, and proposed extraction operations, are considered low.

Further to these results, the existing groundwater monitoring program is considered appropriate for monitoring risks associated with site activities and should continue to be implemented. This includes monthly gauging of water levels in all wells, and field monitoring for pH, electrical conductivity and temperature.

CONTENTS

Figures

Tables

Appendices

Glossary

Acronym	Description
AHD	Australian Height Datum
CAS	Chemical Abstract Service
CoPC	Constituent of Potential Concern
DJPR	Department of Jobs, Precincts and Regions
DO	Dissolved Oxygen
EC	Electrical conductivity
EPA	Environment Protection Authority
EP Act	Environment Protection Act (2017)
ERR	Earth Resources Regulation
ERS	Environment Reference Standard
GME	Groundwater Monitoring Event
mbgl	Metres below ground level
mbTOC	Metres below top of casing
NEPC	National Environment Protection Council
NEPM	National Environmental Protection Measure
NHMRC	National Health and Medical Research Council
ORP	Oxidation Reduction Potential
Poly DADMAC	2-Propen-1-aminium, N,N-dimethyl-N-2-propenyl-, chloride
QA/QC	Quality Assurance / Quality Control
RL	Reduced level
SVOC	Semi Volatile Organic Compound
SRW	Southern Rural Water
TDS	Total dissolved solids
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
VOC	Volatile Organic Compound
WA	Work Authority
WMIS	Water Management Information System
WSPA	Water Supply Protection Area

1. INTRODUCTION

Hanson Construction Materials (Hanson) operates the Yannathan extraction and processing operations at 870 and 910 Westernport Road, Yannathan, VIC 3981 (the Site). The site is operated under the existing Work Authority (WA127).

Hanson wishes to extend the depth and area of extraction at the Site. Ricardo Energy Environment and Planning (Ricardo) was commissioned by Hanson to prepare Work Plan Variation documentation for submission to the Earth Resources Regulation (ERR) branch of Department of Jobs, Precincts and Regions (DJPR) for Site. A Work Plan Variation was submitted to ERR on 14 October 2022 which included a Hydrogeological Assessment (Ricardo 2022).

Concurrently with preparation of the Work Plan Variation, Ricardo consulted with Southern Rural Water (SRW) with regard to the suitability of the Hydrogeological Assessment. SRW replied by letter dated 7 October 2022, and its comments included:

- *“SRW recommends that the proponent undertakes a risk assessment of the proposed quarrying activities in respect of potential water quality changes that may occur, including but not limited to chemicals on site, chemicals used in the processing of aggregates, and the disturbance caused by the dredging activity.*
- *The groundwater quality data in the report indicates that the groundwater ph at the western end of the site (ph 4 – 5). is lower than the background (ph 6 – 7). SRW suggests that the cause of the low ph is identified and this issue is included in the risk assessment. Is there any risk of quarrying increasing the groundwater acidity and will this impact offsite?*
- *A suitable water quality monitoring plan, with triggers and actions should be developed to ensure no unacceptable offsite impacts. Groundwater quality data should be collated annually and reports made available to the relevant authorities.”*

1.1 OBJECTIVES

To address the above SRW comments, the objective of this report is to assess potential impacts from Site activities to water quality at the Site, and to provide a water quality management plan for future use.

2. BACKGROUND

2.1 SITE BACKGROUND

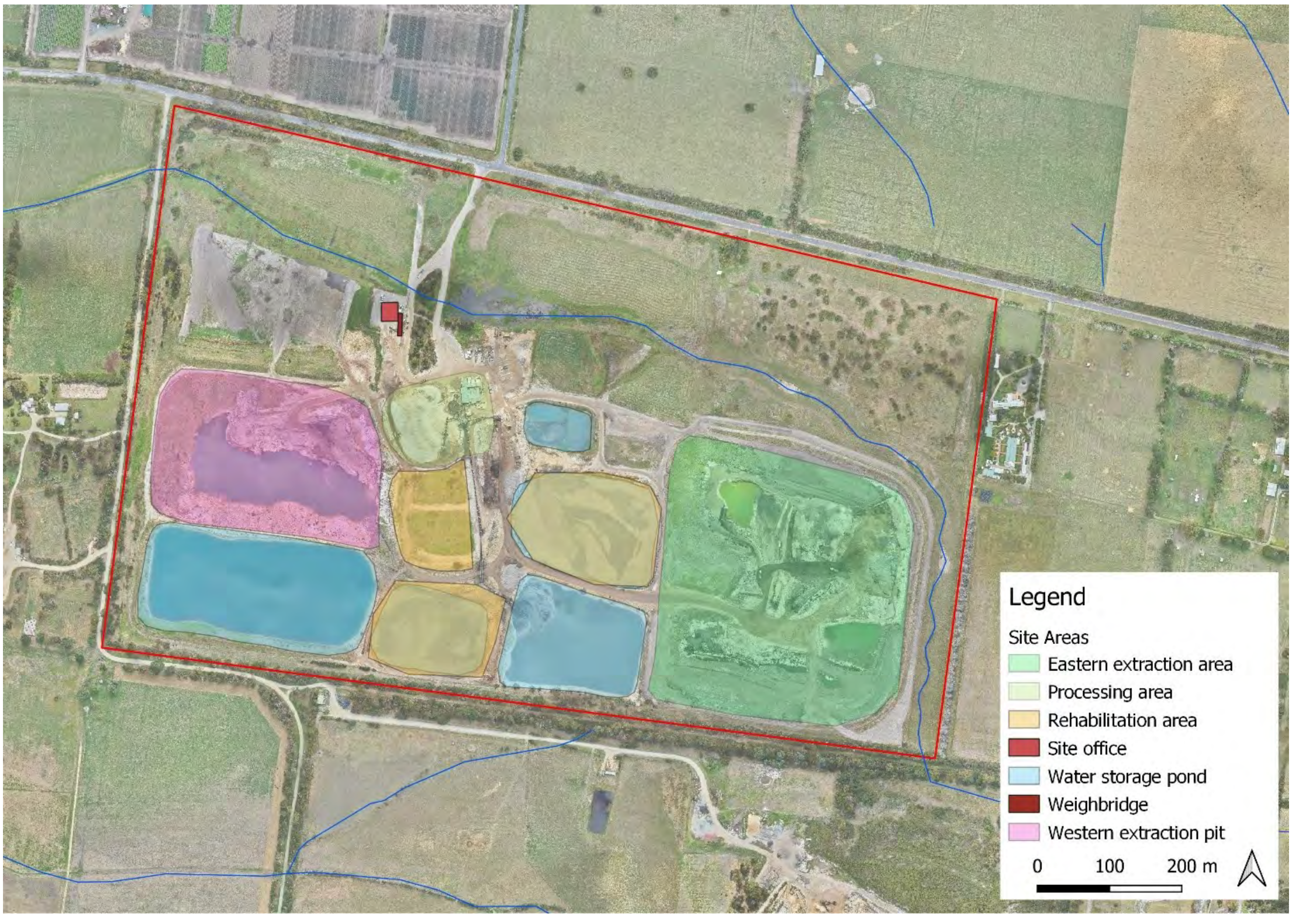
The Site is located on Westernport Rd, Yannathan, approximately 6km east-north-east of Lang Lang, opposite the intersection with Heads Road (**Figure 2-1**). The Site is on a relatively flat alluvial plain approximately midway between the Lang Lang River to the north and the Little Lang Lang River to the south.

Figure 2-1 Site location

The existing pits, **Figure 2-2**, are operated using dry quarrying means, with the inflowing water draining to the base of the pit. Water is pumped from the base of the pit to onsite storages for use in sand processing or water storage.

Groundwater extracted from the pits is retained on Site. The Site has a groundwater extraction licence for 19.5 ML to account for groundwater lost with exported wet product. The licence is by annual transfer since the Water Supply Protection Area (WSPA) is fully allocated and no new licences are available.

Figure 2-2 Site plan



2.2 SITE HYDROGEOLOGY

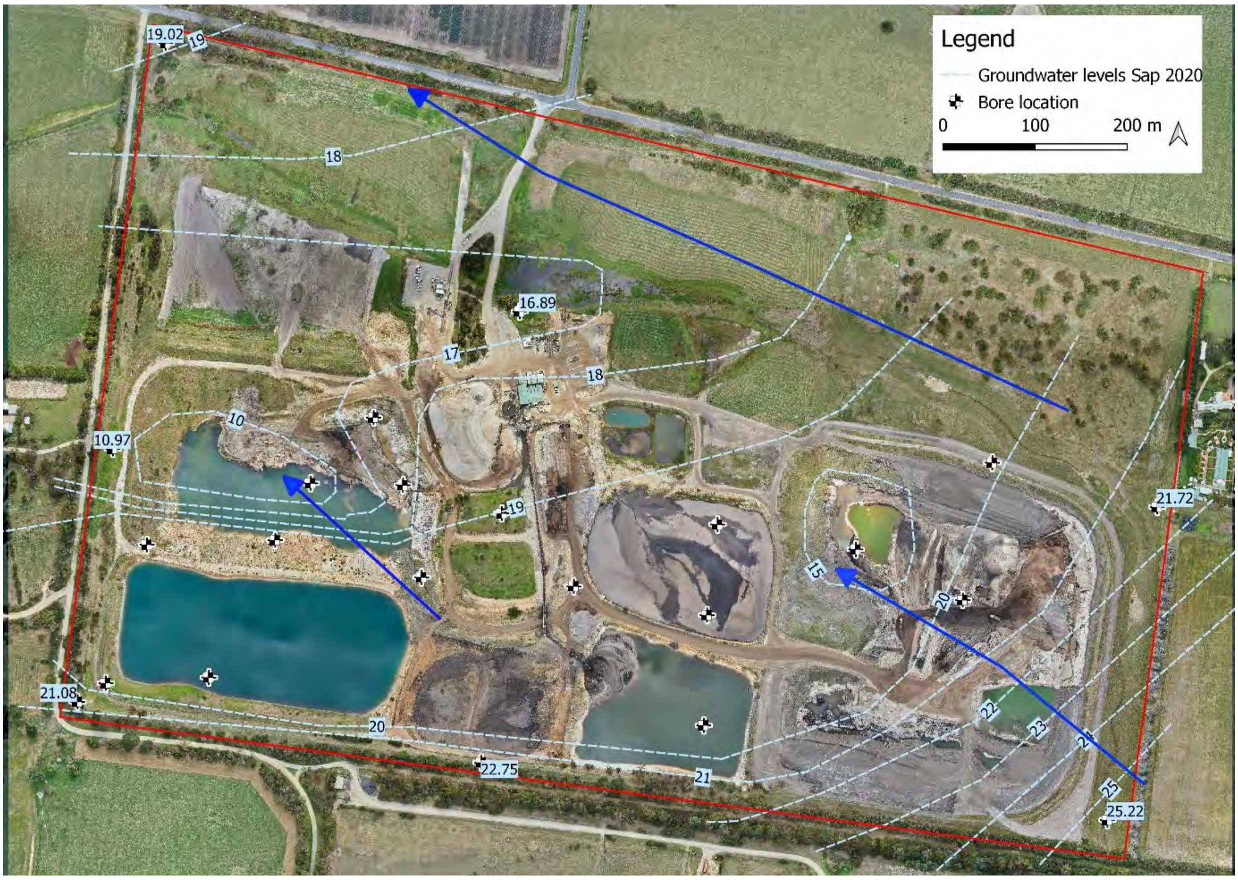
The first hydrogeological assessment of the Site was undertaken by Dames and Moore (Dames and Moore 1999). This study followed an earlier investigation and included additional groundwater bore installation, slope stability assessments, groundwater monitoring and aquifer testing. The current groundwater monitoring network comprises seven active monitoring bores.

Groundwater monitoring commenced with a network of eight monitoring bores. As operations have moved from pit to pit some bores have been decommissioned and other new bores have been added. The current monitoring network is shown in **Figure 2-3** below.

Figure 2-3 Groundwater monitoring network

Groundwater flow is shown in Figure 2-4 below. The flow was interpreted from September 2020 water levels (Larkin, 2021) and is shown as approximately 25mAHD in the south-western corner of the site and flows north-westerly. The two pits on the site are shown to be having a localised impact on groundwater flow.

Figure 2-4 Groundwater flow Sep 2020



Data obtained in 30/07/98, prior to quarrying activities, shows that the background pH is slightly acidic with average field pH readings of 5.7 pH units. No major ion analyses have been undertaken since this time, but pH and electrical conductivity are monitored when water levels are recorded.

The most recent monitoring results (Larkin, 2021) indicates pH generally ranges between 5 to 6 at the Site consistent with pre-quarrying conditions, however the southwestern bores reported lower pH of below 4. The pH in these bores is returning to the natural range. LL19 is located on the western boundary of the Site and has had low pH concentrations reported as recently as 2018, but in recent years has returned to above 4.

Conductivity generally ranges between approximately 500 µS/cm to 1,000 µS/cm at the Site. However, a spike of over 18,000 µS/cm at LL9 in 2016 was reported. This bore is located on the northeastern boundary and up-gradient to the Site adjacent to the kennels/cattery. The high conductivity concentration may relate to contaminating activities on the neighbouring property.

The water in the southwestern pit is hydraulically connected with the groundwater. Salinity as indicated by the electrical conductivity is showing an increasing trend associated with evaporative concentration in the open pit.

2.3 CHEMICAL USED AT THE SITE

Chemicals used at the Site include diesel fuel stored in a 10,000 litre tank fitted with a bowser. The tank is bunded to 120% capacity, is roofed and locked. A bunded store is used for smaller quantities of oils / lubricants. Any quantities of hydrocarbons released from these sources are likely to be small and are expected to naturally degrade. Therefore, the risks from these sources are considered low, and they have not been considered further in this assessment.

The following coagulants and flocculants are used on site in the processing plant:

- Flocculant “Magnafloc® 5250”, (polyacrylamide).
- Coagulant “Magnafloc® 1425”, 2-Propen-1-aminium, N,N-dimethyl-N-2-propenyl-, chloride, homopolymer (“poly DADMAC”).

Safety data sheets (SDS) are provided in **Appendix A**. In 2021, the following quantities were used at the site:

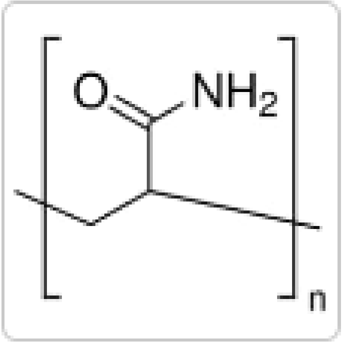
- Polyacrylamide 59,201kg
- PolyDADMAC 173,880L (10%-50% w/w solution)

Polyacrylamide and polyDADMAC are widely used as coagulants / flocculants for effluent treatment, in paper manufacture and water purification. Both chemicals are endorsed by the National Health and Medical Research Council (NHMRC) for use in drinking water treatment (NHMRC, 2011). Polyacrylamide may also be used as a soil conditioner in agriculture, and as a surfactant in herbicides (Reber *et al*, 2007). At the Yannathan site they are used as coagulants / flocculants to assist in the removal of undersized material (“fines”) to produce a filter cake. The filter cake is currently used to fill extracted pits / ponds in addition to oversize material. Currently, the filter cake (including residual coagulant / flocculant) is disposed by conveyor to the pond south of the processing plant.

2.3.1 Polyacrylamide degradation

The structure of polyacrylamide (CAS number 9003-05-8) is shown in **Figure 2-5**. Polyacrylamide may degrade slowly in the environment by physical or microbial processes. Whilst polyacrylamide is manufactured from acrylamide, they are unlikely to degrade to acrylamide by physical or microbial processes (Caufiled *et al* (2002), Nyyssola and Ahlgren, (2019), Reber *et al* (2007).

Figure 2-5 Polyacrylamide structure



Degradation of polyacrylamide may lead to formation of a complex number of smaller polymer units prior to complete mineralisation. The following are Constituents of Potential Concern (CoPCs):

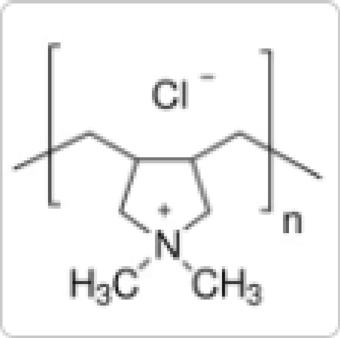
- Partial degradation products measurable as Total Organic Carbon (TOC) or Total Kjeldahl Nitrogen (TKN).
- Nitrogen containing non-organic compounds (nitrate, nitrite, ammonia).
- Acrylamide is not expected to be present but due to its relative toxicity has been included for completeness.

Complete mineralisation may also generate carbon dioxide. However, this is not considered a major CoPC and has not been considered further.

2.3.2 PolyDADMAC degradation

The structure of polyDADMAC (CAS number 9003-05-8) is shown in **Figure 2-6**.

Figure 2-6 Poly DADMAC structure



Whilst the degradation of polyDADMAC is less well studied than polyacrylamide, potential degradation products include:

- Partial degradation products measurable as Total Organic Carbon (TOC) or Total Kjeldahl Nitrogen (TKN).
- Nitrogen containing non-organic compounds (nitrate, nitrite, ammonia).
- Chloride as the product is supplied as the chloride salt.

2.3.3 Summary CoPCs

In summary, the following may result from the degradation of coagulants / flocculants used at the Site:

- Total Organic Carbon (TOC).
- Total Kjeldahl Nitrogen (TKN).
- Nitrogen containing non-organic compounds (nitrate, nitrite, ammonia).
- Acrylamide
- Chloride

Additionally, microbial activity may reduce the pH value of groundwater.

It is also noted that the sand resource at the Site is carbonaceous in some areas (i.e. contains lignite). This may also result in elevated levels of TOC, TKN or other nitrogen compounds.

3. METHODOLOGY

Works were completed in accordance with:

- National Environment Protection Council (NEPC), 1999, National Environmental Protection (Assessment of Site Contamination) Measure (ASC NEPM), (as amended 15 May 2013).
- Environment Protection Authority, 2009, Sampling and Analysis of Waters, Wastewaters, Soils and Wastes, Publication IWRG701, June 2009
- Environment Protection Authority, 2022, Groundwater Sampling Guidelines, Publication 669.1, Version 2, (as published 28 February 2022).

The scope of work included:

- Preparation of Safe Work Method Statement for field work.
- Prior to sampling, the depth to groundwater in each bore was gauged using a dip meter.
- Samples collected from monitoring bores LL8, LL9, LL13, LL15, LL16, LL19 and LL20 (**Figure 2-3)**. The bores are located hydraulically upgradient, and hydraulically downgradient from the Hanson Construction Materials operations at Yannathan.
- Micropurge pumping techniques were chosen as the most appropriate method for retrieval of water quality samples from Hanson construction Materials monitoring bores. Consideration was taken to ensure accurate collection of data which would be most representative of in-situ groundwater conditions, while also minimising local drawdown and the mixing of stagnant water in the monitoring well as a result of pumping.
- Surface water was sampled from the cell receiving filter cake through the use of a bailer.
- Field parameters of pH, conductivity, oxidation and reduction potential, water temperature and dissolved oxygen were monitored during micropurge pumping until these conditions stabilised.
- Primary samples were collected from each selected location after micropurge equilibrium was reached, these samples were stored in laboratory supplied containers which conformed to the requirements of the selected analytical techniques and placed on ice.
- Three Quality Assurance and Quality Control (QA/QC) samples were collected, these included one blind duplicate (QC01) and one split triplicate (QC02) from well LL09, as well as one rinsate blank (QC03) from sampling equipment, in order to assess quality assurance.
- Samples were submitted for laboratory analysis under strict Chain of Custody (CoC) procedures, with analytical suites selected which comprised of total organic carbon, nitrate, nitrite, ammonia, total Kjeldahl nitrogen (TKN), chloride and acrylamide. Primary samples, blind sample QC01, and rinsate blank QC03 were submitted to ALS Environmental, Springvale, while split QC02 was submitted to Eurofins Environmental Testing, Melbourne. Both laboratories are NATA accredited.
- Results have been interpreted and reported as according to Australian and Victorian guidelines.

4. ASSESSMENT CRITERIA

Groundwater Assessment Criteria

Part 5 Division 2 of the ERS identifies potential environmental values of groundwater based on the salinity (TDS) of the water. The Environmental Values are presented in **Table 4-1**.

Table 4-1 Potential Environmental Values of Groundwater

Environmental Value	Segments (mg/L TDS)						
	A1 0 - 600	A2 600-1,200	B 1,201-3,100	C 3101-5,400	D 5,401-7,100	E 7,101-10,000	F >10,000
Water dependent ecosystems & species	✓	✓	✓	✓	✓	✓	✓
Potable water supply – desirable	✓						
Potable water supply – acceptable		✓					
Potable mineral water supply	✓	✓	✓	✓			
Agriculture & irrigation	✓	✓	✓				
Agriculture & irrigation (stock watering)	✓	✓	✓	✓	✓	✓	
Industrial & commercial	✓	✓	✓	✓	✓		
Water-based recreation (primary contact recreation)	✓	✓	✓	✓	✓	✓	✓
Traditional Owner cultural values	✓	✓	✓	✓	✓	✓	✓
Cultural & spiritual values	✓	✓	✓	✓	✓	✓	✓
Buildings & structures	✓	✓	✓	✓	✓	✓	✓
Geothermal properties	✓	✓	✓	✓	✓	✓	✓

Measured TDS ranged from 200 to 1100mg/L in the October 2022 GME. Therefore, the groundwater is classified as Segment A1 in accordance with the ERS.

Adopted criteria for groundwater environmental values

For groundwater monitoring events, trigger levels for groundwater have been adopted in accordance with ERS. Trigger levels have been adopted in accordance with **Table 4-2** below:

Table 4-2 Adopted groundwater environmental values

Environmental Value	Adopted guidelines	Relevance
Water dependent ecosystems & species	The criteria for groundwater quality for water dependent ecosystems & species apply at the point of discharge to surface water, prior to dilution and mixing with the receiving surface water. Therefore, the groundwater screening criteria for water dependent ecosystems & species are the same as those for surface water discussed in Australian & New Zealand Guidelines for Fresh & Marine Water Quality (https://www.waterquality.gov.au/anz-guidelines).[1] As the nearest surface water body is within the 'central foothills and coastal plains' surface water segment (defined in the ERS) a Trigger Level of 95% level of protection (fresh water) for relevant	Relevant

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[1] https://www.waterquality.gov.au/anz-guidelines

Environmental Value	Adopted guidelines	Relevance
	analytes applies. ERS criteria (Table 5) have also been applied to pH (field results) and total nitrogen	
Potable mineral water supply	The ERS defines potable mineral water as "groundwater that is safe to drink and in its natural state contains carbon dioxide and other soluble matter in sufficient concentration to cause effervescence". The water at the site is not in a mineral springs area and does not effervesce therefore this environmental value is not applicable.	Not existing, not relevant
Agriculture and irrigation (irrigation)	Australian Water Quality Guidelines[2] include water quality guidelines for Primary Industries for Water Quality for Irrigation and General Water Use. Long term trigger values (irrigation water up to 100 years) have been adopted. Given the zoning of the site and the presence of groundwater bores in the region that are used for irrigation this environmental value is an existing use in the area.	Relevant
Agriculture and irrigation (stock watering)	Australian Water Quality Guidelines include water quality guidelines for Primary Industries for Water Quality for Livestock Drinking Water Quality. Where there are no stock watering specific objectives the document recommends drinking water guidelines for human health be adopted (National Medical Health and Research Council (NHMRC, 2011) as per the potable water supply environmental value above. Given the zoning of the Site and the presence of groundwater bores in the region that are used for stock purposes this environmental value is an existing use in the area.	Relevant
Industrial and commercial	The Australian Water Quality Guidelines provide no specific guidance for industrial water use because "industrial water requirements are so varied (both within and between industries) and sources of water for industry have other coincidental environmental values that tend to drive management of the resource". The on-site use of water for sand processing is not sensitive to water quality. Given the location of the Site in a commercial industrial/residential area, the above agriculture and irrigation environmental values are considered adequately protective of the industrial / commercial environmental value.	Not relevant
Water-based recreation (primary contact recreation)	Primary contact recreation screening criteria for groundwater is based on the National Health and Medical Research Council (NHRMC) drinking water guidelines (NHRMC 2011) and recreational water risks (NHMRC 2008). NHMRC (2008) states that to account for percentage of daily intake from recreational waters, the potable water supply guidelines (above) can be modified by a factor of 10 to provide screening levels for chemicals. Therefore, the guideline has been modified by a factor of 10 when impact to the environmental value is addressed. Where there is a risk of bioaccumulation or bio magnification or a human health risk via inhalation (i.e., in the case of SVOCs or VOCs), the drinking water criteria are not be modified.	Relevant
Traditional Owner cultural values	No specific environmental quality indicators or objectives are provided for the environmental values of Traditional Owner Cultural. Environmental quality objectives for other environmental values such as water dependent ecosystems and their species will in part protect the cultural and spiritual values including spiritual relationships, sacred sites and customary use. Where environmental quality indicators and objectives specified for other environmental values do not adequately protect	Based on ecosystem criteria

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[2] https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/primary-industries

Environmental Value	Adopted guidelines	Relevance
	Traditional Owner cultural values, then further assessment may be required	
Buildings and structures	Introduced contaminants shall not cause groundwater to be corrosive to buildings, structures property and materials. Indicators include pH, sulfate, chloride, redox potential salinity or any chemical substance or waste that may have a detrimental impact on the structural integrity of buildings or other structures). Guidelines for the prevention of damage to buildings and structures have been sourced from Australian Standard AS 5100.5:2017 Bridge design Part 5:Concrete.	Relevant
Geothermal properties	According to the ERS, no activity must affect the geothermal properties of groundwater; and specific indicators include temperature between 30 and 70 degrees Celsius.	Not existing, not relevant

Surface Water Environmental Values

While the Environmental Reference Standards do not apply to off-stream dams, the assessment criteria for groundwater have been applied to the cell water as the cell may be a source of impacts to groundwater in the area.

5. RESULTS

5.1 FIELD RESULTS

Monitoring well construction details and groundwater levels made during the October GME are presented in **Table 5-1** below. Copies of groundwater monitoring sheets are included in **Appendix B**.

Table 5-1 Gauging Results

Well ID	Date Gauged	Easting (MGA55)	Northing (MGA55)	Well Depth (m BTOC)	Depth to Water (mBTOC)	Top of Casing Elevation (mAHD)	Ground-water Elevation (mAHD)
LL8	12/10/2022	380226	5764844	11.035	2.413	28.46	26.05
LL9	12/10/2022	381267	5765203	11.755	8.763	28.86	20.10
LL13	13/10/2022	380303	5765890	14.900	5.456	24.76	19.30
LL15	13/10/2022	380646	5765110	19.920	6.41	29.12	22.71
LL16	12/10/2022	380687	5765599	14.130	9.228	27.05	17.82
LL19	13/10/2022	380246	5765450	20.210	14.563	28.42	13.86
LL20	13/10/2022	380208	5765176	20.750	8.513	30.19	21.68

Monitoring well field observations made during the October GME are presented in **Table 5-2 below**. Copies of groundwater monitoring sheets are included in **Appendix B**.

Table 5-2 Groundwater Physiochemical Parameters

Well ID	Sampling Date	DO (mg/L)	EC (µS/cm)	TDS (mg/L)	pH	ORP (mV)	Temp °C
LL8	12/10/2022	0.10	716	465	4.50	-103.9	15.9
LL9	12/10/2022	0.21	2,198	1,428	4.21	-58.10	14.4
LL13	13/10/2022	1.49	1,766	1,141	4.29	-40.20	14.8
LL15	13/10/2022	0.89	394	256	4.37	-4.3	15.5
LL16	12/10/2022	0.34	826	536	5.36	138.6	15.6
LL19	13/10/2022	7.91	493	320	3.18	506.90	14.0
LL20	13/10/2022	3.24	580	377	3.85	396.10	16.2
Cell Water	12/10/2022	9.95	N/A	-	6.28	167.9	17.4

Note: TDS mg/L was calculated from EC µS/cm x 0.65.

During sampling, no hydrocarbon sheen or odours were observed in groundwater monitoring wells. Slight turbidity was noted at LL09 during the October GME, with this monitoring well also showing increased electrical conductivity relative to the rest of the site.

5.2 LABORATORY RESULTS

Results from laboratory analysis carried out by ALS Environmental and Eurofins Scientific are summarised in **Appendix C**. Laboratory certificates and chain of custody documentation is provided in **Appendix D**.

5.3 QAQC

A data validation report has been included in **Appendix E.**

Based on the quality assurance and control review, the data is believed to be of suitable quality for interpretive use and to meet the project objectives.

6. DISCUSSION

6.1 GROUNDWATER LEVELS

Groundwater levels and interpreted contours are provided in **Figure 6-1**. Groundwater levels have increased in most wells since September 2020 (**Figure 2-4**) which is consistent with above average rainfall over the winter 2022 period. Overall groundwater flow directions are consistent with September 2020. Groundwater flow is generally from the south east to north west with localised depressions where extraction is occurring.

Figure 6-1 Groundwater Contours

6.2 GROUNDWATER PHYSIOCHEMICAL PARAMETERS

The following is noted regarding physiochemical parameters (**Table 5-2**):

- Reduced dissolved oxygen and corresponding ORP results were observed for hydraulically up-gradient wells LL8 and LL9, and to a lesser extent in wells LL16 (centre of site) and LL13 (north west of site).
- Elevated electrical conductivity (EC) results showed a similar distribution to DO / ORP results, with higher results upgradient (LL9) and across the centre / north west of the site. EC results were consistent with September 2020 results (Larkin, 2020).

The reason for the decreased DO / ORP readings, and elevated EC readings are not known. However, as the highest reading was in hydraulically upgradient well LL9, it is not considered to be related to site activities.

The pH readings were acidic across the site (pH value 3.18 – 5.36), consistent with a sand geology. pH is discussed further in **Section 6.3** below.

Physiochemical results for the cell water indicate more neutral pH readings (6.28) than groundwater, and DO / ORP readings are not reduced as observed in some monitoring wells. An EC reading was not available for this location.

6.3 LABORATORY RESULTS

Laboratory results and field pH readings are shown in **Appendix C** and results exceeding the adopted groundwater assessment criteria shown in **Figure 6-2**.

Figure 6-2 Groundwater Results Exceeding Assessment Criteria

The following is noted:

- No results exceeded assessment criteria in the cell receiving filter cake, with the exception of pH. The pH value of 6.28 was slightly below drinking water aesthetic criteria (6.5) and ERS criteria for the area (6.8).
- The pH values have reduced since September 2020 (Larkin 2021) in upgradient wells LL8, LL9 and also in well LL13 to the north east. The pH values in 2022 were also below historical values in these wells. The pH values in wells LL19 and LL20 to the west of the site have also decreased, but are within historical ranges.
- Elevated chloride concentrations were observed in upgradient wells LL8 and LL9 and in well LL13 to the north west.
- Increased nitrate / Total Kjeldahl Nitrogen results were observed in upgradient wells LL9 and wells LL19 and LL20 to the west of the site.
- No assessment criteria was identified for Total Organic Carbon. However, concentrations were highest in upgradient well LL9.
- No acrylamide was reported in any well.

Overall, with the exception of slightly reduced pH, no impacts above assessment criteria were reported in the cell receiving filter cake. Some impacts above assessment criteria were observed in groundwater for chloride, nitrate and Total Kjeldahl Nitrogen. However, these were observed in hydraulically upgradient wells to the east of the site, or to the west of the site. Groundwater contours indicate that extraction activities in the west pit may be drawing groundwater towards the site, so impacts in the east and west of the site may be from off-site sources.

7. CONCLUSIONS AND RECOMMENDATIONS

From sampling of the cell into which filter cake is deposited, it is concluded that coagulants and flocculants used in processing are not unacceptably impacting cell water or groundwater.

Groundwater impacts were observed in some monitoring wells. This included reduced pH across the site including upgradient well LL8 which is likely a regional issue due to the site geology. Other localised impacts (pH, elevated electrical conductivity / TDS, chloride, nitrate and TKN) are hydraulically upgradient of site operations, noting that pit dewatering activities may be drawing groundwater on-site to the west. These localised impacts are consistent with off-site sources rather than site activities. Therefore, risks to groundwater quality from chemicals used in processing aggregates are considered low.

Further to these results, the existing groundwater monitoring program is considered appropriate for monitoring risks associated with site activities and should continue to be implemented. This includes monthly gauging of water levels in all wells, and field monitoring for pH, electrical conductivity and temperature.

8. REFERENCES

Australian and New Zealand Governments and Australian state and territory governments, 2018, ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

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9. LIMITATIONS

This report was prepared for the sole use of Hanson Construction Materials and should not be relied upon by any other person. None of Ricardo Environmental Energy and Planning Pty Ltd or any of its related entities, employees or directors (each a Ricardo Person) owes a duty of care (whether in contract, tort, statute or otherwise) to any third party with respect to or in connection with this report and no Ricardo Person accepts any liability for any loss or damage suffered or costs incurred arising out of or in connection with the use this report by any third party.

The report has been prepared with the objectives and scope of work outlined in the proposal dated 6 October 2022. The work was carried out in accordance with the agreed terms and conditions.

The conclusions and recommendations provided in this report are based on available information and it is possible that different conclusions and recommendations could be made should new information become available, or with changing site conditions over time.

The report will not be updated if anything occurs after the date of this report and Ricardo will not be obliged to inform any person of any matter arising or coming to its attention after that date.

Appendix A Safety Data Sheets

Safety data sheet

1. Substance/preparation and manufacturer/supplier identification

Product name:
Magnafloc® 1425

Use: Coagulant

Manufacturer/supplier:
BASF Australia Limited (ABN 62 008 437 867)
Level 12, 28 Freshwater Place Southbank
Victoria 3006, AUSTRALIA
Telephone: +61 3 8855-6600
Telefax number: +61 3 8855-6511

Emergency information:
BASF Emergency Advice Number: 1800 803 440 (24h) [within Australia]
BASF Emergency Advice Number: + 61 3 8855 6666 [outside Australia]

2. Hazard identification

Classification of the substance and mixture:
Hazardous to the aquatic environment - acute: Cat.3
Hazardous to the aquatic environment - chronic: Cat.3

Label elements and precautionary statement:

Hazard Statement:

H402	Harmful to aquatic life.
H412	Harmful to aquatic life with long lasting effects.

Precautionary Statements (Prevention):

P273	Avoid release to the environment.

Precautionary Statements (Disposal):

P501	Dispose of contents and container to hazardous or special waste collection point.

Other hazards which do not result in classification:
High risk of slipping due to leakage/spillage of product.
The product does not contain a substance fulfilling the PBT (persistent/bioaccumulative/toxic) criteria or the vPvB (very persistent/very bioaccumulative) criteria.

3. Composition/information on ingredients

Chemical nature

Substance nature: mixture

Aqueous solution based on: homopolymer, cationic

Hazardous ingredients

2-Propen-1-aminium, N,N-dimethyl-N-2-propenyl-, chloride, homopolymer

Content (W/W): >= 10 % - <= 50 %	Aquatic Acute: Cat. 3
CAS Number: 26062-79-3	Aquatic Chronic: Cat. 3

4. First-Aid Measures

General advice:
Remove contaminated clothing.

If inhaled:
Keep patient calm, remove to fresh air, seek medical attention.

On skin contact:
Wash thoroughly with soap and water

On contact with eyes:
Wash affected eyes for at least 15 minutes under running water with eyelids held open.

On ingestion:
Rinse mouth and then drink 200-300 ml of water.

Note to physician:
Symptoms: Information, i.e. additional information on symptoms and effects may be included in the GHS labeling phrases available in Section 2 and in the Toxicological assessments available in Section 11., (Further) symptoms and / or effects are not known so far
Hazards: No hazard is expected under intended use and appropriate handling.
Treatment: Treat according to symptoms (decontamination, vital functions), no known specific antidote.

5. Fire-Fighting Measures

Suitable extinguishing media:
water spray, dry powder, foam

Additional information:
If water is used, restrict pedestrian and vehicular traffic in areas where slip hazard may exist.

Specific hazards:
harmful vapours
Evolution of fumes/fog. The substances/groups of substances mentioned can be released in case of fire. Do not release chemically contaminated water into drains, soil or surface water. Sufficient measures must be taken to retain the water used for extinguishing. Dispose of contaminated water and soil according to local regulations.

Special protective equipment:
Wear self-contained breathing apparatus and chemical-protective clothing.

Further information:
Contaminated extinguishing water must be disposed of in accordance with official regulations.

6. Accidental Release Measures

Personal precautions:
Use personal protective clothing.

Environmental precautions:
Contain contaminated water/firefighting water. Do not discharge into drains/surface waters/groundwater.

Methods for cleaning up or taking up:
For large amounts: Pump off product.
For residues: Pick up with suitable absorbent material. Dispose of absorbed material in accordance with regulations.

Additional information: High risk of slipping due to leakage/spillage of product.

7. Handling and Storage

Handling

No eating, drinking, smoking or tobacco use at the place of work. Remove contaminated clothing and protective equipment before entering eating areas. Hands and/or face should be washed before breaks and at the end of the shift.

Protection against fire and explosion:
No special precautions necessary.

Storage

Further information on storage conditions: Keep container tightly closed and in a cool place. Avoid extremes of temperature, especially frost and freezing conditions.

Storage stability:
Storage temperature: > 0 °C

Avoid freezing.

8. Exposure controls and personal protection

Components with occupational exposure limits

No substance specific occupational exposure limits known.

Personal protective equipment

Respiratory protection:
Wear respiratory protection if ventilation is inadequate. Gas filter for gases/vapours of organic compounds (boiling point >65 °C, e. g. EN 14387 Type A)

Hand protection:
Chemical resistant protective gloves
Suitable materials also with prolonged, direct contact (Recommended: Protective index 6, corresponding > 480 minutes of permeation time according to EN ISO 374-1):
e.g. nitrile rubber (0.4 mm), chloroprene rubber (0.5 mm), polyvinylchloride (0.7 mm) and other
Supplementary note: The specifications are based on tests, literature data and information of glove manufacturers or are derived from similar substances by analogy. Due to many conditions (e.g. temperature) it must be considered, that the practical usage of a chemical-protective glove in practice may be much shorter than the permeation time determined through testing.
Manufacturer's directions for use should be observed because of great diversity of types.

Eye protection:
Safety glasses with side-shields.

Body protection:
Body protection must be chosen depending on activity and possible exposure, e.g. apron, protecting boots, chemical-protection suit (according to EN 14605 in case of splashes or EN ISO 13982 in case of dust).

General safety and hygiene measures:
Handle in accordance with good industrial hygiene and safety practice. Wearing of closed work clothing is recommended. No eating, drinking, smoking or tobacco use at the place of work.

9. Physical and Chemical Properties

Form:	liquid
Colour:	straw yellow
Odour:	amine-like, slight odour
Odour threshold:	not determined
pH value:	approx. 5.5
Melting point:	
	not determined
Boiling point:	> 100 °C

Flash point:	> 120 °C A flash point determination is unnecessary due to the high water content.	
Evaporation rate:	not determined	
Flammability (solid/gas):	not flammable	
Lower explosion limit:	For liquids not relevant for classification and labelling., The lower explosion point may be 5 - 15 °C below the flash point.	
Upper explosion limit:	For liquids not relevant for classification and labelling.	
Ignition temperature:	Based on the water content the product does not ignite.	
Thermal decomposition:	No decomposition if stored and handled as prescribed/indicated.	
Self ignition:	not self-igniting	
Self heating ability:	It is not a substance capable of spontaneous heating.	
Explosion hazard:	not explosive	
Fire promoting properties:	not fire-propagating	
Vapour pressure:	approx. 32 mbar (25 °C)	
Density:	approx. 1.1 g/cm3 (20 °C)	
Relative vapour density (air):	not determined	
Solubility in water:	miscible	
Miscibility with water:	miscible	
Partitioning coefficient n-octanol/water (log Pow):	Study scientifically not justified.	
Viscosity, dynamic:	approx. 2,000 mPa.s (25 °C)	
Viscosity, kinematic:	approx. 1,800 mm2/s (25 °C)	(calculated (from dynamic viscosity))

Other Information:
If necessary, information on other physical and chemical parameters is indicated in this section.

10. Stability and Reactivity

Conditions to avoid:
Avoid excessive temperatures. Avoid freezing.

Thermal decomposition:	No decomposition if stored and handled as prescribed/indicated.

Substances to avoid:
strong acids, strong bases, strong oxidizing agents

Corrosion to metals: No corrosive effect on metal.

Hazardous reactions:
No hazardous reactions when stored and handled according to instructions.

Hazardous decomposition products:
No hazardous decomposition products if stored and handled as prescribed/indicated.

Chemical stability:
The product is stable if stored and handled as prescribed/indicated.

11. Toxicological Information

Routes of exposure

Acute oral toxicity

Experimental/calculated data:
LD50rat (oral): > 5,000 mg/kg

Symptoms

Information, i.e. additional information on symptoms and effects may be included in the GHS labeling phrases available in Section 2 and in the Toxicological assessments available in Section 11.
(Further) symptoms and / or effects are not known so far

Irritation

Experimental/calculated data:
Skin corrosion/irritation rabbit: non-irritant (OECD Guideline 404)

Serious eye damage/irritation rabbit: non-irritant (OECD Guideline 405)

Respiratory/Skin sensitization

Assessment of sensitization:
Based on the ingredients, there is no suspicion of a skin-sensitizing potential.

Germ cell mutagenicity

Assessment of mutagenicity:
Based on the ingredients, there is no suspicion of a mutagenic effect.

Carcinogenicity

Assessment of carcinogenicity:
Based on the ingredients there is no suspicion of a carcinogenic effect in humans.

Reproductive toxicity

Assessment of reproduction toxicity:
Based on the ingredients, there is no suspicion of a toxic effect on reproduction.

Developmental toxicity

Assessment of teratogenicity:
Based on the ingredients, there is no suspicion of a teratogenic effect.

Specific target organ toxicity (single exposure)

No data available.

Repeated dose toxicity and Specific target organ toxicity (repeated exposure)

Assessment of repeated dose toxicity:
Based on our experience and the information available, no adverse health effects are expected if handled as recommended with suitable precautions for designated uses. The product has not been tested. The statement has been derived from the properties of the individual components.

Aspiration hazard

No aspiration hazard expected.

Other relevant toxicity information

The product has not been tested. The statements on toxicology have been derived from products of a similar structure and composition.

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12. Ecological Information

Ecotoxicity

Assessment of aquatic toxicity:
The product has not been tested. The statement has been derived from substances/products of a similar structure or composition.

Toxicity to fish:
LC50 (96 h) 10 - 100 mg/l, Fish

Aquatic invertebrates:
EC50 (48 h) 10 - 100 mg/l, Daphnia magna

Mobility

Assessment transport between environmental compartments:
No data available.

Information on: 2-Propen-1-aminium, N,N-dimethyl-N-2-propenyl-, chloride, homopolymer
Assessment transport between environmental compartments:
Adsorption to solid soil phase is expected.

Persistence and degradability

Assessment biodegradation and elimination (H2O):
Not readily biodegradable (by OECD criteria).

Bioaccumulation potential

Bioaccumulation potential:
Based on its structural properties, the polymer is not biologically available. Accumulation in organisms is not to be expected.

13. Disposal Considerations

Must be disposed of or incinerated in accordance with local regulations.

Contaminated packaging:
Uncontaminated packaging can be re-used.
Packs that cannot be cleaned should be disposed of in the same manner as the contents.

14. Transport Information

Domestic transport:

	Not classified as a dangerous good under transport regulations
UN number or ID number	Not applicable
UN proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable
Packing group:	Not applicable
Environmental hazards:	Not applicable
Special precautions for user	None known

Sea transport
IMDG

	Not classified as a dangerous good under transport regulations
UN number or ID number:	Not applicable
UN proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable
Packing group:	Not applicable
Environmental hazards:	Not applicable
Special precautions for	None known

user

Air transport
IATA/ICAO

	Not classified as a dangerous good under transport regulations
UN number or ID number	Not applicable
Proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable
Packing group:	Not applicable
Environmental hazards:	Not applicable
Special precautions for user	None known

15. Regulatory Information

Other regulations

If other regulatory information applies that is not already provided elsewhere in this safety data sheet, then it is described in this subsection.

Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP): Not Scheduled

Registration status:

AICS, AU released / listed

16. Other Information

Vertical lines in the left hand margin indicate an amendment from the previous version.

The data contained in this safety data sheet are based on our current knowledge and experience and describe the product only with regard to safety requirements. This safety data sheet is neither a Certificate of Analysis (CoA) nor technical data sheet and shall not be mistaken for a specification agreement. Identified uses in this safety data sheet do neither represent an agreement on the corresponding contractual quality of the substance/mixture nor a contractually designated use. It is the responsibility of the recipient of the product to ensure any proprietary rights and existing laws and legislation are observed.

Safety data sheet

1. Substance/preparation and manufacturer/supplier identification

Product name:
Magnafloc® 5250

Use: flocculation agent

Manufacturer/supplier:
BASF Australia Limited (ABN 62 008 437 867)
Level 12, 28 Freshwater Place Southbank
Victoria 3006, AUSTRALIA
Telephone: +61 3 8855-6600
Telefax number: +61 3 8855-6511

Emergency information:
BASF Emergency Advice Number: 1800 803 440 (24h) [within Australia]
BASF Emergency Advice Number: + 61 3 8855 6666 [outside Australia]

2. Hazard identification

Classification of the substance and mixture:
No need for classification according to GHS criteria for this product.

Label elements and precautionary statement:

The product does not require a hazard warning label in accordance with GHS criteria.

Other hazards which do not result in classification:
Very slippery when wet.
This type of product has a tendency to create dust if roughly handled. The product does not burn readily but as with many organic powders, flammable dust clouds may be formed in air. The product is under certain conditions capable of dust explosion.
The product does not contain a substance fulfilling the PBT (persistent/bioaccumulative/toxic) criteria or the vPvB (very persistent/very bioaccumulative) criteria.

3. Composition/information on ingredients

Chemical nature

Substance nature: mixture

polyacrylamide, anionic

No particular hazards known.

4. First-Aid Measures

General advice:
Remove contaminated clothing.

If inhaled:
After inhalation of dust. Remove the affected individual into fresh air and keep the person calm. If the patient is likely to become unconscious, place and transport in stable sideways position (recovery position). If symptoms persist, seek medical advice.

On skin contact:
Wash thoroughly with soap and water

On contact with eyes:
Wash affected eyes for at least 15 minutes under running water with eyelids held open. Remove contact lenses, if present.

On ingestion:
Rinse mouth and then drink 200-300 ml of water. Check breathing and pulse. Place victim in the recovery position, cover and keep warm. Loosen tight clothing such as a collar, tie, belt or waistband. Seek medical attention. Never induce vomiting or give anything by mouth if the victim is unconscious or having convulsions.

Note to physician:
Symptoms: Information, i.e. additional information on symptoms and effects may be included in the GHS labeling phrases available in Section 2 and in the Toxicological assessments available in Section 11., (Further) symptoms and / or effects are not known so far
Treatment: Treat according to symptoms (decontamination, vital functions), no known specific antidote.

5. Fire-Fighting Measures

Suitable extinguishing media:
foam, water spray

Unsuitable extinguishing media for safety reasons:
water jet

Additional information:
If water is used, restrict pedestrian and vehicular traffic in areas where slip hazard may exist.

Specific hazards:
carbon oxides, nitrogen oxides, harmful vapours
The substances/groups of substances mentioned can be released in case of fire. Very slippery when wet.

Special protective equipment:
Wear a self-contained breathing apparatus.

Further information:
Extend fire extinguishing measures to the surroundings. The degree of risk is governed by the burning substance and the fire conditions. Collect contaminated extinguishing water separately, do not allow to reach sewage or effluent systems. Contaminated extinguishing water must be disposed of in accordance with official regulations.

6. Accidental Release Measures

Personal precautions:
Use personal protective clothing. Do not breathe dust. Keep unprotected persons away. Ensure adequate ventilation. Avoid all sources of ignition: heat, sparks, open flame.

Environmental precautions:
Do not discharge into drains/surface waters/groundwater.

Methods for cleaning up or taking up:
For small amounts: Pick up with suitable appliance and dispose of.
For large amounts: Contain with dust binding material and dispose of.
Collect waste in suitable containers, which can be labeled and sealed. Avoid raising dust.

Additional information: Avoid dispersal of dust in the air (i.e., clearing dust surfaces with compressed air). Avoid the formation and build-up of dust - danger of dust explosion. Dust in sufficient concentration can result in an explosive mixture in air. Handle to minimize dusting and eliminate open flame and other sources of ignition. Forms slippery surfaces with water.

7. Handling and Storage

Handling

Breathing must be protected when large quantities are decanted without local exhaust ventilation. Avoid inhalation of dusts. Forms slippery surfaces with water. Wear suitable personal protective equipment. No eating, drinking, smoking or tobacco use at the place of work. Remove contaminated clothing and protective equipment before entering eating areas. Wash hands before breaks and at end of work.

Protection against fire and explosion:
Avoid dust formation. Dust in sufficient concentration can result in an explosive mixture in air. Handle to minimize dusting and eliminate open flame and other sources of ignition. Dry powders can build static electricity charges when subjected to the friction of transfer and mixing operations. Provide adequate precautions, such as electrical grounding and bonding, or inert atmospheres.

Storage

Unsuitable materials for containers: Aluminium

Further information on storage conditions: Store in unopened original containers in a cool and dry place. Avoid wet, damp or humid conditions, temperature extremes and ignition sources.

Storage stability:
Avoid extreme heat.

Protect from temperatures above: 60 °C

8. Exposure controls and personal protection

Components with occupational exposure limits

No substance specific occupational exposure limits known.

Particles, not otherwise specified, inhalable
TWA value 10 mg/m3 (ACGIHTLV), Inhalable particles

Particles, not otherwise specified, respirable
TWA value 3 mg/m3 (ACGIHTLV), Respirable particles

Engineering Controls

Advice on system design:
Ensure adequate ventilation.
Avoid the formation and deposition of dust.

Personal protective equipment

Respiratory protection:
Suitable respiratory protection for lower concentrations or short-term effect: Particle filter with medium efficiency for solid and liquid particles (e.g. EN 143 or 149, Type P2 or FFP2)

Hand protection:
Chemical resistant protective gloves
Suitable materials also with prolonged, direct contact (Recommended: Protective index 6, corresponding > 480 minutes of permeation time according to EN ISO 374-1):
e.g. nitrile rubber (0.4 mm), chloroprene rubber (0.5 mm), polyvinylchloride (0.7 mm) and other
Supplementary note: The specifications are based on tests, literature data and information of glove manufacturers or are derived from similar substances by analogy. Due to many conditions (e.g. temperature) it must be considered, that the practical usage of a chemical-protective glove in practice may be much shorter than the permeation time determined through testing.
Manufacturer's directions for use should be observed because of great diversity of types.

Eye protection:
Safety glasses with side-shields.

Body protection:
chemical protection overall (f.e. according to EN 13982) if dust is formed.

General safety and hygiene measures:
Ensure adequate ventilation. Wearing of closed work clothing is recommended. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and Chemical Properties

Form:	powder
Colour:	whitish
Odour:	odourless
Odour threshold:	not determined
pH value:	7.2 (1 %(m)) solution
Melting point:	The substance / product decomposes therefore not determined.
Boiling point:	not applicable
Flash point:	not applicable, the product is a solid
Evaporation rate:	The product is a non-volatile solid.
Flammability (solid/gas):	not highly flammable
Lower explosion limit:	For solids not relevant for classification and labelling.
Upper explosion limit:	For solids not relevant for classification and labelling.
Thermal decomposition:	not determined
Self ignition:	not self-igniting
Self heating ability:	It is not a substance capable of spontaneous heating.
Explosion hazard:	not explosive
Fire promoting properties:	not fire-propagating
Vapour pressure:	The product has not been tested.
Bulk density:	approx. 750 kg/m3
Relative vapour density (air):	The product is a non-volatile solid.
Solubility in water:	Forms a viscous solution.

Partitioning coefficient n-octanol/water (log Pow):
Study scientifically not justified.

Viscosity, dynamic:
not applicable, the product is a solid
Viscosity, kinematic:
not applicable, the product is a solid

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10. Stability and Reactivity

Conditions to avoid:
Avoid extreme temperatures. Avoid humidity. Avoid sources of ignition.

Thermal decomposition: not determined

Substances to avoid:
strong acids, strong bases, strong oxidizing agents, nitrates

Corrosion to metals: No corrosive effect on metal.

Hazardous reactions:
The product is not a dust explosion risk as supplied; however the build-up of fine dust can lead to a risk of dust explosions.

Hazardous decomposition products:
No hazardous decomposition products if stored and handled as prescribed/indicated.

Chemical stability:
The product is stable if stored and handled as prescribed/indicated.

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11. Toxicological Information

Routes of exposure

Acute oral toxicity

Experimental/calculated data:
ATErat (oral): > 5,000 mg/kg (other)

Assessment of acute toxicity

Based on available data, the classification criteria are not met.

Symptoms

Information, i.e. additional information on symptoms and effects may be included in the GHS labeling phrases available in Section 2 and in the Toxicological assessments available in Section 11.
(Further) symptoms and / or effects are not known so far

Irritation

Assessment of irritating effects:

Based on available data, the classification criteria are not met. May cause slight irritation to the respiratory tract.

Experimental/calculated data:
Skin corrosion/irritation rabbit: non-irritant (OECD Guideline 404)

Serious eye damage/irritation rabbit: non-irritant

Respiratory/Skin sensitization

Assessment of sensitization:
Based on available data, the classification criteria are not met.

Germ cell mutagenicity

Assessment of mutagenicity:
Based on available data, the classification criteria are not met.

Carcinogenicity

Assessment of carcinogenicity:
The whole of the information assessable provides no indication of a carcinogenic effect.

Reproductive toxicity

Assessment of reproduction toxicity:
Based on available data, the classification criteria are not met.

Specific target organ toxicity (single exposure)

Based on available data, the classification criteria are not met.

Repeated dose toxicity and Specific target organ toxicity (repeated exposure)

Assessment of repeated dose toxicity:
Based on our experience and the information available, no adverse health effects are expected if handled as recommended with suitable precautions for designated uses.

Aspiration hazard

No aspiration hazard expected.

Other relevant toxicity information

The product has not been tested. The statements on toxicology have been derived from products of a similar structure and composition.

12. Ecological Information

Ecotoxicity

Assessment of aquatic toxicity:
There is a high probability that the product is not acutely harmful to aquatic organisms.

Toxicity to fish:
LC50 (96 h) > 100 mg/l, Brachydanio rerio (OECD 203; ISO 7346; 84/449/EEC, C.1)
The product has not been tested. The statement has been derived from substances/products of a similar structure or composition.

Aquatic invertebrates:
EC50 (48 h) > 100 mg/l, Daphnia magna (OECD Guideline 202, part 1)
The product has not been tested. The statement has been derived from substances/products of a similar structure or composition.

Aquatic plants:
EC50 (72 h) > 100 mg/l (growth rate), Scenedesmus subspicatus (OECD Guideline 201, static)
The product has not been tested. The statement has been derived from substances/products of a similar structure or composition.

Mobility

Information on: Anionic polyacrylamide
Assessment transport between environmental compartments:
Adsorption to solid soil phase is expected.

Persistence and degradability

Assessment biodegradation and elimination (H2O):
Not readily biodegradable (by OECD criteria).

Bioaccumulation potential

Assessment bioaccumulation potential:
Based on its structural properties, the polymer is not biologically available. Accumulation in organisms is not to be expected.

Additional information

Other ecotoxicological advice:
The product has not been tested. The statements on ecotoxicology have been derived from products of a similar structure and composition.

13. Disposal Considerations

Must be disposed of or incinerated in accordance with local regulations.

Contaminated packaging:
Packs that cannot be cleaned should be disposed of in the same manner as the contents. Uncontaminated packaging can be re-used.

14. Transport Information

Domestic transport:

Not classified as a dangerous good under transport regulations

UN number or ID number	Not applicable
UN proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable
Packing group:	Not applicable
Environmental hazards:	Not applicable
Special precautions for user	None known

Sea transport
IMDG

	Not classified as a dangerous good under transport regulations
UN number or ID number:	Not applicable
UN proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable
Packing group:	Not applicable
Environmental hazards:	Not applicable
Special precautions for user	None known

Air transport
IATA/ICAO

	Not classified as a dangerous good under transport regulations
UN number or ID number	Not applicable
Proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable
Packing group:	Not applicable
Environmental hazards:	Not applicable
Special precautions for user	None known

15. Regulatory Information

Other regulations

If other regulatory information applies that is not already provided elsewhere in this safety data sheet, then it is described in this subsection.

Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP): Not Scheduled

Registration status:

AICS, AU	released / listed

16. Other Information

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Appendix B Groundwater Monitoring Sheets

Well ID LL8
Sampled By: Ait
Initial SWL: 2·413
Water Level Meter Type: Solinst
Project Number: 30765.02
Location: Hanson Yannathan Quarry
SWL after pump added: 2.285
Water Quality Meter Type: YSI
Project Name: Yannathan GME
Purge Method: Low Flow
Total Depth: 11·035
Pump Intake Setting: 10m
Date: 12-Oct-22
Sample Method: Low Flow
Screened Interval:

Start: 10:41
Stop: 2·36
Before Pumping SWL: 2.785
Final SWL: 2·260
Weather: wet

Time	Vol (L)	DO (mg/L)	EC (µS/cm)	pH	ORP (mV)	Temp (°C)	SWL m(BTOC)	Flow/Purge Rate	Notes/Observations
1 40	0.2	3.92	647	5.04	-41.6	16.1	2.235	25/5	1(MP2)
1.45	0.6	1.5	696	4.88	-57.8	15.1	2.245		
1.48	0.9	0.51	701	4.39	-59.8	14.8	2.245		
1.51	1.7	1.0	700	4.18	-122.7	15.0	2.236.		
2.14	1.9	2.0	722	4.18	-99.1	16.0	2.265		
2.23	2.0	0.23	716	4.43	-98.5	16.0	2.235		
2.25	2.1	0.19	717	4.36	-98.1	16.3	2.245		
2.28	2.3	0.16.	722	4.41	-97.6	16.2	2.245		
2:31	2.5	0.14	719	4.5	-101.4	16.0	2.25		
2.33	2.7	0.1	717	4.49	-102.7	16.0	2.257		
2:36	2.9	0.1	716	4.5	-103.9	15.9.	2.26	↓	
		±10%	±3%	±0.05	±10mV	±0.2	<0.1m		Turbidity, Colour, Odour, Sheen, Other

Sample ID	Type	Container	Analysis	Preservatives	Lab
LL8	2p 1v 1amber				

Bore Volume Calcul $\pi r_1^2 \times h_1 + (n \times (\pi r_2^2 \times h_2) - (\pi r_1^2 \times h_2)) \times 100000$
n = gravel pack porosity (0.3), r_1 = well radius (m), r_2 = ann
h_1 = water coloumn length (m), h_2 = length of saturated gra
π = 3.142

Field QA Checks
Air bubbles in vials? Y [✓ N]
Any violent reactions? Y / [✓ N]
Equipment cleaned and decontaminated? [✓ Y] N

Bore Condition:

Well ID	LL09	Sampled By:	SES	Initial SWL:	8.763	Water Level Meter Type:	50/m +
Project Number:	30765.02	Location:	Hanson Yannathan Quarry	SWL after pump added:	8.773	Water Quality Meter Type:	YSI
Project Name:	Yannathan GME	Purge Method:	Low Flow	Total Depth:	11.755	Pump Intake Setting:	10.7
Date:	12-Oct-22	Sample Method:	Low Flow	Screened Interval:			

8. 755

Start: 11.39 Stop: 1.03 Before Pumping SWL: 8.773 Final SWL: 8.765 Weather: wet

Time	Vol (L)	DO (mg/L)	EC (µS/cm)	pH	ORP (mV)	Temp (°C)	SWL m(BTOC)	Flow/Purge Rate	Notes/Observations
11.39								CPM 3	25/5
12.59								CMP 4	10/5 8.775
12.38	0.6	0.78	2717	4.42	-40.4	14.2	8.750		25/5 Sl brown turbid.
12.41	0.6	0.71	2733	4.41	-47.9	14.5	8.775		
1243	1	0.62	2747	4.40	-50.2	14.5	8.763		
1245	1.2	0.67	2765	4.32	-51.5	14.2	8.763		
12.46	1.4	0.55	2747	4.28	-46.6	14.2	8.754		
12.49	1.6	0.38	2767	4.22	-44.4	14.4	8.757	CMP 1	50/10
12.51	1.8	0.33	2782	4.22	-51.4	14.5	8.762		
12.54	1.9	0.31	2788	4.22	-52	14.5	8.752		
12.54	2	0.22	2800	4.22	-45.3	14.6	8.756		
12.56	2.1	0.25	2803	4.22	-55.9	14.5	8.764		
1 pm	2.2	0.23	2800	4.22	-56.6	14.4	8.765		
1.01	2.3	0.22	2796	4.22	-57.3	14.4	8.765		
1.03	2.4	0.21	2795	4.21	-58.1	14.4	8.765		
		±10%	±3%	±0.05	±10mV	±0.2	<0.1m		Turbidity, Colour, Odour, Sheen, Other

Sample ID	Type	Container	Analysis	Preservatives	Lab
QC1	Blind	2P, V, 1 amber			
QC2	Split				
LL09	Primary				

Bore Volume Calcul: $\pi r_1^2 \times h_1 + (n \times (\pi r_2^2 \times h_2) - (\pi r_1^2 \times h_2)) \times 100000$
n = gravel pack porosity (0.3), r_1 = well radius (m), r_2 = ann
h_1 = water coloumn length (m), h_2 = length of saturated gra
π = 3.142

Field QA Checks
Air bubbles in vials? Y [✓ N]
Any violent reactions? Y [✓ N]
Equipment cleaned and decontaminated? [✓ Y] N

Bore Condition:

Well ID	LL13	Sampled By:	SS	Initial SWL:	5.456.	Water Level Meter Type:	Solinst
Project Number:	30765.02	Location:	Hanson Yannathan Quarry	SWL after pump added:	5.453	Water Quality Meter Type:	YSI
Project Name:	Yannathan GME	Purge Method:	Low Flow	Total Depth:	14.90 m	Pump Intake Setting:	12m
Date:	13 12-Oct-22	Sample Method:	Low Flow	Screened Interval:			

Start: 10:33 Stop: 11:14 Before Pumping SWL: 5.453 Final SWL: Weather: wet

Time	Vol (L)	DO (mg/L)	EC (µS/cm)	pH	ORP (mV)	Temp (°C)	SWL m(BTOC)	Flow/Purge Rate	Notes/Observations
10.41	0.3	4.55	1589	4.87	177.2	14.6	5.458	CPMZ 25/5	Clear, no odour
10:44	0.5	3.14	1661	4.72	64.3	14.7	5.465		
10:47	0.7	2.6	1700	4.60	15.6	14.7	5.413		
10:50	0.9	2.53	1717	4.51	2.9	15.0	5.460		
10.55	1.1	2.25	1725	4.46	-10.7	15.0	5.459		
10.56	1.3	2.08	1735	4.42	-17.8	15.1	5.413		
10.59	1.50	1.97	1736	4.39	-24.3	14.9	5.456		
11:03	1.7	1.85	1738	4.35	-29.1	14.7	5.456		
11:07	1.9	1.66	1742	4.37	-33.3	14.8	5.462		
11:09	2.0	1.56	1751	4.33	-36.6	14.7	5.457		
11.10	2.1	1.51	1756	4.32	-38.8	14.7	5.455		
11.12	2.2	1.49	1761	4.31	-40.2	14.2	5.455		
11 14	2.3	1.49	1761	4.29	-40.2	14.8	5.453		
		±10%	±3%	±0.05	±10mV	±0.2	<0.1m		Turbidity, Colour, Odour, Sheen, Other

Sample ID	Type	Container	Analysis	Preservatives	Lab
LL13	Primary	2plv 2amber			

Bore Volume Calcul $\pi r_1^2 \times h_1 + (n \times (\pi r_2^2 \times h_2) - (\pi r_1^2 \times h_2)) \times 100000$
n = gravel pack porosity (0.3), r_1 = well radius (m), r_2 = ann
h_1 = water coloumn length (m), h_2 = length of saturated gra
π = 3.142

Field QA Checks
Air bubbles in vials? Y / [✓ N]
Any violent reactions? Y / [✓ N]
Equipment cleaned and decontaminated? [✓ Y] / N

Bore Condition:

Well ID	LL15	Sampled By:	AHo	Initial SWL:	6.41	Water Level Meter Type:	Solinst
Project Number:	30765.02	Location:	Hanson Yannathan Quarry	SWL after pump added:	6.354	Water Quality Meter Type:	YSI
Project Name:	Yannathan GME	Purge Method:	Low Flow	Total Depth:	19.92.	Pump Intake Setting:	15 m
Date:	13/10/22 ~~12-Oct-22~~	Sample Method:	Low Flow	Screened Interval:			

Start: 1.58 Stop: 2-20 Before Pumping SWL: 6.354 Final SWL: 6.325 Weather: wet

Time	Vol (L)	DO (mg/L)	EC (µS/cm)	pH	ORP (mV)	Temp (°C)	SWL m(BTOC)	Flow/Purge Rate	Notes/Observations
2.01	0.3	1.16	389.5	4.46	1.7	15.2	6.35	25/5	
2.05	0.5	0.88	386.6	4.43	-2.0	15.3	6.355		
2.07	0.7	0.88	387.5	4.41	-2.6	15.3	6.35		
2.12	0.9	0.9	388.4	4.44	-3.6	15.3	6.343		
2.15	1.1	0.9	391.7	4.38	-3.3	15.5	6.339		
2.20	1.3	0.89	394	4.37	-4.3	15.5	6.325	v	
		±10%	±3%	±0.05	±10mV	±0.2	<0.1m		Turbidity, Colour, Odour, Sheen, Other

Sample ID	Type	Container	Analysis	Preservatives	Lab
LL15	2p 1v 1	amber			

Bore Volume Calcul: $\pi r_1^2 \times h_1 + (n \times (\pi r_2^2 \times h_2) - (\pi r_1^2 \times h_2)) \times 100000$
n = gravel pack porosity (0.3), r_1 = well radius (m), r_2 = ann
h_1 = water coloumn length (m), h_2 = length of saturated gra
π = 3.142

Field QA Checks
Air bubbles in vials? Y / N
Any violent reactions? Y / N
Equipment cleaned and decontaminated? Y / N

Bore Condition:

Well ID	LL16.	Sampled By:	SS + AH	Initial SWL:	9.228	Water Level Meter Type:	Solinst
Project Number:	30765.02	Location:	Hanson Yannathan Quarry	SWL after pump added:	9.243	Water Quality Meter Type:	YSI
Project Name:	Yannathan GME	Purge Method:	Low Flow	Total Depth:	14430	Pump Intake Setting:	12 m
Date:	12-Oct-22	Sample Method:	Low Flow	Screened Interval:			

Start: 4.26 Stop: 5.09 Before Pumping SWL: 9.245 Final SWL: Weather:

Time	Vol (L)	DO (mg/L)	EC (µS/cm)	pH	ORP (mV)	Temp (°C)	SWL m(BTOC)	Flow/Purge Rate	Notes/Observations
4.39	0.2	1.86	769	5.63	126.6	14.5	9.248	25/5	CPMz 25/5
4.44	0.4	0.71	767	5.57	137	14.6	9.250		Clear.
4.46	0.6	0.44	768	5.56	139.7	14.4	9.245		
4:49.	0.8	0.33	784	5.12	120.6	14.4	9.255		
4:51	0.9	0.28	633	5.59	127.9	14.4	9.252		
4:53	1.0	0.24	778	5.61	105.9	14.4	9.252		
4:55	1.1	0.18	634	5.68	9		9.250		
4.55	1.1	0.1	780	5.66		14.5			Battery died in YSI m changed meter
5.00	1.2	1.34	830	5.41	135.8	16.1	9.252		
5.02	1.3	0.37	833	5.30	137.7	16.2	9.296		
5.03	1.4	0.57	833	5.37	139.1	16.0	9.251		
5.05	1.6	0.46	828	5.37	139.8	15.7	9.249		
5.07	1.7	0.41	826	5.36	140.1	15.6	9.250		
5.08	1.8	0.38	822	5.32	140.	15.6	9.250		
5.09	1.9	0.34	826	5.36	138.6	15.6	9.255		
		±10%	±3%	±0.05	±10mV	±0.2	<0.1m		Turbidity, Colour, Odour, Sheen, Other

500
0.6
0.7
0.6
0.9
1.0
1.1
1.2

Sample ID	Type	Container	Analysis	Preservatives	Lab
LL16	Prim	2p, 1v, 1amb			

Bore Volume Calcul $\pi r_1^2 \times h_1 + (n \times (\pi r_2^2 \times h_2) - (\pi r_1^2 \times h_2)) \times 100000$
n = gravel pack porosity (0.3), r_1 = well radius (m), r_2 = ann
h_1 = water coloumn length (m), h_2 = length of saturated gra
π = 3.142

Field QA Checks
Air bubbles in vials? Y [✓ N]
Any violent reactions? Y [✓ N]
Equipment cleaned and decontaminated? [✓ Y] N

Bore Condition:

Well ID	~~[illegible]~~ CC19	Sampled By:	SEJ	Initial SWL:	14.563	Water Level Meter Type:	Solinst
Project Number:	30765.02	Location:	Hanson Yannathan Quarry	SWL after pump added:	14.565	Water Quality Meter Type:	YSI
Project Name:	Yannathan GME	Purge Method:	Low Flow	Total Depth:	20.210	Pump Intake Setting:	18.4
Date:	13 ~~12~~-Oct-22	Sample Method:	Low Flow	Screened Interval:			

Start: 2.08 Stop: 2.50 Before Pumping SWL: 14.565 Final SWL: 14.553 Weather: wet

Time	Vol (L)	DO (mg/L)	EC (µS/cm)	pH	ORP (mV)	Temp (°C)	SWL m(BTOC)	Flow/Purge Rate	Notes/Observations
2.33	0.2	7.96	426.2	3.3	476.1	14.3	14.466	CPM4 90/10	Clear
2.37	0.3	7.59	473.0	3.2	498.9	14.3	14.555	CMP2 25/5	"
2.43	0.4	8.06	487.3	3.18	503.1	14.2	14.552	"	
2.47	0.5	8.31	492.8	3.18	505.1	14.1	14.553		
2.50	0.6	7.91	493.8	3.18	506.9	14.0	14.553	"	Sample.
		±10%	±3%	±0.05	±10mV	±0.2	<0.1m		Turbidity, Colour, Odour, Sheen, Other

Sample ID	Type	Container	Analysis	Preservatives	Lab
CC19	2p 1v 1	amber			

Bore Volume Calcul: $\pi r_1^2 \times h_1 + (n \times (\pi r_2^2 \times h_2) - (\pi r_1^2 \times h_2)) \times 100000$	**Field QA Checks**	**Bore Condition:**
n = gravel pack porosity (0.3), r$_1$ = well radius (m), r$_2$ = ann	Air bubbles in vials? Y / [✓ N]	
h$_1$ = water coloumn length (m), h$_2$ = length of saturated gra	Any violent reactions? Y / [✓ N]	
π = 3.142	Equipment cleaned and decontaminated? [✓ Y] / N	

Well ID LL20 | Sampled By: AH | Initial SWL: 8.513 | Water Level Meter Type: Solinst
Project Number: 30765.02 | Location: Hanson Yannathan Quarry | SWL after pump added: 8.547 | Water Quality Meter Type: YSI
Project Name: Yannathan GME | Purge Method: Low Flow | Total Depth: 20.75 | Pump Intake Setting: 16 m
Date: 13 ~~12~~Oct-22 | Sample Method: Low Flow | Screened Interval:

Start: 10:33 | Stop: 11:51 | Before Pumping SWL: 8.547 | Final SWL: | Weather: Wet

Time	Vol (L)	DO (mg/L)	EC (µS/cm)	pH	ORP (mV)	Temp (°C)	SWL m(BTOC)	Flow/Purge Rate	Notes/Observations
11.04	0.3	42.6	417.1	4.08	249.9	16.8	8.552	CPM 2	25/5
11.15	0.5	3.50	501	3.86	372.7	17	8.55		
11.24	0.7	3.45	550	3.88	376.5	16.6	8.53		
11.32	0.9	3.45	570	3.85	391.2	16.6	8.538		
11.36	1.1	3.31	572	3.85	393.3	15.9	8.546		
11.48	1.3	3.26	579	3.85	394	16.2	8.568		
11.51	1.4	3.24	580	3.85	396.1	16.2	8.554		
		±10%	±3%	±0.05	±10mV	±0.2	<0.1m		Turbidity, Colour, Odour, Sheen, Other

Sample ID	Type	Container	Analysis	Preservatives	Lab
LL20	Primary	2p, 1v, 1amber			

Bore Volume Calcul $\pi r_1^2 \times h_1 + (n \times (\pi r_2^2 \times h_2) - (\pi r_1^2 \times h_2)) \times 100000$
n = gravel pack porosity (0.3), r_1 = well radius (m), r_2 = ann
h_1 = water coloumn length (m), h_2 = length of saturated gra
π = 3.142

Field QA Checks
Air bubbles in vials? Y [✓ N]
Any violent reactions? Y [✓ N]
Equipment cleaned and decontaminated? [✓ Y] N

Bore Condition:

QA/QC REGISTER

Project Number: 30765.02	Location: Hanson Yannathan Quarry
Project Name: Yannathan GME	

Sample ID	Date	QA/QC Type	Parent Sample	Laboratory	Analysis	Rinsate water batch number, trip blank batch number etc.)
QC01	12-Oct-22	Blind Replicate	LL09	ALS	Dissolved organic carbon, nitrate, nitrite, ammonia, total Kjeldahl nitrogen (TKN), chloride and acrylamide	
QC02	12-Oct-22	Split	LL09	Eurofins	Dissolved organic carbon, nitrate, nitrite, ammonia, total Kjeldahl nitrogen (TKN), chloride and acrylamide	
QC03	12-Oct-22	Rinsate	NA	ALS	Dissolved organic carbon, nitrate, nitrite, ammonia, total Kjeldahl nitrogen (TKN), chloride and acrylamide	

Appendix C Results Tables

		Inorganics								Organic	
		pH (Field Result)	Nitrite + Nitrate as N	Ammonia as N	Chloride	Kjeldahl Nitrogen Total (as N)	Nitrate (as N)	Nitrite (as N)	Nitrogen (Total)	Total Organic Carbon	Acrylamide
		pH value	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L
EQL		0.01	0.01	0.01	1	0.1	0.01	0.01	0.1	1	0.2
ADWG 2022 Aesthetic		6.5 - 8.5		0.5	250						
ADWG 2022 Health						11 (note 1)		3			0.2
ANZG (2018) Freshwater 95% LOSP Toxicant DGVs (March 2021)				0.9			2.4 (note 2)				
ERS (2021) Table 5 Central Foothills and Coastal Plains		6.8 - 8.0				<1.1					
ANZECC 2000 Irrigation Long Term Trigger Values									5		
ANZECC 2000 Irrigation Short Term Trigger Values								3.29			
AS5100 Concrete Exposure Classification		>5.5			2000						
Field ID	Date										
LL8	12 Oct 2022	4.5	0.01	0.44	288	0.7	0.01	<0.01	0.7	11	<0.2
LL9	12 Oct 2022	4.21	<0.01	0.41	1,170	0.7	<0.01	<0.01	0.7	14	<0.2
QC01	12 Oct 2022	-	<0.01	0.40	1,200	0.5	<0.01	<0.01	0.5	18	<0.2
QC02	12 Oct 2022	-	-	0.32	1,200	3.0	<0.02	<0.02	-	20*	<1,000
LL13	13 Oct 2022	4.29	0.06	0.14	750	0.1	0.06	<0.01	0.2	<5	<0.2
LL15	13 Oct 2022	4.37	0.02	0.02	81	0.5	0.02	<0.01	0.5	9	<0.2
LL16	12 Oct 2022	5.36	0.98	0.07	240	0.6	0.98	<0.01	1.6	6	<0.2
LL19	13 Oct 2022	3.18	<0.01	0.76	134	1.1	<0.01	<0.01	1.1	11	<0.2
LL20	13 Oct 2022	3.85	3.43	0.04	216	0.6	3.43	<0.01	4.0	1	<0.2
POND	13 Oct 2022	6.28	0.05	0.14	178	0.1	0.05	<0.01	0.2	<1	<0.2

*Reported as DOC by Eurofins however samples were not field filtered so comparable data has been represented against TOC

Note 1: Total Nitrogen 50 mg/L as nitrate converted to as nitrogen

Note 2: Hickey 2013

Environmental Standards
NHMRC, May 2022, ADWG 2022 Aesthetic
NHMRC, May 2022, ADWG 2022 Health
ANZG, March 2021, ANZG (2018) Freshwater 95% LOSP Toxicant DGVs (March 2021)
DoE, 2000, ANZECC 2000 FW 95%
DoE, 2000, ANZECC 2000 Irrigation Long Term Trigger Values
DoE, 2000, ANZECC 2000 Irrigation Short Term Trigger Values
Hickey, 2013, Updating Nitrate Toxicity Effects on Freshwater Aquatic Species

Appendix D Laboratory Documentation