NOTE:  
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
VERTICAL TURBINE PUMPS

CONCRETE DECKING

CONCRETE CAISSON (NOTE 1)

FISH EXCLUSION SCREEN WITH RETRIEVAL SYSTEM TO ENABLE LIFTING OF THE SCREEN FOR MAINTENANCE. REFER DRAWINGS AEG155-0000-TD-DRG-CV-0100 FOR FISH SCREEN MODELS.

CONCRETE WALL PERFORATED TO ALLOW INFLOW OF SEAWATER TO FISH SCREENS (NOTE 1)

PUMF CENTERLINE
11m AHD
JETTY DECK LEVEL
10.5m AHD

HEADSTOCK LEVEL
5m AHD

SEA LEVEL
5m AHD (VARIATION IS BETWEEN 0.75 AND 0.88m AHD)

CAISSON INVERT LEVEL
-5m AHD

NOTES:
1. SOME DETAILS OMITTED FROM THE CAISSON STRUCTURE, REFER TO DRAWINGS AEG155-0000-TD-DRG-CV-1000 AND 1001 FOR CAISSON DETAILS.
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.

DISCLAIMER
THE INFORMATION contained in this document is for information purposes only and is not intended to form an element of a contract or agreement. KBR shall not be liable for any loss or damage of any nature incurred as a result of, or in relation to, the use of this document.

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR. NOT FOR CONSTRUCTION.
NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
RAILING
CONCRETE DECKING

GRP DISCHARGE AT END OF JETTY
THROUGH CONE VALVE DIFFUSER NOZZLE

RAILING
CONCRETE DECKING

GRAVITY FOUNDATION

RAILING
CONCRETE DECKING

RAILING
CONCRETE DECKING

RAILING
CONCRETE DECKING

RAILING
CONCRETE DECKING

SHEET 1 OF 1

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
NOTES:

1. DREDGING FOR PUMP OUT INFRASTRUCTURE WILL BE REQUIRED WITH TEMPORARY DREDGATE PIPEWORK RUN ON GROUND AND ADJACENT ACCESS TRACK TO NEAR SHORE DISCHARGE.

2. IT IS EXPECTED THAT PIPELINE INSTALLATION FOR PUMP OUT INFRASTRUCTURE WILL UTILISE CONVENTIONAL OPEN TRENCHING, HOWEVER THE CONSTRUCTION METHOD WILL BE CONFIRMED DURING DETAILED DESIGN.
POSSIBLE BARGE RECEIVAL POINT AND LAYDOWN AREA (APPROX 1 Ha)

POSSIBLE MARINE CONSTRUCTION LAYDOWN AREA (APPROX 1 Ha)

POSSIBLE LAYDOWN AREA AND BARGING POINT (APPROX 1 Ha)

BARGE MOVEMENT ROUTE (APPROX 50m WIDE x 4350m LONG x 1m DEEP DREDGE REQUIRED)

OCEAN BEACH FOR ENLARGEMENT, REFER DRG. No. AEG155-0000-TD-DRG-CV-0402

COORONG SOUTH LAGOON

NOTES:

1. Haul route for breakwater materials will be along ocean beach.
2. Dredging for pump out infrastructure and barge route will be required with temporary dredgate pipework run on ground and adjacent access track to nearshore discharge.
3. It is expected that pipeline installation for pump out infrastructure will utilise conventional open trenching. However, the construction method will be confirmed during detailed design.

NOTE: THIS DRAWING IS TO BE PRINTED IN COLOUR

NOT FOR CONSTRUCTION
1. Haul route for breakwater materials will be along Ocean Beach.
2. Dredging for pump out infrastructure and barge route will be required with temporary dredgate pipework run on ground and adjacent access track to near shore discharge.
3. It is expected that pipeline installation for pump out infrastructure will utilise conventional open trenching. However, the construction method will be confirmed during detailed design.

NOTES:

- POSSIBLE BARGE RECEIVAL POINT & LAYDOWN AREA (APPROX 1 Ha)
- POSSIBLE MARINE CONSTRUCTION LAYDOWN AREA (APPROX 1 Ha)
- 6m WIDE ACCESS (TYPICAL)
- POSSIBLE CRANE PAD AND CONCRETE BATCHING PLANT WITHIN CLEARED PUMP STATION AREA

CONSTRUCTION ACCESS

SCALE 1 : 1250

NOTE: THIS DRAWING IS TO BE PRINTED IN COLOUR

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
SITEWIDE
CONSTRUCTION ACCESS - OPTIONS 3, 4, 5 & 6 SHEET 2

AEG155-0000-TD-DRG-CV-0402

NOT FOR CONSTRUCTION
NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
NOTICE:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
DUNE TRENCH
TYPICAL DETAIL

NOTE:
1. ALL DIMENSIONS SHOWN ARE IN MILLIMETRES, UNLESS NOTED OTHERWISE.

PIPE DIAMETER VARIES
DUNE TO BE BACKFILLED AND REINSTATED.
DUNE EMBANKMENT TO BE EXCAVATED AND STOCKPILED ON SITE

SIDE ZONE/INITIAL BACKFILL
(TO BE INSTALLED TO MANUFACTURER'S SPECIFICATIONS)

Haunch Zone Backfill
(TO BE INSTALLED TO MANUFACTURER'S SPECIFICATIONS)

COMPACTED PIPE BEDDING

THIS DOCUMENT CONTAINS INTELLECTUAL PROPERTY RIGHTS OWNED BY OR LICENSED TO THE CLIENT AND DESIGN SERVICES CONSULTANT, AND MUST NOT BE REPRODUCED OR DISCLOSED OTHER THAN IN ACCORDANCE WITH THE DESIGN SERVICES CONTRACT, DESIGN SERVICES SUBCONTRACT AND SUBCONSULTANT DEED OF COVENANT BETWEEN THE CLIENT, DESIGN SERVICES CONSULTANT AND DESIGN SERVICES SUBCONSULTANT.

DISCLAIMER

NOTE:
1. ALL DIMENSIONS SHOWN ARE IN MILLIMETRES, UNLESS NOTED OTHERWISE.
PRECAST HEAVY DUTY PAVEMENT
REINFORCED CONCRETE PATHWAY
C
5.00 m
OCEAN SIDE
DOUBLE LAYER PRIMARY ARMOUR -
REINFORCED CONCRETE
(THICKNESS OF DOUBLE = 2.9m)
1
1.5
1
1.5
+2.33 mAHD TOP OF ARMOUR EL.
SECONDARY ARMOUR
M
50
= 750 kg
STANDARD GRADING HMA
300/1000 kg
CREST ELEMENT
REINFORCED CONCRETE
+3.43 mAHD CREST ELEMENT EL.
-8.800 mAHD (VARIES)
DESIGN TOE LEVEL
LAT
ROCK TOE PROTECTION
(BURIED 2.0m MIN DEPTH)
IMPORTED CORE (SECONDARY ARMOUR)
LEE SIDE (BASIN)
2.52 m
2.55 m
14.00 m
14.00 m
NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. OVERTOPPING LIMITED TO 1.0 L/s/m SAFE FOR PEDESTRIANS.
3. CREST LEVEL SET TO ALLOW FOR 40 ML/day OVERTOPPING VOLUME DURING AMBIENT CONDITIONS.

SCALE 1 : 100

HEAD UNITS

<table>
<thead>
<tr>
<th>MASS OF UNIT (t)</th>
<th>DIMENSION</th>
<th>EQUIVALENT UNIT LENGTH (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>635</td>
<td>3.25</td>
</tr>
<tr>
<td>B</td>
<td>327</td>
<td>1.50</td>
</tr>
<tr>
<td>C</td>
<td>1295</td>
<td>6.25</td>
</tr>
<tr>
<td>D</td>
<td>1363</td>
<td>6.20</td>
</tr>
<tr>
<td>E</td>
<td>555</td>
<td>7.00</td>
</tr>
<tr>
<td>F</td>
<td>1836</td>
<td>15.10</td>
</tr>
<tr>
<td>G</td>
<td>506</td>
<td>2.00</td>
</tr>
<tr>
<td>H</td>
<td>2631</td>
<td>3.40</td>
</tr>
<tr>
<td>I</td>
<td>1775</td>
<td>2.70</td>
</tr>
<tr>
<td>J</td>
<td>555</td>
<td>2.00</td>
</tr>
<tr>
<td>K</td>
<td>3688</td>
<td>3.00</td>
</tr>
<tr>
<td>L</td>
<td>3589</td>
<td>3.00</td>
</tr>
</tbody>
</table>

SIDE UNITS

<table>
<thead>
<tr>
<th>MASS OF UNIT (t)</th>
<th>DIMENSION</th>
<th>EQUIVALENT UNIT LENGTH (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>983</td>
<td>1.37</td>
</tr>
<tr>
<td>B</td>
<td>341</td>
<td>2.00</td>
</tr>
<tr>
<td>C</td>
<td>1078</td>
<td>2.00</td>
</tr>
<tr>
<td>D</td>
<td>982</td>
<td>2.00</td>
</tr>
<tr>
<td>E</td>
<td>351</td>
<td>2.00</td>
</tr>
<tr>
<td>F</td>
<td>1656</td>
<td>1.37</td>
</tr>
<tr>
<td>G</td>
<td>406</td>
<td>2.00</td>
</tr>
<tr>
<td>H</td>
<td>1265</td>
<td>2.00</td>
</tr>
<tr>
<td>I</td>
<td>1370</td>
<td>2.00</td>
</tr>
<tr>
<td>J</td>
<td>685</td>
<td>2.00</td>
</tr>
<tr>
<td>K</td>
<td>2466</td>
<td>2.00</td>
</tr>
<tr>
<td>L</td>
<td>2714</td>
<td>2.00</td>
</tr>
</tbody>
</table>

BREAKWATER - TYPICAL SECTION

DESIGN TOE LEVEL
NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. JETTY DECK HIDDEN FROM SECTION.

CABLE RACK
STEEL MEMBER
TURBINE RETURN SHAFT FASTENER

SAND SLURRY REJECTION PIPEWORK

SAND SLURRY REJECTION PIPEWORK
FISH SCREEN GUIDE RAILS FOR LIFTING

CONCRETE WALL PERFORATED TO ALLOW INFLOW OF SEAWATER TO FISH SCREENS. PERFORATION QUANTITY AND SIZE TO BE CONFIRMED DURING DETAILED DESIGN TO ENSURE APPROACH VELOCITY MATCHES ALLOWABLE FISH SCREEN APPROACH VELOCITY.

FISH EXCLUSION SCREEN WITH RETRIEVAL SYSTEM. REFER DRG. No. AEG155-0000-TD-DRG-ME-0001 FOR FISH SCREEN MODELS

NOTE: THIS DRAWING IS TO BE PRINTED IN COLOUR

NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
LONG JETTY OCEAN WATER INTAKE / OUTFALL
CAISSON STRUCTURE SECTION
NOTE:
1. FISH EXCLUSION SCREENS SUPPLIED BY AWMA, REFER AWMA FOR FURTHER DETAILS.
   FINAL SCREEN TYPES AND DIMENSIONS TO BE CONFIRMED DURING DETAILED DESIGN.

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
FISH SCREEN DETAIL

NOTE: THIS DOCUMENT CONTAINS INTELLECTUAL PROPERTY RIGHTS OWNED BY OR LICENSED TO THE CLIENT AND DESIGN SERVICES CONSULTANT, AND MUST NOT BE REPRODUCED OR DISCLOSED OTHER THAN IN ACCORDANCE WITH THE DESIGN SERVICES CONTRACT, DESIGN SERVICES SUBCONTRACT AND SUBCONSULTANT DEED OF COVENANT BETWEEN THE CLIENT, DESIGN SERVICES CONSULTANT AND DESIGN SERVICES SUBCONSULTANT.
DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
LAKE ALBERT CONNECTOR OPTION 1A

<table>
<thead>
<tr>
<th>DRAWING No.</th>
<th>DRAWING TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEG155-0000-TD-DRG-CV-0001</td>
<td>PROJECT KEY PLAN</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0800</td>
<td>TYPICAL TRENCH DETAILS</td>
</tr>
<tr>
<td>AEG155-1000-TD-DRG-CV-0001</td>
<td>COVER SHEET AND DRAWING LIST</td>
</tr>
<tr>
<td>AEG155-1000-TD-DRG-CV-0002</td>
<td>LAKE ALBERT CONNECTOR OPTION 1A/B - OPTIONS KEY PLAN</td>
</tr>
<tr>
<td>AEG155-1000-TD-DRG-CV-1000</td>
<td>LAKE ALBERT CONNECTOR OPTION 1A - PLAN AND LONGITUDINAL SECTION SHEET 1 OF 4</td>
</tr>
<tr>
<td>AEG155-1000-TD-DRG-CV-1001</td>
<td>LAKE ALBERT CONNECTOR OPTION 1A - PLAN AND LONGITUDINAL SECTION SHEET 2 OF 4</td>
</tr>
<tr>
<td>AEG155-1000-TD-DRG-CV-1002</td>
<td>LAKE ALBERT CONNECTOR OPTION 1A - PLAN AND LONGITUDINAL SECTION SHEET 3 OF 4</td>
</tr>
<tr>
<td>AEG155-1000-TD-DRG-CV-1003</td>
<td>LAKE ALBERT CONNECTOR OPTION 1A - PLAN AND LONGITUDINAL SECTION SHEET 4 OF 4</td>
</tr>
<tr>
<td>AEG155-1000-TD-DRG-CV-7000</td>
<td>LAKE ALBERT CONNECTOR OPTION 1A - INLET REGULATING STRUCTURE - SITE PLAN</td>
</tr>
<tr>
<td>AEG155-1000-TD-DRG-CV-7001</td>
<td>LAKE ALBERT CONNECTOR OPTION 1A/B - INLET REGULATING STRUCTURE - ELEVATION</td>
</tr>
</tbody>
</table>

NOT FOR CONSTRUCTION
OPEN CHANNEL DISCHARGE INTO COORONG NORTH LAGOON (DESIGN: INVERT LEVEL -1.48 m AHD).

CHANNEL EXCAVATED SPOIL TO BE STOCKPILED ADJACENT. REFER AEG155-1000-TD-DRG-CV-7100

<table>
<thead>
<tr>
<th>CHAINAGE</th>
<th>DESIGN INVERT LEVEL</th>
<th>EXISTING SURFACE</th>
<th>DEPTH TO INVERT</th>
<th>CHAINAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>-1.48</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>50.00</td>
<td>-1.47</td>
<td></td>
<td></td>
<td>50.00</td>
</tr>
<tr>
<td>100.00</td>
<td>-1.46</td>
<td></td>
<td></td>
<td>100.00</td>
</tr>
<tr>
<td>150.00</td>
<td>-1.45</td>
<td></td>
<td></td>
<td>150.00</td>
</tr>
<tr>
<td>200.00</td>
<td>-1.44</td>
<td></td>
<td></td>
<td>200.00</td>
</tr>
<tr>
<td>250.00</td>
<td>-1.43</td>
<td></td>
<td></td>
<td>250.00</td>
</tr>
<tr>
<td>300.00</td>
<td>-1.42</td>
<td></td>
<td></td>
<td>300.00</td>
</tr>
<tr>
<td>350.00</td>
<td>-1.41</td>
<td></td>
<td></td>
<td>350.00</td>
</tr>
<tr>
<td>400.00</td>
<td>-1.40</td>
<td></td>
<td></td>
<td>400.00</td>
</tr>
<tr>
<td>450.00</td>
<td>-1.39</td>
<td></td>
<td></td>
<td>450.00</td>
</tr>
<tr>
<td>500.00</td>
<td>-1.38</td>
<td></td>
<td></td>
<td>500.00</td>
</tr>
<tr>
<td>550.00</td>
<td>-1.37</td>
<td></td>
<td></td>
<td>550.00</td>
</tr>
<tr>
<td>600.00</td>
<td>-1.36</td>
<td></td>
<td></td>
<td>600.00</td>
</tr>
<tr>
<td>650.00</td>
<td>-1.35</td>
<td></td>
<td></td>
<td>650.00</td>
</tr>
<tr>
<td>700.00</td>
<td>-1.34</td>
<td></td>
<td></td>
<td>700.00</td>
</tr>
<tr>
<td>750.00</td>
<td>-1.33</td>
<td></td>
<td></td>
<td>750.00</td>
</tr>
<tr>
<td>800.00</td>
<td>-1.32</td>
<td></td>
<td></td>
<td>800.00</td>
</tr>
<tr>
<td>850.00</td>
<td>-1.31</td>
<td></td>
<td></td>
<td>850.00</td>
</tr>
<tr>
<td>900.00</td>
<td>-1.30</td>
<td></td>
<td></td>
<td>900.00</td>
</tr>
<tr>
<td>950.00</td>
<td>-1.29</td>
<td></td>
<td></td>
<td>950.00</td>
</tr>
<tr>
<td>1000.00</td>
<td>-1.28</td>
<td></td>
<td></td>
<td>1000.00</td>
</tr>
<tr>
<td>1050.00</td>
<td>-1.27</td>
<td></td>
<td></td>
<td>1050.00</td>
</tr>
</tbody>
</table>

LAKE ALBERT DRAIN LONGITUDINAL SECTION

- BASE WIDTH: 13.3m
- BATTER SLOPE: 1H IN 4V
- TOTAL CUT: 288.975 m³

NOT FOR CONSTRUCTION
LAKE ALBERT INLET REGULATOR (NARRUNG ROAD): 5 OFF 2.7m W x 2.7m H x 12.0m L REINFORCED CONCRETE BOX CULVERT (RCBC). REFER DRG No. AEG155-1000-TD-DRG-CV-7000 & 7001

CHANNEL EXCAVATED SPOIL TO BE STOCKPILED ADJACENT. REFER AEG155-1000-TD-DRG-CV-7100

CHAINAGE DESIGN INVERT LEVEL DEPTH TO INVERT EXISTING SURFACE DATUM R.L.-39.000
LAKE ALBERT TO COORONG NORTH LAGOON CONNECTOR FLOW

1. TWO 2.0m WIDE x 2.0m LONG ROCK RIFFLES, 150mm FALL BETWEEN

2. 2100mm WIDE CULVERT (LEGS UP) WITH STOCK GRID OVER CULVERT FOR VEHICULAR PASSAGE TO REGULATOR

3. 2100mm WIDE CULVERT (LEGS UP) WITH GRATED COVER AND STOP LOGS TO UPSTREAM SIDE. CULVERT IL. 0.700 mAHD

4. THREE 2.0m WIDE x 2.0m LONG ROCK RIFFLES, 100mm FALL BETWEEN

5. 2100mm WIDE CULVERT (LEGS UP) WITH GRATED COVER AND STOP LOGS TO UPSTREAM SIDE. CULVERT IL. 0.400 mAHD

6. SHEET PILE CUT OFF TO EL. -6.00 mAHD (5.0m LONG PILES). SHEET PILE, MINIMUM GAUGE 6mm, MINIMUM GRADE 235 MPa

7. COMMENCE TO FLOW 1

8. COMMENCE TO FLOW 2

9. REGULATING STRUCTURE WITH 5 OFF PENSTOCKS AND 2 OFF LAYFLAT GATES (IL. -1.000 mAHD). REFER DRG. No. AEG155-1000-TD-DRG-CV-7001 FOR ELEVATION DETAILS

10. MINIMUM 350mm THICK HEAD WALLS, REINFORCEMENT RATE 150 Kg/m³

11. BASE SLAB THICKNESS 300mm MINIMUM WITH CUT-OFF WALL AT EL. MINIMUM GAUGE 8mm MINIMUM THICKNESS 255.16mm

12. FISHWAY ENTRANCE

13. FISHWAY DESIGN PARAMETERS

- TWL LAKE ALBERT: 1.200 mAHD
- TWL COORONG NORTH: 1.000 mAHD
- BWL LAKE ALBERT: 0.400 mAHD
- BWL COORONG NORTH: -0.200 mAHD
- COMMENCE TO FLOW 1: 0.700 mAHD
- COMMENCE TO FLOW 2: 0.400 mAHD

14. MINIMUM 350mm THICK WING WALLS, REINFORCEMENT RATE 170 Kg/m³

15. LAKE ALBERT CONNECTOR (CHANNEL) INLET REGULATING STRUCTURE - SITE PLAN

NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. FISHWAY SHALL INCLUDE GEOSYNTHETIC CLAY LINER FINISHING 0.50m BELOW FINAL GROUND SURFACE AT TOP OF BATTERS. RIM BEAMS SHALL EXTEND THROUGH TO 0.10m BELOW FINAL GROUND SURFACE.
3. ALL STRUCTURAL STEEL TO BE HOT DIP GALVANIZED.

FISHWAY DESIGN PARAMETERS

- TWL LAKE ALBERT: 1.200 mAHD
- TWL COORONG NORTH: 1.000 mAHD
- BWL LAKE ALBERT: 0.400 mAHD
- BWL COORONG NORTH: -0.200 mAHD
- COMMENCE TO FLOW 1: 0.700 mAHD
- COMMENCE TO FLOW 2: 0.400 mAHD

LAKE ALBERT CONNECTOR OPTION 1A
INLET REGULATING STRUCTURE - SITE PLAN

DEPARTMENT FOR ENVIRONMENT AND WATER COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT LAKE ALBERT CONNECTOR OPTION 1A INLET REGULATING STRUCTURE - SITE PLAN
NOTES:

1. ALL DIMENSIONS IN MILLIMETRES, UNLESS NOTED OTHERWISE.
2. INLET REGULATING STRUCTURE APPLICABLE TO BOTH CHANNEL (OPTION 1A) AND PIPE CONNECTOR (OPTION 1B) OPTIONS.

LAKE ALBERT CONNECTOR INLET REGULATING STRUCTURE - ELEVATION (FACING DOWNSTREAM)

NOTE: LAY-FLAT GATES OMITTED.

<table>
<thead>
<tr>
<th>CULVERT #</th>
<th>DESCRIPTION</th>
<th>HEIGHT &quot;H&quot; (mm)</th>
<th>MIN. OPEN HEIGHT &quot;OH&quot; (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SINGLE LEAF PENSTOCK</td>
<td>2500</td>
<td>2500</td>
</tr>
<tr>
<td>2</td>
<td>SINGLE LEAF PENSTOCK</td>
<td>2500</td>
<td>2500</td>
</tr>
<tr>
<td>3</td>
<td>SINGLE LEAF PENSTOCK</td>
<td>2500</td>
<td>2100</td>
</tr>
<tr>
<td>4</td>
<td>SINGLE LEAF PENSTOCK</td>
<td>2500</td>
<td>2100</td>
</tr>
<tr>
<td>5</td>
<td>SINGLE LEAF PENSTOCK</td>
<td>2500</td>
<td>2500</td>
</tr>
<tr>
<td>6</td>
<td>LAY-FLAT GATE</td>
<td>2500</td>
<td>N/A</td>
</tr>
<tr>
<td>7</td>
<td>LAY-FLAT GATE</td>
<td>2500</td>
<td>N/A</td>
</tr>
</tbody>
</table>

TEN OFF 6.0m x 2.0m x 0.3m ROCK FILLED BATTER PROTECTION MATRIMESSES PLACED BETWEEN ROCK PROTECTION ON BATTER SLOPES.

HOT DIP GALVANISED HAND RAILS AND KICK PLATES TO AS1657 TO TOP OF WING WALL.

ROCK PROTECTION TO BATTER SLOPES (FOUR LOCATIONS).

NOTE: LAY-FLAT GATES OMITTED.

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
LAKE ALBERT CONNECTOR OPTION 1A/B
INLET REGULATING STRUCTURE - ELEVATION

F. RAPONI
S. WEBB
B. CHUA
P. STANIFORD
P. STANIFORD
M. PIGNATA

Monday, 20 December 2021 4:48:47 PM

ISSUED FOR CLIENT REVIEW
28.10.2021

CONCEPT DESIGN ISSUE
1.12.2021

FINAL CONCEPT ISSUE
12.21.2021

FILE:
O:\G&I\CAD\PROJECTS\AEG155\03 CAD\CIVIL\01 DRAWINGS\AEG155-1000-TD-DRG-CV-7001.DWG

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
LAKE ALBERT CONNECTOR OPTION 1A/B
INLET REGULATING STRUCTURE - ELEVATION
NOTES:
1. CHANNEL INVERT LEVEL SHOWN ON LONGITUDINAL SECTIONS
(AEG155-1000-TD-DRG-CV-1000 TO 1002).
2. SPOIL MOUND TO BE GRASSED TO MINIMISE EROSION AND DUST, EITHER WITH NATIVE
   GRASSES OR SIMILAR.
3. TOP OF SPOIL MOUND SHALL BE TRAFFICABLE. ALL ENDS OF SPOIL MOUNDS SHALL HAVE
   MAX. 1V : 8H APPROACH GRADES. SPOIL MOUND SHALL BE CONTINUOUS UNLESS NOTED
   OTHERWISE.
4. CHANNEL BATTER SLOPES 1V : 4H.

TOP OF SPOIL MOUND

VARIES DEPENDING ON VOLUME OF SPOIL

N.S.L.

DESIGN W.L.

FLOODWAY TOP WIDTH

5.00 MIN.

VARIES DEPENDING ON VOLUME OF SPOIL

SPOIL MOUND

TRAFFICABLE

ACCESS

CONSTRUCTED CHANNEL

PLANE/FRONT TOP WIDTH:

FLOODWAY TOP WIDTH:

CHANNEL BASE WIDTH (1.27)

TYPICAL CHANNEL CROSS SECTION

1 : 250

1V : 4H (TYP.)
DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
LAKE ALBERT CONNECTOR OPTION 1B

DRAWING LIST: LAKE ALBERT CONNECTOR OPTION 1B

<table>
<thead>
<tr>
<th>DRAWING No.</th>
<th>DRAWING TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEG155-0000-TD-DRG-CV-0001</td>
<td>PROJECT KEY PLAN</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0800</td>
<td>TYPICAL TRENCH DETAILS</td>
</tr>
<tr>
<td>AEG155-1500-TD-DRG-CV-0001</td>
<td>COVER SHEET AND DRAWING LIST</td>
</tr>
<tr>
<td>AEG155-1000-TD-DRG-CV-0002</td>
<td>LAKE ALBERT CONNECTOR OPTION 1A/B - OPTIONS KEY PLAN</td>
</tr>
<tr>
<td>AEG155-1500-TD-DRG-CV-1000</td>
<td>LAKE ALBERT CONNECTOR OPTION 1B - PLAN AND LONGITUDINAL SECTION SHEET 1 OF 3</td>
</tr>
<tr>
<td>AEG155-1500-TD-DRG-CV-1001</td>
<td>LAKE ALBERT CONNECTOR OPTION 1B - PLAN AND LONGITUDINAL SECTION SHEET 2 OF 3</td>
</tr>
<tr>
<td>AEG155-1500-TD-DRG-CV-1002</td>
<td>LAKE ALBERT CONNECTOR OPTION 1B - PLAN AND LONGITUDINAL SECTION SHEET 3 OF 3</td>
</tr>
<tr>
<td>AEG155-1500-TD-DRG-CV-7000</td>
<td>LAKE ALBERT CONNECTOR OPTION 1B - INLET REGULATING STRUCTURE - SITE PLAN</td>
</tr>
<tr>
<td>AEG155-1000-TD-DRG-CV-7001</td>
<td>LAKE ALBERT CONNECTOR OPTION 1B - INLET REGULATING STRUCTURE - ELEVATION</td>
</tr>
</tbody>
</table>

P.J.S.  J.T.B.  P.J.S.  B.C.  M.V.P.
### PLAN

**Scale 1:2000**

**Lake Albert Connector Option 1B Longitudinal Section**

<table>
<thead>
<tr>
<th>Chainage</th>
<th>Depth to Invert</th>
<th>Existing Surface</th>
<th>Design Invert Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>000.00</td>
<td>-1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>005.00</td>
<td>-1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>010.00</td>
<td>-1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>015.00</td>
<td>-1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>020.00</td>
<td>-1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>025.00</td>
<td>-1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>030.00</td>
<td>-1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>035.00</td>
<td>-1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>040.00</td>
<td>-1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>045.00</td>
<td>-1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>050.00</td>
<td>-1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Pipe Discharge into Coorong North Lagoon with Concrete Headwall (Invert Level -1.28 mAHD)**

**Discharge Power and Piped Flow Along the Side of Seven Mile Road**

**Overhead Power and Poles Run Along the Side of Seven Mile Road**

**Telstra Run Along the Side of Seven Mile Road**

**Design Invert Level**, **Existing Surface**

**Chainage**

**Lake Albert Connector Option 1B Plan and Longitudinal Section Sheet 1 of 3**

**Not For Construction**

---

**Kellogg Brown & Root Pty Ltd**

**ABN 91 007 660 317**

---

**FOR CONSTRUCTION RE: ORIG. SIZE**

---

**G & I CAD PROJECTS AEG155 03 CAD CIVIL 01 DRAWINGS AEG155-1500-TD-DRG-CV-1000**

---

**DATE: Tuesday, December 21, 2021 12:30:48 PM**

**FILE: O:\G & I CAD PROJECTS AEG155 03 CAD CIVIL 01 DRAWINGS AEG155-1500-TD-DRG-CV-1000.DWG**

---

**CONCEPT DESIGN ISSUE**

**FINAL CONCEPT ISSUE**

---

**P. STANIFORD**

**B. CHUA**

**S. WEBB**

**M. PIGNATA**

---

**DISCLAIMER**

This document contains intellectual property rights owned by or licensed to the client and design services consultant, and must not be reproduced or disclosed other than in accordance with the design services contract, design services subcontract and subconsultant deed of covenant between the client, design services consultant and design services subconsultant.
BASCOMBE BAY, LAKE ALBERT OPEN CHANNEL INLET (INVERT LEVEL -1.00 m.AHD)

<table>
<thead>
<tr>
<th>CHAINAGE</th>
<th>DESIGN INVERT LEVEL</th>
<th>EXISTING SURFACE</th>
<th>DEPTH TO INVERT</th>
<th>DATUM R.L.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2400.000</td>
<td>-1.000</td>
<td></td>
<td>0.000</td>
<td>-39.000</td>
</tr>
<tr>
<td>2450.000</td>
<td>-1.000</td>
<td>-0.975</td>
<td>-0.025</td>
<td>-39.353</td>
</tr>
<tr>
<td>2500.000</td>
<td>-1.000</td>
<td>-0.647</td>
<td>-0.353</td>
<td>-42.753</td>
</tr>
<tr>
<td>2550.000</td>
<td>-1.000</td>
<td>-0.500</td>
<td>-0.500</td>
<td>-42.753</td>
</tr>
<tr>
<td>2600.000</td>
<td>-1.000</td>
<td>-0.500</td>
<td>-0.500</td>
<td>-42.753</td>
</tr>
<tr>
<td>2650.000</td>
<td>-1.000</td>
<td>-0.500</td>
<td>-0.500</td>
<td>-42.753</td>
</tr>
<tr>
<td>2700.000</td>
<td>-1.000</td>
<td>-0.500</td>
<td>-0.500</td>
<td>-42.753</td>
</tr>
<tr>
<td>2723.934</td>
<td>-1.000</td>
<td>-0.500</td>
<td>-0.500</td>
<td>-42.753</td>
</tr>
</tbody>
</table>

SCALE 1:2000H; 1:500V

LAKE ALBERT CONNECTOR OPTION 1B LONGITUDINAL SECTION

NOT FOR CONSTRUCTION
LAKE ALBERT TO COORONG
NORTH LAGOON CONNECTOR

FLOW

SHEET PILE CUT-OFF WALL. 3.0m THICK. MINIMUM GAUGE 5mm. MINIMUM GRADE 235 MPa

2.50
5.0
2.50
1.00
1.00
1.50
2.50

LAKE ALBERT CONNECTOR (CHANNEL) INLET REGULATING STRUCTURE - SITE PLAN

NOT FOR CONSTRUCTION

NOTE:
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. ALL STRUCTURAL STEEL TO BE HOT DIP GALVANISED.

SHEET PILE CUT-OFF WALL. 3.0m THICK. MINIMUM GAUGE 5mm. MINIMUM GRADE 235 MPa

MINIMUM 150mm THICK HEAD WALL. REINFORCEMENT RATE 170 Kg/m³

PROVIDE GRATING AND STRUCTURAL FRAMING TO LAYFLAT GATE VOID ALLOWING PENSTOCK AND LAYFLAT GATE ACCESS.

MINIMUM 150mm THICK WING WALLS. REINFORCEMENT RATE 170 Kg/m³

MINIMUM 350mm THICK HEAD WALLS. REINFORCEMENT RATE 150 Kg/m³

MINIMUM 350mm THICK WING WALLS. REINFORCEMENT RATE 170 Kg/m³

RE-INSTATE DISTURBED NARRUNG ROAD ALIGNMENT. 300mm THICK PM2/20, 150mm THICK PM1/20, 100mm SPRAY SEAL ON MEDIUM PRIME (OR EQUIVALENT)

[Scale: 1:125]

[Sheet: 1 of 1]
NOTES:

1. ALL DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.

2. REINSTATEMENT OF THE DISTURBED TRENCH ALIGNMENT SHALL BE COMPLETED TO MATCH EXISTING SURFACE TO THE SAME THICKNESS AND FINISH (E.G. TOPSOIL, ROAD, ETC.).

3. TRENCH BACKFILL IN AREAS OTHER THAN ROAD CROSSINGS SHALL BE LOCALLY WON MATERIAL COMPACTED TO 95% SMDD.

4. SMDD - STANDARD MAXIMUM DRY DENSITY TO AS1289.5.1.1

MMDD - MODIFIED MAXIMUM DRY DENSITY TO AS1289.5.2.1

5. WHERE NON-ENGINEERED FULL, SOFT, WET, WEAK OR POORLY CONSOLIDATED MATERIAL IS ENCOUNTERED AT SUBGRADE LEVEL, MATERIAL SHALL BE EXCAVATED AND REPLACED WITH SELECT FILL COMPACTED TO 98% SMDD TO MIN. 600mm DEPTH BELOW SUBGRADE LEVEL.

EMBEDMENT ZONE:

SAND TO Sa-C

COMPACTED TO 95% MMDD IN LAYERS

NO THICKER THAN 150mm AND IN ACCORDANCE WITH AS/NZS 2566.1

TRENCH BACKFILL:

LOCALLY WON OR IMPORTED MATERIAL (NOTES 3 & 4).
# DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 2 PARNKA NARROWS DREDGE

<table>
<thead>
<tr>
<th>DRAWING No.</th>
<th>DRAWING TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEG155-0000-TD-DRG-CV-0001</td>
<td>PROJECT KEY PLAN</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-0001</td>
<td>COVER SHEET AND DRAWING LIST</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-1000</td>
<td>PARNKA NARROWS DREDGE - KEY PLAN</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-1001</td>
<td>PARNKA NARROWS DREDGE - PLAN SHEET 1 OF 14</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-1002</td>
<td>PARNKA NARROWS DREDGE - PLAN SHEET 2 OF 14</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-1003</td>
<td>PARNKA NARROWS DREDGE - PLAN SHEET 3 OF 14</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-1004</td>
<td>PARNKA NARROWS DREDGE - PLAN SHEET 4 OF 14</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-1005</td>
<td>PARNKA NARROWS DREDGE - PLAN SHEET 5 OF 14</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-1006</td>
<td>PARNKA NARROWS DREDGE - PLAN SHEET 6 OF 14</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-1007</td>
<td>PARNKA NARROWS DREDGE - PLAN SHEET 7 OF 14</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-1008</td>
<td>PARNKA NARROWS DREDGE - PLAN SHEET 8 OF 14</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-1009</td>
<td>PARNKA NARROWS DREDGE - PLAN SHEET 9 OF 14</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-1010</td>
<td>PARNKA NARROWS DREDGE - PLAN SHEET 10 OF 14</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-1011</td>
<td>PARNKA NARROWS DREDGE - PLAN SHEET 11 OF 14</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-1012</td>
<td>PARNKA NARROWS DREDGE - PLAN SHEET 12 OF 14</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-1013</td>
<td>PARNKA NARROWS DREDGE - PLAN SHEET 13 OF 14</td>
</tr>
<tr>
<td>AEG155-2000-TD-DRG-CV-1014</td>
<td>PARNKA NARROWS DREDGE - PLAN SHEET 14 OF 14</td>
</tr>
</tbody>
</table>
Legend

Dredge Alignment Chainage

Dredge area (hydrodynamic model mesh grid)

-1.2mAHD Dredge Depth

-1.4mAHD Dredge Depth

Scale at A3 1:4,000

COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 2 - PARINKA NARROWS DREDGE
PLAN - SHEET 3 OF 14

Prepared: SAW
Checked: PJS
DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 3A - 1000 ML/D CSL PUMP OUT (JETTY DISCHARGE)

<table>
<thead>
<tr>
<th>DRAWING No.</th>
<th>DRAWING TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEG155-3000-TD-DRG-CV-0001</td>
<td>PROJECT KEY PLAN</td>
</tr>
<tr>
<td>AEG155-3000-TD-DRG-CV-0005</td>
<td>TYPICAL JETTY GENERAL ARRANGEMENT</td>
</tr>
<tr>
<td>AEG155-3000-TD-DRG-CV-0401</td>
<td>TYPICAL DISCHARGE JETTY SECTION</td>
</tr>
<tr>
<td>AEG155-3000-TD-DRG-CV-0402</td>
<td>CONSTRUCTION ACCESS - OPTIONS 3, 4, 5, 6 SHEET 1</td>
</tr>
<tr>
<td>AEG155-3000-TD-DRG-CV-0403</td>
<td>CONSTRUCTION ACCESS - OPTIONS 3, 4, 5, 6 SHEET 2</td>
</tr>
<tr>
<td>AEG155-3000-TD-DRG-CV-0600</td>
<td>TYPICAL TRENCH DETAILS</td>
</tr>
<tr>
<td>AEG155-3000-TD-DRG-ME-0001</td>
<td>FISH SCREEN DETAIL</td>
</tr>
<tr>
<td>AEG155-3000-TD-DRG-CV-0001</td>
<td>COVER PAGE</td>
</tr>
<tr>
<td>AEG155-3000-TD-DRG-CV-0002</td>
<td>KEY PLAN</td>
</tr>
<tr>
<td>AEG155-3000-TD-DRG-CV-1001</td>
<td>PLAN - SHEET 1</td>
</tr>
<tr>
<td>AEG155-3000-TD-DRG-CV-1002</td>
<td>PLAN - SHEET 2</td>
</tr>
<tr>
<td>AEG155-3000-TD-DRG-ME-0001</td>
<td>PUMP STATION SECTIONS - SHEET 1</td>
</tr>
</tbody>
</table>
OUTFALL PIPE TO DISCHARGE FROM END OF JETTY WITH CONE VALVE DIFFUSER NOZZLE

JETTY OUTFALL STRUCTURE

DN2000 PIPE INSTALLED THROUGH DUNES

CONCRETE ANCHOR BLOCK SURROUNDING THE PIPE CONNECTION FROM ABOVE GROUND HOPE TO BELOW GROUND GRP TO MANAGE THRUST FORCES

BUOYS INSTALLED ALONG PIPELINE

FLOATING WALKWAY

REVISION ORIG. SIZE DRAWING SCALE

DRAFTER: SIGNATURE

DATE: FILE:
NOTE: LENGTH OF JETTY SUBJECT TO CHANGE, PENDING BATHYMETRIC SURVEY AND REQUIRED WATER DEPTH.
**NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR**

**NOT FOR CONSTRUCTION**

**DEPARTMENT FOR ENVIRONMENT AND WATER**
**COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT**
**OPTION 3A - 1000 ML/D CSL PUMP OUT (JETTY DISCHARGE)**
**PLAN - SHEET 2**

**SCALE 1:500**

**Connor Pignata**

**DATE: FILE:**
**12/21/2021 11:33:47 AM C:\Users\K061549\Documents\COORONG OPTION_3A_k061549.rvt**

**AEG155-3000-TD-DRG-CV-1002**

**A1**

**Revision:**

**Description:**

- **DN2200 GRP PIPE**
- **OD1800 HDPE PIPE**
- **CONCRETE ANCHOR BLOCK SURROUNDING THE PIPE CONNECTION FROM ABOVE GROUND HDPE TO BELOW GROUND GRP TO MANAGE THRUST FORCES**
- **FLOATING WALKWAY**
- **2X PONTOON MOUNTED PUMPS**
- **4X DN500 CONCRETE PILES PER PONTOON USED FOR MOORING**
- **CONE TYPE FISH EXCLUSION SCREENS TO BE INSTALLED ON PUMP INTAKES, REFER DRAWING AEG155-0000-TD-DRG-ME-0001 FOR FISH SCREEN MODELS**
- **8X PONTOON MOUNTED PUMPS**

**General Notes:**

- **AREA AROUND THE PUMPS TO BE DREDGED TO AN ELEVATION OF APPROX. 4.5m AHD. ELEVATION TO BE CONFIRMED WITH PUMP SUPPLIER TO ENABLE CORRECT OPERATION OF PUMPS**
- **CONCRETE ANCHOR BLOCK SURROUNDING THE PIPE CONNECTION FROM ABOVE GROUND HDPE TO BELOW GROUND GRP TO MANAGE THRUST FORCES**
- **DN2200 GRP PIPE**
- **OD1800 HDPE PIPE**
- **CONCRETE ANCHOR BLOCK SURROUNDING THE PIPE CONNECTION FROM ABOVE GROUND HDPE TO BELOW GROUND GRP TO MANAGE THRUST FORCES**
- **FLOATING WALKWAY**
- **2X PONTOON MOUNTED PUMPS**
- **4X DN500 CONCRETE PILES PER PONTOON USED FOR MOORING**
- **CONE TYPE FISH EXCLUSION SCREENS TO BE INSTALLED ON PUMP INTAKES, REFER DRAWING AEG155-0000-TD-DRG-ME-0001 FOR FISH SCREEN MODELS**
- **8X PONTOON MOUNTED PUMPS**

**Area:**

- **8x PONTOON MOUNTED PUMPS**
- **OD1800 HDPE PIPE**
- **CONCRETE ANCHOR BLOCK SURROUNDING THE PIPE CONNECTION FROM ABOVE GROUND HDPE TO BELOW GROUND GRP TO MANAGE THRUST FORCES**
- **FLOATING WALKWAY**
- **2X PONTOON MOUNTED PUMPS**
- **4X DN500 CONCRETE PILES PER PONTOON USED FOR MOORING**
- **CONE TYPE FISH EXCLUSION SCREENS TO BE INSTALLED ON PUMP INTAKES, REFER DRAWING AEG155-0000-TD-DRG-ME-0001 FOR FISH SCREEN MODELS**
- **8X PONTOON MOUNTED PUMPS**

**Disclaimer:**

This drawing contains intellectual property rights owned by or licensed to the client and design services consultant, and must not be reproduced or disclosed other than in accordance with the design services contract, design services subcontract and subcontractor deed of covenant between the client, design services consultant and design services subcontractor.
COORONG LEVEL
-0.1m to 4.5m AHD (varies between -0.25m and 0.75m)

DREDGED COORONG FLOOR
-0.1m AHD

DREDGED COORONG FLOOR
4.5m AHD

DN1000 BUTTERFLY VALVE

DN1000 CHECK VALVE

PONTIION MOUNTED PUMP

SELF CLEANING CONE FISH EXCLUSION SCREEN, REFER DRAWING AEG155-3000-TD-DRG-ME-0001 FOR FISH SCREEN MODELS.

4x DN600 CONCRETE PILES USED FOR MOORING, EMBEDDED 20m INTO COORONG BED

OD1800 HDPE PN8 PIPE
BUOYS INSTALLED ALONG PIPELINE

PUMP STATION SECTION 1

PUMP STATION SECTION 2

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
2. FISH EXCLUSION SCREEN CLEARANCES AND REQUIRED WATER DEPTHS TO BE CONFIRMED BY SUPPLIER DURING DETAILED DESIGN
DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 3B - 1000 ML/D CSL PUMP OUT (NEARSHORE DISCHARGE)

<table>
<thead>
<tr>
<th>DRAWING No.</th>
<th>DRAWING TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEG155-0000-TD-DRG-CV-0001</td>
<td>PROJECT KEY PLAN</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0401</td>
<td>CONSTRUCTION ACCESS - OPTIONS 3,4,5 SHEET 1</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0402</td>
<td>CONSTRUCTION ACCESS - OPTIONS 3,4,5 SHEET 2</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0600</td>
<td>NEARSHORE INFRASTRUCTURE STRUCTURE DETAILS</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0600</td>
<td>TYPICAL TRENCH DETAILS</td>
</tr>
<tr>
<td>AEG155-3100-TD-DRG-CV-0001</td>
<td>PUMP SCREEN DETAIL</td>
</tr>
<tr>
<td>AEG155-3100-TD-DRG-CV-0002</td>
<td>COVER PAGE</td>
</tr>
<tr>
<td>AEG155-3100-TD-DRG-CV-1000</td>
<td>KEY PLAN</td>
</tr>
<tr>
<td>AEG155-3100-TD-DRG-CV-1001</td>
<td>PLAN - SHEET 1</td>
</tr>
<tr>
<td>AEG155-3100-TD-DRG-CV-1004</td>
<td>PLAN - SHEET 2</td>
</tr>
<tr>
<td>AEG155-3100-TD-DRG-ME-0001</td>
<td>PUMP STATION SECTIONS - SHEET 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NAME</th>
<th>POSITION</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. PIGNATA</td>
<td>PS</td>
<td></td>
</tr>
<tr>
<td>M. TOLCVAY</td>
<td>PS</td>
<td></td>
</tr>
<tr>
<td>P. STANIFORD</td>
<td>PS</td>
<td></td>
</tr>
<tr>
<td>J. BOOTH</td>
<td>PS</td>
<td></td>
</tr>
</tbody>
</table>

DISCLAIMER
THE INFORMATION CONTAINED IN THIS DOCUMENT IS FOR INFORMATIONAL PURPOSES ONLY AND SHOULD NOT BE CONSIDERED AS LEGAL, FINANCIAL OR TECHNICAL ADVICE. THIS DOCUMENT IS PROVIDED "AS IS" WITHOUT WARRANTIES EXPRESS OR IMPLIED. KBR DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

NOT FOR CONSTRUCTION

NOT TO SCALE

AEG155-3100-TD-DRG-CV-0001
CONCRETE APRON OUTFALL STRUCTURE

FLEXMAT FM250

OD1800 PN8 HDPE PIPE

FLOATING WALKWAY

8x PONTOON MOUNTED PUMPS

OD1200 HDPE PN10 PIPES

6x PONTOON MOUNTED PUMPS

DN2200 PIPE INSTALLED THROUGH DUNES

BUOYS INSTALLED ALONG PIPELINE

CONCRETE ANCHOR BLOCK SURROUNDING THE PIPE CONNECTION FROM ABOVE GROUND HDPE TO BELOW GROUND GRP TO MANAGE THRUST FORCES

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR
NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 3B - 2000 ML/D CSL PUMP OUT (NEARSHORE DISCHARGE)
KEY PLAN

A1

Kellogg Brown & Root Pty Ltd
ABN 91 007 660 317

NOTE: THIS DOCUMENT CONTAINS INTELLECTUAL PROPERTY RIGHTS OWNED BY OR LICENSED TO THE CLIENT AND DESIGN SERVICES CONSULTANT, AND MUST NOT BE REPRODUCED OR DISCLOSED OTHER THAN IN ACCORDANCE WITH THE DESIGN SERVICES CONTRACT, DESIGN SERVICES SUBCONTRACT AND SUBCONSULTANT DEED OF COVENANT BETWEEN THE CLIENT, DESIGN SERVICES CONSULTANT AND DESIGN SERVICES SUBCONSULTANT.

DISCLAIMER

DATE: FILE:

12/21/2021 11:38:53 AM C:\Users\K061549\Documents\COORONG OPTION_3B_k061549.rvt

AEG155-3100-TD-DRG-CV-1000

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 3B - 2000 ML/D CSL PUMP OUT (NEARSHORE DISCHARGE)

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR
NOT FOR CONSTRUCTION

COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 3B - 2000 ML/D CSL PUMP OUT (NEARSHORE DISCHARGE)

CONCEPT DESIGN ISSUE 01/12/2021

CONCEPT DESIGN ISSUE 17/12/2021

FINAL CONCEPT ISSUE 21/12/2021

A ISSUED FOR CLIENT REVIEW 28/10/2021

B

C

D

F

P. PIGNATA

OPTION 3B - 1000 ML/D CSL PUMP OUT (NEARSHORE DISCHARGE)

COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT

M. TOLCVAY

P. STANIFORD

J. BOOTH

F. RAPONI

P. STANIFORD PS

MT

JB

FR
**CONCRETE ANCHOR BLOCK SURROUNDING THE PIPE CONNECTION FROM ABOVE GROUND HDPE TO BELOW GROUND GRP TO MANAGE THRUST FORCES**

**CONE TYPE FISH EXCLUSION SCREENS TO BE INSTALLED ON PUMP INTAKES**
**REFER DRAWING AEG155-0000-TD-ME-0001 FOR FISH SCREEN MODELS**

**BUOYS INSTALLED ALONG PIPELINE**

**AREA AROUND THE PUMPS TO BE DREDGED TO PROVIDE A WATER DEPTH OF APPROXIMATELY 4.5m. DEPTH TO BE CONFIRMED BY PUMP SUPPLIER**

**O&D 1200 HDPE PN10 PIPES**

**8x PONTOON MOUNTED PUMPS**

**6x CONCRETE PILES PER PONTOON USED FOR MOORING**

**OD 1800 HDPE PIPE**

**OD 2200 GRP PIPE**

**FLOATING WALKWAY**

**CONCRETE ANCHOR BLOCK SURROUNDING THE PIPE CONNECTION FROM ABOVE GROUND HDPE TO BELOW GROUND GRP TO MANAGE THRUST FORCES**

---

**NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR**

**NOT FOR CONSTRUCTION**

---

**DEPARTMENT FOR ENVIRONMENT AND WATER**

**COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT**

**OPTION 3B - 1000 ML/D CSL PUMP OUT (NEARSHORE DISCHARGE)**

**PLAN - SHEET 1**

---

**AEG155-3100-TD-DRG-CV-1001**

---

<table>
<thead>
<tr>
<th>DEVELOPMENT</th>
<th>DATE</th>
<th>FILE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLIENT APPROVAL</td>
<td>28/10/2021</td>
<td>ISSUED FOR CLIENT REVIEW</td>
</tr>
<tr>
<td>TECHNICAL APPROVAL</td>
<td>FINAL CONCEPT ISSUE 21/12/2021</td>
<td></td>
</tr>
<tr>
<td>DRAFTING CHECK</td>
<td>INDEPENDENT CHECK</td>
<td></td>
</tr>
<tr>
<td>DESIGN SERVICES CONTRACT</td>
<td>DESIGN SERVICES SUBCONTRACT AND SUBCONSULTANT DEED OF COVENANT BETWEEN THE CLIENT, DESIGN SERVICES CONSULTANT AND DESIGN SERVICES SUBCONSULTANT.</td>
<td></td>
</tr>
<tr>
<td>DISCLOSURE</td>
<td>THIS DRAWING IS TO BE READ / PRINTED IN COLOUR</td>
<td>NOT FOR CONSTRUCTION</td>
</tr>
</tbody>
</table>
NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
RIVER LEVEL 0

DN1200 BUTTERFLY VALVES

DN1200 CHECK VALVES

PONTOON MOUNTED PUMPS

4x DN600 CONCRETE PILES USED FOR MOORING, EMBEDDED 20m INTO COORONG BED

DREDGED COORONG FLOOR -4.8m AHD

DREDGED COORONG LEVEL -4.3m AHD (VARIES BETWEEN -0.25m AND 0.75m)

OD1200 HDPE PN10 PIPES

ACCESS PLATFORMS OVER PIPES

OD1800 PN8 HDPE PIPE

SELF CLEANING CONE FISH EXCLUSION SCREEN, REFER DRAWING AEG155-0800-TD-DRG-ME-0001 FOR FISH SCREEN MODELS

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
2. FISH EXCLUSION SCREEN CLEARANCES AND REQUIRED WATER DEPTHS TO BE CONFIRMED BY SUPPLIER DURING DETAILED DESIGN.

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR.
DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 3C - 250 ML/D CSL PUMP OUT (JETTY DISCHARGE)
JETTY OUTFALL STRUCTURE

OUTFALL PIPE TO TO DISCHARGE FROM END OF JETTY WITH CONE VALVE DIFFUSER NOZZLE

CONCRETE ANCHOR BLOCK SURROUNDING THE PIPE CONNECTION FROM ABOVE GROUND HDPE TO BELOW GROUND GRP TO MANAGE THRUST FORCES

OD1400 PN10 HDPE PIPE

FLOATING WALKWAY

OD1000 HDPE PN10 PIPES

3x PONTOON MOUNTED PUMPS

BUOYS INSTALLED ALONG PIPELINE

DN1200 GRP PIPE INSTALLED THROUGH DUNES

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR

NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 3C - 250 ML/D CSL PUMP OUT (JETTY DISCHARGE)
KEY PLAN
FLOATING WALKWAY

CONCRETE ANCHOR BLOCK SURROUNDING THE PIPE CONNECTION FROM ABOVE GROUND HDPE TO BELOW GROUND GRP TO MANAGE THRUST FORCES.

FLEXIBLE CONNECTION TO BE INSTALLED TO MANAGE THE INTERFACE BETWEEN THE FLOATING WALKWAY AND BURIED PIPEWORK.

BUOYS INSTALLED ALONG PIPELINE

CONE TYPE FISH EXCLUSION SCREENS TO BE INSTALLED ON PUMP INTAKES. REFER DRAWING AEG155-0000-TD-DRG-ME-0001 FOR FISH SCREEN MODELS.

4x DN600 CONCRETE PILES PER PONTOON USED FOR MOORING.

3x PONTOON MOUNTED PUMPS

50m x 25m AREA BELOW PUMPS TO BE DREDGED TO PROVIDE A WATER DEPTH OF APPROX. -4.5 AND DEPTH TO BE CONFIRMED BY PUMP SUPPLIER.

3x PONTOON MOUNTED PUMPS

OD1400 PN10 HDPE PIPE

OD1000 HDPE PN10 PIPE

NOT FOR CONSTRUCTION

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 3C - 250 MLD CSL PUMP OUT (JETTY DISCHARGE)
PLAN - SHEET 1
OUTFALL PIPE TO DISCHARGE
FROM END OF JETTY THROUGH
CONE VALVE DIFFUSER NOZZLE

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR
NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 3C - 250 ML/D CSL PUMP OUT (JETTY DISCHARGE)
PLAN - SHEET 2

NOTE: LENGTH OF JETTY SUBJECT TO CHANGE, PENDING
BATHYMETRIC SURVEY AND REQUIRED WATER DEPTH.

REFERENCE DRAWINGS: AEG155-3200-TD-DRG-CV-0000 AND 0001 FOR
TYPICAL DISCHARGE JETTY GENERAL ARRANGEMENT AND SECTION

OUTFALL PIPE TO DISCHARGE
FROM END OF JETTY THROUGH
CONE VALVE DIFFUSER NOZZLE

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR
NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 3C - 250 ML/D CSL PUMP OUT (JETTY DISCHARGE)
PLAN - SHEET 2

NOTE: LENGTH OF JETTY SUBJECT TO CHANGE, PENDING
BATHYMETRIC SURVEY AND REQUIRED WATER DEPTH.

REFERENCE DRAWINGS: AEG155-3200-TD-DRG-CV-0000 AND 0001 FOR
TYPICAL DISCHARGE JETTY GENERAL ARRANGEMENT AND SECTION
DREDGED COORONG FLOOR
-4.5m AHD

SEA LEVEL
0m

COORONG LEVEL
0m

Self Cleaning Cone Fish Exclusion Screen

DN1000 Check Valve

DN1000 Butterfly Valve

Access Platform over Pipe

4x DN600 Concrete Piles Used for Moorings, Embedded 20m into Coorong Bed

PONTOON MOUNTED PUMP

NOTES:
1. All dimensions are in millimeters unless noted otherwise.
2. Fish exclusion screen clearances and required water depths to be confirmed by supplier during detailed design.

PONTOON SECTION 1
1/100

PONTOON SECTION 2
1/100
DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 3D- 250 ML/D CSL PUMP OUT (NEARSHORE DISCHARGE)
CONCRETE APRON OUTFALL STRUCTURE

FLEXMAT FM250

CONCRETE ANCHOR BLOCK SURROUNDING THE PIPE CONNECTION FROM ABOVE GROUND HDPE TO BELOW GROUND GRP TO MANAGE THRUST FORCES

FLOATING WALKWAY

OD1400 HDPE PIPE

OD1000 HDPE PIPE

3x PONTOON MOUNTED PUMPS

BUOYS INSTALLED ALONG PIPELINE

DN1200 GRP PIPE INSTALLED THROUGH DUNES

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR

NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 3D - 250 ML/D CSL PUMP OUT (NEARSHORE DISCHARGE)

KEY PLAN

P. PIGNATA

OPTION 3D - 250 ML/D CSL PUMP OUT (NEARSHORE DISCHARGE)

COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT

M. TOLCVAY

P. STANIFORD

J. BOOTH

A. ISSUED FOR CLIENT REVIEW 28/10/2021

B. CONCEPT DESIGN ISSUE 01/12/2021

C. CONCEPT DESIGN ISSUE 17/12/2021

D. FINAL CONCEPT ISSUE 21/12/2021

F. RAPONI

P. STANIFORD PS

MT

JB

FR

NOT TO SCALE
FLOATING WALKWAY

DN1200 GRP PIPE

OD1000 HDPE

PN10 PIPES

3x PONTOON MOUNTED PUMPS

NOM. 100 m

CONCRETE ANCHOR BLOCK SURROUNDING THE PIPE CONNECTION FROM ABOVE GROUND HDPE TO BELOW GROUND GRP TO MANAGE THRUST FORCES

OD1400 PN10 HDPE PIPE

OD1200 GRP PIPE

OD1400 PN10 HDPE PIPE

BUOYS INSTALLED ALONG PIPELINE

50 x 25m AREA AROUND THE PUMPS TO BE DREDGED TO PROVIDE A WATER DEPTH OF APPROXIMATELY 4.5m. DEPTH TO BE CONFIRMED BY PUMP SUPPLIER

CONE TYPE FISH EXCLUSION SCREENS TO BE INSTALLED ON PUMP INTAKES, REFER DRAWING AEG155-0000-TO-DRG-ME-0001 FOR FISH SCREEN MODELS

4x DN600 CONCRETE PILES PER PONTOON USED FOR MOORING

3x PONTOON MOUNTED PUMPS

DEPARTMENT FOR ENVIRONMENT AND WATER

COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT

OPTION 3D - 250 ML/D CSL PUMP OUT (NEARSHORE DISCHARGE)

PLAN - SHEET 1

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR

NOT FOR CONSTRUCTION
DREDGED COORONG FLOOR
4.5m AHD

COORONG LEVEL
0m AHD
(VARIES BETWEEN 0.25m AND 0.75m)

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR

NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 3D - 250 ML/D CSL PUMP OUT (NEARSHORE DISCHARGE)
PUMP STATION SECTION

NOTE:
1. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE
2. FISH EXCLUSION SCREEN CLEARANCES AND REQUIRED WATER DEPTHS TO BE CONFIRMED BY SUPPLIER DURING DETAILED DESIGN.
DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 4A - BI-DIRECTIONAL TWO PUMP STATIONS

<table>
<thead>
<tr>
<th>DRAWING No.</th>
<th>DRAWING TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEG155-4000-TD-DRG-CV-0001</td>
<td>COVER PAGE</td>
</tr>
<tr>
<td>AEG155-4000-TD-DRG-CV-0002</td>
<td>GENERAL NOTES</td>
</tr>
<tr>
<td>AEG155-4000-TD-DRG-CV-1000</td>
<td>KEY PLAN</td>
</tr>
<tr>
<td>AEG155-4000-TD-DRG-CV-1001</td>
<td>PLAN - SHEET 1</td>
</tr>
<tr>
<td>AEG155-4000-TD-DRG-CV-1002</td>
<td>PLAN - SHEET 2</td>
</tr>
<tr>
<td>AEG155-4000-TD-DRG-EL-8000</td>
<td>SINGLE LINE DIAGRAM</td>
</tr>
<tr>
<td>AEG155-4000-TD-DRG-EL-8001</td>
<td>SCHEMATIC</td>
</tr>
<tr>
<td>AEG155-4000-TD-DRG-ME-6000</td>
<td>PONTOON PUMP SECTION</td>
</tr>
<tr>
<td>AEG155-4000-TD-DRG-ME-6001</td>
<td>PONTOON PUMP DETAIL</td>
</tr>
<tr>
<td>AEG155-4000-TD-DRG-ME-7000</td>
<td>PONTOON PUMP DETAIL</td>
</tr>
<tr>
<td>AEG155-4000-TD-DRG-ME-7001</td>
<td>PONTOON PUMP DETAIL</td>
</tr>
<tr>
<td>AEG155-4000-TD-DRG-ME-7002</td>
<td>PONTOON PUMP DETAIL</td>
</tr>
</tbody>
</table>

NOT TO SCALE

DISCLAIMER
This document contains intellectual property rights owned by or licensed to the Client and Design Services Consultant, and must not be reproduced or disclosed other than in accordance with the Design Services Contract, Design Services Subcontract and Subconsultant Deed of Covenant between the Client, Design Services Consultant and Design Services Subconsultant.
VERTICAL TURBINE PUMPS
WITH CONE VALVE DISCHARGE NOZZLE

CONCRETE CAISSON
DN1400 ISOLATION VALVES

PLUNGING JET DISCHARGE PIPEWORK
WITH CONE VALVE DISCHARGE NOZZLE

DN1400 GRP PIPEWORK INSTALLED
BELOW GROUND THROUGH DUNES

12.5m NOM.
300m NOM.
50m NOM.

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR
NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 4A - BI-DIRECTIONAL TWO PUMP STATIONS
PLAN - SHEET 1

AEG155-4000-TD-DRG-CV-1001
C

1 2 3 4 5 6 7 8 9 10 11 12

DATE: 12/21/2021 FILE: C:\Users\K061549\Documents\SURFACE_OPTION 4A_v2_TEST_k061549.rvt

KBR

NOTE: THIS DOCUMENT CONTAINS INTELLECTUAL PROPERTY RIGHTS OWNED BY OR LICENSED TO THE CLIENT AND DESIGN SERVICES CONSULTANT, AND MUST NOT BE REPRODUCED OR DISCLOSED OTHER THAN IN ACCORDANCE WITH THE DESIGN SERVICES CONTRACT, DESIGN SERVICES SUBCONTRACT AND SUBCONSULTANT DEED OF COVENANT BETWEEN THE CLIENT, DESIGN SERVICES CONSULTANT AND DESIGN SERVICES SUBCONSULTANT.

DISCLAIMER

THE INFORMATION CONTAINED IN THIS DOCUMENT IS PROPRIETARY TO THE DESIGN SERVICES CONSULTANT AND NO TEXT OR GRAPHIC CONTAINED HEREIN MAY BE REPRODUCED OR DISCLOSED TO ANY OTHER PARTY OR USED FOR ANY PURPOSE OTHER THAN THE IMPLEMENTATION OF THE DESIGNED WORKS.

THIS DRAWING IS TO BE READ / PRINTED IN COLOUR
NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 4A - BI-DIRECTIONAL TWO PUMP STATIONS
PLAN - SHEET 1

AEG155-4000-TD-DRG-CV-1001
C

DATE: 12/21/2021 FILE: C:\Users\K061549\Documents\SURFACE_OPTION 4A_v2_TEST_k061549.rvt

KBR

NOTE: THIS DOCUMENT CONTAINS INTELLECTUAL PROPERTY RIGHTS OWNED BY OR LICENSED TO THE CLIENT AND DESIGN SERVICES CONSULTANT, AND MUST NOT BE REPRODUCED OR DISCLOSED OTHER THAN IN ACCORDANCE WITH THE DESIGN SERVICES CONTRACT, DESIGN SERVICES SUBCONTRACT AND SUBCONSULTANT DEED OF COVENANT BETWEEN THE CLIENT, DESIGN SERVICES CONSULTANT AND DESIGN SERVICES SUBCONSULTANT.

DISCLAIMER

THE INFORMATION CONTAINED IN THIS DOCUMENT IS PROPRIETARY TO THE DESIGN SERVICES CONSULTANT AND NO TEXT OR GRAPHIC CONTAINED HEREIN MAY BE REPRODUCED OR DISCLOSED TO ANY OTHER PARTY OR USED FOR ANY PURPOSE OTHER THAN THE IMPLEMENTATION OF THE DESIGNED WORKS.

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR
NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 4A - BI-DIRECTIONAL TWO PUMP STATIONS
PLAN - SHEET 1

AEG155-4000-TD-DRG-CV-1001
C

DATE: 12/21/2021 FILE: C:\Users\K061549\Documents\SURFACE_OPTION 4A_v2_TEST_k061549.rvt

KBR

NOTE: THIS DOCUMENT CONTAINS INTELLECTUAL PROPERTY RIGHTS OWNED BY OR LICENSED TO THE CLIENT AND DESIGN SERVICES CONSULTANT, AND MUST NOT BE REPRODUCED OR DISCLOSED OTHER THAN IN ACCORDANCE WITH THE DESIGN SERVICES CONTRACT, DESIGN SERVICES SUBCONTRACT AND SUBCONSULTANT DEED OF COVENANT BETWEEN THE CLIENT, DESIGN SERVICES CONSULTANT AND DESIGN SERVICES SUBCONSULTANT.

DISCLAIMER

THE INFORMATION CONTAINED IN THIS DOCUMENT IS PROPRIETARY TO THE DESIGN SERVICES CONSULTANT AND NO TEXT OR GRAPHIC CONTAINED HEREIN MAY BE REPRODUCED OR DISCLOSED TO ANY OTHER PARTY OR USED FOR ANY PURPOSE OTHER THAN THE IMPLEMENTATION OF THE DESIGNED WORKS.

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR
NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 4A - BI-DIRECTIONAL TWO PUMP STATIONS
PLAN - SHEET 1

AEG155-4000-TD-DRG-CV-1001
C

DATE: 12/21/2021 FILE: C:\Users\K061549\Documents\SURFACE_OPTION 4A_v2_TEST_k061549.rvt

KBR

NOTE: THIS DOCUMENT CONTAINS INTELLECTUAL PROPERTY RIGHTS OWNED BY OR LICENSED TO THE CLIENT AND DESIGN SERVICES CONSULTANT, AND MUST NOT BE REPRODUCED OR DISCLOSED OTHER THAN IN ACCORDANCE WITH THE DESIGN SERVICES CONTRACT, DESIGN SERVICES SUBCONTRACT AND SUBCONSULTANT DEED OF COVENANT BETWEEN THE CLIENT, DESIGN SERVICES CONSULTANT AND DESIGN SERVICES SUBCONSULTANT.

DISCLAIMER

THE INFORMATION CONTAINED IN THIS DOCUMENT IS PROPRIETARY TO THE DESIGN SERVICES CONSULTANT AND NO TEXT OR GRAPHIC CONTAINED HEREIN MAY BE REPRODUCED OR DISCLOSED TO ANY OTHER PARTY OR USED FOR ANY PURPOSE OTHER THAN THE IMPLEMENTATION OF THE DESIGNED WORKS.

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR
NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 4A - BI-DIRECTIONAL TWO PUMP STATIONS
PLAN - SHEET 1

AEG155-4000-TD-DRG-CV-1001
C

DATE: 12/21/2021 FILE: C:\Users\K061549\Documents\SURFACE_OPTION 4A_v2_TEST_k061549.rvt

KBR

NOTE: THIS DOCUMENT CONTAINS INTELLECTUAL PROPERTY RIGHTS OWNED BY OR LICENSED TO THE CLIENT AND DESIGN SERVICES CONSULTANT, AND MUST NOT BE REPRODUCED OR DISCLOSED OTHER THAN IN ACCORDANCE WITH THE DESIGN SERVICES CONTRACT, DESIGN SERVICES SUBCONTRACT AND SUBCONSULTANT DEED OF COVENANT BETWEEN THE CLIENT, DESIGN SERVICES CONSULTANT AND DESIGN SERVICES SUBCONSULTANT.

DISCLAIMER

THE INFORMATION CONTAINED IN THIS DOCUMENT IS PROPRIETARY TO THE DESIGN SERVICES CONSULTANT AND NO TEXT OR GRAPHIC CONTAINED HEREIN MAY BE REPRODUCED OR DISCLOSED TO ANY OTHER PARTY OR USED FOR ANY PURPOSE OTHER THAN THE IMPLEMENTATION OF THE DESIGNED WORKS.
NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 4A - BI-DIRECTIONAL TWO PUMP STATIONS
PLAN - SHEET 2

A EG155-4000-TD-DRG-CV-1002

PONTOON MOUNTED PUMP
PLUNGING JET DISCHARGE PIPEWORK WITH
CONE VALVE DISCHARGE NOZZLE, LOCALLY
ARMOUR THE BED UNDER THE PLUNGING JET

DN1600 ISOLATION VALVE
DN1600 ISOLATION VALVE

OD1600 PN10 HDPE PIPE
OD1000 HDPE PN10 PIPEWORK
DN1400 GRP PIPE INSTALLED

THROUGH DUNES

CONE TYPE FISH EXCLUSION SCREENS TO BE INSTALLED ON PUMP INTAKES,
REFER DRAWING AEG155-4000-TD-DRG-ME-0001 FOR FISH SCREEN MODELS

4x DN600 CONCRETE PILES PER PONTOON USED FOR MOORING

60m x 25m AREA AROUND THE PUMPS TO BE DREDGED
TO PROVIDE A SUITABLE DEPTH OF APPROXIMATELY
A 4.5m DEPTH TO BE CONFIRMED BY PUMP SUPPLIER

CONE TYPE FISH EXCLUSION SCREENS TO BE INSTALLED ON PUMP INTAKES
PLUNGING JET DISCHARGE PIPEWORK WITH
CONE VALVE DISCHARGE NOZZLE, LOCALLY
ARMOUR THE BED UNDER THE PLUNGING JET

NOT FOR CONSTRUCTION

This document contains intellectual property rights owned by or licensed to the client and Design Services Consultant, and must not be reproduced or disclosed other than in accordance with the Design Services Contract, Design Services Subcontract and Subconsultant Deed of Covenant between the Client, Design Services Consultant and Design Services Subconsultant.

DISCLAIMER

This product contains intellectual property rights owned by or licensed to the client and Design Services Consultant, and must not be reproduced or disclosed other than in accordance with the Design Services Contract, Design Services Subcontract and Subconsultant Deed of Covenant between the Client, Design Services Consultant and Design Services Subconsultant.
SEA LEVEL

SELF CLEANING CONE TYPE FISH EXCLUSION SCREENS TO BE INSTALLED ON PUMP INTAKES, REFER DRAWING AEG155-0000-TD-DRG-ME-0001 FOR FISH SCREEN MODELS.

DN1000 CHECK VALVE

DN1000 BUTTERFLY VALVE

PONTOON MOUNTED PUMP

ACCESS PLATFORM OVER PIPE

DREDGED COORONG FLOOR

DREDGED COORONG FLOOR

COORONG LEVEL

5m AW (VARIES BETWEEN 0.25m AND 0.75m)

AREA BELOW PUMPS TO BE DREDGED TO 4.5m TO PROVIDE SUFFICIENT DEPTH FOR PUMP OPERATION. PUMP SUPPLIER TO CONFIRM REQUIRED DEPTH.

4x DN600 CONCRETE PILES PER PONTOON USED FOR MOORING, EMBEDDED 20m INTO COORONG BED.

NOTE: FISH EXCLUSION SCREEN CLEARANCES AND REQUIRED WATER DEPTHS TO BE CONFIRMED BY SUPPLIER DURING DETAILED DESIGN.

 NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
2. FISH EXCLUSION SCREEN CLEARANCES AND REQUIRED WATER DEPTHS TO BE CONFIRMED BY SUPPLIER DURING DETAILED DESIGN.

DEPARTMENT FOR ENVIRONMENT AND WATER

COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT

OPTION 4A - BI-DIRECTIONAL TWO PUMP STATIONS

POONTO PUMP SECTION

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR  NOT FOR CONSTRUCTION
DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 4B - BI-DIRECTIONAL ONE PUMP STATION

DRAWING LIST: OPTION 4B - BI-DIRECTIONAL ONE PUMP STATION

<table>
<thead>
<tr>
<th>DRAWING No.</th>
<th>DRAWING TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEG155-0000-TD-DRG-CV-0900</td>
<td>BREAKWATER DETAILS</td>
</tr>
<tr>
<td>AEG155-4100-TD-DRG-CV-0001</td>
<td>COVER PAGE</td>
</tr>
<tr>
<td>AEG155-4100-TD-DRG-CV-0002</td>
<td>GENERAL NOTES</td>
</tr>
<tr>
<td>AEG155-4100-TD-DRG-CV-1000</td>
<td>KEY PLAN</td>
</tr>
<tr>
<td>AEG155-4100-TD-DRG-CV-1001</td>
<td>PLAN - SHEET 1</td>
</tr>
<tr>
<td>AEG155-4100-TD-DRG-CV-1002</td>
<td>PLAN - SHEET 2</td>
</tr>
<tr>
<td>AEG155-4100-TD-DRG-CV-1003</td>
<td>PLAN - SHEET 3</td>
</tr>
<tr>
<td>AEG155-4100-TD-DRG-CV-1004</td>
<td>PIPING SECTION</td>
</tr>
<tr>
<td>AEG155-4100-TD-DRG-EL-8000</td>
<td>SINGLE LINE DIAGRAM</td>
</tr>
<tr>
<td>AEG155-4100-TD-DRG-EL-8001</td>
<td>SCHEMATIC</td>
</tr>
<tr>
<td>AEG155-4100-TD-DRG-ME-6000</td>
<td>PUMP STATION SECTION</td>
</tr>
<tr>
<td>AEG155-4100-TD-DRG-ME-6001</td>
<td>PUMP STATION ISOMETRIC VIEW SHEET 1</td>
</tr>
<tr>
<td>AEG155-4100-TD-DRG-ME-6002</td>
<td>PUMP STATION ISOMETRIC VIEW SHEET 2</td>
</tr>
<tr>
<td>AEG155-4100-TD-DRG-ME-6003</td>
<td>INTAKE/DISCHARGE STRUCTURE DETAIL</td>
</tr>
</tbody>
</table>

PS    PS    MT    JB    FR
250m BREAKWATER LENGTH
50m BREAKWATER WIDTH

BREAKWATER,
REFER DRAWING AEG155-0000-TD-DRG-CV-0900 FOR DETAILS

CYLINDER FISH EXCLUSION SCREEN ON INTAKE LINE TO
REDUCE INFLOW OF SOLIDS, REFER DRAWING AEG155-4100-TD-
DRG-ME-0003 FOR INTAKE/DISCHARGE STRUCTURE DETAILS

PRIMARY ARMOUR LAYER -
TETRAPOD CONCRETE UNITS.

REINFORCED CONCRETE
CREST WALKWAY

DN1600 GRP PIPE

BREAKWATER EXTENDED
NOMINALLY 50m INTO THE
SHORE TO ACCOMMODATE
FUTURE SHORE EROSION

PRECAST CONCRETE BASE TO SUPPORT DISCHARGE, REFER
DRAWING AEG155-4100-TD-DRG-ME-0003 FOR DETAILS

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR
NOT FOR CONSTRUCTION
NOTES:
1. WALL REINFORCEMENT RATE
   150kg/m²
2. SLAB REINFORCEMENT RATE
   200kg/m²
3. SLAB THICKNESS: 2000mm
4. FLOW PATHS SHOWN IN BLUE AND RED. BLUE PATH INDICATES THE FLOW OF WATER FROM THE COORONG TO THE SOUTHERN OCEAN AND THE RED PATH INDICATES THE FLOW PATH FROM THE SOUTHERN OCEAN TO THE COORONG. VALVES ARE REQUIRED TO BE MANUALLY OPENED AND CLOSED TO CONTROL FLOW PATHS.
5. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
DN1600 GRP PIPE

CYLINDER FISH EXCLUSION SCREEN ON INTAKE LINE TO REDUCE INFLOW OF SOLIDS

PILED PRECAST CONCRETE BASE TO SUPPORT DISCHARGE REFER DRAWING AEG155-4100-TD-DRG-MS-6003 FOR DETAILS
DN1600 GRP PIPEWORK

BREAKWATER, REFER DRAWING AEG155-4000-TD-DRG-CV-0000 FOR DETAILS

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.

PRECAST CONCRETE BASE ON A PILE TO SUPPORT DISCHARGE, REFER DRAWING AEG155-4100-TD-DRG-ME-0003 FOR INTAKE/DISCHARGE STRUCTURE DETAILS

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR
NOT FOR CONSTRUCTION
1. WALL REINFORCEMENT RATE 150kg/m³
2. SLAB REINFORCEMENT RATE 200kg/m³
3. SLAB THICKNESS 2000mm
NOTE:  
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 5A - SIMULTANEOUS PUMP IN, PUMP OUT ON JETTY

DRAWING LIST. OPTION 5A - SIMULTANEOUS PUMP IN, PUMP OUT ON JETTY

<table>
<thead>
<tr>
<th>DRAWING No.</th>
<th>DRAWING TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEG155-0000-TD-DRG-CV-0001</td>
<td>PROJECT KEY PLAN</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0200</td>
<td>TYPICAL JETTY GENERAL ARRANGEMENT</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0201</td>
<td>TYPICAL JETTY SECTION</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0300</td>
<td>TYPICAL DISCHARGE JETTY GENERAL ARRANGEMENT</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0301</td>
<td>TYPICAL DISCHARGE JETTY SECTION</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0600</td>
<td>DISCHARGE STRUCTURE - SECTION</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-1000</td>
<td>CAISSON STRUCTURE GENERAL ARRANGEMENT</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-1001</td>
<td>CAISSON STRUCTURE SECTION</td>
</tr>
<tr>
<td>AEG155-5000-TD-DRG-CV-0001</td>
<td>COVER PAGE</td>
</tr>
<tr>
<td>AEG155-5000-TD-DRG-CV-0002</td>
<td>GENERAL NOTES</td>
</tr>
<tr>
<td>AEG155-5000-TD-DRG-CV-1000</td>
<td>PARNKA POINT LOCATION KEY PLAN</td>
</tr>
<tr>
<td>AEG155-5000-TD-DRG-CV-1001</td>
<td>PARNKA POINT LOCATION PLAN - SHEET 1</td>
</tr>
<tr>
<td>AEG155-5000-TD-DRG-CV-1002</td>
<td>PARNKA POINT LOCATION PLAN - SHEET 2</td>
</tr>
<tr>
<td>AEG155-5000-TD-DRG-CV-1004</td>
<td>WOODS WELL LOCATION KEY PLAN</td>
</tr>
<tr>
<td>AEG155-5000-TD-DRG-CV-1005</td>
<td>WOODS WELL LOCATION PLAN - SHEET 1</td>
</tr>
<tr>
<td>AEG155-5000-TD-DRG-CV-1006</td>
<td>WOODS WELL LOCATION PLAN - SHEET 2</td>
</tr>
<tr>
<td>AEG155-5000-TD-DRG-ME-6000</td>
<td>PONTOON PUMP SECTION</td>
</tr>
</tbody>
</table>

DECLARATION

This document contains intellectual property rights owned by or licensed to the client and design services consultant, and must not be reproduced or disclosed other than in accordance with the design services contract, design services subcontract and subconsultant deed of covenant between the client, design services consultant and design services subconsultant.

DISCLAIMER

This document contains intellectual property rights owned by or licensed to the client and design services consultant, and must not be reproduced or disclosed other than in accordance with the design services contract, design services subcontract and subconsultant deed of covenant between the client, design services consultant and design services subconsultant.

NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 5A - SIMULTANEOUS PUMP IN, PUMP OUT ON JETTY
COVER PAGE

NOT TO SCALE

Scale: 1:1

Sheet No.: A1

C

AEG155-5000-TD-DRG-CV-0001
CONCRETE ANCHOR BLOCK SURROUNDING THE PIPE CONNECTION FROM ABOVE GROUND HDPE TO BELOW GROUND HDPE TO MANAGE THRUST FORCES

DN1400 GRP PIPE INSTALLED BELOW GROUND THROUGH DUNES

DISCHARGE AT END OF JETTY THROUGH CONE VALVE DIFFUSER NOZZLE

ODO100 HDPE PN10 PIPEWORK

FLOATING WALKWAY

OPTION 5A - SIMULTANEOUS PUMP IN, PUMP OUT ON JETTY

COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT

PARNKA POINT LOCATION KEY PLAN

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR

NOT FOR CONSTRUCTION
DISCHARGE AT END OF JETTY THROUGH CONE VALVE DIFFUSER NOZZLE

DN1400 GRP PIPE INSTALLED BELOW GROUND THROUGH DUNES

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR

NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 5A - SIMULTANEOUS PUMP IN, PUMP OUT ON JETTY
PARNKA POINT LOCATION PLAN - SHEET 1

AEG155-5000-TD-DRG-CV-1001

A. ISSUED FOR REVIEW 28/10/2021
B. CONCEPT DESIGN ISSUE 01/12/2021
C. FINAL CONCEPT ISSUE 21/12/2021
FLOATING WALKWAY

PONTOON MOUNTED PUMPS

DN1400 GRP PIPE INSTALLED BELOW GROUND THROUGH DUNES

OD1600 HDPE PIPE

1.5m x 2.5m AREA AROUND THE PUMPS TO BE DREDGED TO PROVIDE A WATER DEPTH OF APPROXIMATELY 4.5m. DEPTH TO BE CONFIRMED BY PUMP SUPPLIER

60m x 25m AREA AROUND THE PUMPS TO BE DREDGED TO PROVIDE A WATER DEPTH OF APPROXIMATELY 4.5m. DEPTH TO BE CONFIRMED BY PUMP SUPPLIER

OD1600 HDPE PIPE

BUOYS INSTALLED ALONG PIPELINE

OD1000 HDPE PN10 PIPEWORK

200m NOM.

CONCRETE ANCHOR BLOCK SURROUNDING THE PIPE CONNECTION FROM ABOVE GROUND HDPE TO BELOW GROUND GRP TO MANAGE THRUST FORCES

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR

NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 5A - SIMULTANEOUS PUMP IN, PUMP OUT ON JETTY
PARNKA POINT LOCATION PLAN - SHEET 2

DATE: FILE: 12/21/2021 C:\Users\K061549\Documents\SURFACE_OPTION 5A_v2_TEST_k061549.rvt

AEG155-5000-TD-DRG-CV-1002

KELLOGG BROWN & ROOT Pty Ltd
ABN 91 007 660 317

NOTE: THIS DOCUMENT CONTAINS INTELLECTUAL PROPERTY RIGHTS OWNED BY OR LICENSED TO THE CLIENT AND DESIGN SERVICES CONSULTANT, AND MUST NOT BE REPRODUCED OR DISCLOSED OTHER THAN IN ACCORDANCE WITH THE DESIGN SERVICES CONTRACT, DESIGN SERVICES SUBCONTRACT AND SUBCONSULTANT DEED OF COVENANT BETWEEN THE CLIENT, DESIGN SERVICES CONSULTANT AND DESIGN SERVICES SUBCONSULTANT.

DISCLAIMER
12.5m WIDE
350m LONG JETTY (NOM.)
DN1400 GRP PIPEWORK
PIPE INSTALLED BELOW GROUND THROUGH DUNES
VERTICAL TURBINE PUMPS WITH OD1000 PN10 HDPE DISCHARGE PIPEWORK
CONCRETE CAISSON
REFER DRAWINGS AEG155-0000-TD-DRG-CV-0200 AND 0201 FOR JETTY SECTION AND GENERAL ARRANGEMENT

CONCRETE CAISSON
VERTICAL TURBINE PUMPS WITH OD1000 PN10 HDPE DISCHARGE PIPEWORK
DN1400 GRP PIPEWORK
PIPE INSTALLED BELOW GROUND THROUGH DUNES

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR
NOT FOR CONSTRUCTION

KELLOGG BROWN & ROOT Pty Ltd
ABN 91 007 660 317

NOTE: THIS DOCUMENT CONTAINS INTELLECTUAL PROPERTY RIGHTS OWNED BY OR LICENSED TO THE CLIENT AND DESIGN SERVICES CONSULTANT, AND MUST NOT BE REPRODUCED OR DISCLOSED OTHER THAN IN ACCORDANCE WITH THE DESIGN SERVICES CONTRACT, DESIGN SERVICES SUBCONTRACT AND SUBCONSULTANT DEED OF COVENANT BETWEEN THE CLIENT, DESIGN SERVICES CONSULTANT AND DESIGN SERVICES SUBCONSULTANT.
PIPE INSTALLED BELOW GROUND THROUGH DUNES
DN1400 GRP PIPEWORK
DISCHARGE STRUCTURE, REFER DRAWING AEG155-0000-TD-DRG-CV-0600 FOR DETAILS

PRECAST CONCRETE BASE TO SUPPORT DISCHARGE

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR

NOT FOR CONSTRUCTION

DEPARTMENT FOR ENVIRONMENT AND WATER
CORRONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 5A - SIMULTANEOUS PUMP IN, PUMP OUT ON JETTY
WOODS WELL LOCATION PLAN - SHEET 2

12/21/2021 12:45:46 PM C:\Users\K061549\Documents\SURFACE_OPTION 5A_v2_TEST_k061549.rvt
NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
2. FISH EXCLUSION SCREEN CLEARANCES AND REQUIRED WATER DEPTHS TO BE CONFIRMED BY SUPPLIER DURING DETAILED DESIGN

PONTOON PUMP SECTION

- DN1000 HDPE PN10 PIPEWORK
- SELF CLEANING CONE TYPE FISH SCREEN, REFER DRAWING AEG155-5000-TD-DRG-ME-0001 FOR FISH SCREEN MODELS
- 4x DN600 CONCRETE PILES USED FOR MOORING, EMBEDDED 20m INTO COORONG BED
- ACCESS PLATFORM OVER PIPE
- DN1000 CHECK VALVE
- DN1000 BUTTERFLY VALVE

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
2. FISH EXCLUSION SCREEN CLEARANCES AND REQUIRED WATER DEPTHS TO BE CONFIRMED BY SUPPLIER DURING DETAILED DESIGN.

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 5A - SIMULTANEOUS PUMP IN, PUMP OUT ON JETTY
PONTOON PUMP SECTION
DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 5B - SIMULTANEOUS PUMP IN, PUMP OUT TO NEARSHORE

DRAWING LIST: OPTION 5B - SIMULTANEOUS PUMP IN, PUMP OUT TO NEARSHORE

<table>
<thead>
<tr>
<th>DRAWING NO.</th>
<th>DRAWING TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEG155-0000-TD-DRG-CV-0001</td>
<td>PROJECT KEY PLAN</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0200</td>
<td>TYPICAL JETTY GENERAL ARRANGEMENT</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0201</td>
<td>TYPICAL JETTY SECTION</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0300</td>
<td>TYPICAL DISCHARGE JETTY GENERAL ARRANGEMENT</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0301</td>
<td>TYPICAL DISCHARGE JETTY SECTION</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0600</td>
<td>DISCHARGE STRUCTURE - SECTION</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-1000</td>
<td>CAISSON STRUCTURE GENERAL ARRANGEMENT</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-1001</td>
<td>CAISSON STRUCTURE SECTION</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-ME-0001</td>
<td>FISH SCREEN DETAIL</td>
</tr>
<tr>
<td>AEG155-5100-TD-DRG-CV-0001</td>
<td>COVER PAGE</td>
</tr>
<tr>
<td>AEG155-5100-TD-DRG-CV-0002</td>
<td>GENERAL NOTES</td>
</tr>
<tr>
<td>AEG155-5100-TD-DRG-CV-1000</td>
<td>PARNKA POINT LOCATION KEY PLAN</td>
</tr>
<tr>
<td>AEG155-5100-TD-DRG-CV-1001</td>
<td>PARNKA POINT LOCATION PLAN - SHEET 1</td>
</tr>
<tr>
<td>AEG155-5100-TD-DRG-CV-1002</td>
<td>PARNKA POINT LOCATION PLAN - SHEET 2</td>
</tr>
<tr>
<td>AEG155-5100-TD-DRG-CV-1003</td>
<td>WOODS WELL LOCATION KEY PLAN</td>
</tr>
<tr>
<td>AEG155-5100-TD-DRG-CV-1004</td>
<td>WOODS WELL LOCATION PLAN - SHEET 1</td>
</tr>
<tr>
<td>AEG155-5100-TD-DRG-CV-1005</td>
<td>WOODS WELL LOCATION PLAN - SHEET 2</td>
</tr>
<tr>
<td>AEG155-5100-TD-DRG-ME-6000</td>
<td>PONTOON PUMP SECTION</td>
</tr>
</tbody>
</table>

DISCLAIMER
This document contains intellectual property rights owned by or licensed to the client and design services consultant, and must not be reproduced or disclosed other than in accordance with the design services contract, design services subcontract and subconsultant covenant between the client, design services consultant and design services subconsultant.
CONCRETE APRON
OUTFALL STRUCTURE

FLEXMAT FM250

REFER DRAWING AEG155-0000-TD-DRG-CV-0700 FOR
NEARSHORE DISCHARGE STRUCTURE DETAILS

15m NOM.
55m NOM.
20m NOM.

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR
NOT FOR CONSTRUCTION
DN1400 GRP PIPE INSTALLED BELOW GROUND THROUGH DUNES

4x DN600 CONCRETE PILES PER PONTOON USED FOR MOORING

60m x 25m AREA AROUND THE PUMPS TO BE DREDGED TO PROVIDE A WATER DEPTH OF APPROXIMATELY 4.5m DEPTH TO BE CONFIRMED BY PUMP SUPPLIER.

CONCRETE ANCHOR BLOCK SURROUNDING THE PIPE CONNECTION FROM ABOVE GROUND GRP TO BELOW GROUND HDPE TO MANAGE THRUST FORCES

OD1200 HDPE PN10 PIPEWORK

BUOYS INSTALLED ALONG PIPELINE

FLOATING WALKWAY

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR
DN1400 GRP PIPEWORK INSTALLED THROUGH DUNES

PRECAST BASE TO SUPPORT DISCHARGE

CONCRETE CAISSON

4 VERTICAL TURBINE PUMPS

310m LONG JETTY (NOM.)
VERTICAL TURBINE PUMPS WITH OD1000 PN10 HDPE DISCHARGE PIPEWORK

CONCRETE CAISSON

REFERENCE DRAWINGS AEG155-0000-TD-DRG-CV-0200 AND 0201 FOR JETTY SECTION AND GENERAL ARRANGEMENT

DN1400 GRP PIPEWORK

350m LONG JETTY
PIPE INSTALLED BELOW GROUND THROUGH DUNES

DN1400 GRP PIPEWORK

100m NOH

DISCHARGE STRUCTURE, REFER DRAWING AEG155-5000-TD-DRG-CV-0800 FOR DETAILS

PRECAST CONCRETE BASE TO SUPPORT DISCHARGE
NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
2. FISH EXCLUSION SCREEN CLEARANCES AND REQUIRED WATER DEPTHS TO BE CONFIRMED BY SUPPLIER DURING DETAILED DESIGN.

PONTOON MOUNTED PUMP
DN1200 BUTTERFLY VALVE
DN1200 CHECK VALVE
OD1200 HDPE PN10 PIPEWORK
SELF CLEANING CONE TYPE FISH SCREEN, REFER DRAWING AEG155-0000-TD-DRG-ME-0001 FOR FISH SCREEN MODELS
4x DN600 CONCRETE PILES PER PONTOON USED FOR MOORING
ACCESS PLATFORM OVER PIPE

DREDGED COORONG FLOOR
COORONG LEVEL
0m AHD (VARIES BETWEEN 0.25m AND 0.75m)

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
2. FISH EXCLUSION SCREEN CLEARANCES AND REQUIRED WATER DEPTHS TO BE CONFIRMED BY SUPPLIER DURING DETAILED DESIGN.
DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 6 - PASSIVE PIPEWORK CSL IN/OUT WITH BREAKWATER

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR
NOT FOR CONSTRUCTION

DRAWING LIST: OPTION 6 - PASSIVE PIPEWORK CSL IN/OUT WITH BREAKWATER

<table>
<thead>
<tr>
<th>DRAWING NO.</th>
<th>DRAWING TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEG155-0000-TD-DRG-CV-0001</td>
<td>PROJECT KEY PLAN</td>
</tr>
<tr>
<td>AEG155-0000-TD-DRG-CV-0900</td>
<td>BREAKWATER DETAILS</td>
</tr>
<tr>
<td>AEG155-6000-TD-DRG-CV-0001</td>
<td>COVER PAGE</td>
</tr>
<tr>
<td>AEG155-6000-TD-DRG-CV-0002</td>
<td>GENERAL NOTES</td>
</tr>
<tr>
<td>AEG155-6000-TD-DRG-CV-1000</td>
<td>KEY PLAN</td>
</tr>
<tr>
<td>AEG155-6000-TD-DRG-CV-1001</td>
<td>PLAN - SHEET 1</td>
</tr>
<tr>
<td>AEG155-6000-TD-DRG-CV-1002</td>
<td>PLAN - SHEET 2</td>
</tr>
<tr>
<td>AEG155-6000-TD-DRG-CV-1003</td>
<td>PASSIVE INTAKE/OUTFALL STRUCTURE - SECTION</td>
</tr>
<tr>
<td>AEG155-6000-TD-DRG-CV-5000</td>
<td>PIPING SECTION</td>
</tr>
</tbody>
</table>

A ISSUED FOR REVIEW 28/10/2021
B CONCEPT DESIGN ISSUE 01/12/2021
C FINAL CONCEPT ISSUE 21/12/2021
BREAKWATER
PRECAST CONCRETE BASE TO SUPPORT INTAKE/DISCHARGE WITH GRILLAGE
10x DN2000 GRP PIPES INSTALLED BELOW GROUND THROUGH DUNES

PRECAST CONCRETE VALVE PIT
PRECAST CONCRETE VALVE PIT

NOT FOR CONSTRUCTION
NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR

DEPARTMENT FOR ENVIRONMENT AND WATER
COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT
OPTION 6 - PASSIVE PIPEWORK CSL IN/OUT WITH BREAKWATER
KEY PLAN

M. MACIEL
M. TOLCVAY
P. STANIFORD
J. BOOTH
F. RAPONI

A ISSUED FOR REVIEW 28/10/2021
B CONCEPT DESIGN ISSUE 01/12/2021
FINAL CONCEPT ISSUE 21/12/2021

C

PS
PS
MT
JB
FR
BREAKWATER STRUCTURE, REFER DRAWING AEG155-0000-TD-DRG-CV-0900 FOR DETAILS

PRIMARY ARMOUR LAYER: TETRAPOD CONCRETE UNITS
REINFORCED CONCRETE CREST WALKWAY

HOLE ISbred ON WORKS OUTLET TO TRAP GROSS POLLUTANTS

PILED PRECAST CONCRETE BASE TO SUPPORT INTAKE/OUTLET, REFER DRAWING AEG155-0000-TD-DRG-CV-1003 FOR DETAILS

DN2000 MANUALLY ACTUATED BUTTERFLY VALVE
PRECAST CONCRETE VALVE PIT
10x DN2000 GRP PIPES
GRILLAGE ON INTAKE/OUTLET TO TRAP GROSS POLLUTANTS

NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR NOT FOR CONSTRUCTION
10 DN2000 GRP PIPES
PRECAST CONCRETE VALVE PIT
DN2000 MANUALLY ACTUATED BUTTERFLY VALVE
PILED PRECAST CONCRETE BASE TO SUPPORT INTAKE/OUTLET
INTAKE/OUTLET, REFER DRAWING AEG155-6000-TD-DRG-CV-1002 FOR DETAILS
GRILLAGE ON INTAKE/OUTLET TO TRAP GROSS POLLUTANTS

### Drawing Details

<table>
<thead>
<tr>
<th>DRAWING No.</th>
<th>TITLE</th>
<th>CLIENT</th>
<th>A1</th>
<th>SCALE</th>
<th>SIGNATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEG155-6000-TD-DRG-CV-1002</td>
<td>DEPARTMENT FOR ENVIRONMENT AND WATER COORONG INFRASTRUCTURE INVESTIGATIONS PROJECT OPTION 6 - PASSIVE PIPEWORK CSL IN/OUT WITH BREAKWATER PLAN - SHEET 2</td>
<td>Kellogg Brown &amp; Root Pty Ltd</td>
<td></td>
<td>1:500</td>
<td>M. MACIEL</td>
</tr>
</tbody>
</table>

### Revision History

- **A ISSUED FOR REVIEW** 28/10/2021
- **B CONCEPT DESIGN ISSUE** 01/12/2021
- **FINAL CONCEPT ISSUE** 21/12/2021

### Technical Approvals

- **F. RAPONI**
- **P. STANIFORD**
- **J. BOOTH**

### NOT FOR CONSTRUCTION

**NOTE: THIS DRAWING IS TO BE READ / PRINTED IN COLOUR**
GUIDE PILES GROUTED IN PLACE

BED LEVEL -3.000 mAHD

BAR SCREEN DETAIL

PRECAST CONCRETE BASE

BAR SCREEN TO TRAP GROSS POLLUTANTS.
REFER DETAIL ON THIS DRAWING.
FISH SCREENS NOT REQUIRED

EXCAVATION PROFILE
(SAND) FOR INSTALLATION OF INTAKE STRUCTURE

FILL WITH 0.4t ROCK ARMOUR BED, 6000 WIDE

BUOY TO INFORM OPERATORS OF STRUCTURE LOCATIONS

NOTE: THIS DRAWING IS TO BE PRINTED IN COLOUR
Appendix B

Basis of Concept Design
Coorong Infrastructure Feasibility Investigations
Basis of Concept Design
Limitations Statement

The sole purpose of this report and the associated services performed by Kellogg Brown & Root Pty Ltd (KBR) is to document the design basis for the concept design in accordance with the scope of services set out in the contract between KBR and Department for Environment & Water (‘the Client’). That scope of services was defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

KBR derived the data in this report primarily from visual inspections, examination of records either provided by Department for Environment & Water or in the public domain, interviews with individuals with information about the site, and a limited amount of sub-surface explorations. The passage of time, manifestation of latent conditions or impacts of future events may require further exploration at the site and subsequent data analysis, and re-evaluation of the findings, observations and conclusions expressed in this report.

In preparing this report, KBR has relied upon and presumed accurate certain information (or absence thereof) relative to the sites considered and the surrounding environments provided by government officials and authorities, the Client and others identified herein. Except as otherwise stated in the report, KBR has not attempted to verify the accuracy or completeness of any such information.

The findings, observations and conclusions expressed by KBR in this report are not, and should not be considered, an opinion concerning the final scope of works for each option and associated capital and operating costs. No warranty or guarantee, whether express or implied, is made with respect to the data reported or to the findings, observations and conclusions expressed in this report. Further, such data, findings, observations and conclusions are based solely upon site conditions, information and drawings supplied by the Client and gained from our site visit in existence at the time of the investigation.

This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the provisions of the agreement between KBR and the Client. KBR accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party.

Revision History

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Comment</th>
<th>Signatures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Originated by</td>
</tr>
<tr>
<td>0</td>
<td>06/08/21</td>
<td>Issued for Use</td>
<td>SAW</td>
</tr>
<tr>
<td>1</td>
<td>06/10/21</td>
<td>Issued for Use</td>
<td>SAW</td>
</tr>
<tr>
<td>2</td>
<td>1/12/21</td>
<td>Issued for Use</td>
<td>SAW</td>
</tr>
</tbody>
</table>
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>1.1 Purpose of this report</td>
<td>1</td>
</tr>
<tr>
<td>1.2 Project background</td>
<td>1</td>
</tr>
<tr>
<td>1.3 Shortlisted infrastructure options and scope of works</td>
<td>1</td>
</tr>
<tr>
<td>1.4 Exclusions from the scope of work</td>
<td>3</td>
</tr>
<tr>
<td>1.5 Reference documents and input data</td>
<td>3</td>
</tr>
<tr>
<td>2 LIST OF PRINCIPAL DESIGN CODES</td>
<td>5</td>
</tr>
<tr>
<td>2.1 Application of Standards and Design Codes</td>
<td>5</td>
</tr>
<tr>
<td>2.2 Design standards</td>
<td>5</td>
</tr>
<tr>
<td>3 PERFORMANCE REQUIREMENTS</td>
<td>11</td>
</tr>
<tr>
<td>3.1 Flow metrics</td>
<td>11</td>
</tr>
<tr>
<td>3.2 Civil design</td>
<td>13</td>
</tr>
<tr>
<td>3.3 Mechanical design</td>
<td>17</td>
</tr>
<tr>
<td>3.4 Electrical design</td>
<td>18</td>
</tr>
<tr>
<td>3.5 Marine structure characteristics</td>
<td>19</td>
</tr>
<tr>
<td>3.6 Marine design criteria</td>
<td>20</td>
</tr>
<tr>
<td>4 DESIGN INPUTS</td>
<td>25</td>
</tr>
<tr>
<td>4.1 Survey and datum</td>
<td>25</td>
</tr>
<tr>
<td>4.2 Bathymetry</td>
<td>25</td>
</tr>
<tr>
<td>4.3 Geotechnical</td>
<td>25</td>
</tr>
<tr>
<td>5 ENVIRONMENT AND SUSTAINABILITY</td>
<td>26</td>
</tr>
<tr>
<td>5.1 Sustainable design</td>
<td>26</td>
</tr>
<tr>
<td>5.2 Environmental considerations</td>
<td>27</td>
</tr>
<tr>
<td>6 DURABILITY AND LIFE CYCLE REQUIREMENTS</td>
<td>29</td>
</tr>
<tr>
<td>6.1 Design life</td>
<td>29</td>
</tr>
<tr>
<td>6.2 Material selection</td>
<td>29</td>
</tr>
<tr>
<td>7 OPERATIONS AND MAINTENANCE REQUIREMENTS</td>
<td>33</td>
</tr>
<tr>
<td>7.1 General</td>
<td>33</td>
</tr>
<tr>
<td>7.2 Operating environment</td>
<td>33</td>
</tr>
<tr>
<td>7.3 Equipment location</td>
<td>33</td>
</tr>
<tr>
<td>7.4 Operation</td>
<td>33</td>
</tr>
<tr>
<td>7.5 Labelling</td>
<td>33</td>
</tr>
<tr>
<td>7.6 Site security</td>
<td>34</td>
</tr>
<tr>
<td>7.7 Energy efficiency</td>
<td>34</td>
</tr>
<tr>
<td>7.8 Plant equipment selection</td>
<td>34</td>
</tr>
<tr>
<td>7.9 Operating and maintenance manuals</td>
<td>35</td>
</tr>
<tr>
<td>7.10 Decommissioning requirements</td>
<td>35</td>
</tr>
<tr>
<td>7.11 Redundancy</td>
<td>35</td>
</tr>
<tr>
<td>8 SAFETY IN DESIGN CONSIDERATIONS</td>
<td>36</td>
</tr>
<tr>
<td>8.1 Health and safety objectives</td>
<td>36</td>
</tr>
<tr>
<td>8.2 Safety in design</td>
<td>36</td>
</tr>
<tr>
<td>8.3 Public access risks</td>
<td>36</td>
</tr>
<tr>
<td>8.4 Health and safety hazards</td>
<td>37</td>
</tr>
<tr>
<td>8.5 Constructability and maintenance</td>
<td>37</td>
</tr>
</tbody>
</table>
## List of tables

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>Scope of works for shortlisted infrastructure options</td>
</tr>
<tr>
<td>Table 2</td>
<td>Australian standards and other reference codes</td>
</tr>
<tr>
<td>Table 3</td>
<td>International standards</td>
</tr>
<tr>
<td>Table 4</td>
<td>Other applicable standards and specifications</td>
</tr>
<tr>
<td>Table 5</td>
<td>Design basis flow metrics</td>
</tr>
<tr>
<td>Table 6</td>
<td>Hydraulic boundary conditions</td>
</tr>
<tr>
<td>Table 7</td>
<td>Native soil modulus</td>
</tr>
<tr>
<td>Table 8</td>
<td>Minimum clearances between underground services</td>
</tr>
<tr>
<td>Table 9</td>
<td>Design Criteria</td>
</tr>
<tr>
<td>Table 10</td>
<td>Dead load (self-weight) unit weights</td>
</tr>
<tr>
<td>Table 11</td>
<td>Southern Ocean tidal plane</td>
</tr>
<tr>
<td>Table 12</td>
<td>Design life of project equipment and structures</td>
</tr>
<tr>
<td>Table 13</td>
<td>Minimum standard for materials and finishes</td>
</tr>
<tr>
<td>Table 14</td>
<td>Concrete design properties</td>
</tr>
<tr>
<td>Table 15</td>
<td>Corrosion rates</td>
</tr>
<tr>
<td>Table 16</td>
<td>Equipment unit redundancy</td>
</tr>
</tbody>
</table>
1 Introduction

1.1 PURPOSE OF THIS REPORT

This report outlines the basis of concept design for the Coorong Infrastructure Investigations Project (CIIP) Engineering Services engagement. The purpose of the basis of design is to:

- Communicate the basis of design information to the Client for their agreement.
- Summarise proposed design standards, manuals, and technical documents applicable to the design of the infrastructure relevant to the CIIP engagement.
- Document the target design and performance criteria for the infrastructure options.
- Document constraints having a bearing on the design of the infrastructure options.

1.2 PROJECT BACKGROUND

The CIIP forms part of the Healthy Coorong, Healthy Basin (HCHB) program. As part of the CIIP, Kellogg Brown & Root Pty Ltd (KBR) has been engaged by Department for Environment & Water (DEW) to investigate the engineering feasibility of long term infrastructure and management regimes to improve the ecological health of the Coorong, provide the opportunity for habitat restoration and to sustain the ecosystem for many years to come.

The Coorong as a system has a special connection to many community members, and importantly the Traditional Owners, as a place of recreation, natural beauty, education, and sustenance of livelihoods. DEW is focused on engagement of the community in decision making as part of the CIIP and has already sought feedback from the community on preferred options for improvement of the ecological health of the Coorong South Lagoon in particular. This list of options has guided development of the infrastructure options that will now be considered in this feasibility and concept design study.

The CIIP Engineering Services engagement will allow engineering assessment of these shortlisted infrastructure options to determine potential suites of infrastructure that will achieve the objectives set by the HCHB program and provide confidence in the expected outcomes of the infrastructure to be implemented.

1.3 SHORTLISTED INFRASTRUCTURE OPTIONS AND SCOPE OF WORKS

As part of the CIIP Engineering Services engagement, KBR will complete options assessment and concept design for a range of potential infrastructure options aimed at better managing inflows and outflows from the Coorong South Lagoon (CSL) to improve its ecological health. These designs will be used to inform the feasibility assessment reporting and justification of the proposed long term infrastructure and management regimes ahead of implementation.

The shortlisted infrastructure options and a high level summary of their scope of works is summarised in Table 1.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Passive open channel connection between Lake Albert and Coorong North Lagoon: 1,000 ML/d passive connection between Lake Albert and Coorong North Lagoon via an open channel with regulator structure.</td>
</tr>
<tr>
<td>Option</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>1B</td>
<td>Passive piped connection between Lake Albert and Coorong North Lagoon: 1,000 ML/d passive connection between Lake Albert and Coorong North Lagoon via one or more closed conduits (pipes) with regulator structure.</td>
</tr>
<tr>
<td>2</td>
<td>Dredge Parnka Point: 18.5 km long to a target depth of between -1.2 mAH and -1.4 mAH centred around Parnka Point to varying width.</td>
</tr>
<tr>
<td>3A</td>
<td>Intermittent pumped connection out of Coorong South Lagoon – near shore discharge structure: 1,000 ML/d pumped connection out of Coorong South Lagoon via pumps on a pontoon structure adjacent Younghusband Peninsula to a near shore discharge structure (within Southern Ocean).</td>
</tr>
<tr>
<td>3B</td>
<td>Intermittent pumped connection out of Coorong South Lagoon – low visual impact discharge structure: 1,000 ML/d pumped connection out of Coorong South Lagoon via pumps on a pontoon structure adjacent Younghusband Peninsula to a beach discharge structure (likely within tidal zone).</td>
</tr>
<tr>
<td>3C</td>
<td>Pumped connection out of Coorong South Lagoon – near shore discharge structure: 250 ML/d pumped connection out of Coorong South Lagoon via pumps on a pontoon structure adjacent Younghusband Peninsula to a near shore discharge structure (within Southern Ocean).</td>
</tr>
<tr>
<td>3D</td>
<td>Pumped connection out of Coorong South Lagoon – low visual impact discharge structure: 250 ML/d pumped connection out of Coorong South Lagoon via pumps on a pontoon structure adjacent Younghusband Peninsula to a beach discharge structure (likely within tidal zone).</td>
</tr>
<tr>
<td>4A</td>
<td>Bi-directional pumped Southern Ocean connection – one location, separate pumping stations, pump in location with caisson structure: 350 ML/d bi-directional pumped connection into and out of Coorong South Lagoon via jetty mounted pumps on 300 m long jetty in the Southern Ocean with caisson structure and pumps on a pontoon structure in Coorong South Lagoon. Pumping can only occur in one direction at any one time.</td>
</tr>
<tr>
<td>4B</td>
<td>Bi-directional pumped Southern Ocean connection – one location, one common pumping station, near shore discharge / intake protected by breakwater: 350 ML/d bi-directional pumped connection into and out of Coorong South Lagoon via a common dry well pumping station positioned within Younghusband Peninsula with reversible flow pipes and a single set of pumps. Pumping can only occur in one direction at any one time. Near shore protected discharge / intake provided.</td>
</tr>
<tr>
<td>5A</td>
<td>Simultaneous pumped Southern Ocean connection – two locations, separate pumping stations, pump in location with caisson structure and pump out location with a near shore discharge structure: 350 ML/d simultaneous pumped connection into and out of Coorong South Lagoon via jetty mounted pumps on 300 m long jetty in the Southern Ocean with caisson structure and pumps on a pontoon structure in Coorong South Lagoon with infrastructure positioned at two separate locations allowing circulation of flows within Coorong South Lagoon (i.e. pumping in at Parnka Point and pumping out at Woods Well). Pumping can occur concurrently through each pumping station.</td>
</tr>
<tr>
<td>Option</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>5B</td>
<td><strong>Simultaneous pumped Southern Ocean connection</strong> – two locations, separate pumping stations, pump in location with caisson structure and pump out location with a low visual impact discharge structure: 350 ML/d simultaneous pumped connection into and out of Coorong South Lagoon via jetty mounted pumps on 300 m long jetty in the Southern Ocean with caisson structure and pumps on a pontoon structure in Coorong South Lagoon with infrastructure positioned at two separate locations allowing circulation of flows within Coorong South Lagoon (i.e. pumping in at Parnka Point and pumping out at Woods Well). Pumping can occur concurrently through each pumping station.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Passive open channel connection between Lake Albert and Coorong North Lagoon:</strong> 1,000 ML/d passive connection between Lake Albert and Coorong North Lagoon via an open channel with regulator structure.</td>
</tr>
</tbody>
</table>

### 1.4 EXCLUSIONS FROM THE SCOPE OF WORK

The CIIP design scope of work excludes the following:

- Improvements to the ecological state of the Coorong North Lagoon or Lake Albert.
- Review and assessment of the River Murray mouth dredging regime and flow conditions.

### 1.5 REFERENCE DOCUMENTS AND INPUT DATA

In parallel with the CIIP Engineering Services engagement, several additional technical studies have been or are being undertaken by DEW to provide guidance and information to assist in selection of the preferred concept designs. These parallel studies have included:

#### 1.5.1 Completed surveys and studies

- Hydrodynamic, biogeochemical and habitat modelling study (completed by BMT, reference R.10780.0001.00, May 2021).
- Bathymetric survey of the Coorong lagoons in the vicinity of the locations proposed for dredging.

#### 1.5.2 Ongoing or future surveys and studies

- Stage 2 hydrodynamic modelling scenarios.
- Stage 2 hydrodynamic, biogeochemical and habitat modelling scenarios.
- Geotechnical investigations associated with the engineering services required under this engagement (engaged and coordinated by KBR).
- Engineering survey associated with the engineering services required under this engagement (engaged and coordinated by KBR).
- Geophysical survey in the Southern Ocean for a proposed infrastructure alignment (4 km long x 1 km wide expected survey extent).
- Geophysical survey in the Parnka Narrows (dredge alignment) to determine if there is a historical channel that has been infilled with soft materials or sediments over time (pending approval).
• Geophysical survey of one or more proposed infrastructure alignments through Younghusband Peninsula to investigate expected geology of dune system (pending approval).

• Additional surveys or investigations identified in the gap analysis memorandum (pending approval).
2 List of Principal design codes

2.1 APPLICATION OF STANDARDS AND DESIGN CODES

All standards, specifications and design codes referenced, and all applicable national and international standards and codes, local and statutory regulations, and written instructions will be complied with.

If any dispute arises between standards, design codes or other regulations, the following order of precedence will apply:

- Government legislation, principally the current South Australian Workplace Health and Safety Act and its Regulations and any associated Codes of Practice.
- Standards or codes of practice nominated by the Principal and approved in writing by the Superintendent.
- The Principal’s own engineering and safety standards.
- The contents of the technical specification and drawings prepared as part for this project.
- Australian Standards.
- International Standards.
- Other standards or codes of practice relevant to the scope of works.

2.2 DESIGN STANDARDS

2.2.1 Australian Standards

The Australian standards in Table 2, will be referenced in development of design documentation.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1100 Set</td>
<td>Technical drawing</td>
</tr>
<tr>
<td>AS 1101 Set</td>
<td>Graphic symbols for general engineering</td>
</tr>
<tr>
<td>AS 1170.0-2002</td>
<td>Structural design actions - Part 0: General Principals</td>
</tr>
<tr>
<td>AS 1170.1-2002</td>
<td>Structural design actions - Part 1: Permanent, imposed and other actions</td>
</tr>
<tr>
<td>AS 1170.2-2011</td>
<td>Structural design actions - Part 2: Wind actions</td>
</tr>
<tr>
<td>AS 1170.4-2007</td>
<td>Structural design actions - Part 4: Earthquake actions in Australia</td>
</tr>
<tr>
<td>AS 1181-1982</td>
<td>Methods of measurement of civil engineering quantities</td>
</tr>
<tr>
<td>AS 1345-1995</td>
<td>Identification of the contents of pipes, conduits and ducts</td>
</tr>
<tr>
<td>AS 1428.1-2009</td>
<td>Design for access and mobility - Part 1: General requirements for access - New building work</td>
</tr>
<tr>
<td>Code</td>
<td>Title</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>AS 1428.2-1992</td>
<td>Design for access and mobility - Part 2: Enhanced and additional requirements — Buildings and facilities</td>
</tr>
<tr>
<td>R2015</td>
<td></td>
</tr>
<tr>
<td>AS 1477-2006</td>
<td>PVC pipes and fittings for pressure applications</td>
</tr>
<tr>
<td>AS 1597.1-1996</td>
<td>Precast reinforced box culverts — Small culverts (not exceeding 1,200 mm span and 1,200 mm height)</td>
</tr>
<tr>
<td>AS 1597.2-1996</td>
<td>Precast reinforced concrete box culverts - Large culverts (from 1,500 mm span and up to and including 4,200 mm span and 4,200 height)</td>
</tr>
<tr>
<td>AS 1627 Set</td>
<td>Metal finishing</td>
</tr>
<tr>
<td>AS 1646-2007</td>
<td>Elastomeric seals for waterworks purposes — general requirements</td>
</tr>
<tr>
<td>(R2018)</td>
<td></td>
</tr>
<tr>
<td>AS 1659-2018</td>
<td>Fixed platforms, walkways, stairways and ladders - Design, construction and installation</td>
</tr>
<tr>
<td>AS/NZS 1664-1997</td>
<td>Aluminium structures code</td>
</tr>
<tr>
<td>AS 2033-2008</td>
<td>Installation of polyethylene pipe systems</td>
</tr>
<tr>
<td>AS 2129-2000</td>
<td>Flanges for pipe, valves and fittings</td>
</tr>
<tr>
<td>AS 2159-2009</td>
<td>Piled footings design and installation</td>
</tr>
<tr>
<td>AS 2200-2006</td>
<td>Design charts for water supply and sewerage</td>
</tr>
<tr>
<td>AS/NZS 2280-2012</td>
<td>Ductile iron pipe and fittings</td>
</tr>
<tr>
<td>AS 2312.1-2014</td>
<td>Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings — Part 1 Paint coatings</td>
</tr>
<tr>
<td>AS 2566 Set</td>
<td>Buried flexible pipelines</td>
</tr>
<tr>
<td>AS 2638.2-2011</td>
<td>Gate valves for water works purposes — resilient seated</td>
</tr>
<tr>
<td>AS 2067-2016</td>
<td>Substations and high voltage installations exceeding 1kV AC</td>
</tr>
<tr>
<td>AS 2832 Set</td>
<td>Cathodic protection of metals</td>
</tr>
<tr>
<td>AS 2870-2011</td>
<td>Residential slabs and footings</td>
</tr>
<tr>
<td>AS/NZS 3000-2018</td>
<td>Wiring Rules</td>
</tr>
<tr>
<td>AS 3571 Set</td>
<td>Plastics Piping Systems – glass-reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin</td>
</tr>
<tr>
<td>AS 3600-2018</td>
<td>Concrete structures</td>
</tr>
<tr>
<td>AS 3679-2010</td>
<td>Structural steel — Hot rolled bars and sections</td>
</tr>
<tr>
<td>AS 3678-2011</td>
<td>Structural steel — Hot rolled plates, floorplates and slabs</td>
</tr>
<tr>
<td>AS 3798-2007</td>
<td>Guidelines on earthworks for commercial and residential developments</td>
</tr>
<tr>
<td>AS 3962-2020</td>
<td>Guidelines for the design of marinas</td>
</tr>
<tr>
<td>AS/NZS 3735-2001</td>
<td>Concrete structures for retaining liquids</td>
</tr>
</tbody>
</table>
### Basis of Concept Design

**2.2.2 International standards**

The international standards in Table 3 will be referenced in development of design documentation.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 21650:2007(E)</td>
<td>Actions from waves and currents on coastal structures</td>
</tr>
<tr>
<td>BS 6349-1-2016</td>
<td>Maritime Structures, Part 1: Code of Practice for General Criteria</td>
</tr>
<tr>
<td>ASTM A312/A312M-21</td>
<td>Standard Specification for Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes</td>
</tr>
<tr>
<td>ASTM A666-15</td>
<td>Standard Specification for Annealed or Cold Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bars</td>
</tr>
<tr>
<td>ASTM F593-17</td>
<td>Standard Specification for Stainless Steel Bolts, Hex Cap Nuts, Screws and Studs</td>
</tr>
<tr>
<td>AWS D1.6-2017</td>
<td>Structural Welding (stainless steel)</td>
</tr>
<tr>
<td>ISO 3514</td>
<td>Chlorinate polyvinyl chloride (CPVC) pipes and fittings – specification and determination of density</td>
</tr>
<tr>
<td>IECA (international Erosion control Association)</td>
<td>Best Practice Erosion and Sediment Control (BPESC) document</td>
</tr>
<tr>
<td>IALA 0139</td>
<td>Marking Man-Made Offshore Structures</td>
</tr>
</tbody>
</table>
2.2.3 Other applicable standards and specifications

The following standards and specifications listed in Table 4 will be referenced in development of design documentation.

Table 4 Other applicable standards and specifications

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA Water TS 4</td>
<td>Packing sand (pipe embedment and trench fill sand)</td>
</tr>
<tr>
<td>SA Water TS 27</td>
<td>Bolt tightening procedure for mechanical plant</td>
</tr>
<tr>
<td>SA Water TS 15</td>
<td>Protection of steelwork in submersible environments.</td>
</tr>
<tr>
<td>SA Water TS 16</td>
<td>Protection of steelwork in atmospheric environments</td>
</tr>
<tr>
<td>SA Water TS 18</td>
<td>Protection of steelwork in buried environments</td>
</tr>
<tr>
<td>SA Water TS 0132</td>
<td>Operating and maintenance manuals</td>
</tr>
<tr>
<td>SA Water TS 0133</td>
<td>Requirements for asset labelling</td>
</tr>
<tr>
<td>SA Water TS 0146b</td>
<td>Requirements for pump specification, procurement and testing and the preparation of pump datasheets</td>
</tr>
<tr>
<td>SA Water TS 0204</td>
<td>Colour coding of pipework</td>
</tr>
<tr>
<td>SA Water TS 0230</td>
<td>Gate and butterfly valve requirements</td>
</tr>
<tr>
<td>SA Water TS 0300</td>
<td>Supply and installation of low voltage equipment</td>
</tr>
<tr>
<td>SA Water TS 0302</td>
<td>Stand-alone solar power supply systems</td>
</tr>
<tr>
<td>SA Water TS 0340</td>
<td>Design, supply, installation and testing of high voltage equipment</td>
</tr>
<tr>
<td>SA Water TS 0600</td>
<td>Water tightness testing of liquid retaining structures</td>
</tr>
<tr>
<td>SA Water TS 0630</td>
<td>Coarse aggregates for civil works</td>
</tr>
<tr>
<td>SA Water TS 0710</td>
<td>Concrete</td>
</tr>
<tr>
<td>SA Power Networks</td>
<td>Service and installation rules – Manual No. 32</td>
</tr>
<tr>
<td>WSAA WSA-01</td>
<td>Polyethylene Pipeline Code</td>
</tr>
<tr>
<td>WSAA WSA-03</td>
<td>Water Supply Code of Australia</td>
</tr>
<tr>
<td>Australasian Society for Trenchless Technology</td>
<td>Standard for Micro tunnelling &amp; Pipe Jacking</td>
</tr>
</tbody>
</table>

2.2.4 Guidelines and manuals

A non-exhaustive list of the guidelines and manuals that will be referenced in development of design documentation includes:


• Australian Pipelines and Gas Association Ltd: Code of Environmental Practice.

• Environment Project Authority SA: A guide to managing acid sulphate soil risks in South Australian River Murray wetlands.

• Safe Work Australia – Noise.

2.2.5 Other documents and reports

The current version of the following Standards, Manuals, Acts and Guidelines will be consulted where appropriate:

• Environmental Planning, Department of Environment and Heritage Protection (2013). ‘Coastal hazard technical guide - Determining coastal hazard areas’.


• Pilarczyk (1998) ‘Structural Response’ Design of revetments (Dutch Public Works Department (RWS)).


• South Australia Power Networks Technical Standards.

• Australian Government Department of the Environment and Energy 2017: NATIONAL GREENHOUSE ACCOUNTS FACTORS.

• Australian Government, Department of the Environment, Matters of National Environmental Significance, Significant Impact Guidelines 1.1.

• Australian Government, Department of the Environment, National Assessment Guidelines for Dredging 2009.


2.2.6 Acts

Acts relevant to the engineering design include:

Commonwealth

• Environment Protection and Biodiversity Conservation Act 1999.
• Native Title Act 1993.
• Water Act 2007.

South Australia

• Aboriginal Heritage Act 1988.
• Work Health and Safety Regulations 2012.
• Native Vegetation Act 1991.
• Landscape South Australia Act 2019.
• Local Government Act 1999.
• Construction Industry Training Fund Act 1993.
• Crown Land Management Act 2009.
• Heritage Places Act 1993.
• Electricity Act 1996.
• Electricity (General) Regulations 2012.
• Environment Protection Act 1993.
• Environment Protection Regulations 2009.
• Mining Act 1971.
• River Murray Act 2003.
• National Parks & Wildlife Act 1972.
• Planning, Development and Infrastructure Act 2016.
• Native Title (South Australia) Act 1994.
• Marine Parks Act 2007.
3 Performance requirements

3.1 FLOW METRICS

The target flow metrics summarised in Table 5 form the design basis for the project, and consequently inform scale of infrastructure required for each design option. Some refinement to the parameters stated in this table will be required as engineering design and documentation progresses.
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Water Source</th>
<th>Maximum daily target flow yield</th>
<th>Maximum annual target flow yield</th>
<th>Minimum flow required</th>
<th>Typical flow days</th>
<th>Frequency of Transfers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Passive connection between Lake Albert and Coorong North Lagoon</td>
<td>Bascombe Bay, Lake Albert</td>
<td>1,000 ML/d (with 0.5 mAHD in Lake Albert and 0.3 mAHD in Coorong North Lagoon)</td>
<td>89 GL (dry) – 196 GL (typical) (dependent on Lower Lakes inflows)</td>
<td>0</td>
<td>Between 143 days (with climate change) and 241 days (current conditions)</td>
<td>Typically, when flow over barrages is greater than 2,000 ML/d.</td>
</tr>
<tr>
<td>2</td>
<td>Dredge Parnka Point alignment</td>
<td>Coorong North Lagoon</td>
<td>n/a (complementary action)</td>
<td>n/a (complementary action)</td>
<td>n/a</td>
<td>365</td>
<td>Permanent operation (24 hours per day, 365 days per year).</td>
</tr>
<tr>
<td>3</td>
<td>Pumped connection out of Coorong South Lagoon</td>
<td>Southern Ocean</td>
<td>1,000 ML/d (intermittent operation only when Coorong South Lagoon water level &gt; 0.3 mAHD) 250 ML/d (permanent operation)</td>
<td>To be confirmed</td>
<td>0</td>
<td>Between 137 days (current conditions) and 189 days (with climate change) @1000 ML/d 365 days @ 250 ML/d</td>
<td>Permanent operation (24 hours per day, 365 days per year). Permanenent operation (24 hours per day, 365 days per year).</td>
</tr>
<tr>
<td>4</td>
<td>Bi-directional pumped Southern Ocean connection – one location, separate pumping stations</td>
<td>Southern Ocean</td>
<td>350 ML/d (max out) 350 ML/d (max in)</td>
<td>128 GL (total transfer volume at 350 ML/d flow rate)</td>
<td>0</td>
<td>365</td>
<td>Permanent operation (24 hours per day, 365 days per year) with pumping directions alternating.</td>
</tr>
<tr>
<td>5</td>
<td>Bi-directional pumped Southern Ocean connection – two locations, separate pumping stations</td>
<td>Southern Ocean</td>
<td>350 ML/d (max out) 350 ML/d (max in)</td>
<td>128 GL (in and out at 350 ML/d flow rate)</td>
<td>0</td>
<td>Between 222 days (current conditions) and 166 days (with climate change) @ 350 ML/d pump in 365 days @ 350 ML/d pump out</td>
<td>Intermittent operation for pump in (dependent on Coorong water levels) and permanent operation for pump out (24 hours per day, 365 days per year).</td>
</tr>
<tr>
<td>6</td>
<td>Bi-directional passive piped connection into and out of Coorong South Lagoon</td>
<td>Southern Ocean</td>
<td>4,000 ML/d (maximum for ten x DN2000 pipes flowing into Coorong South Lagoon)</td>
<td>To be confirmed (total transferred volume)</td>
<td>0</td>
<td>365</td>
<td>Permanent operation (24 hours per day, 365 days per year).</td>
</tr>
</tbody>
</table>
3.2 CIVIL DESIGN

3.2.1 Geotechnical information

Existing geotechnical information is available from previous design assessment completed for the South East Flows Restoration Project and Lake Albert Connector Investigations. These previous investigations will be referenced as part of design development to inform the desktop studies and field investigations to be completed. Relevant parameters can be incorporated within the basis of design once identified.

At this stage of design, specific geotechnical information is not available within the Younghusband Peninsula. Geophysical survey will be completed to assist in better understanding geotechnical conditions.

3.2.2 Open channel design philosophy

In the design of open channels, consideration will be given to maintaining the existing drainage of the landscape through which it flows. In general, the water surface will be kept below existing ground level where reasonably and practically possible. Where this cannot be achieved, flows will be contained by levees and catch drains will be provided to accommodate runoff from the local catchment or flow will be allowed to spill into other confined areas (as may be preferred). Sediment and erosion control planning will be incorporated here to minimise the impacts of sediment, nutrient loads and turbidity exiting the channel.

In areas where native vegetation is identified as being of high ecological value or sites of cultural significance are identified, the location of the spoil bank will be considered to minimise, where possible, the impact to these communities and the impact to cultural sites/values.

Batter slopes will be nominated to allow for safe vehicle and fauna access within a grass-lined channel, assuming the channel is constructed within existing farmland. This may be steepened dependent on geotechnical conditions and final adopted channel alignment. Fencing to channel alignment will be provided.

Crossing structures will be provided where required to allow local landholder or public road access requirements to be maintained. Crossing structures will be designed to utilise precast concrete culvert or pipe sections.

The following requirements will be adopted for the open channel design:

- A batter slope of 1V:4H will be adopted for all new open channels.
- Minimum bed width of 2 m will be adopted.
- A minimum top width of any levee or spoil mounds will be 3 m.
- A minimum access track width of 5 m will be provided adjacent to all open channels on both sides. Proposed track to be formed of natural materials but unsurfaced. Proposed design vehicle is a four wheel drive utility with no public access.
- At regulator structure, a hardstand will be provided allowing crane access and for other operational purposes.
- Rock armouring will be provided at the inlet and outlet of flow regulator and inlet and discharge headwalls to assist in erosion mitigation.
- A minimum crossing width of 4.5 m and a minimum load rating of 10 t will be adopted to suit access by emergency services vehicles (including CFS vehicles).
- A maximum height of any spoil mound will be 2 m.
The open channel gradient will be selected considering local topography and design flow requirements ensuring the target flow rate can be achieved for the designed cross sectional area.

- Maximum permissible velocity for open channel: 0.5 m/s.
- Target velocity for culverts: 1 m/s.

### 3.2.3 Open channel hydraulic roughness

The following Manning’s roughness coefficients (Manning’s ‘n’) will be assumed for the hydraulic design of open channel infrastructure:

- Earthen open channel: 0.030 – 0.035
- Box culvert or pipe: 0.011 – 0.013 (reinforced concrete).

### 3.2.4 Open channel freeboard

Minimum freeboard within open channels will be set to 200 mm where the design water level is below the existing ground level (may vary slightly depending on final alignment).

### 3.2.5 Hydraulic boundary conditions

Table 6 presents a summary of hydraulic boundary conditions to be adopted for design.

**Table 6 Hydraulic boundary conditions**

<table>
<thead>
<tr>
<th>Location</th>
<th>Boundary condition (mAHD)</th>
<th>Comment/description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coorong North Lagoon (max)</td>
<td>1.00</td>
<td>Expected maximum operating water level</td>
<td>Adopted from review of water.data.sa.gov.au data</td>
</tr>
<tr>
<td>Coorong North Lagoon (min)</td>
<td>-0.25</td>
<td>Adopted minimum water level</td>
<td>Adopted from review of water.data.sa.gov.au data</td>
</tr>
<tr>
<td>Coorong South Lagoon (max)</td>
<td>1.10</td>
<td>Adopted maximum water level</td>
<td>Adopted from review of water.data.sa.gov.au data</td>
</tr>
<tr>
<td>Coorong South Lagoon (min)</td>
<td>-0.40</td>
<td>Adopted minimum water level</td>
<td>Adopted from review of water.data.sa.gov.au data</td>
</tr>
<tr>
<td>Lake Albert (max)</td>
<td>1.20</td>
<td>Adopted maximum water level</td>
<td>Adopted from review of water.data.sa.gov.au data</td>
</tr>
<tr>
<td>Lake Albert (min)</td>
<td>0.40</td>
<td>Expected minimum operating water level</td>
<td>Adopted from review of water.data.sa.gov.au data</td>
</tr>
<tr>
<td>Southern Ocean (max)</td>
<td>0.876</td>
<td>Highest Astronomical Tide</td>
<td>Bureau of Meteorology tidal planes</td>
</tr>
<tr>
<td>Southern Ocean (min)</td>
<td>-0.747</td>
<td>Lowest Astronomical Tide</td>
<td>Bureau of Meteorology tidal planes</td>
</tr>
</tbody>
</table>

### 3.2.6 Dredging parameters

For the dredge design option within the Coorong Estuary, the following design parameters will be adopted:

- Dredging tolerance/survey uncertainty: ± 200 mm/+ 0 mm (i.e. over-dredge of up to 200 mm and under-dredge of up to 0 mm).
- Batter slopes for dredge profile: 1V:5H (may vary due to geotechnical conditions).
Until advised otherwise, dredgate is assumed to not be re-useable (i.e. unsuitable for beach nourishment or other beneficial reuse purposes). This will be reviewed following geotechnical investigations and testing.

Dredgate is assumed to contain potential acid sulphate soils (PASS). Any material that does not remain in a saturated state and is placed on land will require treatment as part of the material management and ultimate disposal process. This will be reviewed following geotechnical investigations and testing.

For any material to be placed on land, treatment ponds or bunds will be required to be >2 times the dredge volume in situ to allow for decant water.

It is assumed that any decant water will be returned to the Coorong.

The provision of channel markers are likely and will be reviewed through the safety in design process.

### 3.2.7 Pipeline loading

For the structural design of buried pipelines, the following design parameters for flexible pipe design to AS 2566.1 will be adopted:

- **Live loading:** A160 axle load (16 t axle load) (W80 wheel load – 8 t wheel load) in accordance with AS 5100.2.
- **Unit weight of dry soil of 20 kN/m³.**
- **Minimum pipe cover of 750 mm.**
- **All pipelines supplied by a pump will be assessed under full vacuum conditions (98 kPa).**
- **Live load and vacuum will be applied concurrently to assess the potential for buckling within easements and roadways (very low probability elsewhere).**

Key pipeline design criteria are:

- **Pressure pipelines (pumped flow) designed assuming full pipe flow with reference to Colebrook White roughness coefficients and the Colebrook-White equation. It is noted that due to the hydraulic grade under certain flow conditions the pipeline will operate partially full and will drain when the pumps stop pumping.**
- **Gravity pipelines or conduits (no pumped flow or passive pipe systems) will be assessed assuming partial pipe or full pipe flow with reference to either Manning or Colebrook White roughness coefficients used within the Manning equation (partial pipe flow) or the Colebrook White equation (full pipe flow).**
- **The minimum falling grade on the pipeline sections that operate under partially full conditions will be 0.4%. However, it is important to note that the modelled scenarios by DEW assume a horizontal grade of 0% under full pipe flow conditions.**
- **The minimum design pipeline velocity under partially full conditions will be a self-cleaning velocity of 0.7 m/s.**
- **The minimum operating flow rate and velocity for pipelines under pressurised conditions will be determined following selection of appropriate sand entrainment mitigation features.**
- **Pipes will be designed for entrained air transport, to prevent air accumulating within pipes.**
- **Pressure pipeline diameters will be set targeting a velocity of greater than 2.0 m/s minimising potential accumulation of marine growth and ensuring efficient pipe diameter selection.**
Pipeline head loss calculations will be completed in accordance with AS 2200 (Design charts for water supply and sewerage). Proposed roughness values will be increased from the values provided in AS 2200 to account for marine growth that will be experienced in seawater.

Detailed surge analysis will only be undertaken during the detailed design stage. An allowance of 1.75 times of operating pressure will be considered through concept design.

Pipe temperature range will be 0°C - 20°C for all buried pipes and pipes submerged in water.

### 3.2.8 Pipeline hydraulic roughness

The following Colebrook White roughness coefficients (k) will be assumed for the hydraulic design of pipeline infrastructure. These values are noted to exceed the values presented in AS 2200, which has been adopted to account for potential marine growth:

- High density polyethylene: 0.015 mm – 0.030 mm
- Reinforced concrete: 0.60 mm
- Glass reinforced plastic (GRP): 0.035 mm

No defined pig launching stations will be provided.

### 3.2.9 Temperature de-rating

Generally, it is expected that the infrastructure will be regularly operated assisting in maintaining a pipe wall temperature similar to the water temperature being conveyed (up to 30°C). Where intermittent operation is expected (e.g. Option 3A & Option 3B), pipe wall temperatures may increase but the pipe will not be under pressure at these elevated temperatures.

A reduction factor of 50% of the pipe pressure class will be applied for GRP pipe based on guidance from Clover Pipe (Superlit GRP Pipe & Fittings – GRP Pipeline System Version 1.0). This allows for a pipe wall temperature of up to 50°C. A minimum GRP pressure class of PN10 will be adopted to accommodate this temperature de-rating.

### 3.2.10 Trench requirements

Pipe embedment design will be completed to the requirements of AS 2566.1, with the following assumptions:

- The allowable horizontal bearing pressure of 50 kPa (subject to refinement following receipt of geotechnical investigation results).
- The allowable vertical bearing pressure of 100 kPa (subject to refinement following receipt of geotechnical investigation results).
- Native soil modulus as per Table 7 (subject to refinement following receipt of geotechnical investigation results).

#### Table 7 Native soil modulus

<table>
<thead>
<tr>
<th>Location</th>
<th>Native soil modulus</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bascombe Bay, Lake Albert</td>
<td>5 MPa</td>
<td>CMW Geosciences Investigation Report, ADL2021-0001AD Rev 0, 31 August 2021.</td>
</tr>
<tr>
<td>Coorong Estuary</td>
<td>1 MPa</td>
<td>Adopted based on industry minimum.</td>
</tr>
<tr>
<td>Younghusband Peninsula</td>
<td>3 MPa</td>
<td>Adopted assuming dense sand at depth.</td>
</tr>
</tbody>
</table>
• Groundwater is assumed to be encountered at mean sea level through Younghusband Peninsula (to be confirmed following geotechnical investigation).
• Embedment soil modulus of 7 MPa.
• Trench widths will be in accordance with AS 2566.1.
• Minimum clearance between water mains and underground services will be designed as per WSA 03-2011, as per Table 8.

<table>
<thead>
<tr>
<th>Service</th>
<th>Minimum Horizontal Clearance</th>
<th>Minimum Vertical Clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ DN200</td>
<td>&gt; DN200</td>
</tr>
<tr>
<td>Water mains &gt; DN375</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>Water mains ≤ DN375</td>
<td>300</td>
<td>600</td>
</tr>
<tr>
<td>Telecommunication conduits and cables</td>
<td>300</td>
<td>600</td>
</tr>
<tr>
<td>Electricity conduits and cables</td>
<td>500</td>
<td>1000</td>
</tr>
</tbody>
</table>

3.3 MECHANICAL DESIGN

3.3.1 Mechanical equipment

In the selection and placement of equipment, the designer will ensure that access and egress requirements are maintained in accordance with the South Australian Work Health and Safety Regulations. The equipment will also be procured, installed and maintained in accordance with the relevant Australian Standards.

Plinths for equipment will be located with consideration to operating and maintenance access. Manufacturer’s recommendations for minimum maintenance access will be followed.

A minimum clearance of 900 mm will be maintained between equipment, including concrete plinths, for personnel access.

A minimum clearance of 1,200 mm will be maintained between equipment, including concrete plinths, where maintenance is required.

All equipment will be installed in accordance with the Work Health and Safety Act, supported by the Work Health and Safety Regulations, in respect to noise levels. In addition, all equipment will be installed in accordance with mechanical equipment datasheets and manufacturer’s specifications. All equipment will have a maximum allowable sound pressure level (SPL) of 85 dB(A) at a distance of 1 m in accordance with the Safe Work Australia guidelines.

3.3.2 Pumps

Where possible, pumps will be sized so that duty points correspond with pumps readily available in the marketplace. Variable speed drives and mechanical seals will be considered in the design.

Equipment bases for pumps (where required) will be designed based on the following:
• Equipment bases will be rigidly constructed of fabricated steel unless otherwise approved.
• Equipment will be assembled and mounted on the base in the shop prior to delivery where applicable.
• Tapped holes will not be used in bases for mounting components.
• Bases will be designed to avoid the accumulation of foreign matter such as dirt or water.

Pump intakes will be designed based on the following:

• Where primary screens are included, they will be designed to exclude gross debris, have approximate aperture size of 25 mm and be removable for maintenance and cleaning.

• Intakes will be located >500 mm above the sand bed after accounting for sand accretion.

• Intakes will be located where there is minimal suspended sand in the water column where possible. This will involve locating intakes in the Southern Ocean at a point where the water depth exceeds 12 m (TBC) or locating them within a structure that removes suspended sand.

• It is assumed that there is minimal sand (or other suspended solids) in suspension in the Coorong.

• Pump well floors will be sloped to allow for sand accumulation away from the intakes and for easy removal of sand.

• To avoid air entrainment, the intakes will be >1.0 m below the low water level in the Coorong and >1.5 m (TBC) below low tide plus the design wave trough in the Southern Ocean.

3.3.3 Valves

Valving will be designed based on the following points:

• All valving will be designed for easy operational and maintenance access.

• Manual isolation valves will be included on pipework where required to enable the process requirements to be achieved.

• Valve selection will consider corrosion issues, sedimentation and possible blockages.

• Non-return valves will be included in horizontal sections of pipework and in general will have the same nominal diameter as the pipework.

• Non-return valves will have low inertia, low friction and short travel to closure.

• Pneumatic valve actuators will be sized based on an instrument air pressure of 690 kPa(g).

• All actuators will include limit switches to remotely indicate valve position.

3.4 ELECTRICAL DESIGN

3.4.1 Source of Power

Source of power (including power generation) will be investigated but it is expected to be an SAPN mains power network extension and/or one or more renewable sources. The use of diesel-powered equipment (or generators) will not be specified unless utilised as a hybrid solution with renewable sources for power reliability.

Estimates of the diurnal and seasonal load profiles will be considered when evaluating any sources of electrical power.

Currently there are 33 kV overhead lines available some 50 km away via the SAPN 33 kV overhead lines at Tintinara or Meningie. This will require an overhead network extension to a location in proximity to the pump station.

Step down transformer/s will be required to step down from 33 kV to the required motor voltage & LV. Transformer & switchgear enclosures will be suitable for a marine environment.
3.4.2 Pump Motors

All motor drives, particularly those that are direct online, will be started in a sequential pattern so that there will be no co-incident starting of large motor drives. Variable speed drives (VSDs) will be included for pump starting allowing ramp up from low speed to the set point speed to minimise the electrical starting loads.

For maintenance purposes, each motor drive may be switched into local control and stopped or started from the respective motor control centre.

The point of isolation of motor drives will be at the respective motor control centre. Locking facilities will be provided on each motor isolator with safety interlocks fitted to each module door.

Harmonic filtering and power factor correction will be provided for compliance with Australian standard requirements and/or SAPN requirements where an SAPN grid connection is proposed.

3.4.3 Remote Monitoring and Control

Remote control and remote monitoring requirements will be confirmed throughout the design, but this is likely to be a Cloud based SCADA system. It is expected that a combination of manual operation and remote operation will be incorporated to strike a balance between overly complex control systems and simplified operation of the infrastructure. However, it is expected for each motor drive, the following control and indication facilities will be provided at the operator workstations generally in accordance with SA Water TS 0350 design philosophy & SA Water TS 0351 functionality requirements:

- Drive status.
- Availability indication.
- Fault status.
- Start drive.
- Stop drive.
- Speed & current status (for VSD and SS).
- Speed reference (for VSD and SS).

3.4.4 Local control stations

A local control station will be mounted adjacent to the motors to facilitate maintenance operations. Each local control station will include a start and stop pushbutton or key switch.

The requirement for local control stations will be assessed on a case-by-case basis.

3.4.5 Cathodic protection of electrical supplies

Cathodic protection is not required at this point; however, should active cathodic protection system(s) be required (refer Section 6.2.6), the design will consider electrical power supplies for their cathodic protection controllers.

3.5 MARINE STRUCTURE CHARACTERISTICS

3.5.1 Jetty intake / outfall structures

Jetty structures will be proposed as ‘over the top’ construction due to persistent heavy wave action in the Southern Ocean.

Jetty structures proposed in the Coorong will also assume to be constructed via the same method for convenience of construction.
Jetty structures will comprise the following:

- Short spans (i.e. 10 m) to minimise the size of the cantilever pile guide.
- Tubular steel piles.
- Deck is assumed precast concrete headstocks, steel beams and precast concrete deck. The deck will be a minimum of 4.5 m wide (single lane) to suit construction and maintenance cranes.
- Deck loads and design allowances will be per the design criteria Table 9.

It is assumed that public access to a jetty structure will be permitted (unless the facility is manned to prevent public access). However, no provisions for vessel berthing will be incorporated.

3.5.2 Pontoon structures and access gangways

Pontoon structures and gangways will be designed in accordance with AS 3962.

Pontoon structures and gangways will be designed in accordance with AS 3962.

Pontoon structures and gangways will be designed in accordance with AS 3962.

Pontoon structures and gangways will be designed in accordance with AS 3962.

Pontoon structures and gangways will be designed in accordance with AS 3962.

Pontoon structures and gangways will be designed in accordance with AS 3962.

It is assumed that public access to a pontoon structure will be permitted (unless the facility is manned to prevent public access). However, no provisions for vessel berthing will be incorporated.

3.5.3 Submarine trench requirements

It is assumed submerged pipe construction within the Coorong can be floated in and sunk with concrete weights. It is assumed that the Coorong has no meaningful surf zone.

It is assumed that a submarine pipe will have to be buried through the surf zone within the Southern Ocean (weighting of exposed pipes is not feasible due to the high current velocities encountered). It is assumed that the wave plus currents will be too severe to allow floating pipeline installation methods to be used.

It is assumed protection of submerged pipes against ship’s anchors and fishing equipment is not required (refer Section 3.6.8).

3.6 MARINE DESIGN CRITERIA

The design will comply with the listed criteria and take account the provided information as described in Table 9.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Reference/comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deck load classification</td>
<td>15 kPa</td>
<td>AS 4997 Cl 5.3 imposed actions (live loads) Class 15 (15 kPa) for Bridge design code (W7, W8, A160, T44 loading) Small mobile crane up to 20 t SWL</td>
</tr>
<tr>
<td>Parameter</td>
<td>Value</td>
<td>Reference/comment</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-----------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Basis of Concept Design</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Parameter</strong></td>
<td><strong>Value</strong></td>
<td><strong>Reference/comment</strong></td>
</tr>
<tr>
<td><strong>Horizontal load applied at deck level, of at least 2.5% of the maximum permanent and imposed vertical actions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Design Wind Speeds</strong></td>
<td>Regional gust wind speed: 1-year ARI (63.2% AEP): V = 28 m/s</td>
<td>AS/NZS 1170.2 - Structural Design Wind Actions</td>
</tr>
<tr>
<td></td>
<td>100-year ARI (1% AEP): V = 44 m/s</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1000-year ARI (0.1% AEP): V = 50 m/s</td>
<td></td>
</tr>
<tr>
<td><strong>Sea Level Rise (SLR)</strong></td>
<td>1.0 m by 2100 (sea level rise to end of design life to be reconsidered during the life of the structure).</td>
<td>South Australian Coast Protection Board Policy (2016) – 29 July 2016</td>
</tr>
<tr>
<td><strong>Design Storm Tide Event (DSTE) still water level</strong></td>
<td>Ambient water level condition MSL = +0.747 mLAT</td>
<td>Cape Jaffa Tidal Plans by BOM.</td>
</tr>
<tr>
<td></td>
<td>Extreme water level condition (100-year ARI or 1% AEP): DSTE = +2.200 mLAT</td>
<td>Cape Jaffa EIS (2005). For design conditions</td>
</tr>
<tr>
<td><strong>Design Waves</strong></td>
<td>Ambient offshore wave condition Hs = 2.00 m, Tp = 13.00 s</td>
<td>Data provided by NOAA Wavewatch III for [-36.5,139.5].</td>
</tr>
<tr>
<td></td>
<td>Design offshore wave condition (1000-year ARI or 0.1% AEP): Hs = 9.36 m, Tp = 25.85 s</td>
<td>AS 4997, for a design working life of 100 years in combination with an Importance Level of 2 for normal structures the design wave event is 1/100 years.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Offshore wave conditions must be transformed to inshore locations and considerations made to depth limiting wave heights.</td>
</tr>
<tr>
<td><strong>Current Speeds</strong></td>
<td>Wind driven current speed: 1-year ARI (63% AEP): 0.53 m/s</td>
<td>Calculated using Sorenson (2006) Basic coastal eq. 5.28</td>
</tr>
<tr>
<td></td>
<td>100-year ARI (1% AEP): 0.84 m/s</td>
<td>Aurecon (2009c), Coorong Temporary Saline Water Discharge SA Murray Darling Basin NRM Board - Preliminary Hydrodynamic Modelling Report</td>
</tr>
<tr>
<td></td>
<td>1000-year ARI (0.1% AEP): 0.96 m/s</td>
<td></td>
</tr>
<tr>
<td><strong>Hmax / Hs ratio</strong></td>
<td>1.7</td>
<td>AS 4997, CL 5.9.2 Design wave heights</td>
</tr>
<tr>
<td><strong>Seawater properties (Southern Ocean)</strong></td>
<td>Water temperature: 12°C to 20°C</td>
<td>Density assumed to be constant over this temperature range.</td>
</tr>
<tr>
<td></td>
<td>Salinity: 35 to 36 ppt</td>
<td>Aurecon (2009a) Salinity typically fluctuates 35.6 to 35.7 ppt.</td>
</tr>
<tr>
<td></td>
<td>Density: 1,025 kg/m³</td>
<td></td>
</tr>
<tr>
<td><strong>Coorong South Lagoon water properties</strong></td>
<td>Water temperature: 12°C to 30°C</td>
<td>Density assumed to be constant over this temperature range.</td>
</tr>
<tr>
<td></td>
<td>Density: 1,120 kg/m³</td>
<td></td>
</tr>
<tr>
<td><strong>Wind loads</strong></td>
<td>Wind loads on auxiliary structures shall be calculated in accordance with AS 1170: Part 2</td>
<td></td>
</tr>
<tr>
<td><strong>Wave loads</strong></td>
<td>Wave loads shall be calculated in accordance with J.R. Morison. (1950) and Pilarczyk, K. (1998), Section 3.</td>
<td></td>
</tr>
</tbody>
</table>
### Parameter | Value | Reference/comment
--- | --- | ---
Current loads | Current loads on piles and/or the deck of marine structures will be calculated in accordance with Clause 5.5 of AS 4997-2005. Drag coefficients shall be taken from AS 4997 and BS 6349. |  
Buoyancy loads | Buoyancy loads shall include the uplift due to submergence in seawater considering a specific gravity of 1.025 t/m$^3$ for seawater. Buoyancy loads may be ignored where it can be demonstrated that buoyancy of submerged structural components does not contribute to higher stress levels in the structure. The buoyant weight of structural elements shall be used as appropriate in determining loading. |  
Earthquake loads | Design earthquake loads shall be developed in accordance with AS 4997-2005 Section 5.1 (which references AS 1170.4). Note that for this design event the structure is considered to have an Importance Level of 2 as people may be on the structure during an earthquake (i.e. a warning to evacuate prior to an earthquake is not possible) Within offshore, sand medium full depth will be assumed. Within surf zone, dense sand full depth will be assumed. The design earthquake loading to AS 1170.4 is as follows:  
- Importance level: 2  
- Probability factor, kp: 0.5  
- Hazard factor, Z: 0.10  
- Subsoil class: De (deep or soft soil site)  
- Earthquake design category: II |  
Fauna | Consideration will be given to minimisation of harm to marine fauna (e.g. whales, fish, etc.). This may include provision of fish screens and minimisation of any snags that may entrap marine fauna. |  
Shipping boating | Consideration will be given to provision of navigational aids as may be required to minimise potential for impacts to passing vessels (refer Section 3.6.8). |  

### 3.6.1 Combined wave and water levels

All offshore wave conditions presented in Table 9 will be transformed to the relevant location using Battjes, J.A. & Groenendijk (2000).

### Ultimate Limit States (ULS)

For structural design purposes (such as the determination of member sizing and ultimate design loads for structural elements) the ultimate limit state (ULS) design conditions will be applied.

Battjes, J.A. (1974), “Surf similarity” will be applied to the location of the wave and structure and checked against the transformed offshore wave.

It may also be conservatively assumed that depth-limited wave conditions occur inshore at the site under all ULS’s. Therefore the ULS water level will be perfectly coincident with the ULS waves, for both the structural and hydraulic ULS’s.

Deck levels of structures (i.e. jetties) will be set in accordance with Section 3.5.2.
Serviceability Limit States (SLS)

Serviceability limit state conditions relate to typical conditions that may be experienced during the life of the structure. SLS conditions will be considered for the assessment of overtopping and for the establishment of crest elevations.

Frequent event: This event will assume a MSL water level (plus allowance for SLR) combined.

3.6.2 Deck levels

Deck levels for offshore structures will be as low as practicable for functional access, considering sea level rise, storm tide and wave crest levels during frequent (SLS) and ultimate (ULS) events.

The deck height of a fixed structure will be above the ULS event still water level plus an allowance for:

- Wave crest level with air gap.
- Depth of structure deck.

Where this is not practical, Clause 3.1, AS 4997-2005 allows for jetties / marine structures in locations subject to storm surge situations to allow for periodic inundation provided the structure has been designed to withstand lateral loads and uplift from elevated water levels.

3.6.3 Design load factors and combinations

Load factors and combinations will be applied in accordance with AS 4997-2007 Section 5.12 and AS 1170.0 for limit state design.

3.6.4 Dead loads

The following dead loads (self-weights) will be adopted.

<table>
<thead>
<tr>
<th>Table 10</th>
<th>Dead load (self-weight) unit weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Unit Weight</td>
</tr>
<tr>
<td>Concrete</td>
<td>24.5 kN/m³</td>
</tr>
<tr>
<td>Carbon Steel</td>
<td>78.5 kN/m³</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>80.0 kN/m³</td>
</tr>
<tr>
<td>Seawater</td>
<td>10.07 kN/m³</td>
</tr>
<tr>
<td>Timber</td>
<td>10.8 kN/m³</td>
</tr>
</tbody>
</table>

The buoyant weight of elements will be taken into account where it would otherwise increase structure resistance to a design action.

Live loads

As per AS 4997 a design live load of 15.0 kPa will be applied to the deck surface.

A Class 15 maritime structure is deemed suitable given methods of construction may involve mobile cranes.

3.6.5 Piles

Pile design and analysis will be in accordance with AS 4100, AS 2159 and AS 4997. The design will allow for long-term scour of the seabed at the pile locations.

Piles will be designed to resist design axial and lateral loading requirements, and will be developed with coordination between structural and geotechnical designers.
Assessment of appropriate design geotechnical reduction factors will be based on AS 2159 guidelines, to adequately represent geotechnical uncertainty.

Driveability for piles will be assessed based on wave equation analysis.

Dynamic wave analysis pile testing will be assumed as part of the pile driving quality assurance practices requiring regular testing of pile capacity.

### 3.6.6 Overtopping

Run-up and overtopping estimates for the SLS’s only will be guided by the EurOtop (2018) *Manual on wave overtopping of sea defences and related structures*. The wave overtopping design performance targets (Refer Note 1 below) for the ‘Frequent’ and ‘Extreme’ SLS’s are summarised below:

- SLS: 250 mL/day.
- USL: not relevant given the structure will be designed to survive and not operate in such extreme events with signage to warn pedestrians to keep clear.

### 3.6.7 Toe scour

The designs will consider the possibility of failure by scouring under the coastal structure toe and if it is found that the integrity of the structure could be affected by such scour, mitigation measures will be introduced into the design.

Toe scour dimensions will be estimated using the methods in Whitehouse 1998, Section 7.6, with the incident wave height ‘H’ in this reference assumed to be the significant wave height ‘Hs’.

### 3.6.8 Marine traffic

The Southern Ocean coastline is not frequently accessed by marine traffic. Main navigation routes are >30 km offshore. Navigational changes shall be advised through issuance of a Notice to Mariners for both construction activities and for any permanent marine structures. Marine structures may be marked with a lighted beacon or marker as required. The requirement for markers will follow recommendations in IALA 0139 *Marking Man-Made Offshore Structures*.

### 3.6.9 Ocean intake and outfalls

Intakes and outfalls are to be located 500 mm above the maximum expected sand accumulation level.

Intake to be located where there is minimal suspended sand in the water column. In the Southern Ocean this is either in water more than 15 m deep (i.e. beyond the depth of closure), or else inside a structure that excludes suspended sand. In the Coorong, it is assumed that there is minimal sand in suspension.

Submerged outfalls in open ocean locations will be equipped with one-way duckbill valves (Tideflex or equivalent) to prevent ingestion of sand and debris during no and low-flow periods and prevent the formation of an internal salt wedge during the discharge of brine. This applies to Option 3 and Option 5 discharge outfalls only.
4 Design inputs

4.1 SURVEY AND DATUM

4.1.1 Units of measure
All drawings will be produced in metric units.

4.1.2 Coordinate system
For new drawings the coordinate system Map Grid of Australia (MGA2020) will be used. The project area is within MGA2020 Zone 54 South.

4.1.3 Levels
The vertical datum adopted will be the Australian Height Datum (AHD).
Limited tidal level information is available for the site. The proposed tide planes are adopted from Cape Jaffa (SA_TP012) and were provided by BOM, as this is the nearest, non-estuarine tidal station located near the Coorong, as described in Table 11.

<table>
<thead>
<tr>
<th>Tidal Plane</th>
<th>mCD / mLAT</th>
<th>mAHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Astronomical Tide (HAT)</td>
<td>1.623</td>
<td>0.876</td>
</tr>
<tr>
<td>Mean High Water Springs (MHWS)</td>
<td>1.215</td>
<td>0.468</td>
</tr>
<tr>
<td>Mean High Water Neaps (MHWN)</td>
<td>0.932</td>
<td>0.185</td>
</tr>
<tr>
<td>Mean Sea Level (MSL)</td>
<td>0.747</td>
<td>0</td>
</tr>
<tr>
<td>Mean Low Water Neaps (MLWN)</td>
<td>0.562</td>
<td>-0.185</td>
</tr>
<tr>
<td>Mean Low Water Springs (MLWS)</td>
<td>0.279</td>
<td>-0.468</td>
</tr>
<tr>
<td>Lowest Astronomical Tide (LAT) / Chart Datum (CD)</td>
<td>0.00</td>
<td>-0.747</td>
</tr>
</tbody>
</table>

4.2 BATHYMETRY
Offshore bathymetry will be derived from Australian Hydrographic Charts and Naval Charts available from the Naval Hydrographic Office.

It is assumed over the design life that the offshore bathymetry does not alter significantly as it is not feasible to predict broader morphological changes over a 100-year design life.

Designs within the Coorong Estuary will rely on a combination of existing bathymetry survey files (Maritime Constructions 2021) and additional data acquired under this project to complete any gaps.

4.3 GEOTECHNICAL
No geotechnical information is currently available for the marine elements of design. The geotechnical conditions will be assumed to be medium sand at full depth for offshore and dense sand within the surf zone.

Initial stages of pile design will use five multiplied by the pile diameter for depth of fixity.

Liquefaction assessment under the design earthquake should be undertaken in detailed design.
5 Environment and sustainability

5.1 SUSTAINABLE DESIGN

5.1.1 Environmental protection methodology

Detailed design of the infrastructure options will aim to minimise environmental impact through:

- Minimising the extent and footprint of the works (including construction) in areas of native vegetation and Land Management Agreement areas.
- Construction during time periods which will minimise impacts to local species (e.g. migratory birds, nesting season etc).
- Minimising resource use, including minimisation of imported quarry materials and those required for ongoing operation and maintenance.
- Reuse of waste products including spoil or pipes/culverts where possible.
- Maximising opportunities to divert water for environmental benefit where possible, including retention and upgrade of existing wetland diversion and spill provisions (appropriate for open channel infrastructure options).
- Making use of existing infrastructure wherever possible.
- Renewable electrical power generation systems will be considered as part of the power supply arrangement.

During construction, works will be conducted in accordance with a Construction Environmental Management Plan (CEMP), to be prepared by the construction contractor. Protection of the environment will be provided through appropriate:

- Sediment and erosion controls.
- Spoil and stockpile management.
- Stormwater management.
- Water quality management.
- Terrestrial and aquatic/marine flora and fauna management.
- Management of dredged material.
- Management and treatment of actual or potential acid sulphate soils.
- Indigenous and non-indigenous cultural heritage management and protection.
- Storage of materials, chemicals, fuels and waste in appropriate facilities.
- Management of noise and air quality.
- Vehicle access, controlled vehicle access tracks.
- Allocation of laydown areas for construction.
- Minimisation of extent of temporary works.

The design process will identify requirements and constraints for the above which will be included in design reporting and drawings.
The design of infrastructure will also consider how environmental impact caused by operational and maintenance activities can be minimised. Consideration will be given to required infrastructure maintenance and operation activities, specifically access to the sites and the type of activities and frequency required.

5.1.2 Sustainability requirements
The design is to incorporate sustainability by:

- Aiming to minimise transport of material through sourcing local materials (where possible).
- Considering greenhouse gas emissions resulting from operational requirements.
- Incorporating recycled materials (where possible).
- Optimising design to reduce extent of works (where possible).
- Optimising design to reduce impact to native vegetation or sites of cultural significance (where possible).

5.2 ENVIRONMENTAL CONSIDERATIONS

5.2.1 Land management agreements
The proposed infrastructure options may require interaction with landholders as part of construction works and potentially the final infrastructure option and its nominated location. The extents and boundaries of these areas will be further defined during the design period.

5.2.2 Native vegetation
The extent of impact on native vegetation will be limited in so far as possible by the appropriate location of infrastructure. Potential offset areas may be required dependent on level of disturbed vegetation. This will be considered during the design process.

5.2.3 Aboriginal heritage
At present it is known that culturally significant areas are present along the Younghusband Peninsula (including Parnka Point), and the land parcels between Bascombe Bay and the Coorong North Lagoon.

Cultural heritage surveys will be completed during design development and any findings will be addressed within design documentation as appropriate.

5.2.4 Ramsar Wetland
The proposed infrastructure options occur within the Coorong and Lakes Alexandrina and Albert Ramsar Wetland site.

Ramsar wetlands are recognised as a matter of national environmental significance under the EPBC Act. Consequently, as the design progresses, any works that will have, or is likely to have, a significant impact on the ecological character of a Ramsar wetland must be referred to the Commonwealth.

5.2.5 Coastal processes
Consideration of coastal processes, including storms, waves, currents, tides, climate change and sea level rise is required during concept design as these will affect the design process and the ability to construct any of the proposed infrastructure options.
5.2.6 Sediment characteristics

Disturbance of actual or potential acid sulphate soils is likely given the locality and nature of sediments within the project area. Management and potential treatment of acid sulphate soils will be considered further during the concept design process.

5.2.7 Water quality

Majority of the proposed infrastructure options will result in the discharge of hypersaline water to the marine environment. The potential effects of this on baseline water quality conditions, marine ecology and benthic habitats will be considered further as part of the environmental impact review process.

5.2.8 Protected flora and fauna species

During the concept design process, potential risks to protected flora and fauna species will be identified through a preliminary environmental impact review process. Outcomes of the review will be used to inform the design processes and to avoid and/or minimise potential impacts where possible. This will be considered for all proposed infrastructure options covering marine, Coorong, Younghusband Peninsula and Lake Albert infrastructure.

5.2.9 Fishway

A passive fishway will be incorporated within the Lake Albert Connector Option 1A allowing target fish species to migrate from Coorong North Lagoon into Lake Albert bypassing the regulator positioned at Narrung Road. This fishway will be a rock riffle style fishway with a hydraulic gradient allowing 100 mm fall between resting pools. Design operating water levels for the fishway will allow passage of fish species between a top water level in Lake Albert of 1.2 mAH and a low water level in Lake Albert of 0.4 mAH (in line with the water level range specified in Table 6).

5.2.10 Fish exclusion screens

Fish exclusions screens will be fitted to all pump intakes to prevent aquatic life from being entrained into the pumping systems. The screens will be designed in accordance with the below:

- Approach water velocities under 0.12 m/s.
- Screens to have automatic self-cleaning functionality
- Fine mesh to protect fish adults, juveniles, larvae and eggs
- Maximum gridmesh size ≤ 3 mm.

5.2.11 Site access

The following site access constraints will be considered in the design:

- Driving access along beach to be facilitated.
- Boating access from North to South lagoons to be facilitated.
- Access to Younghusband Peninsula is assumed to be northwards along the beach from an access near 42 Mile Crossing or Tea Tree Crossing.
- Marine work using boats in the Southern Ocean will be minimised where possible due to unsafe and rough metocean conditions
- No scuba diving in the Southern Ocean will be proposed for construction or maintenance activities due to unsafe and rough metocean conditions.
6 Durability and life cycle requirements

6.1 DESIGN LIFE

The project specific design lives for the various elements are summarised in Table 12.

Table 12 Design life of project equipment and structures

<table>
<thead>
<tr>
<th>Component</th>
<th>Design life (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marine structures</td>
<td>100</td>
</tr>
<tr>
<td>Civil works and concrete structures</td>
<td>100</td>
</tr>
<tr>
<td>Valves, penstocks and flow control gates</td>
<td>30</td>
</tr>
<tr>
<td>Pumps</td>
<td>30</td>
</tr>
<tr>
<td>Control Equipment (SCADA, PLCs, VSD’s)</td>
<td>15</td>
</tr>
<tr>
<td>Electrical equipment, transformers, switchgear</td>
<td>20</td>
</tr>
<tr>
<td>Above ground pipework (metallic)</td>
<td>30</td>
</tr>
<tr>
<td>Above ground pipework (plastic)</td>
<td>30</td>
</tr>
<tr>
<td>Buried pipework</td>
<td>50</td>
</tr>
<tr>
<td>Structural steel, stairs, platforms (with coating protection system and regular maintenance)</td>
<td>40</td>
</tr>
<tr>
<td>Stainless steel furniture and fixings</td>
<td>50</td>
</tr>
<tr>
<td>Steel grating and mesh, furniture and fixings</td>
<td>20</td>
</tr>
</tbody>
</table>

6.2 MATERIAL SELECTION

Material selection during design will be completed in consideration of material compatibility, environmental conditions, use of coatings, the application, minimum design lives and the repair and maintenance strategies.

6.2.1 Mechanical design

In order to achieve the intended design life, the minimum material requirements shown in Table 13 will be adopted.

Table 13 Minimum standard for materials and finishes

<table>
<thead>
<tr>
<th>Element</th>
<th>Minimum standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural steelwork</td>
<td>Hot dip galvanised steel with additional corrosion protection measures as may be required for the installation environment</td>
</tr>
<tr>
<td>Piping</td>
<td>u-PVC Series 1 in accordance with AS 1477</td>
</tr>
<tr>
<td></td>
<td>m-PVC Series 1 in accordance with AS 1477</td>
</tr>
<tr>
<td></td>
<td>c-PVC in accordance with ISO 3514</td>
</tr>
<tr>
<td></td>
<td>o-PVC in accordance with AS 4441</td>
</tr>
<tr>
<td></td>
<td>Glass reinforced plastic (GRP) in accordance with AS 3571</td>
</tr>
<tr>
<td></td>
<td>HDPE PE100 Series 1 in accordance with AS 4130</td>
</tr>
<tr>
<td></td>
<td>Grade 316 Stainless Steel</td>
</tr>
</tbody>
</table>
Element | Minimum standard
---|---
| | Grade 2205 Duplex Stainless Steel
| | Grade 2507 Super Duplex Stainless Steel

| Fittings | u-PVC in accordance with AS 1477
| | c-PVC in accordance with ISO 3514
| | m-PVC in accordance with AS 1477
| | o-PVC in accordance with AS 1477
| | HDPE in accordance with AS 4129
| | Grade 316 Stainless Steel
| | Grade 2205 Duplex Stainless Steel
| | Grade 2507 Super Duplex Stainless Steel
| | Ductile iron in accordance with AS 2280

| Ball Valves | Polyethylene or polypropylene bodies, polyethylene or polypropylene wetted parts
| | c-PVC
| | Grade 316 Stainless Steel
| | Grade 2205 Duplex Stainless Steel
| | Grade 2507 Super Duplex Stainless Steel

| Butterfly Valves | Ductile iron with fusion bonded polymeric coating bodies, rubber lined with 316 stainless steel internal disc and stem

| Check Valves | Ductile iron, fusion bonded polymeric coating and rubber coated, ductile iron disc

| Gate Valves (DN80 or greater) | Wafer check valves with stainless steel disk, and cast iron or stainless steel body

| Knife-Gate Valves | Ductile iron with fusion bonded polymeric coating bodies, rubber coated or 316 stainless steel internal components, in accordance with AS 2638.2

| Air valves (clean water) | 316 stainless steel cast body and disc

| Pumps | In accordance with SA Water Technical Standard TS 146b
| | Diesel pumps are not permitted; pumps will be electrically driven but may be powered by a diesel generator

| Non-pressurised tanks | Polyethylene

### 6.2.2 Concrete design

Reinforced concrete structures will be designed and specified in accordance with Australian Standards AS 4997 and AS 3600.

The following properties in Table 14 will be applied.

#### Table 14 Concrete design properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
</table>
| Exposure classification | C1 (Exposure Condition: Spray) or C2 (Tidal)
| | In accordance with AS 5100.5 and AS 3600. |
| Concrete strength | 50 MPa |
| | As per Table 6.4 and 6.5 of AS 4997 |
### Property

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinforcement</td>
<td><strong>Concrete finishes</strong>&lt;br&gt;Trafficked areas: Stiff broom, steel trowel along edges&lt;br&gt;Non-trafficked: Wood float or plastic coated ply off-form&lt;br&gt;Stairs and ramps: Non-slip surface products/coating&lt;br&gt;Stair nosings: Non-slip high visibility corrosion resistant nosing&lt;br&gt;10 mm arris/chamfer to all exposed edges&lt;br&gt;Stair and handrail geometry as per AS 1657</td>
</tr>
<tr>
<td>Concrete cracks</td>
<td>Plastic shrinkage cracking will not occur if the specified curing regime and design mixed is applied by the constructor.&lt;br&gt;The crack widths will be controlled by application of the requirements of AS 4997 Table 6.6 in the case of reinforced concrete. Reading this code together with AS 3600 an average surface crack width of 0.25 mm is implied in the AS 4997 Table 6.6 requirements. Assuming that prototype surface crack widths will vary randomly around this mean, crack widths up to 0.5 mm will be deemed to be satisfactory from durability and aesthetic viewpoints. If prototype surface crack widths greater than 0.5 mm are observed, they will be sealed with Xypex paste, after which they will be deemed to be satisfactory from durability and aesthetic viewpoints.&lt;br&gt;Jointing and underlay quality will be used to control the occurrence of cracks in unreinforced concrete.</td>
</tr>
</tbody>
</table>

### 6.2.3 Steelwork design

Steelwork design for marine structures will be in accordance with AS 4100 and AS 4997.

### 6.2.4 Handrails, Furniture and Steel fixings

All fixings will be duplex stainless steel Grade 2205 to meet the required design life.

All handrails will be duplex stainless steel Grade 2205 acid pickled and polished to prevent ‘tea staining’. Stainless steel handrails are selected as they are more durable against corrosion from salt water/salty air compared with aluminium handrails. Aluminium handrails will require regular maintenance and replacement as it has a limited resistance against corrosion (mainly pitting) in the marine environment.

Safety ladders will be specified as required under AS 4997 Cl 3.4.5.

If exposed non-stainless steel is proposed it will be protected with a marine epoxy paint system. Galvanised coatings will not be used in a marine or hypersaline environment because the chlorides in seawater will prematurely dissolve away the zinc content of the galvanising.

No cathodic protection is proposed for handrails, furniture and steel fixings.

### 6.2.5 Marine growth

The design will consider the effects of marine growth on both structural and ancillary items with consideration given to safety, structural capacity and integrity, durability and whole of life costs.

At a minimum, marine growth will be assumed to be a nominal 150 mm thickness and will be applied to all exposed faces between MSL and the seabed level when designing structural elements.

### 6.2.6 Corrosion allowance

It is envisioned that steel CHS piles will be required. An allowance for corrosion protection will be made in the design of all steel structures on the basis that no cathodic protection (CP) or protective coatings will be provided for the concept design. This also applies to other steel members in the maritime environment.
The corrosion allowances are based on a design life of the particular element, assuming normal levels of maintenance.

The design will be performed based on the corroded section properties and checked for strength based on a corrosion allowance. Corrosion rate allowances in Table 15 will be applied.

**Table 15  Corrosion rates**

<table>
<thead>
<tr>
<th>Exposure Condition</th>
<th>Australian Standard</th>
<th>Exposure Classification</th>
<th>Corrosion rate allowance – external (mm/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmospheric</td>
<td>4312</td>
<td>CS-M: Marine</td>
<td>0.08 – 0.2</td>
</tr>
<tr>
<td>Splash</td>
<td>2159 (Table 6.5.2 &amp; 6.5.3)</td>
<td>Very Severe</td>
<td>0.1*</td>
</tr>
<tr>
<td></td>
<td>5100.3</td>
<td></td>
<td>0.16</td>
</tr>
<tr>
<td>Submerged</td>
<td>4997</td>
<td>Strong</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>2159 (Table 6.5.2 &amp; 6.5.3)</td>
<td>Severe</td>
<td>0.04 – 0.1</td>
</tr>
</tbody>
</table>

Internal corrosion allowance for piles is assumed to be 0 mm/year as all oxygen internal to the sealed pile is consumed.

Alternative corrosion prevention measures such as coatings are not considered due to the remoteness of the site and the need for frequent maintenance over the life of the structure. Cathodic protection (CP) systems may be considered to reduce corrosion rates as design of final infrastructure progresses (e.g. impressed current or sacrificial anode).

**Cathodic protection**

CP is generally the accepted method of addressing the shortcomings in protective coatings as it is able to mitigate corrosion at locations where coating breakdown or holidays exist, particularly in submerged or buried regions of a structure.

In instances where full corrosion allowances are uneconomical, cathodic protection (i.e. impressed current cathodic protection) may be specified during future detailed design works. Should active cathodic protection system(s) be required, the design must provide electrical power supplies for their cathodic protection controllers.

The corrosion allowances for the piles and steel members may be reduced, assuming normal levels of maintenance and assuming that the cathodic protection and protective treatment remains effective for the life of the structure.
7 Operations and maintenance requirements

7.1 GENERAL
During the design process, suitable consideration will be given to issues associated with ongoing operation and maintenance of the designed infrastructure. The design phase will impact on operational flexibility and product quality, plant availability and ongoing operation, maintenance and whole of life costs.

7.2 OPERATING ENVIRONMENT
The design will consider the operating environment (and any predicted changes to this environment, e.g. sea level rise) and select suitable equipment and materials to achieve the required design life. Pipework and pumps will be subject to saline (or hypersaline) water within the Coorong Southern Lagoon (hypersaline) as well as the Southern Ocean (saline).

Equipment must also withstand local environmental conditions, which may involve significant stress associated with considerably high summer temperatures, extremes of cold and high winds.

7.3 EQUIPMENT LOCATION
Consideration will be given to where equipment is to be located such that:

- The area can be freely evacuated should the need arise.
- Equipment installed in dry wells need to consider the implication of flooding. Alternatively, electric motors will be located above the flood level or equipment is selected to operate in a submerged environment (e.g. dry well submersible pumpset).
- Equipment installed in a wave environment will need to consider access provisions to allow effective operation and maintenance under incident waves. Alternately, operable elements will be located above wave and water levels or equipment can be removed to complete maintenance activities.
- Electrical switchboards, PLC cabinets, SCADA servers and the like will be located above the flood level and above wave and water levels.
- Where it is least likely to collect pondweed and other floating debris at pump intake sites.

7.4 OPERATION
The infrastructure options will be designed to operate unmanned.

Special care needs to be taken in the design of these facilities to minimise risk of ongoing operational problems and expense.

The control system will be provided with a level of remote monitoring and control to enable the pump systems to operate continuously with the planned level of attendance.

7.5 LABELLING
All mechanical, electrical, instrumentation and control equipment, enclosures and openings, civil, platforms and gratings, pipework, valves, cabling and wiring will be labelled.

Typically, these will take the form of equipment tags, certificates, name plates, energy type labels, and direction of movement arrows, hazard & safety notices, material types and asset location plates.
Asset location and identification labels are required for equipment at pumping stations and will reference SA Water TS 0133 Requirements for asset labelling.

Details on the requirements for labelling of mechanical and electrical equipment are located in SA Water TS 0300 Supply and Installation of Low Voltage Electrical Equipment.

The requirement for labelling of pipework is located in SA Water TS 0204 Colour Coding of pipework and AS 1345 Identification of pipes, conduits and ducts.

All other labelling requirements (e.g. those for work health & safety, environment & security) will be compliant with SA Water Technical Standards and/or relevant AS/NZ standards.

### 7.6 SITE SECURITY

Site security covers all aspects of security pertaining to securing pumping station sites. Site security includes:

- Perimeter fences.
- Perimeter gates.

Site security will be agreed with DEW and could include both physical barriers and CCTV systems to ensure an appropriate level of security is provided at all project infrastructure sites.

### 7.7 ENERGY EFFICIENCY

The design of pumping options will consider the energy efficiency of the process, plant and equipment to optimise ongoing operating costs associated with power. These costs will be considered in context with the whole of life costs.

A sensitivity analysis will be conducted to eliminate inefficiencies in the whole of life cycle cost analysis.

### 7.8 PLANT EQUIPMENT SELECTION

Equipment reliability and the availability of spare parts will be considered during the design phase to minimise maintenance costs and reduce disruption to plant operation. Preference will be given to Australian manufactured equipment where possible, both within the design and when proposed by the Contractor. Special tools for routine plant inspection and maintenance and any critical spares will be agreed with DEW and supplied with plant equipment.

The Contractor will provide the following information to DEW for all major items of equipment once the preferred option has been selected and detailed design and equipment selection has been completed.

- Estimated repair lead time of equipment.
- Estimated supply lead time of spare part.
- Recommended quantity of spares.
- Estimated price of spares.
- Anticipated date of obsolescence.

When selecting common items of equipment such as pumps, preference will be given to a single manufacturer supplying all of the items to minimise the quantity of spares kept on site. If the duty of two sets of equipment (e.g., pumps in different areas) are similar, then consideration will be given to the pump of the higher duty being used for both installations to minimise the inventory of spares kept on site.
7.9 OPERATING AND MAINTENANCE MANUALS
Operation and maintenance manuals will comply with SA Water TS 0132 Operating and Maintenance Manuals.

7.10 DECOMMISSIONING REQUIREMENTS
Throughout design, consideration will also be given to decommissioning requirements ensuring a safe method of decommissioning can be achieved. This will include identification of any elements that may cause harm to personnel, equipment or the environment during decommissioning and will be determined through detailed design.

7.11 REDUNDANCY
Consideration will be given in the design to enable equipment to be isolated for maintenance. Where possible, the pumping options will be designed to allow isolation of a single pump for maintenance while allowing the system to continue operating. Additional equipment will be provided for redundancy in accordance with Table 16.

Table 16  Equipment unit redundancy

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Redundancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Turbine Pumps</td>
<td>N+1</td>
</tr>
<tr>
<td>Pontoon Mounted Pumps</td>
<td>N+1</td>
</tr>
<tr>
<td>Submersible Pumps</td>
<td>N+1</td>
</tr>
</tbody>
</table>
8 Safety in design considerations

8.1 HEALTH AND SAFETY OBJECTIVES

The South Australian Work Health and Safety Act 2012 and Regulations require that persons who have a duty to ensure health and safety to ‘manage risks’ by eliminating health and safety risks so far as reasonably practical, and if it is not practical to do so, to minimise those risks so far as is reasonably practicable.

Throughout design development, a Hazard and Risk Assessment will be completed to identify potential hazards and associated risks in the designed infrastructure. These risks will be reviewed and design modifications incorporated to provide a safe workplace for Contractors, employees, visitors and the public.

This Hazard and Risk Assessment will provide a qualitative risk assessment of potential hazards identified during the design and nominate responsible parties to take carriage of risks in the future stages of the project.

8.2 SAFETY IN DESIGN

Safety in Design will be considered throughout the design phase. A safety in design report will be prepared and is legally required under the Work Health and Safety Act 2012 and Regulation 295 of the Work Health and Safety Regulations 2012.

The report is to identify the hazards of the design, as far as the design engineer is reasonably aware, that:

• Creates a risk to the health or safety of persons who are involved in the construction, operation, maintenance and decommissioning of the project.

• Is specific to the project.

The report does not seek to identify all construction site hazards commonly encountered with projects of this nature, for which the identification and management remains the responsibility of the contractor. The residual risks that need to be managed by the contractor, operator, maintenance personnel or demolisher (as appropriate) are to be summarised.

The Project Manager is to provide a copy of this report to the principal contractors tendering for project works, maintenance personnel and other infrastructure users.

8.3 PUBLIC ACCESS RISKS

It is recognised that with construction of infrastructure in areas accessible by the public that certain safety provisions will be required to ensure safe operation of the assets minimising the risk of safety incident impacting members of the public. The following list of inclusions are examples of safety precautions that will be included within concept design documentation:

• Provision of bollards and signage defining exclusion areas around potential hazards associated with beach discharge structure (or other structures on the beach).

• Provision of guardrails each side of the regulator structures required for Option 1A and Option 1B.

• Provision of ladders at a nominated spacing to all jetty structures allowing for personnel recovery.
• Fencing of regulator and channel sites to assist in exclusion of livestock or native animals and members of the public from constructed infrastructure.

8.4 HEALTH AND SAFETY HAZARDS

The following key identified residual risks that require further consideration throughout the design, construction and operational stages are summarised as follows:

• Site access and performing the works during construction, operation and maintenance.
• Materials used.
• Pedestrian/public safety.
• Pedestrian/public access to facilities and around them (e.g. driving along beach, boating through the lagoons).
• Marine/boating considerations in Southern Ocean.
• First Nations peoples and their continuing connection to the land, water, flora and fauna species.

8.5 CONSTRUCTABILITY AND MAINTENANCE

Access to the Younghusband Peninsula is assumed to be northwards along the beach from an access near 42 Mile Crossing or Tea Tree Crossing.

The following actions will be taken to reduce constructions risks:

• Marine work using boats in the Southern Ocean will be minimised or eliminated where possible due to unsafe and rough metocean conditions.
• Scuba diving in the Southern Ocean will be minimised or eliminated where possible due to unsafe and rough metocean conditions.
• Any construction equipment required to be transported across the Coorong by a vehicle larger than a standard ute is expected to be transported across the Coorong via a barge with temporary mooring and berthing facilities as required.
Appendix C

Geotechnical investigation report - Lake Albert connector desktop assessment
14 July 2021

COORONG INFRASTRUCTURE FEASIBILITY ASSESSMENT: INFRASTRUCTURE OPTION 1 - LAKE ALBERT TO COORONG CONNECTOR

GEOTECHNICAL DESKTOP STUDY

Kellogg Brown and Root
<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 July 2021</td>
<td>0</td>
<td>Initial Report</td>
</tr>
</tbody>
</table>
# Table of Contents

1 INTRODUCTION ............................................................................................................. 1  
2 PROJECT APPRECIATION ............................................................................................... 1  
3 SCOPE OF WORKS ........................................................................................................ 1  
4 REFERENCE DOCUMENTS ............................................................................................ 1  
5 DESKTOP STUDY .......................................................................................................... 2  
   5.1 Engineering Description .......................................................................................... 2  
   5.2 Previous Investigation Findings ............................................................................. 3  
      5.2.1 Topography / Geomorphology ....................................................................... 3  
      5.2.2 Regional Geology .......................................................................................... 3  
      5.2.3 Local Subsurface ......................................................................................... 4  
      5.2.4 ASS/PASS ................................................................................................... 5  
      5.2.5 Groundwater ............................................................................................. 6  
   5.3 Potential Construction Issues ................................................................................ 7  
   5.4 Further Investigation ............................................................................................ 7  
6 LIMITATIONS .............................................................................................................. 7  
7 CLOSURE .................................................................................................................... 8  

# DRAWINGS

Drawing 1 – Project Alignments

# Appendices

Appendix A – Engineering Logs for Alignment 1
Appendix B – Engineering Logs for Alignment 2
Appendix C – Engineering Logs for Alignment 3
INTRODUCTION

CMW Geosciences (CMW) was authorised by KBR to carry out a geotechnical desktop review for the Infrastructure Option 1 – Lake Albert – Coorong Connector.

The scope of work undertaken was generally consistent with our proposal letter referenced ADL2020-0001AA, Rev0 dated 18 January 2021.

Herein is a desktop study of existing information related to the Lake Albert – Coorong Connector.

PROJECT APPRECIATION

Due to historically low River Murray flows, water levels in the Lower Lakes reached a record low of one metre below sea level. This reduction in water level has led to an increase in salinity and threatened the ecology of Lake Albert, the local economy (particularly the agricultural sector) and dependent communities. Potential acid sulfate soil (PASS) has become exposed to oxygen resulting in changes to the ecological characteristics of the region. A number of government investigations, interventions and on-ground works and measures were initiated in response.

Lake Albert is a terminal lake with no direct connectivity to the sea, so the ability for salt to be naturally exported from the system is limited. The lake’s main water inflow comes from Lake Alexandrina via the Narrung Narrows. Despite improvements in water levels and flows since the drought, salinity levels declined but have not returned to pre-drought levels.

A number of management options have been proposed to alleviate the increased salinity in Lake Albert including:

- Construction of an open channel between Basecombe Bay and Coorong North lagoon (herein referred to as Coorong Connector – Alignment 1, and Coorong Connector – Alignment 2): and

- The installation of a pipeline to pump water between Lake Albert and Coorong North Lagoon (referred to herein as Coorong Connector – Alignment 3). It is noted that although this option has been listed as undesirable due to intensive energy demand during operation, it has still been included in the desktop study of the region.

SCOPE OF WORKS

This desk top assessment presents a review of published and provided geological and geotechnical information for the Lake Albert – Coorong Connector. This report includes a compilation of relevant geotechnical information, potential construction issues and presents our recommended scope for further intrusive geotechnical investigation relevant to the proposed structures.

REFERENCE DOCUMENTS

A number of previous reports have been provided to CMW to assist in the desktop study. These reports include environmental reports detailing the environmental modelling completed as well as geotechnical reports investigating some of the proposed infrastructure options.

Other published online resources have also been used in the desktop study, such as geology maps, groundwater well data, topographical information, Acid Sulphate Soil risk maps and aerial images.

5. Government of South Australia, August 2014, “Lake Albert Scoping Study Options Paper”;

5 DESKTOP STUDY

5.1 Engineering Description

Figure 1 depicts the three potential alignments investigated by SKM in 2013 for the Lake Albert – Coorong Connector.

![Figure 1: SKM 2013 Investigation Locations](image)

**Alignment 1 and Alignment 2**: Construction of an open channel between Basecombe Bay and Coorong North lagoon extends from near the south-western extremity of Lake Albert approximately 1.7 km to the Northern Lagoon. The channel would be trapezoidal in shape comprising a 13m wide base with side slopes of approximately 1V:4H. Maximum cut depth of the channels is expected to be up to 9.4m based on previous assessments.

It is understood that dredging into both Basecombe Bay and the Northern lagoon would be required to extend approximately 700m into Coorong North lagoon, and approximately 200m into Basecombe Bay. An aerial overview extracted from the SKM Engineering Feasibility report, including a proposed channel configuration as shown in Figure 2.
Alignment 3: Involves construction of a pipeline to pump water between Lake Albert and the Coorong North Lagoon. Based on the volume of water required (up to 1GL/day), three DN2400 pipes have been proposed. At the time of writing this report, this option is understood to be the least desirable based on the intensive energy requirements to maintain pumping operations.

5.2 Previous Investigation Findings

The following details have been extracted from the SKM 2013 report Lake Albert & Narung Narrows – Field Investigations Report – Final*, Report No. VE23811 Version B.

5.2.1 Topography / Geomorphology

The open channel alignments and the formerly considered pipe alignment traverse cleared paddocks utilised for cropping and pasture. From topographical maps of the area, it appears that the area is generally flat with some local undulation in the terrain with heights ranging from 0mAHD to approximately 14.5mAHD between the Coorong North Lagoon, Lake Albert and Basecombe Bay.

5.2.2 Regional Geology

The Geological Survey of South Australia 1:250,000 geological map Sheet 1 54-13 “Barker” Sheet indicates that the geology at the Narrung Narrows and proposed Coorong Connector alignments is Quaternary kunkarised dunes, sand spreads and kunkar related to calcareous rock. Kunkar soil profiles typically comprise nodular calcium carbonate soils formed in semi-arid regions with alluvial flats.

An excerpt from the SARIG 1:100,000 geological overlay is presented in Figure 3 and illustrates the expected geological units and their distribution. Quaternary alluvial flat deposits are present locally, immediately adjacent to Lake Albert, with shallow depressions expected to contain Holocene Lacustrine Sediments. The southern portion (Coorong Side) of the Ichthus is expected to comprise
Bridgewater Formation materials (calcareous cross-bedded sand dunes with calcrete capping).

Figure 3: Regional Geology of Alignment Options

5.2.3 Local Subsurface
A number of boreholes were drilled as part of the 2013 SKM Investigation. In general, the boreholes along the Coorong Connector alignment encountered reasonably consistent subsurface profiles, comprising of shallow topsoil overlying fine to coarse grained sand, with varying degrees of cementation.

The sands are of marine origin, calcareous and contain traces of gravels and shell fragments. The geotechnical report notes that the cemented sand has the strength of a very weak rock and could not be broken by hand but was penetrable by the hollow auger.

Clay was only encountered in borehole BH06, which is the borehole nearest to the lake, between -12.6 m AHD to the end of the borehole at -15.2 m AHD.

The borehole plan is marked up on Figure 4, below.
The generalised subsurface profile along the Coorong Connector alignments is shown in Table 1. CMW consider this is broadly consistent with the expected regional geology.

<table>
<thead>
<tr>
<th>Level from (m AHD)</th>
<th>Level to (m AHD)</th>
<th>Thickness (m)</th>
<th>Description</th>
<th>Typical SPT Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>+1.6 to +14.5</td>
<td>+1.5 to +14.4</td>
<td>0.1 to 1.2</td>
<td>Fill or Topsoil</td>
<td>NA</td>
</tr>
<tr>
<td>+1.5 to +14.4</td>
<td>+3.5 to -23.5</td>
<td>10 to 27</td>
<td>Very Loose to Very Dense sand, calcareous, variably cemented</td>
<td>1 to Refusal</td>
</tr>
</tbody>
</table>

It is noted that at the time of field investigation, BH09 was not able to be drilled due to unfavourable soft ground conditions for safe operation of the drill rig.

The borehole logs are presented in the Appendix A to Appendix C of this report.

5.2.4 ASS/PASS

During the SKM 2013 investigation, field pH testing was undertaken on soil samples taken from the boreholes drilled from each alignment. In general, low to medium reactions with hydrochloric acid and hydrogen peroxide were noted. pH changes of less than 4 were generally recorded indicating a low probability of ASS/PASS. This low probability corresponds with publicly available information available from the Australian Soil Resource Information System (ASRIS), shown in Figure 5 below.
No tests were undertaken in the inundated soils of both the Coorong North Lagoon and the southern end of Lake Albert, as no drilling over water has yet been completed. According to the ASRIS ASS/PASS probability map, these soils have a high probability of being ASS/PASS and would need to be investigated further during field works.

5.2.5 Groundwater

Groundwater was encountered at varying depths during the 2013 borehole investigation. It is noted that these levels are expected to undergo significant seasonal variations relative to the amount of rainfall, lake water levels and local topography. The existence of separate fresh and saline water tables is also a possibility due to the relative immiscibility of the two fluids.

No water chemistry testing has been undertaken in the 2013 SKM investigation, so it is not possible to determine the salinity of the water encountered.

The groundwater levels encountered during the investigation are summarised in the table on the following page (Table 2).

<table>
<thead>
<tr>
<th>Borehole ID</th>
<th>GWL (mBGL)</th>
<th>GWL (mRL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH04</td>
<td>3.0</td>
<td>-0.5</td>
</tr>
<tr>
<td>BH05</td>
<td>5.0</td>
<td>0.0</td>
</tr>
<tr>
<td>BH06</td>
<td>2.5</td>
<td>0.3</td>
</tr>
<tr>
<td>BH07</td>
<td>5.0</td>
<td>-1.5</td>
</tr>
<tr>
<td>BH08</td>
<td>7.0</td>
<td>0.3</td>
</tr>
<tr>
<td>BH09</td>
<td>Not drilled due to unsuitable ground conditions</td>
<td></td>
</tr>
<tr>
<td>BH10</td>
<td>8.0</td>
<td>0.1</td>
</tr>
<tr>
<td>BH11</td>
<td>Groundwater Not Encountered – Borehole Terminated 11mBGL (3.5mRL)</td>
<td></td>
</tr>
</tbody>
</table>
5.3 Potential Construction Issues

Based on a review of the supplied information as well as publicly available information, we advise that following issues may potentially be encountered during construction and should be taken into account during planning of works:

- Presence of calcrete causing difficult excavation conditions. During the drilling investigation, cemented layers were able to be penetrated with hollow auger drilling techniques and would be expected to be excavatable. Based on previous experience on sites underlain by calcrete, within this region, significant resistance to excavations can be encountered during excavation and dredging that in some cases would necessitate the use of hydraulic breakers and ripping attachments;

- The boundary of the land and lacustrine environment may be difficult for construction trafficking and for equipment to be launched into the water. Select and deliberate investigations and working platform designs would need to be considered.

- There is a high probability that material excavated from the North Coorong Lagoon and the southern portion of Lake Albert are acid sulfate soils which will require consideration and a management plan prior to construction activities.

5.4 Further Investigation

At present, no information is available regarding the ground conditions where dredging activities are proposed. It is recommended that field investigations be completed to quantify the likely ground conditions at these locations. Potential investigation options include drilling boreholes from a floating platform (hovercraft, jack-up barge), vibrocore sampling or geophysical survey techniques such as Multi-Channel Analysis of Surface Waves (MASW).

We note that investigation over or in water can be extremely expensive. The type and extent of investigation will need to be considerate of the design stage of the project.

CMW have proposed a scope of works in our proposal ADL2021-0001AA Rev0 that could be undertaken but at the time of writing this report, the scope of construction works is not well defined. Some discussion would need to take place to ensure an investigation takes place which is sufficient relative to the design objectives.

6 LIMITATIONS

The findings contained within this report are the result of a desktop review of the supplied limited discrete investigations, and publicly available information online. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, can it be considered that these findings represent the actual state of the ground conditions away from the provided investigation locations.
This report has been prepared for use by KBR in relation to the proposed Coorong Connector option which forms part of a larger investigation into remediation and management of Salinity and water levels in the Coorong region, in accordance with generally accepted consulting practice. No other warranty, expressed or implied, is made as to the professional advice included in this report. Use of this report by parties other than KBR and their respective consultants and contractors is at their risk as it may not contain sufficient information for any other purposes.

7 CLOSURE

Should there be any questions in relation to this report, please contact the undersigned.

For and on behalf of
CMW Geosciences

Prepared by: Reviewed/Authorised by:

Paolo Mercorella John Slade
Geotechnical Engineer Principal Geotechnical Engineer, CPEng

Distribution: 1 copy to KBR (electronic)
Original held by CMW Geosciences
Drawings
Appendix A
Engineering Logs – Alignment 1
### SOIL LOG

**HOLE NO:** BH04  
**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**SURFACE ELEVATION:** 2.47 m (AHD)  
**SURFACE CONDITIONS:** Topsoil/Grass  
**LOCATION:** Meningie - Alignment 1  
**RIG TYPE:** MK5 Investigator  
**CONTRACTOR:** Drilling Solutions  
**DATE DRILLED:** 23/9/13 to 23/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**STANDARD:** AS 1726-1993

#### FIELD DATA

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>L</th>
<th>Disturbance</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td></td>
<td>D</td>
<td>Topsoil, Silty SAND (SM); fine to medium grained subangular to subrounded sand, dark brown-black, trace organic matter (root fibres), organic odour</td>
</tr>
<tr>
<td>0.50</td>
<td>L</td>
<td>D</td>
<td>SAND (SW); fine to coarse grained subangular to subrounded sand, dark brown-black, calcareous, organic odour</td>
</tr>
<tr>
<td>0.80</td>
<td></td>
<td></td>
<td>SAND (SW); fine to coarse grained subangular to subrounded sand, while mottled grey/brown/orange, with shell fragments up to 6mm, with silt, calcareous</td>
</tr>
<tr>
<td>1.30</td>
<td></td>
<td>D</td>
<td>Weakly cemented layer (10mm), with increased number of shell fragments</td>
</tr>
<tr>
<td>1.80</td>
<td></td>
<td></td>
<td>SAND (SW); fine to coarse grained subangular to subrounded sand, grey-black, with shell fragments up to 6mm, calcareous</td>
</tr>
<tr>
<td>2.20</td>
<td></td>
<td></td>
<td>Weakly cemented layer (10mm), with increased number of shell fragments</td>
</tr>
<tr>
<td>2.70</td>
<td></td>
<td></td>
<td>SAND (SW); fine to coarse grained subangular to subrounded sand, grey-brown, with shell fragments up to 6mm, calcareous</td>
</tr>
<tr>
<td>3.00</td>
<td></td>
<td></td>
<td>Weakly cemented layer (10mm), with increased number of shell fragments</td>
</tr>
<tr>
<td>3.30</td>
<td></td>
<td></td>
<td>SAND (SP); coarse grained subangular to subrounded sand, grey mottled white/yellow, with fine subangular gravel, with shell fragments up to 6mm, calcareous</td>
</tr>
<tr>
<td>4.00</td>
<td></td>
<td></td>
<td>Weakly cemented layer (10mm), with increased number of shell fragments</td>
</tr>
<tr>
<td>4.50</td>
<td></td>
<td></td>
<td>SAND (SP); coarse grained subangular to subrounded sand, grey-brown, with shell fragments up to 6mm, calcareous</td>
</tr>
<tr>
<td>5.00</td>
<td></td>
<td></td>
<td>Weakly cemented layer (10mm), with increased number of shell fragments</td>
</tr>
<tr>
<td>5.50</td>
<td></td>
<td></td>
<td>SAND (SP); fine grained sand, dark grey, trace silt, calcareous</td>
</tr>
</tbody>
</table>

#### COMMENTS

- 1.00: Very hard to dig at 1 m bgl; SPT Recovery: 0 m
- 2.50: SPT Recovery: 0.51 m
- 3.00: Groundwater encountered
- 4.00: SPT Recovery: 0.42 m
- 5.50: SPT Recovery: 0.4 m
### SOIL LOG

**HOLE NO:** BH04  
**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**POSITION:** E: 341328, N: 6043457 (MGA94)  
**SURFACE ELEVATION:** 2.47 m (AHD)  
**SURFACE CONDITIONS:** Topsoil/Grass  
**LOCATION:** Meningie - Alignment 1  
**RIG TYPE:** MK5 Investigator  
**CONTRACTOR:** Drilling Solutions  
**DATE DRILLED:** 23/9/13 to 23/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**STANDARD:** AS 1726-1993

### MATERIAL DESCRIPTION

<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>SAMPLES &amp; FIELD DATA</th>
<th>GRAPHIC</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.00</td>
<td></td>
<td></td>
<td>SAND (SW); fine to coarse grained subangular to subrounded sand, grey, with shell fragments up to 6mm, with fine to medium grained subrounded gravel, calcareous</td>
</tr>
<tr>
<td>7.14</td>
<td></td>
<td></td>
<td>Gravelly SAND (SW); fine to coarse grained subangular to subrounded sand, pale grey, fine to medium grained subrounded gravel, calcareous</td>
</tr>
<tr>
<td>7.21</td>
<td></td>
<td></td>
<td>SAND (SP); fine to medium grained subangular to subrounded sand, grey, calcareous</td>
</tr>
<tr>
<td>7.50</td>
<td></td>
<td></td>
<td>Silty SAND (SM); fine grained sand, white-yellow, calcareous</td>
</tr>
<tr>
<td>8.50</td>
<td></td>
<td></td>
<td>Gravelly SAND (SW); fine to coarse grained subangular to subrounded sand, grey, fine grained subrounded gravel, trace shell fragments up to 2mm, calcareous</td>
</tr>
<tr>
<td>10.00</td>
<td></td>
<td></td>
<td>Silty SAND (SM); fine grained sand, white-yellow, calcareous</td>
</tr>
</tbody>
</table>

**EOH at 11 m bgl**

**COMMENTS**

**FIELD DATA**

**GROUNDBORER SYMBOLS**

- **HA** = Hand Auger  
- **HAD** = Hollow Auger Drilling  
- **WB** = Washbore  
- **RR** = Rock Rolling  
- **AH** = Air Hammer  

**GROUNDWATER SYMBOLS**

- **=** Water level (static)  
- **=** Water level (during drilling)  
- **=** Water inflow  
- **=** Water outflow

**MOISTURE CONDITION**

- N  = Dry  
- M  = Moist  
- W  = Wet

**REACTION RATE - PEROXIDE**

- L  = slight effervescence  
- M  = moderate reaction  
- H  = vigorous reaction  
- X  = volcanic, very vigorous reaction

**CONSISTENCY (Su) (N-value)**

- VL  = Very Loose  
- L  = Loose  
- MD  = Medium Dense  
- D  = Dense  
- VD  = Very Dense

- VS  = Very Soft  
- S  = Soft  
- F  = Firm  
- St  = Stiff  
- VSt  = Very Stiff

- <12 kPa  = 0-2  
- 12-25  = 2-4  
- 25-50  = 4-8  
- 50-100  = 8-15  
- 100-200  = 15-30  
- >200 kPa  = >30

**DENSITY (N-value)**

- HQ  = HQ Coring  
- NQ  = NQ Coring  
- PQ  = PQ Coring  
- NMLC  = NMLC Coring

**FIELD TEST DATA**

- SPT SPT Sample  
- U  = U50 Sample  
- W  = Water Sample

**REMARKS**

- Disturbed Sample  
- Bulk Sample  
- Env Soil Sample  
- Env Water Sample  
- Hand Penetrometer  
- Hand Vane Shear  
- Peak Su R. Residual Su  
- SPT blows per 300mm

**REPORTED RESULTS**

- SPT Recovery: 0.41 m  
- SPT Recovery: 0.48 m  
- SPT Recovery: 0.35 m  
- SPT Recovery: 0.38 m

**RIG TYPE:** MK5 Investigator  
**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**POSITION:** E: 341328, N: 6043457 (MGA94)  
**SURFACE ELEVATION:** 2.47 m (AHD)  
**SURFACE CONDITIONS:** Topsoil/Grass  
**LOCATION:** Meningie - Alignment 1  
**RIG TYPE:** MK5 Investigator  
**CONTRACTOR:** Drilling Solutions  
**DATE DRILLED:** 23/9/13 to 23/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**STANDARD:** AS 1726-1993
### Soil Log

**HOLE NO:** BH05  
**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**RIG TYPE:** MK5 Investigator  
**DATE DRILLED:** 23/9/13 to 23/9/13  
**CONTRACTOR:** Drilling Solutions  
**SURFACE ELEVATION:** 4.95 m (AHD)  
**SURFACE CONDITIONS:** Topsoil/Grass  
**POSITION:** E: 341951, N: 6043557 (MGA94)  
**LOCATION:** Meningie - Alignment 1  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**FILE:** VE23811.1 BH05  
**JOB NO:** VE23811.1  
**STANDARD:** AS 1726-1993

#### Field Data

<table>
<thead>
<tr>
<th>Hole No</th>
<th>Dip/Azimuth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90°</td>
</tr>
</tbody>
</table>

#### Sample Data

<table>
<thead>
<tr>
<th>Sample</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>Disturbed Sample</td>
</tr>
<tr>
<td>B1</td>
<td>Bulk Sample</td>
</tr>
<tr>
<td>ES1</td>
<td>Env Soil Sample</td>
</tr>
<tr>
<td>EW2</td>
<td>Env Water Sample</td>
</tr>
</tbody>
</table>

#### Material Description

- **Soil Log:** Classification Symbol  
  - SOIL NAME: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations

- **Comments:** Field Test Data & Other Observations

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Density (N-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>1.00 SPT Recovery: 0.39 m</td>
</tr>
<tr>
<td>1.00</td>
<td>1.40m SPT Recovery: 0.33 m</td>
</tr>
<tr>
<td>2.50</td>
<td>1.90m Groundwater encountered</td>
</tr>
</tbody>
</table>

#### Soil Log Details

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Moisture Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 - 1.00</td>
<td>D = Dry</td>
</tr>
<tr>
<td>1.00 - 2.50</td>
<td>L = Moist</td>
</tr>
<tr>
<td>2.50 - 5.00</td>
<td>N = Saturated</td>
</tr>
</tbody>
</table>

#### Groundwater Symbols

- **W:** Water level (static)
- **D:** Water level (during drilling)
- **I:** Water inflow
- **O:** Water outflow

#### DENSITY (N-value)

- **VL:** Very Loose 0 - 4
- **L:** Loose 4 - 10
- **MD:** Medium Dense 10 - 30
- **D:** Dense 30 - 50
- **VD:** Very Dense 50 - 100

#### CONSISTENCY (Su) (N-value)

- **VS:** Very Soft < 12 kPa (0-2)
- **S:** Soft 12 - 25 (2-4)
- **F:** Firm 25 - 50 (4-8)
- **St:** Stiff 50 - 100 (8-15)
- **VSt:** Very Stiff 100 - 200 (15-30)
- **H:** Hard > 200 kPa (>30)
SAND (SW): fine to coarse grained subangular to subrounded sand, pale brown mottled yellow, with shell fragments up to 2mm, trace fine to medium grained subrounded gravel, calcareous (continued)

As above, with increased gravel content

Silty SAND (SM): fine grained sand, mottled pale brown/white, calcareous

Sandy sand (SAND), fine to coarse grained subangular to subrounded sand, pale brown mottled yellow, with shell fragments up to 2mm, trace fine to medium grained subrounded gravel, calcareous

Silty SAND (SM): fine grained sand, mottled pale brown/white, calcareous

Sandy sand (SAND), fine to coarse grained subangular to subrounded sand, pale brown mottled yellow, with shell fragments up to 2mm, calcareous

**FIELD DATA**

<table>
<thead>
<tr>
<th>FIELD DATA</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.96</td>
<td>SAND (SW): fine to coarse grained subangular to subrounded sand, pale brown mottled yellow, with shell fragments up to 2mm, trace fine to medium grained subrounded gravel, calcareous.</td>
</tr>
<tr>
<td>7.93</td>
<td>As above, with increased gravel content</td>
</tr>
<tr>
<td>7.96</td>
<td>SAND (SW): fine to coarse grained subangular to subrounded sand, pale brown mottled yellow, with shell fragments up to 2mm, trace fine to medium grained subrounded gravel, calcareous (continued)</td>
</tr>
<tr>
<td>7.50</td>
<td>Silty SAND (SM): fine grained sand, mottled pale brown/white, calcareous</td>
</tr>
<tr>
<td>8.00</td>
<td>SAND (SW): fine to coarse grained subangular to subrounded sand, pale brown mottled yellow, with shell fragments up to 2mm, trace fine to medium grained subrounded gravel, calcareous</td>
</tr>
<tr>
<td>8.13</td>
<td>Silty SAND (SM), fine grained sand, mottled pale brown/white, calcareous</td>
</tr>
</tbody>
</table>

**DRILLING & DETAIL**

<table>
<thead>
<tr>
<th>DRILLING &amp; DETAIL</th>
<th>FIELD DATA</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.96</td>
<td>SAND (SW): fine to coarse grained subangular to subrounded sand, pale brown mottled yellow, with shell fragments up to 2mm, trace fine to medium grained subrounded gravel, calcareous.</td>
</tr>
<tr>
<td></td>
<td>7.93</td>
<td>As above, with increased gravel content</td>
</tr>
<tr>
<td></td>
<td>7.96</td>
<td>SAND (SW): fine to coarse grained subangular to subrounded sand, pale brown mottled yellow, with shell fragments up to 2mm, trace fine to medium grained subrounded gravel, calcareous (continued)</td>
</tr>
<tr>
<td></td>
<td>7.50</td>
<td>Silty SAND (SM): fine grained sand, mottled pale brown/white, calcareous</td>
</tr>
<tr>
<td></td>
<td>8.00</td>
<td>SAND (SW): fine to coarse grained subangular to subrounded sand, pale brown mottled yellow, with shell fragments up to 2mm, trace fine to medium grained subrounded gravel, calcareous</td>
</tr>
<tr>
<td></td>
<td>8.13</td>
<td>Silty SAND (SM), fine grained sand, mottled pale brown/white, calcareous</td>
</tr>
</tbody>
</table>

**SAMPLES & FIELD TESTS**

<table>
<thead>
<tr>
<th>SAMPLES &amp; FIELD TESTS</th>
<th>FIELD DATA</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.96</td>
<td>SAND (SW): fine to coarse grained subangular to subrounded sand, pale brown mottled yellow, with shell fragments up to 2mm, trace fine to medium grained subrounded gravel, calcareous.</td>
</tr>
<tr>
<td></td>
<td>7.93</td>
<td>As above, with increased gravel content</td>
</tr>
<tr>
<td></td>
<td>7.96</td>
<td>SAND (SW): fine to coarse grained subangular to subrounded sand, pale brown mottled yellow, with shell fragments up to 2mm, trace fine to medium grained subrounded gravel, calcareous (continued)</td>
</tr>
<tr>
<td></td>
<td>7.50</td>
<td>Silty SAND (SM): fine grained sand, mottled pale brown/white, calcareous</td>
</tr>
<tr>
<td></td>
<td>8.00</td>
<td>SAND (SW): fine to coarse grained subangular to subrounded sand, pale brown mottled yellow, with shell fragments up to 2mm, trace fine to medium grained subrounded gravel, calcareous</td>
</tr>
<tr>
<td></td>
<td>8.13</td>
<td>Silty SAND (SM), fine grained sand, mottled pale brown/white, calcareous</td>
</tr>
</tbody>
</table>

**GROUNDWATER SYMBOLS**

<table>
<thead>
<tr>
<th>GROUNDWATER SYMBOLS</th>
<th>FIELD DATA</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>△</td>
<td></td>
<td></td>
</tr>
<tr>
<td>△</td>
<td></td>
<td></td>
</tr>
<tr>
<td>△</td>
<td></td>
<td></td>
</tr>
<tr>
<td>△</td>
<td></td>
<td></td>
</tr>
<tr>
<td>△</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COMMENTS**

Field Test Data & Other Observations

**DENSITY (N-value)**

<table>
<thead>
<tr>
<th>DENSITY (N-value)</th>
<th>CONSISTENCY (Soi) (N-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL Very Loose 0-4</td>
<td>VS Very Soft &lt; 12 kPa (0-2)</td>
</tr>
<tr>
<td>L Loose 4-10</td>
<td>S Soft 12-25 (2-4)</td>
</tr>
<tr>
<td>MD Medium Dense 10-30</td>
<td>F Firm 25-50 (4-8)</td>
</tr>
<tr>
<td>D Dense 30-50</td>
<td>St Stiff 50-100 (8-15)</td>
</tr>
<tr>
<td>VD Very Dense 50-100</td>
<td>H Hard &gt; 200 kPa (&gt;30)</td>
</tr>
</tbody>
</table>

**MOISTURE CONDITION**

<table>
<thead>
<tr>
<th>MOISTURE CONDITION</th>
<th>FIELD DATA</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.00</td>
<td>SPT Recovery: 0.35 m</td>
</tr>
<tr>
<td></td>
<td>10.00</td>
<td>SPT Recovery: 0.35 m</td>
</tr>
</tbody>
</table>

**REACTION RATE - PEROXIDE**

<table>
<thead>
<tr>
<th>REACTION RATE - PEROXIDE</th>
<th>FIELD DATA</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>L slight effervescence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M moderate reaction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H vigorous reaction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X volcanic, very vigorous reaction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SAND (SW); fine to coarse grained subangular to subrounded sand, pale brown, trace fine to medium grained subrounded gravel, trace shell fragments up to 2mm, calcareous

Silty SAND (SM); fine grained sand, mottled pale brown/white, calcareous

SAND (SW); fine to coarse grained subangular to subrounded sand, pale brown, trace fine to medium grained subrounded gravel, trace shell fragments up to 2mm, calcareous

EDH at 14 m bgl

13.00: SPT Recovery: 0.25 m
### Soil Log

**Hole No:** BH06  
**Date Drilled:** 20/9/13 to 20/9/13  
**Logged By:** AL  
**Checked By:** IC  
**Project:** Geotechnical & ASS Inv., Lake Albert  
**Surface Elevation:** 2.76 m (AHD)  
**Surface Conditions:** Topsoil/Grass  
**Location:** Meningie - Alignment 1

### DRILLING & FIELD DATA

<table>
<thead>
<tr>
<th>D</th>
<th>Disturbed Sample</th>
<th>SPT Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Bulk Sample</td>
<td>U Sample</td>
</tr>
<tr>
<td>E</td>
<td>Env Soil Sample</td>
<td>W Sample</td>
</tr>
<tr>
<td>EW</td>
<td>Env Water Sample</td>
<td>MOISTURE CONDITION</td>
</tr>
</tbody>
</table>

### MATERIAL DESCRIPTION

<table>
<thead>
<tr>
<th>Classification Symbol</th>
<th>Soil Name: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>FILL, Silty SAND (SM)</td>
<td>Fine to medium grained subangular to subrounded gravel, trace organic matter (root fibres), organic odour</td>
<td></td>
</tr>
<tr>
<td>FILL, Gravelly SAND (SW)</td>
<td>Fine to medium grained subangular to subrounded sand, pale brown/yellow mottled white, fine to coarse grained subangular gravel</td>
<td></td>
</tr>
<tr>
<td>FILL, SAND (SP)</td>
<td>Fine to medium grained subangular to subrounded sand, dark brown, with silt</td>
<td></td>
</tr>
<tr>
<td>Silty SAND (SM)</td>
<td>Fine to medium grained subangular to subrounded sand, mottled white/orange/yellow, with fine to coarse grained subangular gravel, weakly cemented, calcareous</td>
<td></td>
</tr>
<tr>
<td>SAND (SP)</td>
<td>Fine to medium grained subangular to subrounded sand, brown, trace silt, calcareous</td>
<td></td>
</tr>
<tr>
<td>Gravelly SAND (SW)</td>
<td>Fine to coarse grained subangular to subrounded sand, pale brown mottled orange/yellow, fine to coarse subangular gravel, with silt, trace shell fragments up to 2mm, calcareous</td>
<td></td>
</tr>
</tbody>
</table>

### CONSISTENCY (Soil) [N-value]

- Very Loose: VL 0 - 4
- Loose: L 4 - 10
- Medium Dense: MD 10 - 30
- Dense: D 30 - 50
- Very Dense: VD 50 - 100

### DENSITY (N-value)

- Very Soft: VS < 12 kPa (0-2)
- Soft: S 12 - 25 (2-4)
- Firm: F 25 - 50 (4-8)
- Stiff: St 50 - 100 (8-15)
- Very Stiff: VS 100 - 200 (15-30)
- Hard: H > 200 kPa (>30)

### Groundwater Symbols

- Water level (static)
- Water level (during drilling)
- Water inflow
- Water outflow

---

**Notes:**

- Topsoil, Silty SAND (SM): Fine grained sand, dark brown, with fine to medium grained subangular to subrounded gravel, trace organic matter (root fibres), organic odour
- FILL, Gravelly SAND (SW): Fine to medium grained subangular to subrounded sand, pale brown/yellow mottled white, fine to coarse grained subangular gravel
- FILL, SAND (SP): Fine to medium grained subangular to subrounded sand, dark brown, with silt
- Silty SAND (SM): Fine to medium grained subangular to subrounded sand, mottled white/orange/yellow, with fine to coarse grained subangular gravel, weakly cemented, calcareous

---

**Rig Type:** MK5 Investigator  
**Contractor:** Drilling Solutions  
**Surface Elevation:** 2.76 m  
**Surface Conditions:** Topsoil/Grass  
**Location:** Meningie - Alignment 1

---

**Log Details:**

- **Dip/Azimuth:** 90°
- **Drill Type:** MK5 Investigator
- **Contractor:** Drilling Solutions
- **Surface Elevation:** 2.76 m (AHD)
- **Surface Conditions:** Topsoil/Grass

---

**Other Observations:**

- Field Test Data
- Other Observations
### SOIL LOG

**HOLE NO:** BH06  
**PROJECT:** Geotechnical & AS Inv., Lake Albert  
**POSITION:** E: 342551, N: 604016 (MGA94)  
**RIG TYPE:** MK5 Investigator  
**CONTRACTOR:** Drilling Solutions  
**DATE DRILLED:** 20/9/13 to 20/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**RIG TYPE:** MK5 Investigator  
**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**POSITION:** Meningie - Alignment 1  
**DATE DRILLED:** 20/9/13 to 20/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**RIG TYPE:** MK5 Investigator  
**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**POSITION:** Meningie - Alignment 1  
**DATE DRILLED:** 20/9/13 to 20/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC

**FIELD DATA**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>LF</th>
<th>GR</th>
<th>SP</th>
<th>SPT</th>
<th>Pres. Force</th>
<th>M.o.f.</th>
<th>Consistency</th>
<th>DENSITY</th>
<th>MOISTURE</th>
<th>REACTION RATE - PEROXIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.60</td>
<td>6.60</td>
<td>6.60</td>
<td>6.60</td>
<td>6.60</td>
<td>6.60</td>
<td>6.60</td>
<td>6.60</td>
<td>6.60</td>
<td>6.60</td>
<td>6.60</td>
</tr>
<tr>
<td>7.25</td>
<td>7.25</td>
<td>7.25</td>
<td>7.25</td>
<td>7.25</td>
<td>7.25</td>
<td>7.25</td>
<td>7.25</td>
<td>7.25</td>
<td>7.25</td>
<td>7.25</td>
</tr>
</tbody>
</table>

**MATERIAL DESCRIPTION**

(Classification Symbol) **SOIL NAME:** Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations

- **SAND (SP):** fine to medium grained subangular to subrounded sand, grey with black/white flecks, trace fine to coarse subangular gravel, trace silt, calcareous (continued)
- **Silty SAND (SM):** fine grained sand, grey-blue, organic odour
- **Gravelly SAND (SW):** fine to medium grained subangular to subrounded sand, mottled grey/brown, fine to coarse grained subangular gravel, with silt, calcareous
- **Sandy SAND (SN):** fine to medium grained subangular to subrounded sand, mottled grey/brown, with fine to coarse grained subangular gravel, with silt, calcareous
- **Gravelly SAND (SW):** fine to coarse grained subangular to subrounded sand, grey with black flecks, fine to medium grained subrounded to subangular gravel, trace silt, calcareous

**COMMENTS**

Field Test Data & Other Observations

- **5.00 SPT Recovery:** 0.38 m
- **7.00 SPT Recovery:** 0.42 m
- **8.50 SPT Recovery:** 0.41 m
- **10.00 SPT Recovery:** 0.43 m

**GROUNDWATER SYMBOLS**

- **D = Dry**
- **M = Moist**
- **W = Wet**
- **L = Loose**
- **S = Soft**
- **F = Firm**
- **Stiff**
- **Very Stiff**
- **Hard**

**MOISTURE CONDITION**

- **L** = loose
- **S** = soft
- **F** = firm
- **Stiff**
- **Very Stiff**
- **Hard**

**REACTION RATE - PEROXIDE**

- **L** = slight effervescence
- **M** = moderate reaction
- **H** = vigorous reaction
- **X** = volcanic, very vigorous reaction
<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Soil Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.50</td>
<td>SAND (SW); fine to coarse grained subangular to subrounded sand, grey, with silt, calcareous (continued)</td>
</tr>
<tr>
<td>12.00</td>
<td>SAND (SW); fine to coarse grained subangular to subrounded sand, grey, with silt, calcareous</td>
</tr>
<tr>
<td>12.50</td>
<td>SAND (SP); fine grained sand, white-yellow, with silt, calcareous</td>
</tr>
<tr>
<td>13.00</td>
<td>Gravelly SAND (SW); fine to medium grained subangular to subrounded sand, yellow-white, fine to coarse subangular gravel, with silt, calcareous</td>
</tr>
<tr>
<td>13.50</td>
<td>Silty CLAY (CI); medium plasticity clay, grey mottles white, white mottles composed of fine to coarse grained subangular to subrounded sand and silt, calcareous</td>
</tr>
<tr>
<td>14.00</td>
<td>Silty SAND (SM); fine grained sand, yellow-pale brown, trace fine to medium grained subangular gravel, calcareous</td>
</tr>
<tr>
<td>14.50</td>
<td>Silty SAND (SM); fine grained sand, yellow-pale brown, trace fine to medium grained subangular gravel, calcareous</td>
</tr>
<tr>
<td>15.00</td>
<td>CLAY (CH); high plasticity clay, grey mottled orange, calcareous</td>
</tr>
</tbody>
</table>

**Soil Log**

**Sampling & Field Tests**

- **D**: Disturbed Sample
- **B**: Bulk Sample
- **ES**: Env Soil Sample
- **EW**: Env Water Sample
- **PP**: Hand Penetrometer
- **SV**: Hand Vane Shear
- **N**: SPT blows per 300mm

**Field Data**

- **Depth (m)**
- **Classification Symbol**
- **Soil Name:** Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations

**Comments**

- **Field Test Data**
- **Other Observations**
### FIELD DATA

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Sample Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.00m</td>
<td>Disturbed Sample</td>
<td>CLAY (CH); high plasticity clay, grey mottled orange, calcareous (continued)</td>
</tr>
<tr>
<td>17.50m</td>
<td>Bulk Sample</td>
<td>EOH at 18 m bgl</td>
</tr>
</tbody>
</table>

**MATERIAL DESCRIPTION**

(Classification Symbol) **SOIL NAME:** Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations

- **17.50:** SPT Recovery: 0.48 m

**COMMENTS**

Field Test Data & Other Observations

**GROUNDWATER SYMBOLS**

- **D** = Disturbed Sample
- **B** = Bulk Sample
- **U** = USO Sample
- **W** = Water Sample
- **PP** = Hand Penetrometer
- **SV** = Hand Vane Shear
- **P** = Peak Su R. Residual Su
- **N** = SPT blows per 300mm
Appendix B
Engineering Logs – Alignment 2
**SOIL LOG**

**HOLE NO:** BH07

**PAGE:** 1 OF 5

**PROJECT:** Geotechnical & ASS Inv, Lake Albert

**SURFACE ELEVATION:** 3.53 m (AHD)

**POSITION:** E: 340714, N: 6044178 (MGA94)

**SURFACE CONDITIONS:** Topsoil/Grass

**LOCATION:** Meningie - Alignment 2

**RIG TYPE:** MK5 Investigator

**CONTRACTOR:** Drilling Solutions

**DATE DRILLED:** 22/9/13 to 22/9/13

**LOGGED BY:** AL

**CHECKED BY:** IC

**STANDARD:** AS 1726-1993

**DATE:**

**RIG TYPE:** MK5 Investigator

**POSITION:**

**PROJECT:** Geotechnical & ASS Inv., Lake Albert

**RIG TYPE:** MK5 Investigator

**DATE DRILLED:** 22/9/13 to 22/9/13

**LOGGED BY:** AL

**CHECKED BY:** IC

**STANDARD:** AS 1726-1993

**GROUNDWATER SYMBOLS**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Water level (static)</td>
</tr>
<tr>
<td>D</td>
<td>Water level (during drilling)</td>
</tr>
<tr>
<td>X</td>
<td>Water inflow</td>
</tr>
<tr>
<td>W</td>
<td>Water outflow</td>
</tr>
</tbody>
</table>

**DRILLING**

- **HA:** Hand Auger
- **HQ:** HQ Coring
- **PO:** PQ Coring
- **RR:** Rock Rolling
- **NMLC:** NMLC Coring
- **AH:** Air Hammer

**GROUNDWATER SYMBOLS**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Water level (static)</td>
</tr>
<tr>
<td>D</td>
<td>Water level (during drilling)</td>
</tr>
<tr>
<td>X</td>
<td>Water inflow</td>
</tr>
<tr>
<td>W</td>
<td>Water outflow</td>
</tr>
</tbody>
</table>

**FIELD DATA**

**SAMPLES & FIELD TESTS**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Moisture Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.02</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.04</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.06</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.08</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.10</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.12</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.14</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.16</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.18</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.20</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.22</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.24</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.26</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.28</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.30</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.32</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.34</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.36</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.38</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.40</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.42</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.44</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.46</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.48</td>
<td>Moisture Condition</td>
</tr>
<tr>
<td>0.50</td>
<td>Moisture Condition</td>
</tr>
</tbody>
</table>

**COMMENTS**

- Field Test Data
- & Other Observations

**Soil Log**

**Soil Name:** Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations

**Samples & Field Tests**

- **D:** Disturbed Sample
- **SPT:** SPT Sample

**Density (N-value)**

- **VL:** Very Loose 0 - 4
- **L:** Loose 4 - 10
- **MD:** Medium Dense 10 - 30
- **D:** Dense 30 - 50
- **VD:** Very Dense 50 - 100

- **Consistency (Soil) (N-value)**

- **VS:** Very Soft < 12 kPa (0-2)
- **S:** Soft 12 - 25 (4-8)
- **F:** Firm 25 - 50 (8-15)
- **D:** Dense 50 - 100 (15-30)
- **H:** Hard > 100 kPa (>30)
<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Soil Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.41</td>
<td>Sand (SP)</td>
<td>fine to medium grained subangular to subrounded sand, pale brown-yellow, trace fine grained subrounded gravel, calcareous (continued)</td>
</tr>
<tr>
<td>8.41</td>
<td>Sand (SW)</td>
<td>fine to coarse grained subangular to subrounded sand, pale brown, calcareous</td>
</tr>
<tr>
<td>8.45</td>
<td>Sand (SP)</td>
<td>fine to medium grained subangular to subrounded sand, pale brown, trace shell fragments up to 2mm, calcareous</td>
</tr>
<tr>
<td>8.46</td>
<td>Sand (SM)</td>
<td>fine grained sand, white-pale yellow, calcareous</td>
</tr>
</tbody>
</table>

**FIELD DATA**

- **Sample Type**: Disturbed Sample
- **Consistency**: D = Dry
- **Moisture Condition**: M = Moist
- **Reactivity**: W = Wet
- **Soil Name**: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations
- **Reaction Rate - Peroxide**: M = Moderate reaction
- **SPT Blows per 300mm**: L = Slight effervescence
- **CONSISTENCY (Soil) (N-value)**: V = Very Stiff
- **MOISTURE CONDITION**: X = Volcanic, very vigorous reaction
- **CONSISTENCY (Soil) (N-value)**: H = Hard
- **MOISTURE CONDITION**: > = Greater than
- **CONSISTENCY (Soil) (N-value)**: < = Less than

**SOIL LOG**

- **DRILLING**
  - Hand Auger
  - Hollow Auger Drilling
  - Washbore
  - Rock Rolling
  - Air Hammer

- **GROUNDWATER SYMBOLS**
  - = Water level (static)
  - = Water level (during drilling)
  - = Water inflow
  - = Water outflow

- **PROJECT**: Geotechnical & ASS Inv., Lake Albert
- **SURFACE ELEVATION**: 3.53 m (AHD)
- **POSITION**: E: 340714, N: 6044178 (MGA94)
- **SURFACE CONDITIONS**: Topsoil/Grass
- **LOCATION**: Meningie - Alignment 2
- **RIG TYPE**: MK5 Investigator
- **CONTRACTOR**: Drilling Solutions
- **SURFACE ELEVATION**: 3.53 m (AHD)
- **SURFACE CONDITIONS**: Topsoil/Grass
- **LOCATION**: Meningie - Alignment 2
- **DATE DRILLED**: 22/9/13 to 22/9/13
- **LOGGED BY**: AL
- **CHECKED BY**: IC
- **JOB NO**: VE23811.1
- **CONTRACTOR**: Drilling Solutions
- **SURFACE ELEVATION**: 3.53 m (AHD)
- **SURFACE CONDITIONS**: Topsoil/Grass
- **LOCATION**: Meningie - Alignment 2
- **RIG TYPE**: MK5 Investigator
- **DATE DRILLED**: 22/9/13 to 22/9/13
- **LOGGED BY**: AL
- **CHECKED BY**: IC
- **JOB NO**: VE23811.1

**MATERIAL DESCRIPTION**

- **Classification Symbol**: SOIL NAME: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations
- **Reaction Rate - Peroxide**: M = Moderate reaction
- **SPT Blows per 300mm**: L = Slight effervescence
- **CONSISTENCY (Soil) (N-value)**: V = Very Stiff
- **CONSISTENCY (Soil) (N-value)**: H = Hard
- **CONSISTENCY (Soil) (N-value)**: < = Less than

**COMMENTS**

- **Field Test Data**
- **Other Observations**
### SOIL LOG

**HOLE NO:** BH07  
**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**SURFACE ELEVATION:** 3.53 m (AHD)  
**POSITION:** E: 340714, N: 6044178 (MGA94)  
**SURFACE CONDITIONS:** Topsoil/Grass  
**LOCATION:** Meningie - Alignment 2  
**RIG TYPE:** MK5 Investigator  
**CONTRACTOR:** Drilling Solutions  
**DIP / AZIMUTH:** 90°  
**DATE DRILLED:** 22/9/13 to 22/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**STANDARD:** AS 1726-1993

**DRILLING & FIELD DATA**

<table>
<thead>
<tr>
<th>FIELD DATA</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAMPLES &amp; FIELD DATA</td>
<td>GRAPHIC LOG</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>DEPTH (m)</td>
<td>DENSITY (N-value)</td>
</tr>
<tr>
<td>13.20m</td>
<td></td>
</tr>
<tr>
<td>13.00m</td>
<td></td>
</tr>
<tr>
<td>12.90m</td>
<td></td>
</tr>
<tr>
<td>12.80m</td>
<td></td>
</tr>
<tr>
<td>12.70m</td>
<td></td>
</tr>
<tr>
<td>12.60m</td>
<td></td>
</tr>
<tr>
<td>12.50m</td>
<td></td>
</tr>
<tr>
<td>12.40m</td>
<td></td>
</tr>
<tr>
<td>12.30m</td>
<td></td>
</tr>
<tr>
<td>12.20m</td>
<td></td>
</tr>
<tr>
<td>12.10m</td>
<td></td>
</tr>
<tr>
<td>12.00m</td>
<td></td>
</tr>
<tr>
<td>11.90m</td>
<td></td>
</tr>
<tr>
<td>11.80m</td>
<td></td>
</tr>
<tr>
<td>11.70m</td>
<td></td>
</tr>
<tr>
<td>11.60m</td>
<td></td>
</tr>
<tr>
<td>11.50m</td>
<td></td>
</tr>
<tr>
<td>11.40m</td>
<td></td>
</tr>
<tr>
<td>11.30m</td>
<td></td>
</tr>
<tr>
<td>11.20m</td>
<td></td>
</tr>
<tr>
<td>11.10m</td>
<td></td>
</tr>
<tr>
<td>11.00m</td>
<td></td>
</tr>
<tr>
<td>10.90m</td>
<td></td>
</tr>
<tr>
<td>10.80m</td>
<td></td>
</tr>
<tr>
<td>10.70m</td>
<td></td>
</tr>
<tr>
<td>10.60m</td>
<td></td>
</tr>
<tr>
<td>10.50m</td>
<td></td>
</tr>
<tr>
<td>10.40m</td>
<td></td>
</tr>
<tr>
<td>10.30m</td>
<td></td>
</tr>
<tr>
<td>10.20m</td>
<td></td>
</tr>
<tr>
<td>10.10m</td>
<td></td>
</tr>
<tr>
<td>10.00m</td>
<td></td>
</tr>
<tr>
<td>9.90m</td>
<td></td>
</tr>
<tr>
<td>9.80m</td>
<td></td>
</tr>
<tr>
<td>9.70m</td>
<td></td>
</tr>
<tr>
<td>9.60m</td>
<td></td>
</tr>
<tr>
<td>9.50m</td>
<td></td>
</tr>
<tr>
<td>9.40m</td>
<td></td>
</tr>
<tr>
<td>9.30m</td>
<td></td>
</tr>
<tr>
<td>9.20m</td>
<td></td>
</tr>
<tr>
<td>9.10m</td>
<td></td>
</tr>
<tr>
<td>9.00m</td>
<td></td>
</tr>
<tr>
<td>8.90m</td>
<td></td>
</tr>
<tr>
<td>8.80m</td>
<td></td>
</tr>
<tr>
<td>8.70m</td>
<td></td>
</tr>
<tr>
<td>8.60m</td>
<td></td>
</tr>
<tr>
<td>8.50m</td>
<td></td>
</tr>
<tr>
<td>8.40m</td>
<td></td>
</tr>
<tr>
<td>8.30m</td>
<td></td>
</tr>
<tr>
<td>8.20m</td>
<td></td>
</tr>
<tr>
<td>8.10m</td>
<td></td>
</tr>
<tr>
<td>8.00m</td>
<td></td>
</tr>
<tr>
<td>7.90m</td>
<td></td>
</tr>
<tr>
<td>7.80m</td>
<td></td>
</tr>
<tr>
<td>7.70m</td>
<td></td>
</tr>
<tr>
<td>7.60m</td>
<td></td>
</tr>
<tr>
<td>7.50m</td>
<td></td>
</tr>
<tr>
<td>7.40m</td>
<td></td>
</tr>
<tr>
<td>7.30m</td>
<td></td>
</tr>
<tr>
<td>7.20m</td>
<td></td>
</tr>
<tr>
<td>7.10m</td>
<td></td>
</tr>
<tr>
<td>7.00m</td>
<td></td>
</tr>
<tr>
<td>6.90m</td>
<td></td>
</tr>
<tr>
<td>6.80m</td>
<td></td>
</tr>
<tr>
<td>6.70m</td>
<td></td>
</tr>
<tr>
<td>6.60m</td>
<td></td>
</tr>
<tr>
<td>6.50m</td>
<td></td>
</tr>
<tr>
<td>6.40m</td>
<td></td>
</tr>
<tr>
<td>6.30m</td>
<td></td>
</tr>
<tr>
<td>6.20m</td>
<td></td>
</tr>
<tr>
<td>6.10m</td>
<td></td>
</tr>
<tr>
<td>6.00m</td>
<td></td>
</tr>
<tr>
<td>5.90m</td>
<td></td>
</tr>
<tr>
<td>5.80m</td>
<td></td>
</tr>
<tr>
<td>5.70m</td>
<td></td>
</tr>
<tr>
<td>5.60m</td>
<td></td>
</tr>
<tr>
<td>5.50m</td>
<td></td>
</tr>
<tr>
<td>5.40m</td>
<td></td>
</tr>
<tr>
<td>5.30m</td>
<td></td>
</tr>
<tr>
<td>5.20m</td>
<td></td>
</tr>
<tr>
<td>5.10m</td>
<td></td>
</tr>
<tr>
<td>5.00m</td>
<td></td>
</tr>
<tr>
<td>4.90m</td>
<td></td>
</tr>
<tr>
<td>4.80m</td>
<td></td>
</tr>
<tr>
<td>4.70m</td>
<td></td>
</tr>
<tr>
<td>4.60m</td>
<td></td>
</tr>
<tr>
<td>4.50m</td>
<td></td>
</tr>
<tr>
<td>4.40m</td>
<td></td>
</tr>
<tr>
<td>4.30m</td>
<td></td>
</tr>
<tr>
<td>4.20m</td>
<td></td>
</tr>
<tr>
<td>4.10m</td>
<td></td>
</tr>
<tr>
<td>4.00m</td>
<td></td>
</tr>
<tr>
<td>3.90m</td>
<td></td>
</tr>
<tr>
<td>3.80m</td>
<td></td>
</tr>
<tr>
<td>3.70m</td>
<td></td>
</tr>
<tr>
<td>3.60m</td>
<td></td>
</tr>
<tr>
<td>3.50m</td>
<td></td>
</tr>
<tr>
<td>3.40m</td>
<td></td>
</tr>
<tr>
<td>3.30m</td>
<td></td>
</tr>
<tr>
<td>3.20m</td>
<td></td>
</tr>
<tr>
<td>3.10m</td>
<td></td>
</tr>
<tr>
<td>3.00m</td>
<td></td>
</tr>
<tr>
<td>2.90m</td>
<td></td>
</tr>
<tr>
<td>2.80m</td>
<td></td>
</tr>
<tr>
<td>2.70m</td>
<td></td>
</tr>
<tr>
<td>2.60m</td>
<td></td>
</tr>
<tr>
<td>2.50m</td>
<td></td>
</tr>
<tr>
<td>2.40m</td>
<td></td>
</tr>
<tr>
<td>2.30m</td>
<td></td>
</tr>
<tr>
<td>2.20m</td>
<td></td>
</tr>
<tr>
<td>2.10m</td>
<td></td>
</tr>
<tr>
<td>2.00m</td>
<td></td>
</tr>
<tr>
<td>1.90m</td>
<td></td>
</tr>
<tr>
<td>1.80m</td>
<td></td>
</tr>
<tr>
<td>1.70m</td>
<td></td>
</tr>
<tr>
<td>1.60m</td>
<td></td>
</tr>
<tr>
<td>1.50m</td>
<td></td>
</tr>
<tr>
<td>1.40m</td>
<td></td>
</tr>
<tr>
<td>1.30m</td>
<td></td>
</tr>
<tr>
<td>1.20m</td>
<td></td>
</tr>
<tr>
<td>1.10m</td>
<td></td>
</tr>
<tr>
<td>1.00m</td>
<td></td>
</tr>
<tr>
<td>0.90m</td>
<td></td>
</tr>
<tr>
<td>0.80m</td>
<td></td>
</tr>
<tr>
<td>0.70m</td>
<td></td>
</tr>
<tr>
<td>0.60m</td>
<td></td>
</tr>
<tr>
<td>0.50m</td>
<td></td>
</tr>
<tr>
<td>0.40m</td>
<td></td>
</tr>
<tr>
<td>0.30m</td>
<td></td>
</tr>
<tr>
<td>0.20m</td>
<td></td>
</tr>
<tr>
<td>0.10m</td>
<td></td>
</tr>
</tbody>
</table>

**GROUNDBWATER SYMBOLS**

- = Water level (static)
= Water level (drilling)
= Water inflow
= Water outflow

**MOISTURE CONDITION**

- D = Dry
- M = Moist
- W = Wet

**REACTION RATE - PEROXIDE**

- L = slight effervescence
- M = moderate reaction
- H = vigorous reaction
- X = volcanic, very vigorous reaction

**DENSITY (N-value)**

- VL = Very Loose
- L = Loose
- MD = Medium Dense
- D = Dense
- VD = Very Dense

**CONSISTENCY (Su) (N-value)**

- VS = Very Soft
- S = Soft
- F = Firm
- St = Stiff
- VH = Very Hard

**MATERIAL DESCRIPTION**

(SOIL NAME: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations)

- SPT: Standard Penetration Test
- U50: Unit Weight Test
- NMLC: Numerical Model Laboratory Coring
**SOIL LOG**  
**HOLE NO:** BH07  
**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**SURFACE ELEVATION:** 3.53 m (AHD)  
**POSITION:** E: 340714, N: 6044178 (MGA94)  
**SURFACE CONDITIONS:** Topsoil/Grass  
**LOCATION:** Meningie - Alignment 2  
**RIG TYPE:** MK5 Investigator  
**CONTRACTOR:** Drilling Solutions  
**DATE DRILLED:** 22/9/13 to 22/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**STANDARD:** AS 1726-1993

### FIELD DATA

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.45</td>
<td>Gravely SAND (SW); fine to medium grained subangular to subrounded sand, pale brown, fine to medium grained subrounded gravel, with silt, calcareous</td>
</tr>
<tr>
<td>19.00</td>
<td>SAND (SP); fine to medium grained subangular to subrounded sand, pale brown mottled dark brown, trace fine to medium grained subrounded gravel, calcareous</td>
</tr>
<tr>
<td>18.50</td>
<td>As above, brown</td>
</tr>
<tr>
<td>18.00</td>
<td>As above, brown mottled grey</td>
</tr>
<tr>
<td>17.50</td>
<td>As above, brown mottled yellow</td>
</tr>
<tr>
<td>17.00</td>
<td>As above, with shell fragments (up to 6mm)</td>
</tr>
<tr>
<td>16.50</td>
<td>SAND (SW); fine to medium grained subangular to subrounded sand, brown-yellow, with fine grained subrounded gravel, with shell fragments up to 2mm, calcareous</td>
</tr>
<tr>
<td>16.00</td>
<td>19.00: SPT Recovery: 0.35 m</td>
</tr>
</tbody>
</table>

### MATERIAL DESCRIPTION

(Classification Symbol) SOIL NAME: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations

- As above, brown
- As above, brown mottled grey
- As above, brown mottled yellow
- As above, with shell fragments (up to 6mm)

### DENSITY (N-value)

- VL Very Loose 0 - 4
- L Loose 4 - 10
- MD Medium Dense 10 - 30
- D Dense 30 - 50
- VD Very Dense 50 - 100

### CONSISTENCY (Soil) (N-value)

- VS Very Soft < 12 kPa (0-2)
- S Soft 12 - 25 (2-4)
- F Firm 25 - 50 (4-8)
- St Stiff 50 - 100 (8-15)
- VSt Very Stiff 100 - 200 (15-30)
- H Hard > 200 kPa (>30)

### GROUNDWATER SYMBOLS

- Water level (static)
- Water level (during drilling)
- Water inflow
- Water outflow
**SOIL LOG**

**HOLE NO:** BH07  
**PAGE:** 5 OF 5

**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**SURFACE ELEVATION:** 3.53 m (AHD)  
**POSITION:** E: 340714, N: 6044178 (MGA94)  
**SURFACE CONDITIONS:** Topsoil/Grass  
**LOCATION:** Meningie - Alignment 2

**RIG TYPE:** MK5 Investigator  
**CONTRACTOR:** Drilling Solutions  
**DATE DRILLED:** 22/9/13 to 22/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**STANDARD:** AS 1726-1993

**MATERIAL DESCRIPTION**  
(Classification Symbol) SOIL NAME: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations

**COMMENTS**  
Field Test Data & Other Observations

<table>
<thead>
<tr>
<th><strong>DEPTH (m)</strong></th>
<th><strong>GRAPHIC LOG</strong></th>
<th><strong>FIELD DATA</strong></th>
<th><strong>SAMPLES &amp; FIELD TESTS</strong></th>
<th><strong>MATERIAL DESCRIPTION</strong></th>
<th><strong>DENSITY (N-value)</strong></th>
<th><strong>CONSISTENCY (Su) (N-value)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>22.00</td>
<td></td>
<td></td>
<td></td>
<td>As above, with increase in gravel content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.00</td>
<td></td>
<td></td>
<td></td>
<td>As above, with decrease in gravel content</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**GROUNDWATER SYMBOLS**

- Water level (static)  
- Water level (during drilling)  
- Water inflow  
- Water outflow

---

**MOISTURE CONDITION**

- Very Loose (VL)  
- Very Soft (VS)  
- Soft (S)  
- Fir (F)  
- Firm (St)  
- Very Hard (H)

**REACTION RATE**

- Peroxide (L)
- Moderate reaction (M)
- Vigorous reaction (H)
- Volcanic, very vigorous reaction (X)

---

**DENSITY (N-value)**

- < 12 kPa  
- 12 - 25 kPa  
- 25 - 50 kPa  
- 50 - 100 kPa  
- > 100 kPa

---

**CONSISTENCY (Su) (N-value)**

- Very Loose (VL)  
- Very Soft (VS)  
- Soft (S)  
- Firm (F)  
- Firm (St)  
- Very Hard (H)

---

**FIELD DATA**

- Sand (SW): fine to medium grained subangular to subrounded sand, brown-yellow, with fine grained subrounded gravel, with shell fragments up to 2mm, calcareous (continued)

---

**SPT SPT Sample**

- SPT Blows per 300mm

---

**SPT Recovery:** 0.18 m

---

**SPT Recovery:** 0.36 m

---

**HH at 27 m bgl**
### MATERIAL DESCRIPTION

(Classification Symbol) **SOIL NAME:** Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations

#### FIELD TESTS

**DENSITY (N-value)**

- VL Very Loose 0 - 4
- VS Very Soft < 12 kPa (0-2)
- L Loose 4 - 10
- S Soft 12 - 25 (2-4)
- MD Medium Dense 10 - 30
- F Firm 25 - 50 (4-8)
- D Dense 30 - 50
- St Stiff 50 - 100 (8-15)
- VD Very Dense 50 - 100 (15-30)
- VH Very Stiff 100 - 200 (30-50)
- H Hard > 200 kPa (>30)

**CONSISTENCY (Su) (N-value)**

<table>
<thead>
<tr>
<th>Classification</th>
<th>VL Very Loose</th>
<th>VS Very Soft</th>
<th>L Loose</th>
<th>S Soft</th>
<th>MD Medium Dense</th>
<th>F Firm</th>
<th>D Dense</th>
<th>St Stiff</th>
<th>VD Very Dense</th>
<th>VH Very Stiff</th>
<th>H Hard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasticity</td>
<td>0 - 4</td>
<td>&lt; 12 kPa</td>
<td>4 - 10</td>
<td>12 - 25</td>
<td>10 - 30</td>
<td>25 - 50</td>
<td>30 - 50</td>
<td>50 - 100</td>
<td>50 - 200</td>
<td>100 - 200</td>
<td>&gt; 200 kPa</td>
</tr>
</tbody>
</table>

**REACTION RATE - PEROXIDE**

- L slight effervescence
- M moderate reaction
- H vigorous reaction
- X volcanic, very vigorous reaction

### COMMENTS

Field Test Data & Other Observations

---

**Topsoil, SAND (SW):** fine to medium grained sand, dark brown mottled white, with fine grained subrounded gravel, trace organic matter (root fibres), organic odour

**SAND (SP):** fine to medium grained subangular to subrounded sand, white-yellow mottled orange/yellow, calcareous

As above, with fine grained subrounded gravel

As above, pale brown

As above, yellow-brown

As above, white-yellow

As above, weakly cemented

As above, yellow-brown mottled white

---

## SOIL LOG

<table>
<thead>
<tr>
<th>HOLE NO: BH08</th>
<th>PAGE: 1 OF 3</th>
</tr>
</thead>
</table>

**PROJECT:** Geotechnical & ASS Inv., Lake Albert

**SOIL LOG**

**LOGGED BY:** AL

**DATE DRILLED:** 23/9/13 to 23/9/13

**SAMPLING & FIELD TESTS**

**FIELD DATA**

<table>
<thead>
<tr>
<th>FIELD DATA</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Topsoil, SAND (SW); fine to medium grained sand, dark brown mottled white, with fine grained subrounded gravel, trace organic matter (root fibres), organic odour</td>
</tr>
<tr>
<td></td>
<td>SAND (SP); fine to medium grained subangular to subrounded sand, white-yellow mottled orange/yellow, calcareous</td>
</tr>
<tr>
<td></td>
<td>As above, with fine grained subrounded gravel</td>
</tr>
<tr>
<td></td>
<td>As above, pale brown</td>
</tr>
<tr>
<td></td>
<td>As above, yellow-brown</td>
</tr>
<tr>
<td></td>
<td>As above, white-yellow</td>
</tr>
<tr>
<td></td>
<td>As above, weakly cemented</td>
</tr>
<tr>
<td></td>
<td>As above, yellow-brown mottled white</td>
</tr>
</tbody>
</table>

**GROUNDWATER SYMBOLS**

- Water level (static)
- Water level (draining)
- Water inflow
- Water outflow

---

**RIG TYPE:** MK5 Investigator

**PROJECT:** Geotechnical & ASS Inv., Lake Albert

**POSITION:** E: 341362, N: 6044560 (MGA94)

**SURFACE ELEVATION:** 7.29 m (AHD)

**SURFACE CONDITIONS:** Topsoil/Grass

**LOCATION:** Meningie - Alignment 2

**FILE:** VE23811.1 BH08 Page 1 OF 3
SOIL LOG

HOLE NO: BH08

PROJECT: Geotechnical & ASS Inv., Lake Albert
SURFACE ELEVATION: 7.29 m (AHD)
POSITION: E: 341362, N: 6044560 (MGA94)
SURFACE CONDITIONS: Topsoil/Grass
LOCATION: Meningie - Alignment 2

RIG TYPE: MKS Investigator
CONTRACTOR: Drilling Solutions
DATE DRILLED: 23/9/13 to 23/9/13
LOGGED BY: AL
CHECKED BY: IC
STANDARD: AS 1726-1993

FILE No: VE23811.1 BH08

DIP / AZIMUTH: 90°

DRILLING & DETAIL

SAMPLES & FIELD TESTS

FIELD DATA

MATERIAL DESCRIPTION

(Classification Symbol) SOIL NAME: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations

COMMENTS

Field Test Data & Other Observations

GROUNDWATER SYMBOLS

D = Dry M = Moist W = Wet
VL = Very Loose 0 - 4
L = Loose 4 - 10
U = USO Sample
MOISTURE CONDITION
W = Water Sample
L = slight effervescence
M = Medium reaction
H = vigorous reaction
X = volcanic, very vigorous reaction

As above, with increased sand size of fine to medium grained

As above, white-yellow

As above, white-yellow

As above, with increased sand size of fine to medium grained

As above, white-yellow

HOLE NO: BH08

SAMPLES & FIELD TESTS

D = Disturbed Sample
B = Bulk Sample
ES = Envi Soil Sample
EW = Envi Water Sample
PP = Penetrometer
SV = Vane Shear
P = Peak Su R = Residual Su
N = N-value
SPT SPT Sample

MOISTURE CONDITION

D = Dry M = Moist W = Wet

REACTION RATE - PEROXIDE

L = slight effervescence
M = Medium reaction
H = vigorous reaction
X = volcanic, very vigorous reaction

CONSISTENCY (Su) (N-value)

Very Soft < 12 kPa [0-2]
Soft 12 - 25 [2-4]
Firm 25 - 50 [4-8]
Stiff 50 - 100 [8-15]
Very Stiff 100 - 200 [15-30]
Hard > 200 kPa (>30)

DENSITY (N-value)

VL Very Loose 0 - 4
L Loose 4 - 10
U USO Sample
W Water Sample

Hole Penetrometer

Hand Vane Shear

Peak Su R Residual Su

SPT blows per 300mm
### SOIL LOG

**HOLE NO:** BH08  
**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**SURFACE ELEVATION:** 7.29 m (AHD)  
**POSITION:** E: 341362, N: 6044560 (MGA94)  
**SURFACE CONDITIONS:** Topsoil/Grass  
**LOCATION:** Meningie - Alignment 2  
**RIG TYPE:** MK5 Investigator  
**CONTRACTOR:** Drilling Solutions  
**DATE DRILLED:** 23/9/13 to 23/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**STANDARD:** AS 1726-1993

<table>
<thead>
<tr>
<th>MATERIAL DESCRIPTION</th>
<th>DENSITY (N-value)</th>
<th>CONSISTENCY (Su) (N-value)</th>
</tr>
</thead>
</table>
| SAND (SFP): fine grained sand, brown-yellow, calcareous (continued)  
As above, with decreased sand size to fine grained, pale brown-yellow  
As above, white-yellow  
As above, with increase sand size of fine to medium grained, pale brown-yellow  
As above, pale brown-yellow mottled white  
EDH at 14 m bgl  
11.50: SPT Recovery: 0 m  
13.00: SPT Recovery: 0.26 m |  |  |

**GROUNDWATER SYMBOLS**  
- **=** Water level (static)  
- **=** Water level (during drilling)  
- **=** Water inflow  
- **=** Water outflow

**SAMPLES & FIELD TESTS**

<table>
<thead>
<tr>
<th>MATERIAL DESCRIPTION</th>
<th>DENSITY (N-value)</th>
<th>CONSISTENCY (Su) (N-value)</th>
</tr>
</thead>
</table>
| SAND (SFP): fine grained sand, brown-yellow, calcareous (continued)  
As above, with decreased sand size to fine grained, pale brown-yellow  
As above, white-yellow  
As above, with increase sand size of fine to medium grained, pale brown-yellow  
As above, pale brown-yellow mottled white  
EDH at 14 m bgl  
11.50: SPT Recovery: 0 m  
13.00: SPT Recovery: 0.26 m |  |  |

**MOISTURE CONDITION**

- **L** = Dry  
- **M** = Moist  
- **W** = Wet

**REACTION RATE - PEROXIDE**

- **L** = slight effervescence  
- **M** = moderate reaction  
- **H** = vigorous reaction  
- **X** = volcanic, very vigorous reaction

**DENSITY (N-value)**

- **VL** = Very Loose  
- **L** = Loose  
- **MD** = Medium Dense  
- **D** = Dense  
- **VD** = Very Dense

**CONSISTENCY (Su) (N-value)**

- **VS** = Very Soft  
- **S** = Soft  
- **F** = Firm  
- **D** = Dense  
- **St** = Stiff  
- **VSt** = Very Stiff  
- **H** = Hard
Appendix C
Engineering Logs – Alignment 3
**SOIL LOG**

**HOLE NO:** BH10  
**PAGE:** 1 OF 3

**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**SURFACE ELEVATION:** 8.09 m (AHD)  
**SURFACE CONDITIONS:** Topsoil/Grass  
**LOCATION:** Meningie - Alignment 3

**RIG TYPE:** MK5 Investigator  
**CONTRACTOR:** Drilling Solutions  
**DATE DRILLED:** 17/9/13 to 17/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**STANDARD:** AS 1726-1993

**MATERIAL DESCRIPTION**
(Classification Symbol) SOIL NAME: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations

<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>FIELD DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>1.47</td>
<td></td>
</tr>
<tr>
<td>2.95</td>
<td></td>
</tr>
<tr>
<td>4.45</td>
<td></td>
</tr>
</tbody>
</table>

**COMMENTS**
Field Test Data & Other Observations

**DRILLING**

- HA Hand Auger  
- HQ HQ Coring  
- NMLC NMLC Coring

**GROUNDWATER SYMBOLS**

- Water level (static)  
- Water level (during drilling)  
- Water inflow  
- Water outflow

**SAMPLES & FIELD TESTS**

- D Disturbed Sample  
- SPT SPT Sample  
- B Bulk Sample  
- U USO Sample  
- ES Env Soil Sample  
- W Water Sample  
- PP Hand Penetrometer  
- MOF SPT Sample  
- D D = Dry  
- P Peak Su R Residual Su  
- REACTION RATE - PEROXIDE  
- L slight effervescence  
- M moderate reaction  
- H vigorous reaction  
- X volcanic, very vigorous reaction

**DENSITY (N-value)**

- VL Very Loose 0 - 4  
- L Loose 4 - 10  
- M Medium Dense 10 - 30  
- D Dense 30 - 50  
- VD Very Dense 50 - 100

**CONSISTENCY (Soil N-value)**

- VS Very Soft < 12 kPa (0-2)  
- S Soft 12 - 25 (2-4)  
- F Firm 25 - 50 (4-8)  
- St Sift 50 - 100 (8-15)  
- VS Very Sift 100 - 200 (15-30)  
- H Hard > 200 kPa (>30)
**SOIL LOG**

**HOLE NO:** VE23811.1  
**PAGE:** 2 OF 3

**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**SURFACE ELEVATION:** 8.09 m (AHD)  
**JOB NO:** VE23811.1

**POSITION:** E: 338224, N: 6046273 (MGA94)  
**SURFACE CONDITIONS:** Topsoil/Grass  
**LOCATION:** Meningie - Alignment 3

**RIG TYPE:** MK5 Investigator  
**CONTRACTOR:** Drilling Solutions  
**DATE DRILLED:** 17/9/13 to 17/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**STANDARD:** AS 1726-1993

---

**FIELD DATA**

<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>SOIL NAME: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.00</td>
<td>SAND (SW); fine to coarse grained subangular to subrounded sand, white, with shell fragments up to 12 mm, trace fine to medium grained subangular gravel, calcareous (continued)</td>
</tr>
<tr>
<td>7.00</td>
<td>As above, with increased number of shell fragments, cemented</td>
</tr>
<tr>
<td>9.00</td>
<td>Sandy GRAVEL (SW); shell fragments up to 15 mm, mottled white/yellow, with fine to coarse grained subangular to subrounded sand, calcareous</td>
</tr>
<tr>
<td>10.00</td>
<td>Gravelly SAND (SW); fine to coarse grained subangular to subrounded sand, yellow-white, fine grained subangular to subrounded gravel, with shell fragments up to 15 mm, calcareous</td>
</tr>
<tr>
<td>12.00</td>
<td>SAND (SW); fine to coarse grained subangular to subrounded sand, yellow-brown, with fine grained subrounded gravel, with silt, calcareous</td>
</tr>
</tbody>
</table>

**COMMENTS**

- **5.50:** SPT Recovery: 0.39 m
- **7.00:** SPT Recovery: 0.1 m
- **8.00:** Groundwater encountered
- **8.50:** SPT Recovery: 0.12 m
- **10.00:** SPT Recovery: 0 m

---

**DENSITY (N-value)**

- **0 - 4:** Very Loose
- **4 - 10:** Loose
- **10 - 30:** Medium Dense
- **30 - 50:** Dense
- **50 - 100:** Very Dense

**CONSISTENCY (Soil) (N-value)**

- **< 12 kPa:** Very Soft
- **12 - 25:** Soft
- **25 - 50:** Firm
- **50 - 100:** Hard
- **> 200 kPa:** Very Hard

---

**GROUNDWATER SYMBOLS**

- **↓** = Water level (static)
- **W** = Water level (during drilling)
- **→** = Water inflow
- **←** = Water outflow

---

**FILE:** VE23811.1 BH10  
**PAGE:** 2 OF 3
### MATERIAL DESCRIPTION

(Classification Symbol) SOIL NAME: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations

<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>FACIES</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.50</td>
<td>SPT</td>
<td>SAND (SV); fine to coarse grained subangular to subrounded sand, yellow-brown, with fine grained subrounded gravel, with silt, calcareous (continued)</td>
</tr>
<tr>
<td>13.00</td>
<td>SPT</td>
<td>SAND (SP); fine to medium grained subangular to subrounded sand, yellow-brown, trace shell fragments up to 2mm, calcareous</td>
</tr>
<tr>
<td>14.50</td>
<td>SPT</td>
<td>SAND (SV); fine to coarse grained subangular to subrounded sand, yellow-brown, with fine grained subrounded gravel, with silt, calcareous</td>
</tr>
<tr>
<td>14.50</td>
<td>SPT</td>
<td>SAND (SP); fine grained sand, yellow-brown, with silt, calcareous</td>
</tr>
</tbody>
</table>

**COMMENTS**

Field Test Data & Other Observations

- 11.50: SPT Recovery: 0.2 m
- 13.00: SPT Recovery: 0.41 m
- 14.50: SPT Recovery: 0.44 m

**DENSITY (N-value)**

<table>
<thead>
<tr>
<th>CONSISTENCY (Su) (N-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Soft</td>
</tr>
<tr>
<td>Soft</td>
</tr>
<tr>
<td>Firm</td>
</tr>
<tr>
<td>Very Firm</td>
</tr>
<tr>
<td>Hard</td>
</tr>
</tbody>
</table>

**MOISTURE CONDITION**

- Very Loose: 0 - 4
- Loose: 4 - 10
- Medium Dense: 10 - 30
- Dense: 30 - 50
- Very Dense: 50 - 100

**REACTION RATE - PEROXIDE**

- slight effervescence
- moderate reaction
- vigorous reaction
- volcanic, very vigorous reaction

**GROUNDWATER SYMBOLS**

- V: Water level (static)
- W: Water level (during drilling)
- N: Water inflow
- E: Water outflow
**SOIL LOG**

**HOLE NO:** BH11  
**JOB NO:** VE23811.1

**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**SURFACE ELEVATION:** 14.52 m (AHD)

**POSITION:** E: 339009, N: 6046552 (MGA94)  
**SURFACE CONDITIONS:** Topsoil/Grass

**LOCATION:** Meningie - Alignment 3

**RIG TYPE:** MK5 Investigator  
**CONTRACTOR:** Drilling Solutions

**DATE DRILLED:** 17/9/13 to 17/9/13  
**LOGGED BY:** AL

**CHECKED BY:** IC  
**STANDARD:** AS 1726-1993

---

**FIELD DATA**

<table>
<thead>
<tr>
<th>FIELD DATA</th>
<th>SAMPLES &amp; FIELD TESTS</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Topsoil, Silty SAND (SM); fine to medium grained sand, dark brown, trace organic matter (root fibres), organic odour.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gravelly SAND (SW); fine to coarse grained subangular to subrounded sand, white-yellow with brown mottles, trace fine grained subrounded gravel, with silt, calcareous.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>As above, with increase in gravel content, cemented</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SAND (SP); fine to medium grained subangular to subrounded sand, mottled white/brown/yellow, trace fine grained subrounded gravel, trace silt, calcareous.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>As above, white-yellow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SAND (SW); fine to coarse grained subangular to subrounded sand, brown-yellow, trace subrounded fine gravel, calcareous.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>As above, white-yellow</td>
</tr>
</tbody>
</table>

**GROUNDWATER SYMBOLS**

- = Water level (static)  
= Water level (during drilling)  
= Water inflow  
= Water outflow

---

**SAMPLES & FIELD TESTS**

- **D:** Disturbed Sample  
- **B:** Bulk Sample  
- **ES:** Env Soil Sample  
- **EW:** Env Water Sample  
- **PP:** Hand Penetrometer  
- **SV:** Hand Vane Shear  
- **N:** SPT blows per 300mm

**MOISTURE CONDITION**

- **D:** Dry  
- **M:** Moist  
- **W:** Wet

**REACTION RATE - PEROXIDE**

- **L:** slight effervescence  
- **M:** moderate reaction  
- **H:** vigorous reaction  
- **X:** volcanic, very vigorous reaction

---

**DENSITY (N-value)**

- **VL:** Very Loose 0 - 4  
- **L:** Loose 4 - 10  
- **MD:** Medium Dense 10 - 30  
- **D:** Dense 30 - 50  
- **VD:** Very Dense 50 - 100

**CONSISTENCY (Su) (N-value)**

- **VS:** Very Soft < 12 kPa (0-2)  
- **S:** Soft 12 - 25 (2-4)  
- **F:** Firm 25 - 50 (4-8)  
- **St:** Stiff 50 - 100 (8-15)  
- **VSt:** Very Stiff 100 - 200 (15-30)  
- **H:** Hard > 200 kPa (>30)

---

**DATE DRILLED:** 17/9/13 to 17/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC

---

**FIELD DATA**

- **D:** Disturbed Sample  
- **B:** Bulk Sample  
- **ES:** Env Soil Sample  
- **EW:** Env Water Sample  
- **HA:** Hand Auger  
- **HQ:** HQ Coring  
- **WB:** Washbore  
- **PQ:** PQ Coring  
- **AH:** Air Hammer  
- **HAD:** Hollow Auger Drilling

**SPT SPT Sample**  
**U50:** 
**W:** Water Sample

---

**DRILLING**

- **HA:** Hand Auger  
- **HQ:** HQ Coring  
- **WB:** Washbore  
- **PQ:** PQ Coring  
- **AH:** Air Hammer

**GEOLOGY**

- **SOIL NAME:** Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations

---

**COMMENTS**

Field Test Data & Other Observations

---

**REMARKS**

---

**DENSITY (N-value)**

- **VL:** Very Loose 0 - 4  
- **L:** Loose 4 - 10  
- **MD:** Medium Dense 10 - 30  
- **D:** Dense 30 - 50  
- **VD:** Very Dense 50 - 100

**CONSISTENCY (Su) (N-value)**

- **VS:** Very Soft < 12 kPa (0-2)  
- **S:** Soft 12 - 25 (2-4)  
- **F:** Firm 25 - 50 (4-8)  
- **St:** Stiff 50 - 100 (8-15)  
- **VSt:** Very Stiff 100 - 200 (15-30)  
- **H:** Hard > 200 kPa (>30)

---

**GROUNDWATER SYMBOLS**

- = Water level (static)  
= Water level (during drilling)  
= Water inflow  
= Water outflow

---

**FIELD DATA**

- **D:** Disturbed Sample  
- **B:** Bulk Sample  
- **ES:** Env Soil Sample  
- **EW:** Env Water Sample  
- **PP:** Hand Penetrometer  
- **SV:** Hand Vane Shear  
- **N:** SPT blows per 300mm

---

**DENSITY (N-value)**

- **VL:** Very Loose 0 - 4  
- **L:** Loose 4 - 10  
- **MD:** Medium Dense 10 - 30  
- **D:** Dense 30 - 50  
- **VD:** Very Dense 50 - 100

**CONSISTENCY (Su) (N-value)**

- **VS:** Very Soft < 12 kPa (0-2)  
- **S:** Soft 12 - 25 (2-4)  
- **F:** Firm 25 - 50 (4-8)  
- **St:** Stiff 50 - 100 (8-15)  
- **VSt:** Very Stiff 100 - 200 (15-30)  
- **H:** Hard > 200 kPa (>30)

---

**GROUNDWATER SYMBOLS**

- = Water level (static)  
= Water level (during drilling)  
= Water inflow  
= Water outflow

---

**FIELD DATA**

- **D:** Disturbed Sample  
- **B:** Bulk Sample  
- **ES:** Env Soil Sample  
- **EW:** Env Water Sample  
- **PP:** Hand Penetrometer  
- **SV:** Hand Vane Shear  
- **N:** SPT blows per 300mm

---

**DENSITY (N-value)**

- **VL:** Very Loose 0 - 4  
- **L:** Loose 4 - 10  
- **MD:** Medium Dense 10 - 30  
- **D:** Dense 30 - 50  
- **VD:** Very Dense 50 - 100

**CONSISTENCY (Su) (N-value)**

- **VS:** Very Soft < 12 kPa (0-2)  
- **S:** Soft 12 - 25 (2-4)  
- **F:** Firm 25 - 50 (4-8)  
- **St:** Stiff 50 - 100 (8-15)  
- **VSt:** Very Stiff 100 - 200 (15-30)  
- **H:** Hard > 200 kPa (>30)

---

**GROUNDWATER SYMBOLS**

- = Water level (static)  
= Water level (during drilling)  
= Water inflow  
= Water outflow

---

**FIELD DATA**

- **D:** Disturbed Sample  
- **B:** Bulk Sample  
- **ES:** Env Soil Sample  
- **EW:** Env Water Sample  
- **PP:** Hand Penetrometer  
- **SV:** Hand Vane Shear  
- **N:** SPT blows per 300mm

---

**DENSITY (N-value)**

- **VL:** Very Loose 0 - 4  
- **L:** Loose 4 - 10  
- **MD:** Medium Dense 10 - 30  
- **D:** Dense 30 - 50  
- **VD:** Very Dense 50 - 100

**CONSISTENCY (Su) (N-value)**

- **VS:** Very Soft < 12 kPa (0-2)  
- **S:** Soft 12 - 25 (2-4)  
- **F:** Firm 25 - 50 (4-8)  
- **St:** Stiff 50 - 100 (8-15)  
- **VSt:** Very Stiff 100 - 200 (15-30)  
- **H:** Hard > 200 kPa (>30)
<table>
<thead>
<tr>
<th>HOLE NO.: BH11</th>
<th>SOIL LOG</th>
<th>JOB NO.: VE23811.1</th>
</tr>
</thead>
</table>

### Date Drilled:
- 17/9/13 to 17/9/13

### Location:
- Meningie - Alignment 3

### Surface Elevation:
- 14.52 m (AHD)

### Surface Conditions:
- Topsoil/Grass

### Surface Elevations:
- Topsoil/Grass

### Rig Type:
- MK5 Investigator

### Project:
- Geotechnical & ASS Inv., Lake Albert

### Contractor:
- Drilling Solutions

### Standard:
- AS 1726-1993

### Groundwater Symbols:
- Water level (static)
- Water inflow
- Water outflow

### Drilling Detail:
- Hand Auger
- Hollow Auger Drilling
- Washbore
- Rock Rolling
- Air Hammer

### Field Data:
- Field Test Data
- Other Observations

### Samples & Field Tests:
- Disturbed Sample
- Bulk Sample
- Envi Soil Sample
- Envi Water Sample
- MOISTURE CONDITION
- D = Dry
- M = Moist
- W = Wet
- REACTION RATE - PEROXIDE
- L = slight effervescence
- M = moderate reaction
- H = vigorous reaction
- X = volcanic, very vigorous reaction

### Density (N-value):
- VL: Very Loose
- L: Loose
- MD: Medium Dense
- D: Dense
- VO: Very Dense

### Consistency (Soil) (N-value):
- VS: Very Soft
- S: Soft
- F: Firm
- St: Stiff
- VSt: Very Stiff
- H: Hard

### Comments:
- Field Test Data
- Other Observations

### GRAPHIC LOG:
- SAND (SP): fine to medium grained subangular to subrounded sand, brown-yellow, trace subrounded fine gravel, calcareous

### MOISTURE CONDITIONS:
- Moisture Content

### REACTION RATE - PEROXIDE:
- Reaction Rate

### MOISTURE CONDITION:
- Moisture Condition

### DENSITY (N-value):
- N-value

### CONSISTENCY (Soil) (N-value):
- Soil Consistency

### Field Data:
- 7.00: SPT Recovery: 0.38 m
- 8.50: SPT Recovery: 0.37 m
- 10.00: SPT Recovery: 0.38 m
- 11.00: Groundwater not encountered
### SOIL LOG

#### MATERIAL DESCRIPTION

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.81</td>
<td>Silty SAND (SM); fine to medium grained subangular to subrounded sand, dark brown, organic odour</td>
</tr>
<tr>
<td>8.00</td>
<td>As above, pale brown mottled white</td>
</tr>
<tr>
<td>8.26</td>
<td>As above, red-brown</td>
</tr>
<tr>
<td>8.53</td>
<td>As above, yellow-brown</td>
</tr>
<tr>
<td>8.79</td>
<td>Sandy CLAY (CL); low plasticity clay, mottled white/grey, fine to medium grained subangular to subrounded sand, calcareous</td>
</tr>
<tr>
<td>8.81</td>
<td>Claysy SAND (SC); fine to medium grained subangular to subrounded sand, grey, medium plasticity clay, calcareous</td>
</tr>
</tbody>
</table>

#### COMMENTS

- Field Test Data
- Other Observations

---

**GROUNDWATER SYMBOLS**

- = Water level (static)
- = Water level (during drilling)
- = Water inflow
- = Water outflow

---

**SAMPLES & FIELD TESTS**

- D - Disturbed Sample
- B - Bulk Sample
- ES - Env Soil Sample
- EW - Env Water Sample
- PP - Hand Penetrometer
- SV - Hand Vane Shear
- N - SPT blows per 300mm

**DENSITY (N-value)**

<table>
<thead>
<tr>
<th>Density</th>
<th>Reaction Rate - Peroxide</th>
<th>Consistency (Soil) (N-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VS Very Soft</td>
<td>0 - 4</td>
<td>&lt; 12 kPa (0-2)</td>
</tr>
<tr>
<td>L Loose</td>
<td>4 - 10</td>
<td>12 - 25 (2-4)</td>
</tr>
<tr>
<td>MD Medium Dense</td>
<td>10 - 30</td>
<td>F Firm 25 - 50 (4-8)</td>
</tr>
<tr>
<td>D Dense</td>
<td>30 - 50</td>
<td>St Stiff 50 - 100 (8-15)</td>
</tr>
<tr>
<td>VD Very Dense</td>
<td>50 - 100</td>
<td>VS Stiff 100 - 200 (15-30)</td>
</tr>
<tr>
<td>H Hard</td>
<td>&gt; 200 kPa (&gt;30)</td>
<td></td>
</tr>
</tbody>
</table>
### SOIL LOG

**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**SURFACE ELEVATION:** 13.00 m (AHD)  
**POSITION:** E: 339702, N: 6047158 (MGA94)  
**SURFACE CONDITIONS:** Topsoil/Grass  
**LOCATION:** Meningie - Alignment 3

**RIG TYPE:** MK5 Investigator  
**CONTRACTOR:** Drilling Solutions  
**DIP / AZIMUTH:** 90°  
**DATE DRILLED:** 18/9/13 to 18/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**STANDARD:** AS 1726-1993

#### MATERIAL DESCRIPTION

(Classification Symbol) **SOIL NAME:** Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations

<table>
<thead>
<tr>
<th>N-value</th>
<th>DENSITY</th>
<th>CONSISTENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Very Light</td>
<td>Very Soft</td>
</tr>
<tr>
<td>1 - 2</td>
<td>Light</td>
<td>Soft</td>
</tr>
<tr>
<td>3 - 5</td>
<td>Medium</td>
<td>Firm</td>
</tr>
<tr>
<td>6 - 9</td>
<td>Heavy</td>
<td>Stiff</td>
</tr>
<tr>
<td>10 - 20</td>
<td>Very Heavy</td>
<td>Very Stiff</td>
</tr>
<tr>
<td>&gt; 20</td>
<td>Hard</td>
<td>Hard</td>
</tr>
</tbody>
</table>

**GROUNDWATER SYMBOLS**

- **= Water level (static)**  
- **= Water level (during drilling)**  
- **= Water inflow**  
- **= Water outflow**

<table>
<thead>
<tr>
<th>SAMPLES &amp; FIELD TESTS</th>
<th>MOISTURE CONDITION</th>
<th>REACTION RATE - PEROXIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>D Disturbed Sample</td>
<td>SPT SPT Sample</td>
<td>L slight effervescence</td>
</tr>
<tr>
<td>B Bulk Sample</td>
<td>U USO Sample</td>
<td>M moderate reaction</td>
</tr>
<tr>
<td>ES Env Soil Sample</td>
<td>W Water Sample</td>
<td>H vigorous reaction</td>
</tr>
<tr>
<td>EW Env Water Sample</td>
<td>D= Dry M= Moist W= Wet</td>
<td>X volcanic, very vigorous reaction</td>
</tr>
</tbody>
</table>

**COMMENTS**

Field Test Data

---

- **SAND (SP):** Fine to medium grained subangular to subrounded sand, yellow-brown mottled orange, with silt, calcareous.
- **As above, pale brown**
- **As above, yellow-white**

---

**DRILLING & DETAIL**

- **pH:** pH
- **pHox:** pHox
- **Chopped:** Chopped
- **Drilled:** Drilled
- **Samples:** Samples
- **Field Data:** Field Data

**SPT:** Standard Penetration Test

**U50:** Unified Soil Classification System

**NMLC:** Normalized Linear Compressibility

**HA:** Hand Auger

**HQ:** HQ Coring

**HAD:** Hollow Auger Drilling

**PO:** PQ Coring

**NMLC:** NMLC Coring

**RR:** Rock Rolling

**AH:** Air Hammer

---

**LOGGED BY:** AL  
**CHECKED BY:** IC

**RIG TYPE:** MK5 Investigator  
**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**POSITION:** E: 339702, N: 6047158 (MGA94)  
**DATE DRILLED:** 18/9/13 to 18/9/13  
**LOGGED BY:** AL  
**STANDARD:** AS 1726-1993

---

**FILE:** VE23811.1 BH12  
**PAGE:** 2 OF 3

---

**GROUNDWATER SYMBOLS**

- **= Water level (static)**  
- **= Water level (during drilling)**  
- **= Water inflow**  
- **= Water outflow**
### SOIL LOG

**DATE DRILLED:** 18/9/13 to 18/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**STANDARD:** AS 1726-1993

<table>
<thead>
<tr>
<th>FIELD DATA</th>
<th>GRAPHIC LOG</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SAND (SP); fine to medium grained subangular to subrounded sand, yellow-brown mottled orange, with silt, calcareous (continued)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>As above, becoming fine to coarse grain sand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EOH at 14 m bgl</td>
</tr>
</tbody>
</table>

**GROUNDWATER SYMBOLS**

- `v` = Water level (static)
- `~` = Water level (during drilling)
- `>` = Water inflow
- `a` = Water outflow

**GROUNDWATER SYMBOLS**

- `P` = PP Hand Penetrometer
- `SV` = SV Hand Vane Shear
- `ES` = Env Soil Sample
- `EW` = Env Water Sample

**MOISTURE CONDITION**

- D = Dry
- M = Moist
- W = Wet

**REACTION RATE - PEROXIDE**

- L = slight effervescence
- M = moderate reaction
- H = vigorous reaction
- X = volcanic, very vigorous reaction

**CONSISTENCY (Su) (N-value)**

- VS = Very Soft
- S = Soft
- F = Firm
- St = Stiff
- VSt = Very Stiff
- H = Hard

**DENSITY (N-value)**

- VL = Very Loose
- L = Loose
- MD = Medium Dense
- D = Dense
- VD = Very Dense

**POLYCLAY**

- 0 - 4
- 4 - 10
- 10 - 30
- 30 - 50
- 50 - 100

**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**SURFACE ELEVATION:** 13.00 m (AHD)  
**SURFACE CONDITIONS:** Topsoil/Grass  
**LOCATION:** Meningie - Alignment 3  
**RIG TYPE:** MK5 Investigator  
**CONTRACTOR:** Drilling Solutions  
**DIP / AZIMUTH:** 90°  
**DATE DRILLED:** 18/9/13 to 18/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**STANDARD:** AS 1726-1993

**GROUNDWATER SYMBOLS**

- `= Water level (static)`
- `~` = Water level (during drilling)
- `>` = Water inflow
- `a` = Water outflow

**GROUNDWATER SYMBOLS**

- `P` = PP Hand Penetrometer
- `SV` = SV Hand Vane Shear
- `ES` = Env Soil Sample
- `EW` = Env Water Sample

**MOISTURE CONDITION**

- D = Dry
- M = Moist
- W = Wet

**REACTION RATE - PEROXIDE**

- L = slight effervescence
- M = moderate reaction
- H = vigorous reaction
- X = volcanic, very vigorous reaction

**CONSISTENCY (Su) (N-value)**

- VS = Very Soft
- S = Soft
- F = Firm
- St = Stiff
- VSt = Very Stiff
- H = Hard

**DENSITY (N-value)**

- VL = Very Loose
- L = Loose
- MD = Medium Dense
- D = Dense
- VD = Very Dense

**POLYCLAY**

- 0 - 4
- 4 - 10
- 10 - 30
- 30 - 50
- 50 - 100

**PROJECT:** Geotechnical & ASS Inv., Lake Albert  
**SURFACE ELEVATION:** 13.00 m (AHD)  
**SURFACE CONDITIONS:** Topsoil/Grass  
**LOCATION:** Meningie - Alignment 3  
**RIG TYPE:** MK5 Investigator  
**CONTRACTOR:** Drilling Solutions  
**DIP / AZIMUTH:** 90°  
**DATE DRILLED:** 18/9/13 to 18/9/13  
**LOGGED BY:** AL  
**CHECKED BY:** IC  
**STANDARD:** AS 1726-1993
SOIL LOG

PROJECT: Geotechnical & ASS Inv., Lake Albert
SURFACE ELEVATION: 4.00 m (AHD)

POSITION: E: 340143, N: 6047660 (MGA94)
SURFACE CONDITIONS: Topsoil/Grass

LOCATION: Meningie - Alignment 3

RIG TYPE: MKS Investigator
CONTRACTOR: Drilling Solutions

DATE DRILLED: 18/9/13 to 18/9/13
LOGGED BY: AL
CHECKED BY: IC

STANDARD: AS 1726-1993

FIELD DATA

FIELD DATA & MATERIAL DESCRIPTION

(Classification Symbol) SOIL NAME: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations

SAMPLES & FIELD TESTS

COMMENTS

Field Test Data & Other Observations

DRILLING & FIELD DETAIL

HA Hand Auger
HQ HQ Coring
WB Washbore
PO PQ Coring
AH Air Hammer

SAMPLES

D = Disturbed Sample
B = Bulk Sample
E = Env Soil Sample
W = Water Sample
PP = Hand Penetrometer
SV = Vane Shear
N = SPT blows per 300mm

CONSISTENCY (Soil) (N-value)

H = Hard
VH = Very Stiff
ST = Stiff
D = Dry
M = Moist
W = Wet

DENSITY (N-value)

VL = Very Loose
L = Loose
M = Medium Dense
D = Dense

REACTION RATE - PEROXIDE

L = slight effervescence
M = moderate reaction
V = vigorous reaction
X = volcanic, very vigorous reaction

GROUNDWATER SYMBOLS

= Water level (static)
= Water level (during drilling)
= Water inflow
= Water outflow

MOISTURE CONDITION

= Very Loose
= Loose
= Medium Dense
= Dense

D = Dry
M = Moist
W = Wet
### MATERIAL DESCRIPTION
(Classification Symbol) SOIL NAME: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations

<table>
<thead>
<tr>
<th>SOIL LOG</th>
<th>FIELD DATA</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SAND (SP): fine to medium grained subangular to subrounded sand, pale brown, with silt, calcareous (continued)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SAND (SW): fine to coarse grained subangular to subrounded sand, yellow-white, with silt, calcareous</td>
</tr>
</tbody>
</table>

### DENSITY (N-value) & CONSISTENCY (Su) (N-value)

- **Very Soft (VS)**: N-value < 2 kPa
- **Soft (S)**: 2 - 15 kPa
- **Firm (F)**: 15 - 50 kPa
- **Stiff (St)**: 50 - 100 kPa
- **Very Stiff (VSt)**: 100 - 200 kPa
- **Hard (H)**: > 200 kPa

### COMMENTS
Field Test Data & Other Observations

- **SPT Recovery**: 0 m
- **SPT Recovery**: 0.39 m
- **SPT Recovery**: 0.39 m
- **SPT Recovery**: 0.39 m

### FIELD DATA

- **Dip / Azimuth**: 90°
- **Location**: Meningie - Alignment 3
- **Surface Elevation**: 4.00 m (AHD)
- **Surface Conditions**: Topsoil/Grass

### DRILLING

- **Hand Auger**: HA
- **Hollow Auger**: HA
- **Rock Rolling**: RR
- **Air Hammer**: AH

### GROUNDWATER SYMBOLS

- **< 12 kPa**: Very Soft (VS)
- **12 - 25 kPa**: Soft (S)
- **25 - 50 kPa**: Firm (F)
- **50 - 100 kPa**: Stiff (St)
- **> 200 kPa**: Very Stiff (VSt)
- **> 1000 kPa**: Hard (H)

### SAMPLES & FIELD TESTS

- **Disturbed Sample**: D
- **Bulk Sample**: B
- **Env Soil Sample**: ES
- **Env Water Sample**: EW
- **Hand Penetrometer**: PP
- **Hand Vane Shear**: SV
- **Peak Su Residual Su**: (P)
- **SPT blows per 300mm**: N
- **SPT Sample**: SPT
- **USO Sample**: U
- **Water Sample**: W
- **MOISTURE CONDITION**: D = Dry, M = Moist, W = Wet
- **REACTION RATE - PEROXIDE**: L = slight, M = moderate, H = vigorous, X = very vigorous
- **REACTION RATE - CHLORIDE**: L = slight, M = moderate, H = vigorous, X = very vigorous

### COMMENTS

- 7.00 m: EOH at 11 m bgl
- 8.50 m: EOH at 11 m bgl

### SURFACE CONDITIONS

- Topsoil/Grass
### SOIL LOG

**HOLE NO:** BH14

**DRILLING**
- **RIG TYPE:** MK5 Investigator
- **PROJECT:** Geotechnical & ASS Inv., Lake Albert
- **CONTRACTOR:** Drilling Solutions
- **LOCATION:** Meningie - Alignment 3
- **DATE DRILLED:** 18/9/13 to 18/9/13
- **DIP / AZIMUTH:** 90°

**SAMPLES & FIELD TESTS**
- **SAMPLE TYPE:** Disturbed Sample, Bulk Sample, Env Soil Sample, Env Water Sample
- **SURFACE ELEVATION:** 1.58 m (AHD)
- **SURFACE CONDITIONS:** Topsoil/ Grass
- **DIP / AZIMUTH:** 90°

**MATERIAL DESCRIPTION**
- **SOIL NAME:** Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Structure, Additional Observations
- **DENSITY (N-value):**
  - VL Very Loose: 0 - 4
  - L Loose: 4 - 10
  - MD Medium Dense: 10 - 30
  - D Dense: 30 - 50
  - VD Very Dense: 50 - 100
- **CONSISTENCY (Su) (N-value):**
  - Very Soft: < 12 kPa
  - Soft: 12 - 25
  - Medium Plasticity: 25 - 50
  - Stiff: 50 - 100
  - Very Stiff: > 200 kPa

**GROUNDWATER SYMBOLS**
- = Water level (static)
- = Water level (during drilling)
- = Water inflow
- = Water outflow

### Comments
- 0.50: Groundwater encountered
- 10.0: Topsoil, Silty SAND (SM); fine to medium sand, dark brown, trace organic matter (root fibres), organic odour
- *M* = Medium plasticity clay, dark brown mottled white/orange, fine to medium grained subangular to subrounded sand, calcareous
- SP = SAND (SP); fine to medium grained subangular to subrounded sand, brown mottled grey, with silt, calcareous
- SM = Silty SAND (SM); fine to medium grained subangular to subrounded sand, grey-green, with pocket of mottled white/grey clay, calcareous

File: VE23811.1 BH14 Page 1 OF 2
SOIL LOG

<table>
<thead>
<tr>
<th>FIELD DATA</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.60</td>
<td>SAND (SP); fine to medium grained subangular to subrounded sand, grey with white/black flecks, with silt, calcareous (continued)</td>
</tr>
<tr>
<td>7.63</td>
<td>SAND (SP); fine to medium grained subangular to subrounded sand, grey with white/black flecks, with silt, calcareous</td>
</tr>
<tr>
<td>7.66</td>
<td>SAND (SP); fine to medium grained subangular to subrounded sand, grey with white/black flecks, with silt, calcareous</td>
</tr>
<tr>
<td>7.69</td>
<td>SAND (SP); fine to medium grained subangular to subrounded sand, grey with white/black flecks, with silt, calcareous</td>
</tr>
<tr>
<td>7.90</td>
<td>SAND (SP); fine to coarse grained subangular to subrounded sand, yellow-white, with silt, calcareous</td>
</tr>
</tbody>
</table>

RIG TYPE: MK5 Investigator
PROJECT: Geotechnical & ASS Inv., Lake Albert
SURFACE ELEVATION: 1.58 m (AHD)
LOCATION: Meningie - Alignment 3
DATE DRILLED: 18/9/13 to 18/9/13
LOGGED BY: AL
CHECKED BY: IC
STANDARD: AS 1726-1993

Sample & Field Tests:
- SPT SPT Sample
- U USO Sample
- W Water Sample
- MOISTURE CONDITION: D = Dry, M = Moist, W = Wet
- REACTION RATE - PEROXIDE: L = slight effervescence, M = moderate reaction, H = vigorous reaction, X = volcanic, very vigorous reaction
- DENSITY (N-value):
  - VL Very Loose 0-4
  - L Loose 4-10
  - MD Medium Dense 10-30
  - D Dense 30-50
  - VD Very Dense 50-100
- CONSISTENCY (Su) (N-value):
  - VSVery Soft < 12 kPa (0-2)
  - S Soft 12 - 25 (2-4)
  - F Firm 25 - 50 (4-8)
  - St Stiff 50 - 100 (8-15)
  - VSt Very Stiff 100 - 200 (15-30)
  - H Hard > 200 kPa (>30)

Groundwater Symbols:
- = Water level (static)
- = Water level (during drilling)
= Water inflow
= Water outflow

Drilling:
- HA Hand Auger
- HQ HQ Coring
- HAD Hollow Auger Drilling
- NO Coring
- WB Washbore
- PO PO Coring
- RR Rock Rolling
- NMLC NMLC Coring
- AH Air Hammer
- SPT Sample
- U50 Sample
- W Water Sample

Surface Elevation: 1.58 m (AHD)
Surface Conditions: Topsoil/Grass
Job No: VE23811.1
Contractor: Drilling Solutions
Logged By: AL
Standard: AS 1726-1993

Hole No: BH14
31 August 2021

COORONG INFRASTRUCTURE FEASIBILITY ASSESSMENT: LAKE ALBERT TO COORONG CONNECTOR
SEVEN MILE ROAD, MENINGIE, SA 5264

GEOTECHNICAL INVESTIGATION REPORT

Kellog Brown and Root
ADL2021-0001AD Rev0
Table of Contents

1 EXECUTIVE SUMMARY ................................................................................................ 1
2 INTRODUCTION ........................................................................................................... 1
3 PROJECT APPRECIATION .............................................................................................. 1
4 SITE DESCRIPTION ....................................................................................................... 2
5 FIELD INVESTIGATION ................................................................................................ 4
6 GROUND MODEL ......................................................................................................... 4
   6.1 Regional Geology ............................................................................................................. 4
   6.2 Subsurface Conditions ...................................................................................................... 5
   6.3 Groundwater ..................................................................................................................... 6
7 GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS .......................................... 6
   7.1 Earthworks and Excavation Conditions .............................................................................. 6
   7.2 Site Classification – AS2870 ............................................................................................. 7
   7.3 Geotechnical Model .......................................................................................................... 8
   7.4 Allowable Bearing Capacity ............................................................................................... 8
   7.5 Allowable Horizontal Bearing Capacity – Thrust Block ....................................................... 9
   7.6 Native Soil Modulus ........................................................................................................ 10
   7.7 Construction Issues ........................................................................................................ 10
      7.7.1 Trafficability ......................................................................................................................... 10
      7.7.2 Excavatability ....................................................................................................................... 10
      7.7.3 Site Drainage ....................................................................................................................... 10
      7.7.4 Excavation Stability ............................................................................................................ 11
8 FURTHER WORK ........................................................................................................ 11
9 CLOSURE .................................................................................................................... 11
10 REFERENCES .............................................................................................................. 12

Drawings
Drawing 1 – Site Investigation Plan

Appendices
Appendix A – Results of Field Investigation
1 EXECUTIVE SUMMARY
This report presents the results of the geotechnical and contamination site investigation carried out at Lake Albert – Coorong Connector alignment, at Seven Mile Road, Meningie, SA 5264. Key findings are summarised below.

- Uncontrolled fill was encountered generally at depths up to 0.3m but may extend up to 0.7 metres at the northern end of the alignment (corresponds to BH04);
- Site classification to AS2870-2011 for the site is Class A. However, due to the presence of Carbonate /Calcareous soil, BH01 and BH02 is classified as Class P.
- Pad foundations are considered to be a suitable, subject to recommendations provided herein.
- Groundwater was encountered at variable depth below ground level during the site investigation. Depth of Groundwater varies depending on the terrain and seasonal variation.

Contamination, PASS and ASS results are pending and will be reported separately.

2 INTRODUCTION
CMW Geosciences (CMW) was authorised by KBR to carry out a geotechnical investigation for the proposed infrastructure development options at the Lake Albert - Coorong Connector at Meningie, SA 5264.

The scope of work undertaken was generally consistent with our proposal letter referenced ADL2020-0001AA, Rev1 dated 30 July 2021.

The purpose of this report is to describe the investigation completed, the ground conditions encountered, to provide recommendations and geotechnical parameters and native soil modulus to aid the construction work involved with proposed developments at Lake Albert - Coorong Connector and recommendations for excavatability, long term and short term excavation stability.

Limited environmental testing has been undertaken and the results will be issued in a separate addendum to this report.

3 PROJECT APPRECIATION
Due to historically low River Murray flows, water levels in the Lower Lakes reached a record low of one metre below sea level. This reduction in water level has led to an increase in salinity and threatened the ecology of Lake Albert, the local economy (particularly the agricultural sector) and dependent communities. Potential acid sulphate soil (PASS) has become exposed to oxygen resulting in changes to the ecological characteristics of the region. A number of government investigations, interventions and on-ground works and measures were initiated in response.

Lake Albert is a terminal lake with no direct connectivity to the sea, so the ability for salt to be naturally exported from the system is limited. The lake’s main water inflow comes from Lake Alexandrina via the Narrung Narrows. Despite improvements in water levels and flows since the drought, salinity levels declined but have not returned to pre-drought levels.

An option currently being considered is the installation of pipeline along the Seven Mile Road between Lake Albert and Coorong North Lagoon as shown in Figure 1. KBR requires an understanding of the ground condition within the proposed alignment for the potential development of the infrastructure. As such herein is our preliminary investigation report along this alignment.
4 SITE DESCRIPTION

The proposed development is located along the Seven Mile Road between Lake Albert and Coorong North Lagoon. The investigation locations are evenly distributed along the alignment with two locations at each end of the alignment as close as practical to the shoreline. The alignment along the Seven Mile Road is generally flat with few small hills (elevated sections) along the alignment.

The investigation location at BH01 is approximately 6m away from the shoreline of the Coorong North Lagoon. The ground level of the investigation location is approximately 0.5m above the water level. The surrounding surface consists of dune sand, with low height grass and scattered calcrete near to the water body. General view of BH01 is presented in Figure 2.

The investigation location BH04 is located at the northern end of the alignment located near the intersection of Narrung Road and Seven Mile Road. The investigation location is selected just south of the private property fence approximately 30 to 35m away from the water edge of the Lake Albert.
The investigation locations BH02 and BH03 is located at relatively higher ground upon Seven Mile Road. The location of BH02 is just near to the top of the hill and BH04 is located at a gradient from the top of the hill. General view of the location near BH02 is presented in Figure 3.

Figure 1: Site photograph at BH02 near a small hill top (elevated section) along Seven Mile Road

Figure 2 - Site photograph at BH01, Northern end of the proposed alignment.
5 FIELD INVESTIGATION

Following a dial before you dig search, and onsite service location, the field investigation was carried out on 13 August 2021. All fieldwork was carried out under the direction of CMW Geosciences in general accordance with AS1726 (2017), Geotechnical Site Investigations. The scope of fieldwork completed as follows:

- Completed a dial before you dig search and engaged a specialist service locator for locating the underground services before commencing the drilling work;
- Engaged a specialist traffic management sub-contractor to create Traffic Management Plans (TMPs) and provide Traffic Control services for the work undertaken on Council roads;
- Advance 4x boreholes denoted by BH01 to BH04 along Seven Mile Road alignment to a target depth of 6.0m below ground level or shallower upon practical refusal, using solid auger and pushtube drilling methods by a 4WD mounted drill rig. BH01 was refused early at 3.1m before reaching the target depth;
- Conducted a dynamic cone penetrometer (DCP) test adjacent each borehole location to a depth of 1.5m below ground level (DCP adjacent BH01 encountered shallow refusal);
- Collected sufficient soil samples for subsequent ASS and contamination laboratory testing, including:
  - 8 x samples for Potential Acid Sulphate Soils testing
  - 24x Soil samples in glass jar for contamination testing (SA Waste Screen suite, which includes 13 metals, total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN), polycyclic aromatic hydrocarbons (PAHs), phenols, organochlorine pesticides (OCP), polychlorinated biphenyls (PCBs) and total cyanide; As well as targeted pesticides and metals testing at the following depth below ground level:
    - 0.0 – 0.15m;
    - 0.1 to 0.15m depth of the top of natural material;
    - 0.5 to 0.6m;
    - 1.0 – 1.1m;
    - 1.5 to 1.6m; and
    - 2.0 to 2.1m

Collection of Duplicate soil samples after every 10 samples. Rinsate samples from the re-usable equipment is collected on a daily basis.

Engineering logs of the subsurface conditions, as well as graphical representation of DCP test results are presented in Appendix A. The approximate locations of the respective investigation sites referred to above are shown in the attached site investigation plan (Drawing 1).

The investigation locations were recorded using a hand-held GPS to the inherent accuracy of the unit (+/- 5m) and elevations were inferred based on the survey plan provided.

6 GROUND MODEL

6.1 Regional Geology

The Geological Survey of South Australia 1:250,000 geological map Sheet 1 54-13 “Barker” Sheet indicates that the geology at the Narrung Narrows and proposed Coorong Connector alignments is
Quaternary kunkarised dunes, sand spreads and kunkar related to calcareous rock. Kunkar soil profiles typically comprise nodular calcium carbonate soils formed in semi-arid regions with alluvial flats.

An excerpt from the SARIG 1:100,000 geological overlay is presented in Figure 4 and illustrates the expected geological units and their distribution. Quaternary alluvial flat deposits are present locally, immediately adjacent to Lake Albert, with shallow depressions expected to contain Holocene Lacustrine Sediments (Q). The southern portion (Coorong Side) is expected to comprise Bridgewater Formation materials (Qpcb) calcareous cross-bedded sand dunes with calcrete capping.

Figure 4: Regional Geology of Proposed Alignment (SARIG 2021)

6.2 Subsurface Conditions

The ground conditions encountered and inferred from the investigation were generally consistent with the published geology for the area. Towards the northern end of the alignment (BH01 and BH02) consists to Quarternary alluvial deposit while this unit is not present the southern end of the alignment at BH01 and BH02. The subsurface profile for site can be generalise as below

FILL / TOPSOIL
SAND; fine to medium grained, grey to dark grey, with root fibres.

CARBONATE GRAVELLY SAND; associated with road base within Seven Mile Road consists of fine to coarse grained, grey and white, medium to coarse grained gravel.

SAND
fine to medium grained, pale grey to grey and pale brown. This unit is encountered in northern part of the Lake Albert – Coorong Connector alignment. QUARTERNARY ALLUVIAL

SAND / CALCAREOUS SAND / CARBONATE SAND; fine to coarse grained, pale brown, pale grey to white with fine to medium grained gravel, angular to subangular, trace low plasticity silt, often calcareous or carbonated. BRIDGEWATER FORMATION
CALCAREOUS GRAVELLY SAND; medium to coarse grained, pale grey to white, fine to medium grained, angular to subangular, trace low plasticity silt.

A summary of the subsurface conditions encountered is provided in Table 1. The conditions encountered are described in more detail on the borehole logs presented in Appendix A.

<table>
<thead>
<tr>
<th>Description</th>
<th>BH01</th>
<th>BH02</th>
<th>BH03</th>
<th>BH04</th>
</tr>
</thead>
<tbody>
<tr>
<td>FILL / TOPSOIL</td>
<td>0.05</td>
<td>0.20</td>
<td>0.30</td>
<td>0.70</td>
</tr>
<tr>
<td>SAND (QUATERNARY ALLUVIAL)</td>
<td>NE</td>
<td>NE</td>
<td>2.25</td>
<td>3.90</td>
</tr>
<tr>
<td>SAND/GRAVELLY SAND (BRIDGEWATER FORMATION)</td>
<td>3.10*</td>
<td>6.00*</td>
<td>6.00*</td>
<td>6.00*</td>
</tr>
</tbody>
</table>

Notes: * - termination depth of the borehole, NE – Not Encountered

6.3 Groundwater

During the investigation, which was completed in August 2021 at the end of a wet season period, groundwater was encountered within the investigation depth. The summary of groundwater depth encountered in borehole locations are presented in Table 2.

<table>
<thead>
<tr>
<th>Borehole ID</th>
<th>BH01</th>
<th>BH02</th>
<th>BH03</th>
<th>BH04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater Depth (m)</td>
<td>0.6</td>
<td>5.5</td>
<td>NE</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Note: NE – Not Encountered

It is to be noted that the variation of depth of groundwater table is influenced by the level of ground surface at investigation locations. BH01 and BH04 is close to water body while BH02 and BH04 within the top of the hill along Seven Mile Road which have relatively higher ground level.

Based on regional geology maps (SARIG 2021) groundwater is expected between 2 and 5 metres below ground level. Should further information on permanent site groundwater levels be required, additional investigation would need to be carried out (i.e. installation of groundwater monitoring wells) with ongoing monitoring of levels.

7 GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS

7.1 Earthworks and Excavation Conditions

Earthworks may be required to remove existing uncontrolled fill, vegetation and any topsoil material encountered below the pavement and/or area related to the structure. Based on the ground conditions encountered within the boreholes, stripping depths are recommended to be generally 0.3m but may extend up to 0.7 metres at the southern end (corresponds to BH04) below existing surface level.

General guidelines relating to earthworks for foundations include:

- Remove any uncontrolled fill, loose surface soils and vegetation;
· Moisture condition the exposed subgrade as necessary;
· Proof roll the exposed surface as per AS3798 under the guidance of a suitable trained person;
· Any wet, soft, loose or heaving materials identified during proof rolling should be removed as directed by the geotechnical engineer or Level 1 Geotechnical Inspection and Testing Authority (GITA);
· Fill, where required, should be placed in layers not exceeding 250mm loose thickness and be compacted to the required standard density with each fill layer being level before placing the next layer. Thinner layers (i.e. 150mm to 200mm) may be required for smaller compaction equipment to ensure the required minimum compaction density is achieved. The recommended compaction levels would be:
  o Pavement Subgrades – 98% standard minimum dry density ratio at ±3% optimum moisture content
  o Pavement Materials – 98% modified minimum dry density ratio
  o Beneath Structures – 100% standard minimum dry density ratio at ±2% optimum moisture content

The technical and control requirements for engineered fill, including site observation and compaction testing, are outlined in AS3798. We recommend that this work is completed under the direction and control of a suitably experienced Geotechnical Engineer familiar with the contents of this report. CMW would be pleased to perform this function if required.

7.2 Site Classification – AS2870

Fill was encountered in all borehole locations, with depths ranging between 0.1 and 0.7 metres below ground level. It is assumed that the fill is uncontrolled.

Carbonate / Calcareous sand layers encountered within BH01 and BH02. Carbonate / Calcareous Soils are considered collapsible soil due to its unstable nature especially under the influence of moisture. Collapsing soils appear strong when dry but lose considerable strength on wetting and it is important that they are correctly identified during a site investigation. Characteristically, collapsing soils are of low density and low plasticity and are generally aeolian in origin.

Sites with collapsing soils are designated as Class ‘P’ as per AS2870-2011 “Residential Slabs and Footings” and require individual design consideration. The normal methods currently in use for designing a footing system on a swelling soil profile do not readily translate to a collapsing soil profile and there are no generally accepted design procedures for designing shallow stiffened footings on deep collapsing soils.

Based on the visual-tactile assessment and of the encountered soil, the following instability indexes have been assessed for the material encountered on site:

· The sand and gravel layers are assessed as non-reactive;

Based upon the design suction soil profile and recommendations in AS2870-2011 “Residential Slabs and Footings” a characteristic surface movement \( y_s \) has been assessed for the soil profile encountered in the borehole at the current surface level. The depth of design suction change \( H \) adopted in this assessment is 4m based on Table 2.4 in AS2870-2011 and in accordance with local practice, with a design suction change at ground surface of 1.2pF and crack depth of 3.0m.

A summary of indicative \( y_s \) values and assessed site classification is given in Table 3.
A characteristic surface movement $y_s$ assessed is 0 mm, with the shrink/swell potential considered to be Class A and described as mostly a sand and rock site with little or no ground movement from moisture changes. However, due to the presence of Carbonate / Calcareaous soil and potential for collapsing BH01 and BH02 is considered as Class P. Larger $y_s$ values may occur when the future moisture content change in the soil exceeds design moisture content change as determined from AS2870, it is recommended that the site classification be reassessed.

### 7.3 Geotechnical Model

Based on the subsurface conditions encountered and results of field testing a generalised geotechnical model has been assessed for Lake Albert – Coorong Connector alignment and provided in Table 4.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Depth range (mBGL)</th>
<th>$\Phi'$ (°)</th>
<th>$c'$ (kPa)</th>
<th>$C_u$ (kPa)</th>
<th>$\gamma$ (kN/m³)</th>
<th>$E'$ (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FILL/TOPSOIL</td>
<td>0</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>QUARTERNARY ALLUVIAL (SAND)</td>
<td>0.3</td>
<td>3.0</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>17</td>
</tr>
<tr>
<td>BRIDGEPATTERN FORMATION (SAND/GRAVELLY SAND)</td>
<td>3.0</td>
<td>6.0</td>
<td>32</td>
<td>-</td>
<td>-</td>
<td>18</td>
</tr>
</tbody>
</table>

Where; $\Phi'$ = angle of internal friction, $c'$ = drained cohesion, $C_u$ = Undrained shear strength $\gamma$ = bulk unit weight, $E$ = Young’s Modulus N/A = Not Applicable, uncontrolled fill not suitable founding layer

Note: *is expected to encounter in northern end of the alignment (BH03 and BH04). ** layer is expected below fill layer on the southern end of the alignment (BH01 and BH02) and expected below Quaternary Alluvial Sand.

### 7.4 Allowable Bearing Capacity

The design of available foundation bearing pressures for isolated strip and pad footings at this site has been carried out using the Terzaghi (1943) bearing capacity equation. Subject to completing the earthworks and foundation preparation recommendations provided herein, shallow strip or pad footings founded within natural high plasticity clay be designed based on the maximum allowable bearing pressures provided in Table 5 and Table 6 for Quaternary Alluvial Sand unit and Bridgewater Formation unit respectively.
Notes: – Allowable bearing capacity is dependent not only on ground conditions but also footing dimensions, proximity to slopes and allowable settlement.

The values shown in Table 5 and Table 6 are based on a geotechnical strength reduction factor of 0.5 and an average load factor of 1.5 (Factor of Safety = 3.0). It should be noted that these bearing pressures assume isolated vertical, non-eccentric loads. Groundwater was encountered during the ground investigation and was therefore considered in calculating the values provided.

The assessed bearing capacity outlined above assumes that the bearing surfaces are adequately prepared, are clean and free from spoil and other soft and loose material, and free of water during the placement of concrete.

The settlement values presented in Table 5 and Table 6 are elastic settlement of the spread footing at the maximum allowable bearing pressure presented above. Much of the settlement is expected to be relatively immediate, with some time-dependent creep expected at locations of deeper fill.

### 7.5 Allowable Horizontal Bearing Capacity – Thrust Block

Allowable horizontal bearing pressure depends on the soil type, density and consistency of soil, the size and the average depth of the thrust block or the relevant structure. Table 7 presents a summary of the recommended allowable horizontal bearing pressure for loose to dense sandy soil.
type encountered within the investigation locations. The allowable horizontal bearing pressure is estimated as per the SA Water Technical Guideline TG96 for thrust block design.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Allowable Horizontal Bearing Pressure (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loose Sand</td>
<td>NR</td>
</tr>
<tr>
<td>Medium Dense Sand</td>
<td>50</td>
</tr>
<tr>
<td>Dense Sand</td>
<td>100</td>
</tr>
</tbody>
</table>

Note: NR – No Standard value

### Table 8: Native Soil Modulus

<table>
<thead>
<tr>
<th>Depth (mbgl)</th>
<th>Unit</th>
<th>E' n (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 - 0.3 FILL</td>
<td>QUATERNARY ALLUVIAL SAND</td>
<td>5</td>
</tr>
<tr>
<td>3.0 – 6.0 BRIDGEMarton (MEDIUM DENSE SAND)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BRIDGEMarton (DENSE SAND)</td>
<td>35</td>
</tr>
</tbody>
</table>

E' n – Native Soil Modulus

### 7.6 Native Soil Modulus

Native soil is assumed to be the material present to a distance 2.5 diameter from the centre line of an embedded pipeline. A generalised assessment of the estimated native soil modulus (horizontal) for pipe embedment design as per Section 3.4 of AS 2566.1 and AWWA Manual M45 for the encountered soil is provided in Table 8.

### 7.7 Construction Issues

#### 7.7.1 Trafficability

Trafficability for tyred vehicles on the natural soils is expected to become poor when wetted.

#### 7.7.2 Excavatability

Based on the resistance to drilling penetration encountered and the DCP testing the resistance to excavation or drilling may vary across the site. Granular natural soils/fills are assessed to be excavatable using conventional earthmoving equipment such as backhoes and excavators. A hard calcrete layer was encountered at shallow depth of 0.6m in the southern end of the alignment (correspond to BH01). The hard layer is prone to very strong resistance to the conventional earthmoving equipment such as graders, excavators and backhoes and slower production rates during trenching are anticipated.

#### 7.7.3 Site Drainage

The ground surface adjacent to the footings should be graded once the footing construction has been completed to provide at least 1 in 20 over the first 2m. Alternatively, all water run-offs should be collected and channelled away or pumped out from the footings area.
7.7.4 Excavation Stability

In accordance with the Occupational Health, Safety and Welfare Regulations 2010, all trench excavations deeper than 1.5 m will need to be supported, benched or assessed by an engineer.

Temporary excavations exceeding 0.5m depth should be continuously battered back at a slope no greater than 1V: 2H. Use of heavy machinery adjacent to open excavations must be avoided. Permanent cut fill batter slopes of 1V:3H may be adopted.

It is recommended that upon confirmation of the proposed construction methodology and where required as per the above guideline, geotechnical design advice is sought to ensure mitigation of geotechnical related hazards. CMW are able to assist in such an assessment.

8 FURTHER WORK

CMW has extensive experience in the detailed design of foundations, pad, shallow footings and deep foundations. We would be pleased to undertake this work to optimise the design solutions for the project. If required, CMW can assist in the detailed design or the review of designs prepared by other parties.

It is recommended that an experienced geotechnical engineer attend site to verify the validity of the assumptions made by the designer as to the subsurface conditions encountered.

9 CLOSURE

The findings contained within this report are the result of limited discrete investigations conducted in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, can it be considered that these findings represent the actual state of the ground conditions away from our investigation locations.

If the ground conditions encountered during construction are significantly different from those described in this report and on which the conclusions and recommendations were based, then we must be notified immediately.

This report has been prepared for use for KBR in relation to the proposed development at Coorong Infrastructure Feasibility Assessment of Lake Albert to Coorong Connector Project at Seven Mile Road Road, Meningie SA 5264 in accordance with generally accepted consulting practice.

No other warranty, expressed or implied, is made as to the professional advice included in this report. Use of this report by parties other than KBR and their respective consultants and contractors is at their risk as it may not contain sufficient information for any other purposes.

For and on behalf of CMW Geosciences

Prepared by: Reviewed and authorised by:

Abu Rabbi John Slade
Project Geotechnical Engineer Principal Geotechnical Engineer, CPENG

Distribution: 1 electronic copy to KBR via email
Original held at CMW Geosciences
10 REFERENCES

Drawing 1
Site Plan
APPROXIMATE BOREHOLE (BH) LOCATION

NOTES:
1. AERIAL FROM BING MAPS

SITE LOCATION

LEGEND

BH01

0
300
450
600
750 m

1:15,000

16.08.21
Appendix A

Results of Field Investigation
### Explanatory Notes – Soil Description

<table>
<thead>
<tr>
<th>GRAVEL</th>
<th>Sandy CLAY</th>
<th>FILL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silt</td>
<td>TOPSOIL</td>
<td></td>
</tr>
<tr>
<td>Gravelly SILT</td>
<td>COBBLES &amp; BOULDERS</td>
<td></td>
</tr>
<tr>
<td>Sandy SILT</td>
<td>CONCRETE</td>
<td></td>
</tr>
<tr>
<td>Sandy SILT</td>
<td>PEAT</td>
<td>NO CORE</td>
</tr>
</tbody>
</table>

**Gravelly SAND Sandy CLAY FILL**

**SILT TOPSOIL**

**Gravelly SILT COBBLES & BOULDERS**

**Sandy SILT CONCRETE**

**PEAT NO CORE**

---

### Soil Classification and Inferred Stratigraphy

<table>
<thead>
<tr>
<th>Particle Size</th>
<th>Major Division</th>
<th>Sub-Division</th>
<th>Particle Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boulders</td>
<td></td>
<td></td>
<td>&gt; 200 mm</td>
</tr>
<tr>
<td>Cobbles</td>
<td></td>
<td></td>
<td>63 to 200 mm</td>
</tr>
<tr>
<td>Gravel</td>
<td>Coarse</td>
<td></td>
<td>19 to 63 mm</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td></td>
<td>6.7 to 19 mm</td>
</tr>
<tr>
<td></td>
<td>Fine</td>
<td></td>
<td>2.36 to 6.7 mm</td>
</tr>
<tr>
<td>Sand</td>
<td>Coarse</td>
<td></td>
<td>0.6 to 2.36 mm</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td></td>
<td>0.21 to 0.6 mm</td>
</tr>
<tr>
<td></td>
<td>Fine</td>
<td></td>
<td>0.075 to 0.21 mm</td>
</tr>
<tr>
<td></td>
<td>Silty</td>
<td></td>
<td>0.002 to 0.075 mm</td>
</tr>
</tbody>
</table>

**MOISTURE CONDITION (Cohesionless Soils)**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Dry</td>
<td>Looks and feels dry. Cohesionless and free-running.</td>
</tr>
<tr>
<td>M</td>
<td>Moist</td>
<td>No free water on remoulding. Soil feels cool, darkened in colour. Soil tends to cohere.</td>
</tr>
<tr>
<td>W</td>
<td>Wet</td>
<td>Free water on remoulding. Soil feels cool, darkened in colour. Soil tends to cohere.</td>
</tr>
</tbody>
</table>

**DENSITY (Cohesionless Soils)**

<table>
<thead>
<tr>
<th>Sym.</th>
<th>Term</th>
<th>Density Index (%)</th>
<th>SPT ‘N’</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL</td>
<td>Very Loose</td>
<td>Less than 15</td>
<td>0 to 4</td>
</tr>
<tr>
<td>L</td>
<td>Loose</td>
<td>15 to 35</td>
<td>4 to 10</td>
</tr>
<tr>
<td>MD</td>
<td>Medium Dense</td>
<td>35 to 65</td>
<td>10 to 30</td>
</tr>
<tr>
<td>D</td>
<td>Dense</td>
<td>65 to 85</td>
<td>30 to 50</td>
</tr>
<tr>
<td>VD</td>
<td>Very Dense</td>
<td>Above 85</td>
<td>Above 50</td>
</tr>
</tbody>
</table>

**SECONDARY/MINOR COMPONENTS**

**TERMS FOR SANDS/GRAVELS**

( Less than 35% Particles < 0.075mm)

- Trace... sand/gravel = <15%
- Day/silt = <5%

**TERMS FOR CLAYS/SILTS**

(More than 35% Particles < 0.075mm)

- Trace... sand/gravel = <15%

**MOISTURE CONDITION (Cohesive Soils)**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;PL</td>
<td>Dry</td>
<td>Looks and feels dry. Hard and friable or powdery, well dry of the plastic limit</td>
</tr>
<tr>
<td>&gt;PL</td>
<td>Moist</td>
<td>Soil feels cool, darkened in colour. Soil can be moulded. Near plastic limit.</td>
</tr>
<tr>
<td>&gt;PL</td>
<td>Wet</td>
<td>Solids feels cool, darkened in colour. Usually weakened and free water forms when remoulding. Wet of plastic limit.</td>
</tr>
</tbody>
</table>

**STIFFNESS (Cohesive Soils)**

<table>
<thead>
<tr>
<th>Sym.</th>
<th>Term</th>
<th>Undrained Shear Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>VS</td>
<td>Very Soft</td>
<td>0 to 12 kPa</td>
</tr>
<tr>
<td>S</td>
<td>Soft</td>
<td>12 to 25 kPa</td>
</tr>
<tr>
<td>F</td>
<td>Firm</td>
<td>25 to 50 kPa</td>
</tr>
<tr>
<td>St</td>
<td>Stiff</td>
<td>50 to 100 kPa</td>
</tr>
<tr>
<td>VSt</td>
<td>Very Stiff</td>
<td>100 to 200 kPa</td>
</tr>
</tbody>
</table>

**Sampling and Laboratory / In situ Testing Results**

<table>
<thead>
<tr>
<th>B</th>
<th>Sample Type</th>
<th>U</th>
<th>CBR</th>
<th>CBR</th>
<th>California Bearing Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLK</td>
<td>Block Sample</td>
<td>W</td>
<td>UCS</td>
<td>PLL</td>
<td>Point Load Index</td>
</tr>
<tr>
<td>C</td>
<td>Core Sample</td>
<td>LL</td>
<td>PLI</td>
<td>N</td>
<td>SPT-N Value</td>
</tr>
<tr>
<td>ES</td>
<td>Environmental Soil Sample</td>
<td>PI</td>
<td>PI</td>
<td>N</td>
<td>SPT-N Value</td>
</tr>
<tr>
<td>P</td>
<td>Pison Sample</td>
<td>LS</td>
<td>SPT</td>
<td>N</td>
<td>Standard Penetration Test</td>
</tr>
</tbody>
</table>

**Drilling/Excavation Method**

| AC | Air Core | HA | Hand Auger | RC | Rotary Cored |
| ADH| Hollow Auger Drilling | HQ | Rotary Core 63.5mm | RO | Rotary Open Hole |
| ADV| Auger with V-Bit | HQB | Rotary Core 61.1mm | TP | Test PI |
| ADT| Auger with T-C-Bit | PQ3 | Rotary Drill 83mm |     |               |
| DPP| Direct Push Probe | PT | Push Tube | W | Wash Bore |

---

**Soil colours based on BGS Internal report IR/05/123 “A Revised scheme for coding un lithified deposits”, 2006.**
**Borehole Log - BH01**

Client: KBR  
Project: Coorong Infrastructure Feasibility Assessment  
Location: Meningie, SA  
Project ID: ADL2021-0001  
Date: 13/08/2021

Logged by: Abu Rabbi  
Checked by: YW  
Elevation:  
Angle from horizontal: 90°  
Contractor: JR Soil Sampling

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Material Description</th>
<th>Moisture Condition</th>
<th>Consistency/Relative Density</th>
<th>Dynamic Cone Penetrometer (Blows/100mm)</th>
<th>Structure &amp; other observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.2</td>
<td>TOPSOIL: SAND; fine to medium grained, dark grey, with root fibres.</td>
<td>VL</td>
<td>5</td>
<td>0.00-0.05m: FILL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SP: SAND; medium to coarse grained, pale grey to pale brown.</td>
<td>M</td>
<td>10</td>
<td>0.05-3.10m: BRIDGEWATER FORMATION</td>
<td>0.55-0.75m: Solid auger drilling</td>
</tr>
<tr>
<td>0.5-0.6</td>
<td>SP-SM: CARBONATE SAND; medium to coarse grained; white to pale brown, with low plasticity silt, trace fine to medium grained gravel, angular; with seashells.</td>
<td>D</td>
<td>15</td>
<td></td>
<td>1.10-3.10m: Solid auger drilling</td>
</tr>
<tr>
<td>0.6-0.8</td>
<td>SP: CARBONATE SAND; medium to coarse grained; grey and white; with fine to medium grained gravel, angular; trace low plasticity silt; inferred calcite layer.</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0-1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2-1.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2-1.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5-1.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0-2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0-2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Borehole terminated at 3.10 m

**Remarks:**

This report must be read in conjunction with accompanying notes and abbreviations.
BH01_0.0 to 3.1m

BH01_Site Photograph
**BOREHOLE LOG - BH02**

Client: KBR  
Project: Coorong Infrastructure Feasibility Assessment  
Location: Meningie, SA  
Project ID: ADL2021-0001  
Date: 13/08/2021  
Logged by: Abu Rabbi  
Position: E.342703m N.6043231m  
Checked by: YW  
Elevation: Angle from horizontal: 90°  
Plant used: Rockmaster  
Contractor: JR Soil Sampling

**Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components**

- **0.0-0.2 m**: FILL: CARBONATE GRAVELLY SAND: fine to coarse grained; grey and white; medium to coarse grained, subangular gravel; with low plasticity silt.
- **0.2-0.4 m**: SP: CALCAREOUS SAND: fine to medium grained, brown, trace fine to medium grained gravel, subangular.
- **0.5-0.6 m**: SP: CALCAREOUS SAND: fine to medium grained; white to pale brown; with fine to medium grained gravel, angular; inferred calcrete layer recovered as sand.
- **1.0-1.2 m**: SP: CALCAREOUS SAND: fine to coarse grained; pale brown; with fine to medium grained gravel, subangular.
- **1.2-1.3 m**: SP: CALCAREOUS SAND: fine to coarse grained; white to pale brown; with fine to medium grained gravel, angular; inferred calcrete layer recovered as sand.
- **1.5-1.6 m**: SP: CALCAREOUS SAND: fine to medium grained; pale brown; with fine to medium grained gravel, subangular.
- **2.0-2.2 m**: SP: CALCAREOUS GRAVELLY SAND: medium to coarse grained; pale grey to white; fine to medium grained, angular to subangular gravel; trace low plasticity silt.
- **3.5-5.6 m**: SP: CALCAREOUS SAND: fine to medium grained; pale brown to pale yellow brown; trace fine to medium grained gravel, subrounded.
- **5.5-5.6 m**: SP: SAND: medium grained; brown to orange brown; trace fine grained gravel.

**Dynamic Cone Penetrometer (Blows/100mm)**

- **0.00-0.20 m**: FILL
- **0.20-6.00 m**: BRIDGEPATER FORMATION

**Remarks:**

This report must be read in conjunction with accompanying notes and abbreviations.
BH02_0.0 to 6.0m

BH02_Site Photograph
## BOREHOLE LOG - BH03

**Client:** KBR  
**Project:** Coorong Infrastructure Feasibility Assessment  
**Location:** Meningie, SA  
**Project ID:** ADL2021-0001  
**Date:** 13/08/2021  
**Logged by:** Abu Rabbi  
**Position:** E.342998m N.6043630m  
**Elevation:** Angle from horizontal: 90°  
**Plant used:** Rockmaster  
**Contractor:** JR Soil Sampling

### Graphical Log

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Sample Type</th>
<th>Material Description</th>
<th>Dynamic Cone Penetrometer (Blows/100mm)</th>
<th>Structure &amp; Other Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.2</td>
<td>ES</td>
<td>FILL: SAND: fine to medium grained; pale brown.</td>
<td>VL</td>
<td>0.00-0.30m: FILL</td>
</tr>
<tr>
<td>0.3-0.4</td>
<td>ES</td>
<td>SP: SAND: fine grained; dark grey.</td>
<td>L to MD</td>
<td>0.30-2.25m: QUARTERNARY ALLUVIAL DEPOSITS</td>
</tr>
<tr>
<td>0.5-0.6</td>
<td>ES</td>
<td>SP: SAND: fine grained; pale brown to brown.</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>0.8-0.9</td>
<td>ES</td>
<td>SP: SAND: fine grained; pale brown to brown.</td>
<td>L to MD</td>
<td></td>
</tr>
<tr>
<td>1.0-1.2</td>
<td>ES</td>
<td>SP: CALCAREOUS SAND: fine to medium grained; pale brown to white; trace low plasticity silt; trace fine to medium grained gravel, subangular to subrounded.</td>
<td>MD to D</td>
<td>2.25-6.00m: BRIDGEWATER FORMATION</td>
</tr>
<tr>
<td>1.0-1.2</td>
<td>QC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5-1.6</td>
<td>ES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0-2.2</td>
<td>ES</td>
<td>SP: CALCAREOUS SAND: fine to medium grained; pale brown to white; trace low plasticity silt; trace fine to medium grained gravel, subangular to subrounded.</td>
<td>MD</td>
<td></td>
</tr>
<tr>
<td>3.0-3.1</td>
<td>ES</td>
<td>SP: SAND: fine to medium grained; pale brown to while, trace fine grained gravel.</td>
<td>M</td>
<td></td>
</tr>
</tbody>
</table>

### Remarks:
- This report must be read in conjunction with accompanying notes and abbreviations.
- Client: KBR
- Project: Coorong Infrastructure Feasibility Assessment
- Location: Meningie, SA
- Project ID: ADL2021-0001
- Date: 13/08/2021
- Logged by: Abu Rabbi
- Position: E.342998m N.6043630m
- Elevation: Angle from horizontal: 90°
- Plant used: Rockmaster
- Contractor: JR Soil Sampling
- Plant used: Rockmaster
- Contractor: JR Soil Sampling
- Borehole terminated at 6.00 m
BH03_0.0 to 6.0m

BH03_Site Photograph
### Groundwater Samples & In-situ Tests

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.2</td>
<td>FILL: SAND: fine to medium grained, grey to dark grey; trace low plasticity clay.</td>
</tr>
<tr>
<td>0.5-0.6</td>
<td>FILL: SAND: fine to medium grained; dark grey.</td>
</tr>
<tr>
<td>0.6-0.8</td>
<td>SP: SAND: fine to medium grained; pale grey to pale brown.</td>
</tr>
<tr>
<td>1.0-1.1</td>
<td>SP: SAND: fine to medium grained; pale brown to brown.</td>
</tr>
<tr>
<td>1.5-1.6</td>
<td>SP: SAND: fine to medium grained; pale brown to brown.</td>
</tr>
<tr>
<td>1.9-2.0</td>
<td>FILL: SAND: fine to medium grained; grey to dark grey; trace low plasticity clay.</td>
</tr>
<tr>
<td>2.0-2.1</td>
<td>SP: CALCAROUS SAND: fine to medium grained; pale grey and white; trace low plasticity silt; trace fine to medium grained gravel, angular to subangular.</td>
</tr>
<tr>
<td>2.6-2.7</td>
<td>SP: SAND: fine to medium grained; pale grey.</td>
</tr>
<tr>
<td>3.9-6.0</td>
<td>Borehole terminated at 6.00 m</td>
</tr>
</tbody>
</table>

### Dynamic Cone Penetrometer (Blows/100mm)

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Dynamic Cone Penetrometer (Blows/100mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.2</td>
<td>0.00-0.60m: FILL</td>
</tr>
<tr>
<td>0.6-3.9</td>
<td>0.60-3.90m: QUATERNARY ALLUVIAL DEPOSIT</td>
</tr>
<tr>
<td>3.9-6.0</td>
<td>3.90-6.00m: BRIDGEWATER FORMATION</td>
</tr>
</tbody>
</table>

### In-Situ Vane

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>In situ Vane Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0-0.2</td>
<td></td>
</tr>
<tr>
<td>0.5-0.6</td>
<td></td>
</tr>
<tr>
<td>0.6-0.8</td>
<td></td>
</tr>
<tr>
<td>1.0-1.1</td>
<td></td>
</tr>
<tr>
<td>1.5-1.6</td>
<td></td>
</tr>
<tr>
<td>1.9-2.0</td>
<td></td>
</tr>
<tr>
<td>2.0-2.1</td>
<td></td>
</tr>
<tr>
<td>2.6-2.7</td>
<td></td>
</tr>
<tr>
<td>3.9-6.0</td>
<td></td>
</tr>
</tbody>
</table>

This report must be read in conjunction with accompanying notes and abbreviations.
BH04_0.0 to 6.0m

BH04_Site Photograph
Appendix E

Geotechnical investigation report - Coorong dredge alignment desktop assessment
14 July 2021

COORONG INFRASTRUCTURE FEASIBILITY ASSESSMENT: INFRASTRUCTURE OPTION 2 – COORONG LAGOON DREDGING

GEOTECHNICAL DESKTOP STUDY

ADL2021-0001AC Rev0

Kellogg Brown and Root
<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 July 2021</td>
<td>0</td>
<td>Final Report</td>
</tr>
</tbody>
</table>
# Table of Contents

1 INTRODUCTION .................................................................................................................. 1  
2 PROJECT APPRECIATION .................................................................................................... 1  
3 SCOPE OF WORKS .............................................................................................................. 2  
4 REFERENCE DOCUMENTS .................................................................................................. 2  
5 COORONG LAGOON DREDGING – OPTION 1 (PARNKA NARROWS) ............................... 3  
   5.1 Description ...................................................................................................................... 3  
   5.2 Regional geology ........................................................................................................... 3  
   5.3 Topography and Bathymetry ........................................................................................ 4  
   5.4 Risk of ASS/PASS ......................................................................................................... 5  
6 COORONG LAGOON DREDGING – OPTION 2 (PELICAN POINT) ......................... 6  
   6.1 Description ...................................................................................................................... 6  
   6.2 Regional Geology ........................................................................................................... 6  
   6.3 Risk of ASS/PASS ......................................................................................................... 7  
7 POTENTIAL CONSTRUCTION ISSUES ................................................................. 8  
8 FURTHER INVESTIGATION ............................................................................................. 8  
9 LIMITATIONS .................................................................................................................... 8  
10 CLOSURE .......................................................................................................................... 9  

**Appendices**

*Appendix A – Supplied Bathymetry and Modelling Data*
1 INTRODUCTION

CMW Geosciences (CMW) was authorised by KBR to carry out a geotechnical desktop review for the works associated with Infrastructure Option 2 – Coorong Lagoon Dredging.

The scope of work undertaken was generally consistent with our proposal letter referenced ADL2020-0001AA, Rev0 dated 18 January 2021.

Herein is a desktop study of existing information related to the Coorong Lagoon Dredging.

2 PROJECT APPRECIATION

The Coorong is the only estuary within the Murray-Darling Basin, forming the end-of-system connection for the River Murray to the Southern Ocean. The main sources of flows to the Coorong come from the River Murray (via the barrages), from the South East drainage network and tidal exchange through the Murray Mouth. These flow sources are key in controlling water quality and water levels in the Coorong’s North and South Lagoons, which ultimately influence the ecological character of the site. Over-allocation of Murray–Darling Basin flows and the Millennium Drought further reduced freshwater flows at the northern extent of the Coorong, which has impacted water quality and led to an ongoing ecological decline throughout the Coorong and Lower Lakes. Furthermore, freshwater that historically flowed into the Coorong South Lagoon via wetlands and watercourses of the South East, has been substantially reduced through the construction of an extensive drainage network over the past 150 years.

Whilst the majority of the site is considered to be slowly recovering, the ecology of the Coorong South Lagoon in particular has remained in a degraded state. The effects of reduced freshwater flows are most evident in this area with high salinity, reducing water levels and increasing eutrophic conditions creating water quality conditions that have impacted a number of key aquatic species. For as long as the South Lagoon remains under stress, it is not considered sufficiently resilient to absorb the impacts of a changing climate.

Previous investigations for options to improve North / South Lagoon connectivity have examined the possibility of increasing flowrates between the North and South Lagoon of the Coorong through channel excavation or dredging. Additionally, an option has been proposed to undertake dredging at Pelican Point, although very limited information has been provided regarding the scope of works to be completed at this location.

The general zone considered for dredging is shown in Figure 1. At present, no geotechnical investigation has been completed for the area proposed to be dredged.
3 SCOPE OF WORKS
This will include a review of published geological and environmental information to gain an understanding of potential construction issues as well as aiding in the scoping of an intrusive geotechnical investigation.

4 REFERENCE DOCUMENTS
Several previous reports have been provided to CMW to assist in the desktop study. These reports include environmental reports detailing the environmental modelling completed to date. No known geotechnical investigation has occurred at the time of writing this report.

Other sources have also been used in the desktop study, such as geology maps, groundwater well data, topographical information, Acid Sulphate Soil risk maps and aerial images. CMW have not undertaken a site visit as part of this preliminary scope of works.

5. Hobbs TJ, O’Connor J, Gibbs M (2019). Improved elevation and bathymetry models for the
5 COORONG LAGOON DREDGING – OPTION 1 (PARNKA NARROWS)

5.1 Description
The purpose of this construction option is, in essence, to increase hydraulic connectivity between the North and South Coorong Lagoon. This would be achieved by excavation or dredging of select locations along the proposed alignment where flows are most limited. The image below delineates the potential dredging area at this location.

![Figure 2: Overview of Proposed Possible Dredge Sites (Tonkin, 2020)](image)

5.2 Regional geology
The Geological Survey of South Australia 1:250,000 geological map Sheet 1 54-13 “Barker” Sheet suggests that the expected subsurface conditions of the islands within the channel, and along the northern shore of the Coorong comprise Quaternary kunkarised dunes, sand spreads and kunkar related to calcareous rock. The Younghusband Peninsula is expected to be underlain by quaternary alluvial deposits.

A review of geological information published on the South Australian Resource Information Gateway (SARIG, 2021) indicates the subsurface conditions of the islands and Coorong north shore are described as the Bridgewater Formation (Qpcb) comprising Coastal barrier and shallow sub-tidal sediments: bioclastic and aeolian cross-bedded calcarenite, palaeosol horizons, often capped by calcrete. The Younghusband Peninsula subsurface is expected to be underlain by the Semaphore Sand Member (Qhcks) described therein as unconsolidated white bioclastic quartz-carbonate sand of modern beaches and transgressive dune fields.
An excerpt of the regional geology map taken from SARIG is shown in Figure 3. Based on these reviews, we would expect the dredging/excavation activities to encounter sands, clays and gravels with the potential for high strength calcrete layers to be intercepted at all locations. The investigation of the presence and extent of these calcrete layers would be the key consideration of any intrusive geotechnical investigation.

Figure 3: 1:100k Regional Geology, dredging alignment shown in blue (SARIG, 2021)

5.3 Topography and Bathymetry

Based on a review of DEW Technical report 2019/23 “Improved elevation and bathymetry models for the Coorong”, the banks of the Coorong appear to be at an elevation of approximately 1-2m AHD with the sub-aquatic ground level along the dredging alignment at approximately 0m AHD.

The bathymetry model used in the BMT WBM model and simulation are broadly in accordance with the DEW bathymetry model, however in the area between The Needles and Hell’s Gate, deeper water is expected (ground elevation approximately 0 to -0.75m AHD).

Relevant figures from the Digital Elevation Model (DEM) and the BMT WBM model are included in Appendix A for reference. It is noted that the Hell’s Gate area undergoes significant morphological change due to current and wave action and that these depths are only estimates based on the supplied data.
The BMT WBM model bathymetry before and after dredging are depicted in Figures 4 and 5 respectively.

Figure 4: Modelling Bathymetry (BMT WBM, 2009)

Figure 5: Modelled Bathymetry following Dredging (BMT WBM, 2009)

5.4 Risk of ASS/PASS

Based on a review of the Australian Soil Resource Information System ASS/PASS risk map, the soils underlying the proposed dredging alignment are considered as high risk of being ASS. An excerpt from ASRIS is presented in Figure 6, overlain with the proposed dredging alignment.
6 COORONG LAGOON DREDGING – OPTION 2 (PELICAN POINT)

6.1 Description

At the time of writing this report, CMW are aware that dredging at Pelican Point is being considered as a remediation option. The dredge area is proposed to be approximately 2,500m long and 200m wide to a minimum level of -1.5mAHD. Very limited data is currently available and our desktop review has considered only publicly available regional geology and environmental data. No drawings or actual alignment options have been presented.

This proposed dredging option has not been covered in the currently discussed scope of field investigation, and any additional investigation for this area would need to be discussed whilst planning the field investigation.

6.2 Regional Geology

A review of geological information published on the South Australian Resource Information gateway (SARIG, 2021) indicates the subsurface conditions of Pelican Point as quaternary rocks and soils, with some localised occurrence of Holocene Lacustrine Deposits. The Younghusband Peninsula subsurface is expected to be underlain by the Semaphore Sand Member (Qhcks) described therein as unconsolidated white bioclastic quartz-carbonate sand of modern beaches and transgressive dune fields.

An extract of the regional geology taken from SARIG is presented in Figure 7.

Based on these reviews, we would expect the dredging/excavation activities to encounter sands, clays and gravels with the potential for high strength calcrite layers to be intercepted at all locations. The investigation of the presence and extent of these calcrite layers would be the key outcome of any intrusive geotechnical investigation.
Based on a review of the Australian Soil Resource Information System ASS/PASS risk map, the soils underlying the proposed dredging alignment are considered as high risk of being ASS. An excerpt from ASRIS is displayed in Figure 8, overlain with the assumed dredging area.

Figure 7: 1:100k Geology at Pelican Point (SARIG, 2021)

Figure 8: ASRIS probability map for occurrence of ASS with assumed dredging area in red
7 POTENTIAL CONSTRUCTION ISSUES

Based on a review of the supplied information as well as publicly available information, the following issues may potentially be encountered during construction and should be considered during planning of works:

- Presence of calcrete causing difficult excavation conditions. During previous drilling investigations near Lake Albert (SKM, 2013), cemented layers were able to be penetrated with hollow auger drilling techniques, however based on previous experience on sites underlain by calcrete in other regions of South Australia this material can provide significant resistance to excavations necessitating the use of hydraulic breakers and ripping attachments;

- There is a high probability that material excavated/dredged from the Coorong Lagoon is ASS/PASS, which may pose issues during construction activities and disposal.

8 FURTHER INVESTIGATION

At present, no information is available regarding the ground conditions where excavation/dredging activities are proposed.

Our initial proposal (ADL2021-0001AA Rev0) proposed 1 x DCP per 1000m of dredge alignment however based on supply of additional information and subsequent review, we would consider it prudent to reduce the spacing of test locations to 1 x DCP per 500m of dredging alignment, with several number of boreholes drilled over water (nominally 1 per 1000m of alignment) to facilitate creation of a suitable ground model and to allow for environmental sampling and testing.

9 LIMITATIONS

The findings contained within this report are the result of a desktop review of the supplied limited discrete investigations, and publicly available information online. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, can it be considered that these findings represent the actual state of the ground conditions away from the provided investigation locations.

This report has been prepared for use by KBR in relation to the proposed Coorong Dredging option which forms part of a larger investigation into remediation and management of Salinity and water levels in the Coorong region, in accordance with generally accepted consulting practice. No other warranty, expressed or implied, is made as to the professional advice included in this report. Use of this report by parties other than KBR and their respective consultants and contractors is at their risk as it may not contain sufficient information for any other purposes.
10 CLOSURE
Should there be any questions in relation to this report, please contact the undersigned.

For and on behalf of
CMW Geosciences

Prepared by: Paolo Mercorella
Reviewed/Authorised by: John Slade
Geotechnical Engineer
Principal Geotechnical Engineer, CPEng

Distribution: 1 copy to KBR (electronic)
Original held by CMW Geosciences
Appendix A
Supplied Bathymetry and Modelling Data
Figure 3.3. Elevation and bathymetry between Parnka Point and Woods Well in the southern Coorong.
Figure 3.8. Elevation and bathymetry between Robs Point and Parnka Point in the northern Coorong
Appendix A: Dredged Channel Profile Through Hells Gate

Figure A.1: Existing Bathymetry through Hells Gate Area (Base Case), Grid Size = 1000m

Figure A.2: Dredge Scenario Bathymetry through Hells Gate Area (Channel is typically 20m wide at -0.8 mAHD), Grid Size = 1000m
Appendix F

Geotechnical investigation report - Coorong dredge alignment investigation report
# Table of Contents

1 INTRODUCTION ........................................................................................................... 1  
2 PROJECT APPRECIATION .............................................................................................. 1  
3 SITE DESCRIPTION ....................................................................................................... 2  
4 FIELD INVESTIGATION ................................................................................................. 4  
5 GROUND MODEL ......................................................................................................... 5  
  5.1 Regional Geology ............................................................................................................. 5  
6 GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS .......................................... 6  
  6.1 Estimated Geotechnical Model .......................................................................................... 6  
  6.2 Construction Issues .......................................................................................................... 7  
    6.2.1 Excavatability ............................................................................................................... 7  
    6.2.2 Excavation Stability ..................................................................................................... 7  
7 FURTHER WORK .......................................................................................................... 7  
8 CLOSURE ...................................................................................................................... 7  

## Drawings

Drawing 1 – Site Investigation Plan

## Appendices

Appendix A – Results of Field Investigation
1 INTRODUCTION

CMW Geosciences (CMW) was authorised by KBR to carry out a geotechnical investigation for the proposed dredging option at the Coorong Lagoon at Meningie, SA 5264.

The scope of work undertaken was generally consistent with our proposal letter referenced ADL2020-0001AA, Rev1 dated 30 July 2021.

The purpose of this report is to describe the investigation completed within Coorong Lagoon, and present the field test results, advice on geotechnical parameters, and recommendations for excavatability and excavation stability.

A separate preliminary contamination assessment report will be provided by Fyfe.

2 PROJECT APPRECIATION

The Coorong is the only estuary within the Murray-Darling Basin, forming the end-of-system connection for the River Murray to the Southern Ocean. The main sources of flows to the Coorong come from the River Murray (via the barrages), from the South East drainage network and tidal exchange through the Murray Mouth. These flow sources are key in controlling water quality and water levels in the Coorong’s North and South Lagoons, which ultimately influence the ecological character of the site. Over-allocation of Murray–Darling Basin flows and the Millennium Drought further reduced freshwater flows at the northern extent of the Coorong, which has impacted water quality and led to an ongoing ecological decline throughout the Coorong and Lower Lakes. Furthermore, freshwater that historically flowed into the Coorong South Lagoon via wetlands and watercourses of the South East, has been substantially reduced through the construction of an extensive drainage network over the past 150 years.

Whilst the majority of the site is considered to be slowly recovering, the ecology of the Coorong South Lagoon in particular has remained in a degraded state. The effects of reduced freshwater flows are most evident in this area with high salinity, reducing water levels and increasing eutrophic conditions creating water quality conditions that have impacted a number of key aquatic species. For as long as the South Lagoon remains under stress, it is not considered sufficiently resilient to absorb the impacts of a changing climate.

Previous investigations for options to improve North / South Lagoon connectivity have examined the possibility of increasing flowrates between the North and South Lagoon of the Coorong through channel excavation or dredging. Additionally, an option has been proposed to undertake dredging at Pelican Point, although very limited information has been provided regarding the scope of works to be completed at this location.

The general zone considered for dredging is shown in Figure 1. At present, no geotechnical investigation has been completed for the area proposed to be dredged.
CMW have conducted a desktop study for the aforementioned options and provided a report referenced ADL2021-0001AC, Rev0 dated 14 July 2021.

3 SITE DESCRIPTION

The proposed dredging alignment is located along 17 km length of Coorong Lagoon either side of the Parnka Point. The investigation area is located between Goat Island in the north to the Swan Island on the south side of Coorong Lagoon.

At the time of field investigation, the site was under water. It was noticed the depth of water varied along the channel between approximately 0.6m and 3.0m. Investigation locations were moved slightly from proposed locations, due to safety reason, where the depth of water was greater than 1.5m. The general condition of Coorong Lake is presented in Figure 2 and Figure 3.
Figure 2 - Site photograph at DCP08 near Parnka Point (Looking South)

Figure 2: Site photograph at DCP03 (Looking North-East)
4 FIELD INVESTIGATION

Following a dial before you dig search, and onsite service location, the field investigation was carried out on 11 and 13 August 2021. All fieldwork was carried out under the direction of CMW Geosciences in general accordance with AS1726 (2017), Geotechnical Site Investigations. The scope of fieldwork completed as follows:

- Completed a dial before you dig search and engaged a specialist service locator for locating the underground services before commencing the drilling work.
- Walkover assessment before commencing the work to assess the overall site condition and expected ground condition.
- Advance 17x Dynamic Cone penetration (DCP) tests denoted by DCP01 to DCP17 along the proposed dredging channel to a depth of 1.5m below ground level or shallower upon refusal. DCP08 encountered a refusal at 1.3m below ground level.
- Collected sufficient soil samples for subsequent Environmental laboratory testing, including:
  - 17 x samples for Potential Acid Sulphate Soils testing.
  - 17x Soil samples in glass jar for contamination testing at a depth 0 – 0.15m below ground level.

Collection of Duplicate soil samples after every 10 samples. Rinsate samples from the re-usable equipment is collected on a daily basis.

Environmental laboratory testing is carried out in ALS International a NATA accredited laboratory. Laboratory testing is conducted as per the instruction of our Environmental consultant Fyfe.

DCP test results are presented in Appendix A along with the depth of water at the investigation locations. The approximate locations of the respective investigation sites referred to above are shown in the attached site investigation plan (Drawing 1).

The investigation locations were recorded using a hand-held GPS to the inherent accuracy of the unit (+/- 5m) and elevations were inferred based on the survey plan provided. A summary of the investigation locations are provided in Table 1.

<table>
<thead>
<tr>
<th>Site ID</th>
<th>Depth of Water (m)</th>
<th>Easting (m)</th>
<th>Northing (m)</th>
<th>DCP Termination Depth (mbgl)</th>
<th>Target Depth Reached (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCP01</td>
<td>0.8</td>
<td>350611</td>
<td>6032118</td>
<td>1.5</td>
<td>Y</td>
</tr>
<tr>
<td>DCP02</td>
<td>0.9</td>
<td>351463</td>
<td>6031474</td>
<td>1.5</td>
<td>Y</td>
</tr>
<tr>
<td>DCP03</td>
<td>0.8</td>
<td>352199</td>
<td>6030548</td>
<td>1.5</td>
<td>Y</td>
</tr>
<tr>
<td>DCP04</td>
<td>1.1</td>
<td>353198</td>
<td>6029427</td>
<td>1.5</td>
<td>Y</td>
</tr>
<tr>
<td>DCP05</td>
<td>1.0</td>
<td>353617</td>
<td>6028293</td>
<td>1.5</td>
<td>Y</td>
</tr>
<tr>
<td>DCP06</td>
<td>1.1</td>
<td>354380</td>
<td>6027437</td>
<td>1.5</td>
<td>Y</td>
</tr>
<tr>
<td>DCP07</td>
<td>1.0</td>
<td>355150</td>
<td>6026899</td>
<td>1.5</td>
<td>Y</td>
</tr>
<tr>
<td>Site ID</td>
<td>Depth of Water (m)</td>
<td>Easting (m)</td>
<td>Northing (m)</td>
<td>DCP Termination Depth (mbgl)</td>
<td>Target Depth Reached (Y/N)</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------</td>
<td>-------------</td>
<td>--------------</td>
<td>----------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>DCP08</td>
<td>0.8</td>
<td>355370</td>
<td>6025641</td>
<td>1.3</td>
<td>N</td>
</tr>
<tr>
<td>DCP09</td>
<td>0.9</td>
<td>356322</td>
<td>6025331</td>
<td>1.5</td>
<td>Y</td>
</tr>
<tr>
<td>DCP10</td>
<td>0.8</td>
<td>357015</td>
<td>6024740</td>
<td>1.5</td>
<td>Y</td>
</tr>
<tr>
<td>DCP11</td>
<td>0.7</td>
<td>357976</td>
<td>6024372</td>
<td>1.5</td>
<td>Y</td>
</tr>
<tr>
<td>DCP12</td>
<td>1.2</td>
<td>358867</td>
<td>6023774</td>
<td>1.5</td>
<td>Y</td>
</tr>
<tr>
<td>DCP13</td>
<td>0.7</td>
<td>359451</td>
<td>6022928</td>
<td>1.5</td>
<td>Y</td>
</tr>
<tr>
<td>DCP14</td>
<td>1.1</td>
<td>360029</td>
<td>6022218</td>
<td>1.5</td>
<td>Y</td>
</tr>
<tr>
<td>DCP15</td>
<td>1.2</td>
<td>360464</td>
<td>6021222</td>
<td>1.5</td>
<td>Y</td>
</tr>
<tr>
<td>DCP16</td>
<td>0.6</td>
<td>361070</td>
<td>6020450</td>
<td>1.5</td>
<td>Y</td>
</tr>
<tr>
<td>DCP17</td>
<td>0.7</td>
<td>361598</td>
<td>6019435</td>
<td>1.5</td>
<td>Y</td>
</tr>
</tbody>
</table>

5  GROUND MODEL

5.1 Regional Geology

The Geological Survey of South Australia 1:250,000 geological map Sheet 1 54-13 “Barker” Sheet suggests that the expected subsurface conditions of the islands within the channel, and along the northern shore of the Coorong comprise Quaternary kunkarised dunes, sand spreads and kunkar related to calcareous rock. The Younghusband Peninsula is expected to be underlain by quaternary alluvial deposits.

A review of geological information published on the South Australian Resource Information Gateway (SARIG, 2021) indicates the subsurface conditions of the islands and Coorong north shore are described as the Bridgewater Formation (Qpcb) comprising Coastal barrier and shallow sub-tidal sediments: bioclastic and aeolian cross-bedded calcarenite, palaeosol horizons, often capped by calcrete. The Younghusband Peninsula subsurface is expected to be underlain by the Semaphore Sand Member (Qhcks) described therein as unconsolidated white bioclastic quartz-carbonate sand of modern beaches and transgressive dune fields.

An excerpt of the regional geology map taken from SARIG is shown in Figure 4.

Based on these reviews, we would expect the dredging/excavation activities to encounter sands, clays and gravels with the potential for high strength calcrete layers to be intercepted at all locations. The investigation of the presence and extent of these calcrete layers would be the key consideration of any intrusive geotechnical investigation.
6 GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS

6.1 Estimated Geotechnical Model

The DCP test results indicated that the existing ground has very little resistance within the investigation depth. A slightly increased resistance of (DCP blows between 3 and 10) is found at selected locations (DCP01, DCP06, DCP09, DCP11, DCP15, DCP16 and DCP17) at a depth 1.0m below ground level.

Based on the limited field investigation DCP test data obtained from this study (presented in Appendix A) an estimated geotechnical model has been assessed for Coorong Lagoon Dredging alignment and provided in Table 2.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Depth range (mBGL)</th>
<th>$\phi$ (°)</th>
<th>$c$ (kPa)</th>
<th>$C_u$ (kPa)</th>
<th>$\gamma$ (kN/m²)</th>
<th>$E'$ (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semaphore Sand</td>
<td>0</td>
<td>1.5</td>
<td>25</td>
<td>-</td>
<td>17</td>
<td>5</td>
</tr>
<tr>
<td>Bridgewater Formation Sand*</td>
<td>0</td>
<td>1.5</td>
<td>32</td>
<td>-</td>
<td>18</td>
<td>20</td>
</tr>
</tbody>
</table>

Suitable pad foundation layer not identified
6.2 Construction Issues

6.2.1 Excavatability

Based on the resistance to DCP testing the resistance to excavation or dredging may vary across the site. Granular natural soils and organic clay soils are assessed to be excavatable at least up to 1.5m using conventional earthmoving equipment such as backhoes and excavators. Inferred calcrete layer was encountered at DCP08 at a depth of 1.3m. The hard layer is prone to very strong resistance to the conventional earthmoving equipment such as graders, excavators and backhoes and slower production rates during trenching are anticipated.

6.2.2 Excavation Stability

All trench excavations deeper than 0.5 m will need to be supported, or continuous battered. Noting a specific assessment by geotechnical engineer is recommended.

Temporary excavations exceeding 0.5m depth should be continuously battered back at a slope no greater than 1V: 3H. Use of heavy machinery adjacent to open excavations must be avoided.

It is recommended that upon confirmation of the proposed construction methodology and where required as per the above guideline, geotechnical design advice is sought to ensure mitigation of geotechnical related hazards. CMW are able to assist in such an assessment.

7 FURTHER WORK

CMW has extensive experience in the detailed design of foundations, pad, shallow footings and deep foundations. We would be pleased to undertake this work to optimise the design solutions for the project. If required, CMW can assist in the detailed design or the review of designs prepared by other parties.

It is recommended that an experienced geotechnical engineer attend site to verify the validity of the assumptions made by the designer as to the subsurface conditions encountered.

8 CLOSURE

The findings contained within this report are the result of limited discrete investigations conducted in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, can it be considered that these findings represent the actual state of the ground conditions away from our investigation locations.

If the ground conditions encountered during construction are significantly different from those described in this report and on which the conclusions and recommendations were based, then we must be notified immediately.

This report has been prepared for use for KBR in relation to the proposed development at Coorong Infrastructure Feasibility Assessment of Coorong Lagoon Dredging Project at Coorong SA 5264 in accordance with generally accepted consulting practice.
No other warranty, expressed or implied, is made as to the professional advice included in this report. Use of this report by parties other than KBR and their respective consultants and contractors is at their risk as it may not contain sufficient information for any other purposes.

For and on behalf of CMW Geosciences

Prepared by: Reviewed and authorised by:

Abu Rabbi John Slade
Project Geotechnical Engineer Principal Geotechnical Engineer, CPEng

Distribution: 1 electronic copy to KBR via email
Original held at CMW Geosciences
Drawing 1
Site Plan
Appendix A
Results of Field Investigation
<table>
<thead>
<tr>
<th>Easting</th>
<th>350611</th>
<th>351463</th>
<th>352199</th>
<th>353198</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northing</td>
<td>6032118</td>
<td>6031474</td>
<td>6030548</td>
<td>6029427</td>
</tr>
<tr>
<td>Depth of Water (m)</td>
<td>0.8</td>
<td>0.9</td>
<td>0.8</td>
<td>1.1</td>
</tr>
<tr>
<td>Time of Testing</td>
<td>9.40 AM</td>
<td>10.30 AM</td>
<td>11.00 AM</td>
<td>11.35 AM</td>
</tr>
<tr>
<td>Depth Range (mm)</td>
<td>DCP01</td>
<td>DCP02</td>
<td>DCP03</td>
<td>DCP04</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>0-100</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>100 - 200</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>200 - 300</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>300 - 400</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>400 - 500</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>500 - 600</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>600 - 700</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>700 - 800</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>800 - 900</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>900 - 1000</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1000 - 1100</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1100 - 1200</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1200 - 1300</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1300 - 1400</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1400 - 1500</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1500 - 1600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1600 - 1700</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1700 - 1800</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1800 - 1900</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1900 - 2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000 - 2100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1) DCP tests were recorded as blows / 100 mm interval.
<table>
<thead>
<tr>
<th>Depth Range (mm)</th>
<th>DCP05</th>
<th>DCP06</th>
<th>DCP07</th>
<th>DCP08</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-100</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>100 - 200</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>200 - 300</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>300 - 400</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>400 - 500</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>500 - 600</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>600 - 700</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>700 - 800</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>800 - 900</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>900 - 1000</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1000 - 1100</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1100 - 1200</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1200 - 1300</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>1300 - 1400</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1400 - 1500</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1500 - 1600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1600 - 1700</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1700 - 1800</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1800 - 1900</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1900 - 2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000 - 2100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1) DCP tests were recorded as blows / 100 mm interval.
### Dynamic Cone Penetrometer Testing

**Location:**
- **Easting:** 356322, 357015, 357976, 358867
- **Northing:** 6025331, 6024740, 6024372, 6023774
- **Depth of Water (m):** 0.9, 0.8, 0.7, 1.2
- **Time of Testing:** 2.40 PM, 2.15 PM, 1.40 PM, 1.15 PM

<table>
<thead>
<tr>
<th>Depth Range (mm)</th>
<th>DCP09</th>
<th>DCP10</th>
<th>DCP11</th>
<th>DCP12</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-100</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>100 - 200</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>200 - 300</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>300 - 400</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>400 - 500</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>500 - 600</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>600 - 700</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>700 - 800</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>800 - 900</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>900 - 1000</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1000 - 1100</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1100 - 1200</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1200 - 1300</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>1300 - 1400</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>1400 - 1500</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1500 - 1600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1600 - 1700</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1700 - 1800</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1800 - 1900</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1900 - 2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1) DCP tests were recorded as blows / 100 mm interval.
<table>
<thead>
<tr>
<th>Depth Range (mm)</th>
<th>DCP13</th>
<th>DCP14</th>
<th>DCP15</th>
<th>DCP16</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-100</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>100 - 200</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>200 - 300</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>300 - 400</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>400 - 500</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>500 - 600</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>600 - 700</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>700 - 800</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>800 - 900</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>900 - 1000</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>1000 - 1100</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>1100 - 1200</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>1200 - 1300</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>1300 - 1400</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>1400 - 1500</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>1500 - 1600</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>1600 - 1700</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>1700 - 1800</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>1800 - 1900</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>1900 - 2000</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>10</td>
</tr>
</tbody>
</table>

Notes:
1) DCP tests were recorded as blows / 100 mm interval.
<table>
<thead>
<tr>
<th>Depth Range (mm)</th>
<th>DCP 17</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-100</td>
<td>1</td>
</tr>
<tr>
<td>100 - 200</td>
<td>1</td>
</tr>
<tr>
<td>200 - 300</td>
<td>1</td>
</tr>
<tr>
<td>300 - 400</td>
<td>0</td>
</tr>
<tr>
<td>400 - 500</td>
<td>1</td>
</tr>
<tr>
<td>500 - 600</td>
<td>0</td>
</tr>
<tr>
<td>600 - 700</td>
<td>0</td>
</tr>
<tr>
<td>700 - 800</td>
<td>1</td>
</tr>
<tr>
<td>800 - 900</td>
<td>2</td>
</tr>
<tr>
<td>900 - 1000</td>
<td>3</td>
</tr>
<tr>
<td>1000 - 1100</td>
<td>3</td>
</tr>
<tr>
<td>1100 - 1200</td>
<td>3</td>
</tr>
<tr>
<td>1200 - 1300</td>
<td>4</td>
</tr>
<tr>
<td>1300 - 1400</td>
<td>5</td>
</tr>
<tr>
<td>1400 - 1500</td>
<td>6</td>
</tr>
<tr>
<td>1500 - 1600</td>
<td></td>
</tr>
<tr>
<td>1600 - 1700</td>
<td></td>
</tr>
<tr>
<td>1700 - 1800</td>
<td></td>
</tr>
<tr>
<td>1800 - 1900</td>
<td></td>
</tr>
<tr>
<td>1900 - 2000</td>
<td></td>
</tr>
<tr>
<td>2000 - 2100</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1) DCP tests were recorded as blows / 100 mm interval.