



Government of **Western Australia**  
Department of **Water and Environmental Regulation**

# Esperance saltwater interface project

Bore completion report



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For more information about this report contact the Water Resource Science Branch.

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# 1 Summary

Seawater intrusion is a risk to the groundwater quality of all coastal aquifers in Western Australia. All coastal aquifers discharging into the ocean contain a 'seawater interface' (SWI), the zone of fresh water and seawater interaction that forms where seaward flow of less dense fresh groundwater meets denser seawater. At this interface the seawater is typically present as a wedge-shaped body of saline groundwater along the base of the aquifer underlying the fresh groundwater.

Seawater intrusion risks are currently monitored in various groundwater areas across the state using a network of monitoring bores developed progressively over many decades. This network was constructed for a variety of purposes including stratigraphic and water supply investigation as well as targeted SWI monitoring (SWIM) bores. This network is variably monitored for groundwater levels and/or quality.

The suitability of these bores for ongoing monitoring of seawater intrusion risks has been reviewed for the Esperance groundwater area. Some gaps in the information currently being collected have been identified. The drilling program outlined in this report was undertaken to address these data gaps and improve knowledge of the Esperance hydrogeological system.

The objectives of the drilling program:

- Locate the extent of the SWI in the Esperance groundwater area
- Install infrastructure to enable long-term monitoring of changes in groundwater levels and salinity
- Monitor groundwater levels and changes in salinity for a period of one year
- Provide recommendations for ongoing monitoring in order to satisfy groundwater allocation plan commitments
- Develop groundwater salinity GIS layers to assist licencing officers, and regional hydrogeologists with applications for groundwater abstraction.

The drilling program and this report addresses the first two points. The remainder of the objectives will be addressed in a priority area assessment report.

## 2 Background

This report provides a summary of the drilling works undertaken in the Esperance groundwater area as part of the State Groundwater Investigation Program during 2020.

The aim of this project is to provide the Department of Water and Environmental Regulation (the department) with the appropriate information and infrastructure to effectively monitor and manage the risk to the fresh groundwater resource from seawater intrusion near the coast. The monitoring is focused in areas where the SWI is known or inferred and there is reason to suggest a risk of seawater impacting groundwater users or groundwater dependent ecosystems and amenity values.

A total of ten groundwater areas were identified as being at high risk from SWI movement inland. The Esperance groundwater area was one of the ten identified. The Twilight, Town, and Bandy subareas of the Esperance groundwater area were the focus of the investigation due to the large volume of licensed and unlicensed groundwater abstraction.

### 2.1 Location

The regional centre of Esperance is located on the eastern south coast of Western Australia, approximately 720 km by road from Perth. Esperance is an important service centre for agriculture, fishing, tourism and mining in the area (Figure 1).

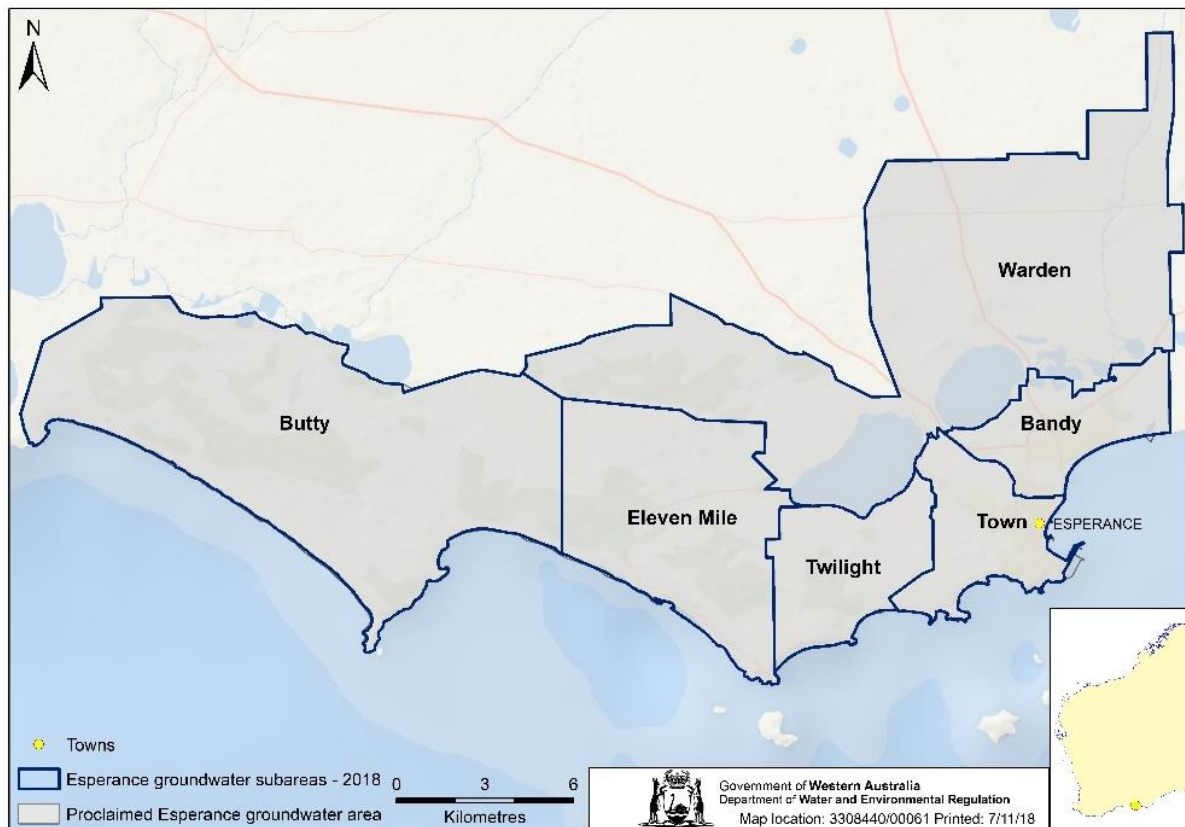


Figure 1 *Esperance SWI project location map*



## 2.2 Regional geology

Basement rock in the study area consists of Proterozoic granite and gneiss of the Albany-Fraser Orogen and Archaean granite of the Yilgarn Craton. Basement rocks were overlain by Tertiary sediments during a marine transgression in the middle to late Eocene. The Tertiary sediments consist of the Werillup Formation and the overlying Pallinup Siltstone known collectively as the Plantagenet Group sediments. Quaternary deposits form shelly limestone and sand ridges extending along the coastline. The thickest of these deposits form prominent sand dunes towards the southwest (Johnson and Baddock, 1998).

The mid-upper Eocene Werillup Formation (*TPw*) was deposited in a low energy fluvial to marginal marine environment. It consists of unconsolidated to consolidated fine to coarse sand, silt and carbonaceous clay with some lignite. The upper Eocene Pallinup Siltstone (*TPp*), which disconformably overlies the Werillup Formation, was deposited in a shallow-marine environment. It consists of multi-coloured siltstone to fine grained clayey sandstone with minor glauconite, spongolites and various marine fossils (Johnson and Baddock, 1998).

The upper portion of the Pallinup Siltstone can be subdivided into the spongolite facies (*TPpg*) and the shoreline facies (*TPps*) shown in Figure 2. The shoreline facies consist of unconsolidated very fine to fine grained quartz sand and silt. The spongolite facies is largely made up of interlayered clay and siliceous spongolite and is highly fossiliferous.

Quaternary sediments overlie the Plantagenet Group sediments or unconformably overlie the weathered or fresh basement rock where absent. Quaternary deposits form large ridges of dune sand overlying calcareous shelly limestone. The limestone consists of fine to coarse grained quartz sand with variable cementation and abundant shells in some areas. Zones of clayey-sand to sandy-clay may occur at the base of the sand profile, possibly due to leaching and accumulation. The stratigraphic sequence is presented in Table 1.

Table 1 Stratigraphic sequence

| Eon         | Era      | Period     | Epoch  | Stratigraphic Unit                |  | Lithology                                                                                        |
|-------------|----------|------------|--------|-----------------------------------|--|--------------------------------------------------------------------------------------------------|
| Phanerozoic | Cenozoic | Quaternary |        | Quaternary coastal sediments (Qs) |  | Fine to coarse grained quartz sand with occasional marine shells. Calcareous sand and limestone. |
|             |          |            |        | <i>Unconformity</i>               |  |                                                                                                  |
|             |          | Tertiary   | Eocene | Plantagenet Group                 |  |                                                                                                  |
|             |          |            |        | Pallinup Siltstone (TPp)          |  | Siliclastic sand, silt and mudstones with spiculites and spongolites.                            |
|             |          |            |        | Werillup Formation (TPw)          |  | Fine to coarse sand, silt and carbonaceous clay with some lignite.                               |
|             |          |            |        | <i>Unconformity</i>               |  |                                                                                                  |
| Proterozoic |          |            |        | Granite and gneiss (Png)          |  | Granitic gneiss, metamorphosed mafic, metasedimentary.                                           |

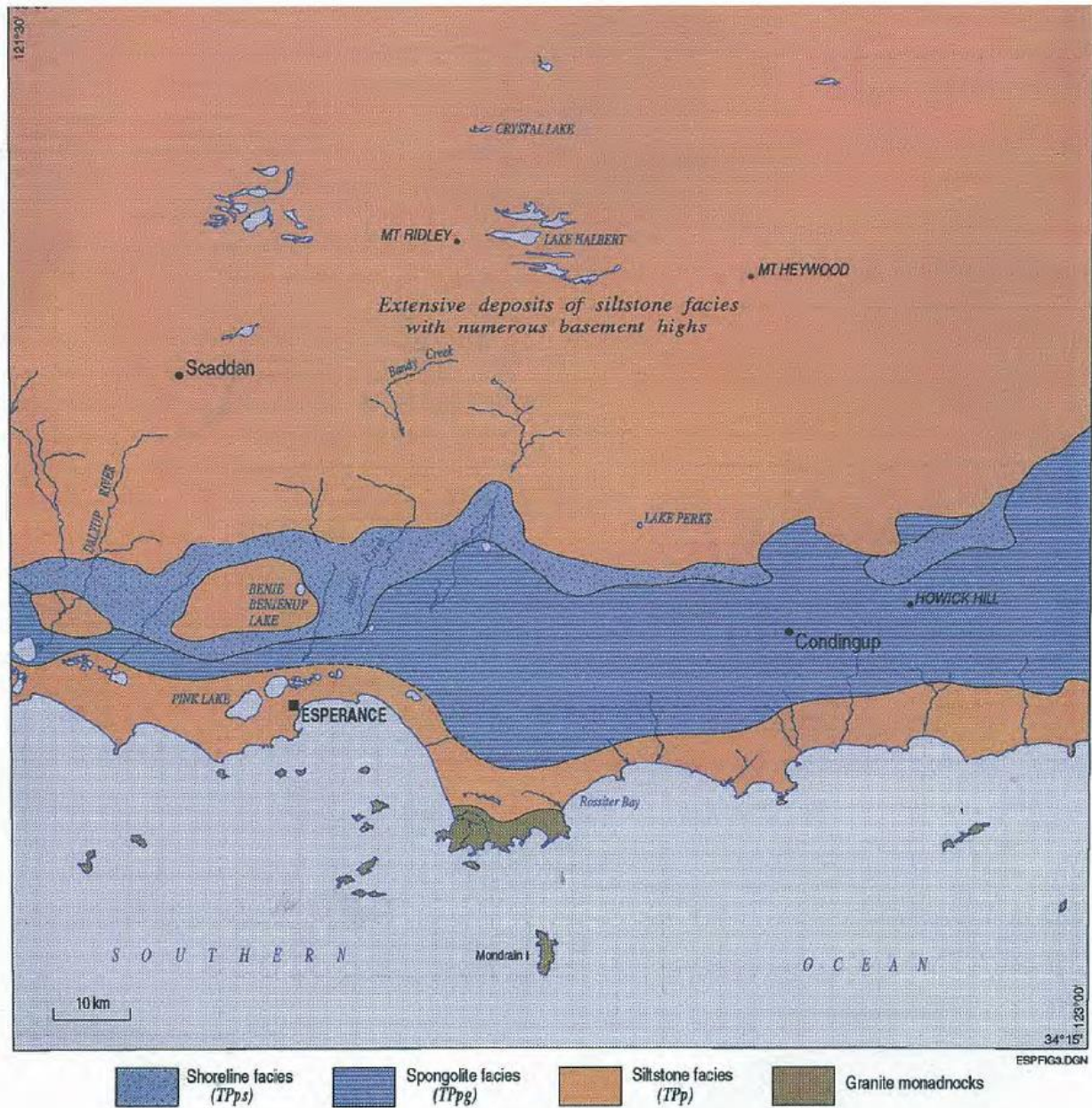


Figure 2 Extent of Pallinup Siltstone (Johnson and Baddock, 1998)

## 2.3 Hydrogeology

The Quaternary and Tertiary sediments along the coastline form the regionally significant superficial aquifer and the sedimentary aquifer respectfully. The underlying fractured rock aquifer comprises Proterozoic basement rocks with groundwater present in localised fractures. A summary of the hydrogeological units is presented in Table 2.

Table 2 Hydrogeological unit summary

| Aquifer        | Stratigraphic Unit                |                          | Hydrogeological Unit      |
|----------------|-----------------------------------|--------------------------|---------------------------|
| Superficial    | Quaternary coastal sediments (Qs) |                          | Aquifer                   |
| Sedimentary    | Plantagenet Group                 | Pallinup Siltstone (TPp) | Minor aquifer to aquitard |
|                |                                   | Werillup Formation (TPw) | Aquifer                   |
| Fractured rock | Granite and gneiss (Png)          |                          | Minor aquifer             |

### Superficial aquifer

The Quaternary coastal sediments form the superficial unconfined aquifer along the coast from Lake Gore to Esperance (DoW, 2007). The aquifer is regionally important and provides the main water supply for the town of Esperance. The sediments comprise fine to medium-grained sand grading into shelly limestone, high intergranular porosity, high permeability and a maximum saturated thickness of up to 30 m (Johnson and Baddock, 1998). The Quaternary sediments are either underlain by the Tertiary Plantagenet Group (Pallinup Siltstone and Werillup Formation) or may lie directly on the weathered or fresh Proterozoic basement (Figure 3).

The aquifer is recharged primarily by infiltration of rainfall. Groundwater recharge is estimated to be 10 per cent to 30 per cent of rainfall in the coastal Quaternary dunes (Johnson and Baddock, 1998). A groundwater mound occurs within the coastal sediments between the coastline and Pink Lake. Groundwater flow is dominated by radial flow away from the crest of the mound towards the ocean and coastal lake discharge boundaries (DoW, 2007). The watertable elevation ranges from a high of over 50 m AHD near the Butty, Eleven Mile and Warden subarea intersection to 0 m AHD at the coast.

Groundwater within the coastal sediments is potable to marginal with salinity ranging between 500 and 800 mg/L (Johnson and Baddock, 1998). Due to the low salinity and density groundwater occurs as a lens overlying deeper saline water present in the aquifer.



## Sedimentary aquifer

The Plantagenet Group sediments, comprising the Werillup Formation and Pallinup Siltstone, form the sedimentary aquifer in the region. Differences in the lithological characteristics between the Werillup Formation and Pallinup Siltstone result in distinct hydrogeological properties between the two units. The Pallinup Siltstone forms a minor unconfined aquifer and is characterised by having low permeability. The Werillup Formation underlies the relatively impermeable siltstone and is characterised as a semi-confined aquifer. Bore yields typically range from 50 to 200 m<sup>3</sup>/day (Johnson and Baddock, 1998), however the groundwater quality in this aquifer is generally saline.

## Fractured rock aquifer

The Proterozoic granitoid and gneissic rocks form a low yielding minor aquifer below the sedimentary aquifer. Groundwater exists within joints and fractures, however are very sparse and potentially infilled with clay resulting in low permeability. Groundwater is generally saline up to 36,000 mg/L (Johnson and Baddock, 1998).

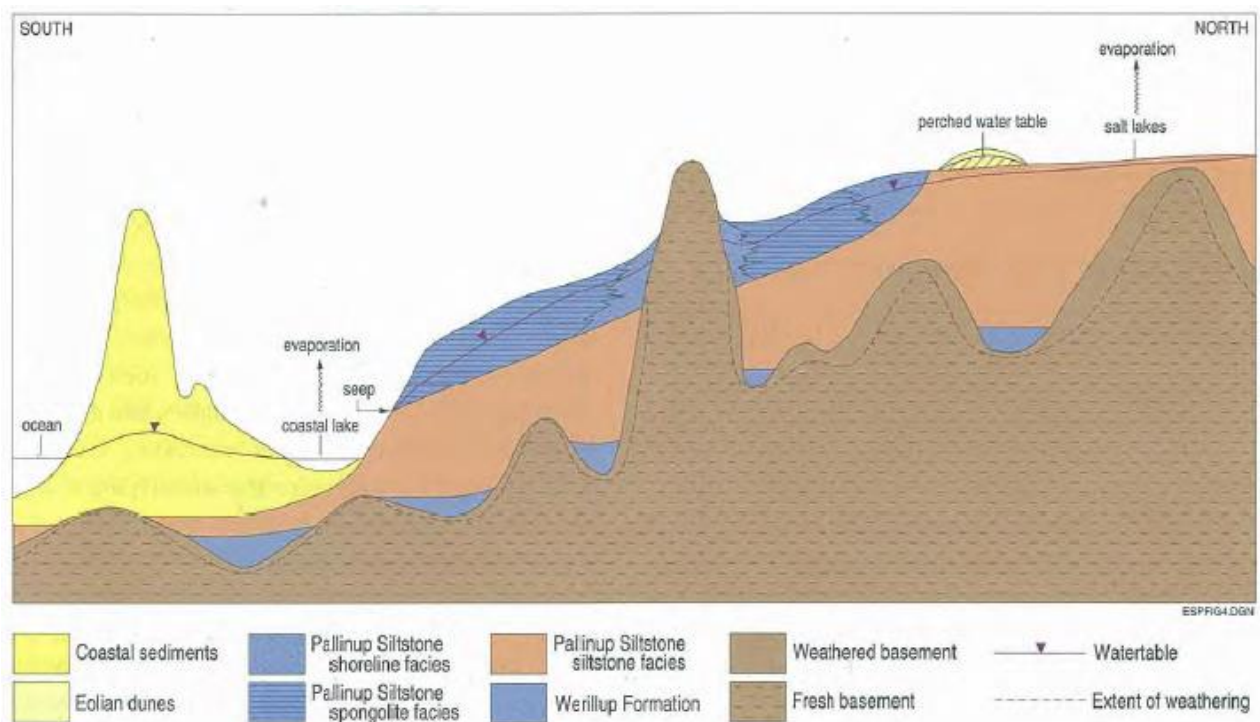


Figure 3 Groundwater occurrence (Johnson and Baddock, 1998)

### 3 Drilling and bore construction

The Esperance SWI drilling program began on 28 April 2020 and was completed on 27 May 2020. A total of 16 SWIM bores were installed (Figure 4). All SWIM bores were installed using sonic drilling methods. Drilling was carried out by Ecoprobe with a CompactRotoSonic drill rig. A (76 mm) 3" core barrel was run into the formation to retrieve lithological samples with 127 mm (5") casing installed to enable drilling through loose sands and karstic conditions. A groundwater sampling tool was also utilised during drilling to evaluate water quality parameters with depth.

Lithological samples were logged by the department's hydrogeologists on site during drilling. Groundwater samples were captured every 3 m below watertable to assess changes in water quality with depth. Palynology samples were collected and analysed by Backhouse Biostrat Pty Ltd (John Backhouse) to estimate age and confirm stratigraphic interpretations.

SWIM bores were constructed as fully screened piezometers to allow continuous electrical conductivity (EC) profiling and discrete hydrochemistry sampling. Bores were installed using a combination of blank and slotted (0.5 mm) 80 mm PN12 PVC casing. The 80 mm diameter casing was selected to enable the use of geophysical monitoring tools for ongoing monitoring of the SWI. The annulus was filled with 1.6 to 3.2 mm graded gravel to above the slotted casing. A sanitary bentonite seal was installed at the top of each bore to prevent surface water ingress and contamination to the aquifer.

Bore development was completed by airlifting until discharge water became clear and sediment free. During airlifting water quality parameters were monitored and collected every ten minutes including EC, pH, total dissolved solids (TDS), water temperature and turbidity.

All bores were completed with steel lockable headworks approximately 1 m above ground level. A concrete plinth was installed surrounding the base of the headworks above ground level. A summary of drilling and bore construction information is presented in Table 3. Further detail for each bore is presented in the following sections of this report.



Figure 4 SWIM bore location map

Table 3 Summary table for installed bores

| Bore          | AWRC     | Drilled Date Start | Drilled Date End | Easting (GDA 94 Z51) | Northing (GDA 94 Z51) | Ground Level (m AHD) | Top of Concrete (m AHD) | Top of PVC (m AHD) | Top of Headworks (m AHD) | Casing Material | Casing Diameter (mm) | Total Drilled Depth (m bgl) | Total Drilled Depth (m AHD) | Screen Interval From (m bgl) | Screen Interval To (m bgl) | Aquifer     | Water Level Date | Water Level (m bTOH) * | Water Level (m AHD) | Airlift Duration (min) | Airlift Date |
|---------------|----------|--------------------|------------------|----------------------|-----------------------|----------------------|-------------------------|--------------------|--------------------------|-----------------|----------------------|-----------------------------|-----------------------------|------------------------------|----------------------------|-------------|------------------|------------------------|---------------------|------------------------|--------------|
| BANSWIM-01-20 | 60140056 | 5/05/2020          | 5/05/2020        | 398365.52            | 6254303.23            | 3.26                 | 3.36                    | 3.75               | 3.81                     | PVC PN12        | 80                   | 24                          | -20.74                      | 3                            | 22                         | Superficial | 28/05/2020       | 2.85                   | 0.96                | 90                     | 8/05/2020    |
| BANSWIM-02-20 | 60140057 | 18/05/2020         | 18/05/2020       | 399683.95            | 6255412.47            | 5.85                 | 6.01                    | 6.29               | 6.53                     | PVC PN12        | 80                   | 27                          | -21.15                      | 5.5                          | 23.5                       | Superficial | 29/05/2020       | 5.40                   | 1.13                | 120                    | 27/05/2020   |
| BANSWIM-03-20 | 60140058 | 21/05/2020         | 21/05/2020       | 400872.43            | 6256770.81            | 4.85                 | 4.85                    | 5.39               | 5.38                     | PVC PN12        | 80                   | 22.4                        | -17.55                      | 3                            | 20                         | Superficial | 29/05/2020       | 4.40                   | 0.98                | 120                    | 22/05/2020   |
| BANSWIM-04-20 | 60140059 | 6/05/2020          | 6/05/2020        | 397639.68            | 6255130.90            | 5.74                 | 5.96                    | 6.27               | 6.40                     | PVC PN12        | 80                   | 24                          | -18.26                      | 3                            | 19                         | Superficial | 28/05/2020       | 2.70                   | 3.7                 | 120                    | 6/05/2020    |
| BANSWIM-05-20 | 60140064 | 26/05/2020         | 26/05/2020       | 399552.74            | 6256500.91            | 5.67                 | 5.79                    | 6.13               | 6.29                     | PVC PN12        | 80                   | 24                          | -18.33                      | 4                            | 20                         | Superficial | 29/05/2020       | 3.27                   | 3.02                | 80                     | 27/05/2020   |
| ELMSWIM-01-20 | 60140065 | 12/05/2020         | 12/05/2020       | 388398.65            | 6252135.44            | 8.38                 | 8.55                    | 8.94               | 9.05                     | PVC PN12        | 80                   | 36                          | -27.62                      | 6                            | 33                         | Superficial | 28/05/2020       | 5.81                   | 3.24                | 100                    | 16/05/2020   |
| TOWSWIM-01-20 | 60140053 | 4/05/2020          | 4/05/2020        | 397786.56            | 6252879.50            | 2.27                 | 2.43                    | 2.63               | 2.75                     | PVC PN12        | 80                   | 24                          | -21.73                      | 3                            | 21                         | Superficial | 28/05/2020       | 1.91                   | 0.84                | 120                    | 4/05/2020    |
| TOWSWIM-02-20 | 60140054 | 30/04/2020         | 1/05/2020        | 397319.16            | 6253255.00            | 5.22                 | 5.38                    | 5.67               | 5.83                     | PVC PN12        | 80                   | 30                          | -24.78                      | 5                            | 23                         | Superficial | 28/05/2020       | 4.13                   | 1.7                 | 120                    | 1/05/2020    |
| TOWSWIM-03-20 | 60140055 | 19/05/2020         | 19/05/2020       | 397555.50            | 6251952.84            | 2.20                 | 2.42                    | 2.75               | 2.88                     | PVC PN12        | 80                   | 30                          | -27.80                      | 3                            | 24                         | Superficial | 28/05/2020       | 2.06                   | 0.82                | 250                    | 22/05/2020   |
| TOWSWIM-04-20 | 60140060 | 6/05/2020          | 6/05/2020        | 393986.00            | 6254682.70            | 4.70                 | 4.88                    | 5.41               | 5.50                     | PVC PN12        | 80                   | 21                          | -16.30                      | 3                            | 18                         | Superficial | 28/05/2020       | 3.99                   | 1.51                | 120                    | 6/05/2020    |
| TOWSWIM-05-20 | 60140061 | 11/05/2020         | 11/05/2020       | 394994.32            | 6253490.60            | 7.88                 | 7.95                    | 8.28               | 8.45                     | PVC PN12        | 80                   | 27                          | -19.12                      | 6                            | 25                         | Superficial | 28/05/2020       | 6.93                   | 1.52                | 150                    | 16/05/2020   |
| TOWSWIM-06-20 | 60140063 | 18/05/2020         | 18/05/2020       | 397154.94            | 6251746.61            | 7.25                 | 7.32                    | 7.67               | 7.88                     | PVC PN12        | 80                   | 27                          | -19.75                      | 8.25                         | 19.25                      | Superficial | 28/05/2020       | 6.25                   | 1.63                | 120                    | 22/05/2020   |
| TOWSWIM-07-20 | 60140067 | 25/05/2020         | 25/05/2020       | 393967.30            | 6252754.16            | 6.96                 | 7.02                    | 7.37               | 7.49                     | PVC PN12        | 80                   | 23                          | -16.04                      | 6.5                          | 22.5                       | Superficial | 28/05/2020       | 7.30                   | 0.19                | 120                    | 25/05/2020   |
| TWLSWIM-01-20 | 60140051 | 29/04/2020         | 30/04/2020       | 389033.98            | 6252670.02            | 9.94                 | 10.03                   | 10.52              | 10.63                    | PVC PN12        | 80                   | 39                          | -29.06                      | 7                            | 37                         | Superficial | 28/05/2020       | 8.02                   | 2.61                | 150                    | 2/05/2020    |
| TWLSWIM-02-20 | 60140052 | 28/04/2020         | 28/04/2020       | 390366.30            | 6252188.69            | 6.10                 | 6.27                    | 6.65               | 6.81                     | PVC PN12        | 80                   | 27                          | -20.90                      | 5                            | 26                         | Superficial | 28/05/2020       | 4.91                   | 1.9                 | 180                    | 2/05/2020    |
| TWLSWIM-03-20 | 60140062 | 13/05/2020         | 14/05/2020       | 391622.88            | 6251302.80            | 24.04                | 24.15                   | 24.70              | 24.79                    | PVC PN12        | 80                   | 54                          | -29.96                      | 21                           | 51                         | Superficial | 28/05/2020       | 23.48                  | 1.31                | 235                    | 16/05/2020   |

\* Water level measured from top of headworks (TOH)



## 4 Bore BANSWIM-01-20

### 4.1 Location, maps and photographs

|                              |                                                                     |    |         |           |          |            |
|------------------------------|---------------------------------------------------------------------|----|---------|-----------|----------|------------|
| OWNER                        | Department of Water and Environmental Regulation                    |    |         |           |          |            |
| LOCATION                     | Intersection of Norseman Rd and Goldfields Rd next to caravan park. |    |         |           |          |            |
| MGA REF                      | Zone                                                                | 51 | Easting | 398365.52 | Northing | 6254303.23 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                                            |    |         |           |          |            |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)                                |    |         |           |          |            |
| PROJECT CODE                 | WA-G-SEAWATERIN                                                     |    |         |           |          |            |
| AWRC Ref. Number             | BANSWIM-01-20                                                       |    |         | 60140056  |          |            |



Figure 5 BANSWIM-01-20 location map

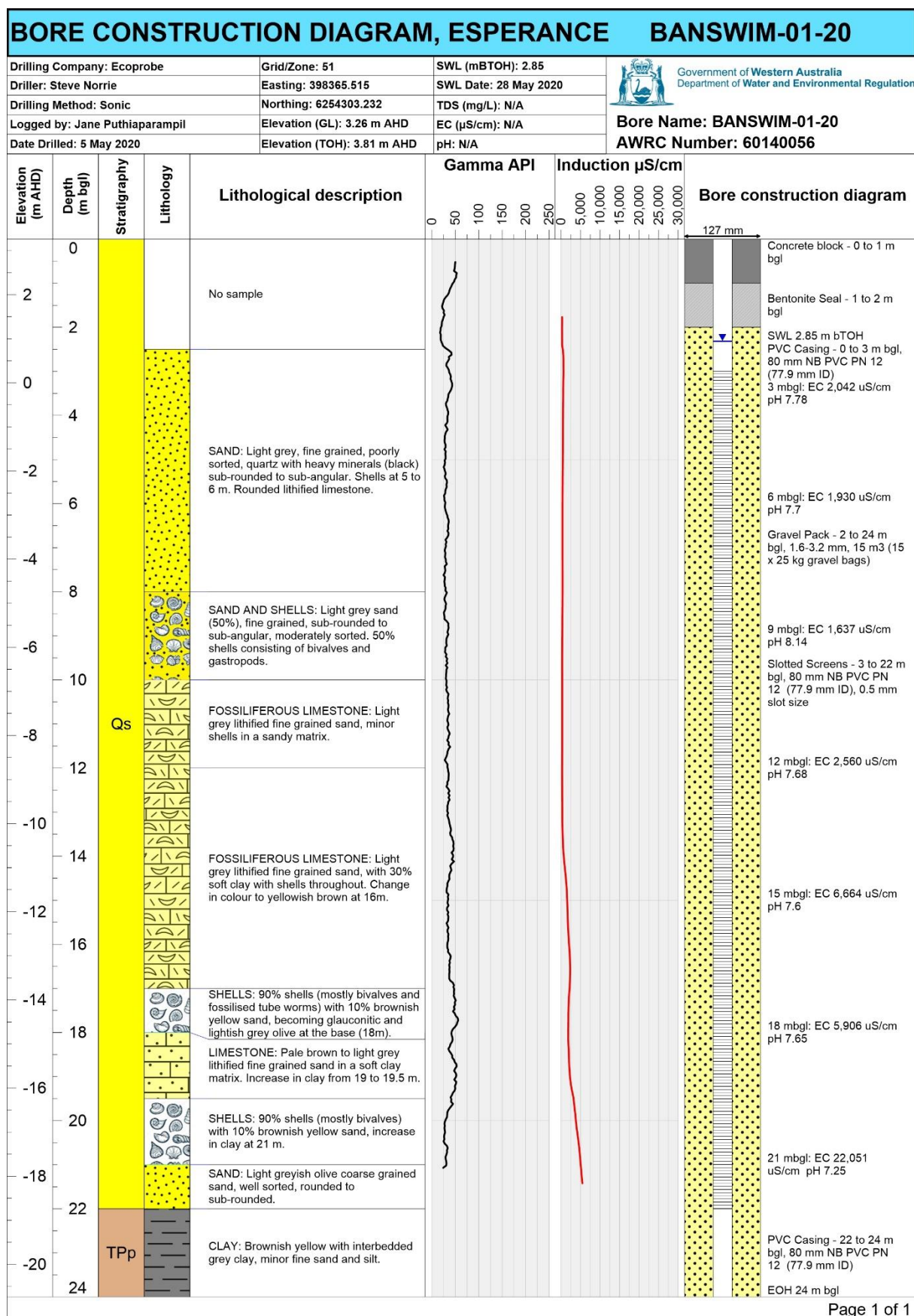




Figure 6 BANSWIM-01-20 photographs



## 4.2 Bore summary diagram



## 4.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Jane Puthiaparampil                                                                           |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 5/05/2020                                                                                     |                                  |                        |
| Drilling complete   | 5/05/2020                                                                                     |                                  |                        |
| Airlifting          | 8/05/2020                                                                                     |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     |                                                                                               | BANSWIM-01-20                    |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 3.26                   |
|                     | Top of casing                                                                                 | -0.49                            | 3.75                   |
|                     | Top of headworks                                                                              | -0.55                            | 3.81                   |
|                     | Cement block                                                                                  | -0.1                             | 3.36                   |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 24                               | 127 (5")               |
| Total depth (m bgl) | 24                                                                                            |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

### CASING AND SCREENS

| Depth (m bgl) |    | Type                            | ID (mm) | OD (mm) |
|---------------|----|---------------------------------|---------|---------|
| From          | To |                                 |         |         |
| 0             | 3  | PN 12 blank PVC                 | 77.93   | 88.9    |
| 3             | 22 | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 22            | 24 | PN 12 blank PVC                 | 77.93   | 88.9    |

### ANNULUS FILL

| Depth (m bgl) |    | Fill type                              |
|---------------|----|----------------------------------------|
| From          | To |                                        |
| 0             | 1  | Concrete seal                          |
| 1             | 2  | Bentonite Seal                         |
| 2             | 24 | Gravel pack (1.6 mm – 3.2 mm diameter) |



## 4.4 Lithological interpretation

| Depth<br>(m bgl) |     | Description                                                                                                                                                    | Stratigraphy         |
|------------------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| From             | To  |                                                                                                                                                                |                      |
| 0                | 2.5 | No sample                                                                                                                                                      | Quaternary sediments |
| 2.5              | 8   | SAND: Light grey, fine grained, poorly sorted, quartz with heavy minerals (black) sub-rounded to sub-angular. Shells at 5 to 6 m. Rounded lithified limestone. |                      |
| 8                | 10  | SAND AND SHELLS: Light grey sand (50%), fine grained, sub-rounded to sub-angular, moderately sorted. 50% shells consisting of bivalves and gastropods.         |                      |
| 10               | 12  | FOSSILIFEROUS LIMESTONE: Light grey lithified fine-grained sand, minor shells in a sandy matrix.                                                               |                      |
| 12               | 17  | FOSSILIFEROUS LIMESTONE: Light grey lithified fine-grained sand, with 30% soft clay with shells throughout. Change in colour to yellowish brown at 16m.        |                      |
| 17               | 18  | SHELLS: 90% shells (mostly bivalves and fossilised tube worms) with 10% brownish yellow sand, becoming glauconitic and lightish grey olive at the base (18m).  |                      |
| 18               | 20  | LIMESTONE: Pale brown to light grey lithified fine-grained sand in a soft clay matrix. Increase in clay from 19 to 19.5 m.                                     |                      |
| 19.5             | 21  | SHELLS: 90% shells (mostly bivalves) with 10% brownish yellow sand, increase in clay at 21 m.                                                                  |                      |
| 21               | 22  | SAND: Light greyish olive coarse-grained sand, well sorted, rounded to sub-rounded.                                                                            | Pallinup Siltstone   |
| 22               | 24  | CLAY: Brownish yellow with interbedded grey clay with minor fine sand and silt.                                                                                |                      |

## 4.5 Hydrogeological data

|                   |                                                      |
|-------------------|------------------------------------------------------|
| BORE              | BANSWIM-01-20                                        |
| SCREENED INTERVAL | 3 to 22 m bgl                                        |
| AQUIFER           | Superficial                                          |
| WATER LEVEL       | 2.85 m bTOH (m below top of headworks) on 28/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)  | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|------------|------|------------|-------------|-----------|--------|-----------|
| Water tank | 7.88 | 1,229      | 787         | 19.4      | 100    | 9.19      |
| Mud        | 8.49 | 1,690      | 1,082       | 20.5      | 95.1   | 8.12      |
| 3          | 7.78 | 2,042      | 1,307       | 2.5       | 48.4   | 4.31      |
| 6          | 7.70 | 1,930      | 1,235       | 20.7      | 29.4   | 2.61      |
| 9          | 8.14 | 1,637      | 1,048       | 20.4      | 81.2   | 7.25      |
| 12         | 7.68 | 2,560      | 1,638       | 21.8      | 66.7   | 5.70      |
| 15         | 7.60 | 6,664      | 4,265       | 24.4      | 4.3    | 0.35      |
| 18         | 7.65 | 5,906      | 3,780       | 21.5      | 70.5   | 6.08      |
| 21         | 7.25 | 22,051     | 14,113      | 23.5      | 14.1   | 1.08      |

\* Calculated TDS (0.64 conversion factor)

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date      | Time  | Depth (m) | L/s | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|-----------|-------|-----------|-----|------|------------|-------------|-----------|-----------------|
| 8/05/2020 | 10:15 | 20        | 0.8 | 7.24 | 22,002     | 14,081      | 17.3      | -               |
| 8/05/2020 | 10:25 | 20        | 0.8 | 7.23 | 21,160     | 13,542      | 17.3      | 32              |
| 8/05/2020 | 10:35 | 20        | 0.8 | 7.27 | 21,927     | 14,033      | 17.7      | 23              |
| 8/05/2020 | 10:45 | 20        | 0.8 | 7.30 | 22,377     | 14,321      | 17.2      | 29              |
| 8/05/2020 | 10:55 | 20        | 0.8 | 7.30 | 22,141     | 14,170      | 17.4      | 17              |
| 8/05/2020 | 11:05 | 20        | 0.8 | 7.25 | 22,205     | 14,211      | 17.6      | 16              |
| 8/05/2020 | 11:15 | 20        | 0.8 | 7.28 | 22,296     | 14,269      | 17.5      | 16              |
| 8/05/2020 | 11:25 | 20        | 0.8 | 7.41 | 22,220     | 14,221      | 16.9      | 16              |

\* Calculated TDS (0.64 conversion factor)

## 4.6 Geophysical data

|              |                                                                                                                                                                                                 |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma <input checked="" type="checkbox"/> Induction<br><input type="checkbox"/> Long and Short Normal Resistivity <input type="checkbox"/> Calliper |
| LOGGING UNIT | Westlog                                                                                                                                                                                         |

## 4.7 Palynology data

| Sample depth<br>(m bgl) | Spore-Pollen zone                                                                                        | Comments and key species present                                                                                                                                                                                                                                                                                                  |
|-------------------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20.5 to 21              | Holocene to possibly Late Pleistocene. Probably equivalent to informal <i>Fenestrites spinosus</i> Zone. | Palynomorphs dominated by MP with colonial algae <i>Botryococcus</i> at 50%, and single-cell algae <i>Leiosphaeridia</i> spp. (27%) most abundant, and angiosperm pollen (18%) next most abundant. The young age assignment based on dominance of the <i>Restionaceae</i> pollen <i>Milfordia incerta</i> at 46% of the SP count. |

## 5 Bore BANSWIM-02-20

### 5.1 Location, maps and photographs

|                              |                                                              |    |         |           |          |            |
|------------------------------|--------------------------------------------------------------|----|---------|-----------|----------|------------|
| OWNER                        | Department of Water and Environmental Regulation             |    |         |           |          |            |
| LOCATION                     | Corner of Chaplin St and Castletown Qys in the median strip. |    |         |           |          |            |
| MGA REF                      | Zone                                                         | 51 | Easting | 399683.95 | Northing | 6255412.47 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                                     |    |         |           |          |            |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)                         |    |         |           |          |            |
| PROJECT CODE                 | WA-G-SEAWATERIN                                              |    |         |           |          |            |
| AWRC Ref. Number             | BANSWIM-02-20                                                |    |         | 60140057  |          |            |





Figure 7 BANSWIM-02-20 location map

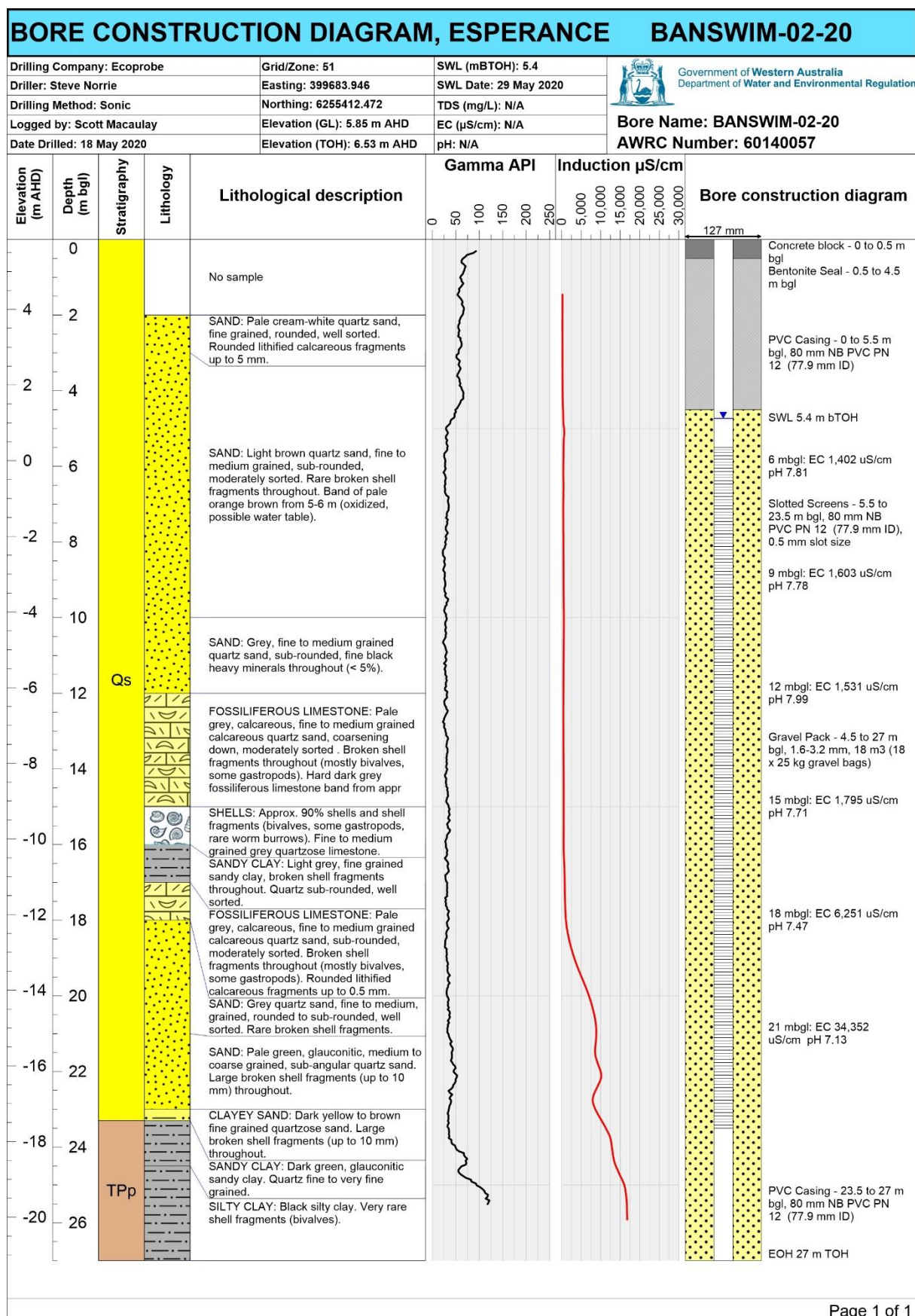




Figure 8 BANSWIM-02-20 photographs



## 5.2 Bore summary diagram



## 5.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Scott Macaulay                                                                                |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 18/05/2020                                                                                    |                                  |                        |
| Drilling complete   | 18/05/2020                                                                                    |                                  |                        |
| Airlifting          | 27/05/2020                                                                                    |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     |                                                                                               | BANSWIM-02-20                    |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 5.85                   |
|                     | Top of casing                                                                                 | -0.44                            | 6.29                   |
|                     | Top of headworks                                                                              | -0.68                            | 6.53                   |
|                     | Cement block                                                                                  | -0.16                            | 6.01                   |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 27                               | 127 (5")               |
| Total depth (m bgl) | 27                                                                                            |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

### CASING AND SCREENS

| Depth (m bgl) |      | Type                            | ID (mm) | OD (mm) |
|---------------|------|---------------------------------|---------|---------|
| From          | To   |                                 |         |         |
| 0             | 5.5  | PN 12 blank PVC                 | 77.93   | 88.9    |
| 5.5           | 23.5 | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 23.5          | 27   | PN 12 blank PVC                 | 77.93   | 88.9    |

### ANNULUS FILL

| Depth (m bgl) |     | Fill type                              |
|---------------|-----|----------------------------------------|
| From          | To  |                                        |
| 0             | 0.5 | Concrete seal                          |
| 0.5           | 4.5 | Bentonite Seal                         |
| 4.5           | 27  | Gravel pack (1.6 mm – 3.2 mm diameter) |



## 5.4 Lithological interpretation

| Depth<br>(m bgl) |    | Description                                                                                                                                                                                                                                                                    | Stratigraphy         |
|------------------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| From             | To |                                                                                                                                                                                                                                                                                |                      |
| 0                | 2  | No sample                                                                                                                                                                                                                                                                      | Quaternary sediments |
| 2                | 3  | SAND: Pale cream-white quartz sand, fine grained, rounded, well sorted. Rounded lithified calcareous fragments up to 5 mm.                                                                                                                                                     |                      |
| 3                | 10 | SAND: Light brown quartz sand, fine to medium grained, sub-rounded, moderately sorted. Rare broken shell fragments throughout. Band of pale orange brown from 5 to 6 m (oxidized, possible water table).                                                                       |                      |
| 10               | 12 | SAND: Grey, fine to medium-grained quartz sand, sub-rounded, fine black heavy minerals throughout (< 5%).                                                                                                                                                                      |                      |
| 12               | 15 | FOSSILIFEROUS LIMESTONE: Pale grey, calcareous, fine to medium-grained calcareous quartz sand, coarsening down, moderately sorted. Broken shell fragments throughout (mostly bivalves, some gastropods). Hard dark grey fossiliferous limestone band from approx 14.8 to 15 m. |                      |
| 15               | 16 | SHELLS: Approx. 90% shells and shell fragments (bivalves, some gastropods, rare worm burrows). Fine to medium-grained grey quartzose limestone.                                                                                                                                |                      |
| 16               | 17 | SANDY CLAY: Light grey, fine-grained sandy clay, broken shell fragments throughout. Quartz sub-rounded, well sorted.                                                                                                                                                           |                      |
| 17               | 18 | FOSSILIFEROUS LIMESTONE: Pale grey, calcareous, fine to medium-grained calcareous quartz sand, sub-rounded, moderately sorted. Broken shell fragments throughout (mostly bivalves, some gastropods). Rounded lithified calcareous fragments up to 0.5 mm.                      |                      |
| 18               | 21 | SAND: Grey quartz sand, fine to medium grained, rounded to sub-rounded, well sorted. Rare broken shell fragments.                                                                                                                                                              |                      |
| 21               | 23 | SAND: Pale green, glauconitic, medium to coarse grained, sub-angular quartz sand. Large broken shell fragments (up to 10 mm) throughout.                                                                                                                                       |                      |
| 23               | 23 | CLAYEY SAND: Dark yellow to brown fine-grained quartzose sand. Large broken shell fragments (up to 10 mm) throughout.                                                                                                                                                          | Pallinup Siltstone   |
| 23.3             | 25 | SANDY CLAY: Dark green, glauconitic sandy clay. Quartz fine to very fine grained.                                                                                                                                                                                              |                      |
| 24.5             | 27 | SILTY CLAY: Black silty clay. Very rare shell fragments (bivalves).                                                                                                                                                                                                            |                      |

## 5.5 Hydrogeological data

|                   |                                                     |
|-------------------|-----------------------------------------------------|
| BORE              | BANSWIM-02-20                                       |
| SCREENED INTERVAL | 5.5 to 23.5 m bgl                                   |
| AQUIFER           | Superficial                                         |
| WATER LEVEL       | 5.4 m bTOH (m below top of headworks) on 29/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)  | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|------------|------|------------|-------------|-----------|--------|-----------|
| Water tank | 7.41 | 1,271      | 813         | 16.8      | 71.6   | 6.89      |
| Mud        | 7.97 | 1,863      | 1,192       | 14.9      | 19.6   | 2.04      |
| 6          | 7.81 | 1,402      | 897         | 20.0      | 7.0    | 0.64      |
| 9          | 7.78 | 1,603      | 1,026       | 19.1      | 6.0    | 0.55      |
| 12         | 7.99 | 1,531      | 980         | 17.1      | 59.9   | 5.73      |
| 15         | 7.71 | 1,795      | 1,149       | 19.1      | 5.4    | 0.48      |
| 18         | 7.47 | 6,251      | 4,001       | 25.1      | 4.0    | 0.34      |
| 21         | 7.13 | 34,352     | 21,985      | 19.8      | 17.9   | 1.46      |

\* Calculated TDS (0.64 conversion factor)

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date       | Time  | Depth (m) | L/s | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|------------|-------|-----------|-----|------|------------|-------------|-----------|-----------------|
| 27/05/2020 | 11:10 | 26        | 1   | 7.81 | 35,746     | 22,877      | 20.5      | 210             |
| 27/05/2020 | 11:20 | 26        | 1   | 7.85 | 39,325     | 25,168      | 19.2      | 92              |
| 27/05/2020 | 11:30 | 26        | 1   | 7.64 | 40,220     | 25,741      | 19.8      | 17              |
| 27/05/2020 | 11:40 | 26        | 1   | 7.60 | 39,544     | 25,308      | 19.2      | 18              |
| 27/05/2020 | 11:50 | 26        | 1   | 7.76 | 39,575     | 25,328      | 18.3      | 19              |
| 27/05/2020 | 12:00 | 26        | 1   | 7.65 | 39,215     | 25,098      | 19.0      | 19              |
| 27/05/2020 | 12:10 | 26        | 1   | 7.74 | 39,205     | 25,091      | 18.4      | 19              |
| 27/05/2020 | 12:20 | 26        | 1   | 7.62 | 38,837     | 24,856      | 18.8      | 19              |
| 27/05/2020 | 12:30 | 26        | 1   | 7.61 | 38,431     | 24,596      | 18.9      | 17              |
| 27/05/2020 | 12:40 | 26        | 1   | 7.60 | 38,681     | 24,756      | 18.8      | 14              |
| 27/05/2020 | 12:50 | 26        | 1   | 7.75 | 38,709     | 24,774      | 17.7      | 13              |
| 27/05/2020 | 13:00 | 26        | 1   | 7.75 | 38,708     | 24,773      | 18.4      | 9               |

\* Calculated TDS (0.64 conversion factor)

## 5.6 Geophysical data

|              |                                                                                                                                                                                                 |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma <input checked="" type="checkbox"/> Induction<br><input type="checkbox"/> Long and Short Normal Resistivity <input type="checkbox"/> Calliper |
| LOGGING UNIT | Westlog                                                                                                                                                                                         |

## 5.7 Palynology data

| Sample depth<br>(m bgl) | Spore-Pollen zone                                                                    | Comments and key species present                                                                                                                                                                                                                                |
|-------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24                      | Lower N. asperus Zone ( <i>D. heterophlycta</i> Zone). Bartonian late Middle Eocene. | Limited marine assemblage with MP 2% of SP + MP count. Abundant <i>Nothofagidites</i> spp. at 29% in similar assemblage favours same SP zone assignment. FO of <i>D. heterophlycta</i> in limited diversity MP assemblage also favours same MP zone assignment. |
| 26                      | Lower N. asperus Zone ( <i>D. heterophlycta</i> Zone). Bartonian late Middle Eocene. | Marine assemblage with MP 23% of SP + MP count. Abundant <i>Nothofagidites</i> spp. at 25% in another similar assemblage again favours same SP zone assignment. FO of <i>D. heterophlycta</i> again favours same MP zone assignment.                            |

## 6 Bore BANSWIM-03-20

### 6.1 Location, maps and photographs

|                              |                                                  |    |         |           |          |            |
|------------------------------|--------------------------------------------------|----|---------|-----------|----------|------------|
| OWNER                        | Department of Water and Environmental Regulation |    |         |           |          |            |
| LOCATION                     | End of Frank Freeman Dr in cul-de-sac island.    |    |         |           |          |            |
| MGA REF                      | Zone                                             | 51 | Easting | 400872.43 | Northing | 6256770.81 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                         |    |         |           |          |            |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)             |    |         |           |          |            |
| PROJECT CODE                 | WA-G-SEAWATERIN                                  |    |         |           |          |            |
| AWRC Ref. Number             | BANSWIM-03-20                                    |    |         | 60140058  |          |            |





Figure 9 BANSWIM-03-20 location map

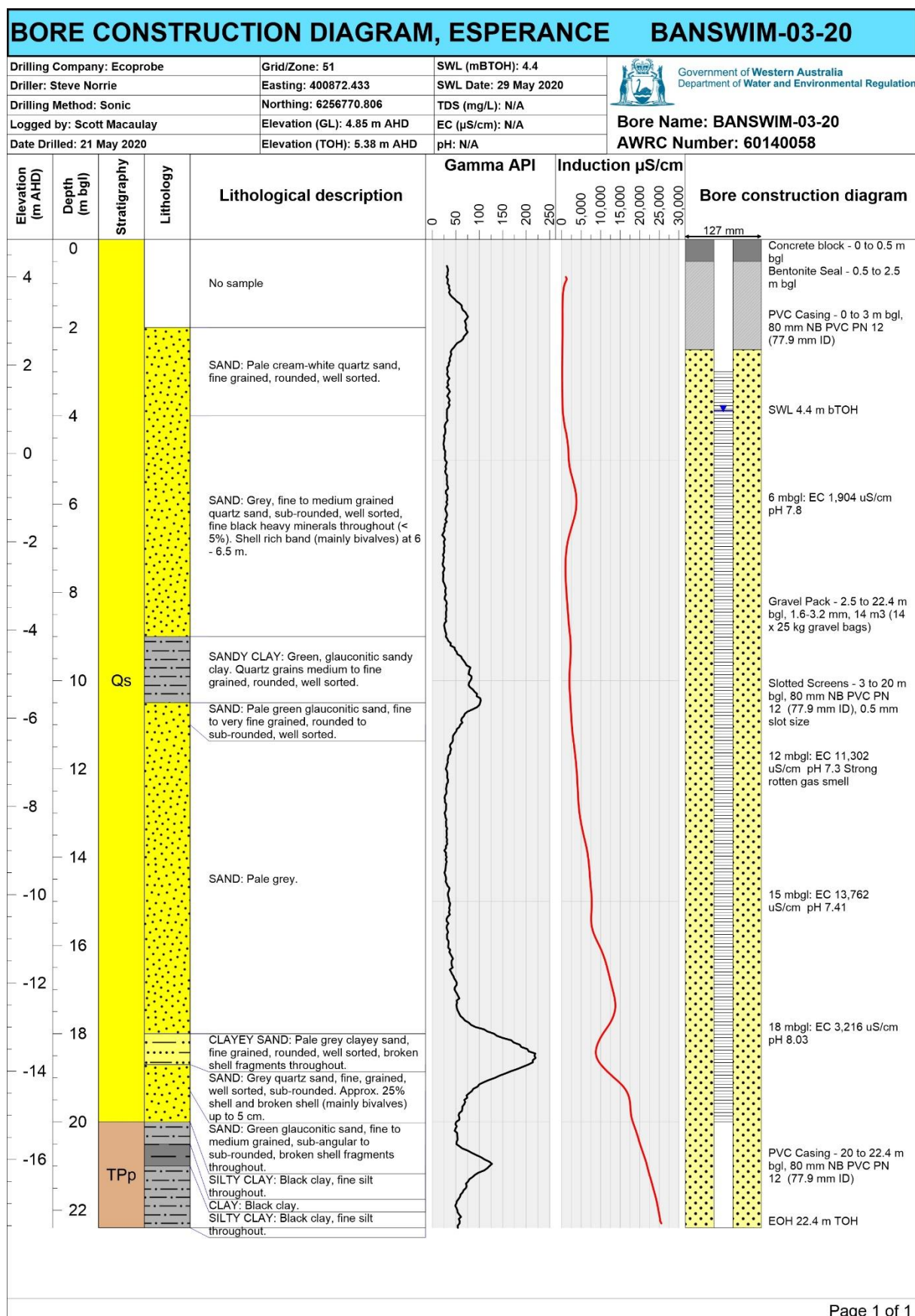




Figure 10      BANSWIM-03-20 photographs



## 6.2 Bore summary diagram



## 6.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Scott Macaulay                                                                                |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 21/05/2020                                                                                    |                                  |                        |
| Drilling complete   | 21/05/2020                                                                                    |                                  |                        |
| Airlifting          | 22/05/2020                                                                                    |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     |                                                                                               | BANSWIM-03-20                    |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 4.85                   |
|                     | Top of casing                                                                                 | -0.54                            | 5.39                   |
|                     | Top of headworks                                                                              | -0.53                            | 5.38                   |
|                     | Cement block                                                                                  | 0                                | 4.85                   |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 22.4                             | 127 (5")               |
| Total depth (m bgl) | 22.4                                                                                          |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

### CASING AND SCREENS

| Depth (m bgl) |      | Type                            | ID (mm) | OD (mm) |
|---------------|------|---------------------------------|---------|---------|
| From          | To   |                                 |         |         |
| 0             | 3    | PN 12 blank PVC                 | 77.93   | 88.9    |
| 3             | 20   | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 20            | 22.4 | PN 12 blank PVC                 | 77.93   | 88.9    |

### ANNULUS FILL

| Depth (m bgl) |      | Fill type                              |
|---------------|------|----------------------------------------|
| From          | To   |                                        |
| 0             | 0.5  | Concrete seal                          |
| 0.5           | 2.5  | Bentonite Seal                         |
| 2.5           | 22.4 | Gravel pack (1.6 mm – 3.2 mm diameter) |



## 6.4 Lithological interpretation

| Depth<br>(m bgl) |      | Description                                                                                                                                                            | Stratigraphy         |
|------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| From             | To   |                                                                                                                                                                        |                      |
| 0.0              | 2.0  | No sample                                                                                                                                                              | Quaternary sediments |
| 2.0              | 4.0  | SAND: Pale cream-white quartz sand, fine grained, rounded, well sorted.                                                                                                |                      |
| 4.0              | 9.0  | SAND: Grey, fine to medium-grained quartz sand, sub-rounded, well sorted, fine black heavy minerals throughout (< 5%). Shell rich band (mainly bivalves) at 6 - 6.5 m. |                      |
| 9.0              | 10.5 | SANDY CLAY: Green, glauconitic sandy clay. Quartz grains medium to fine grained, rounded, well sorted.                                                                 |                      |
| 10.5             | 11.0 | SAND: Pale green glauconitic sand, fine to very fine grained, rounded to sub-rounded, well sorted.                                                                     |                      |
| 11.0             | 18.0 | SAND: Pale grey.                                                                                                                                                       |                      |
| 18.0             | 18.7 | CLAYEY SAND: Pale grey clayey sand, fine grained, rounded, well sorted, broken shell fragments throughout.                                                             |                      |
| 18.7             | 19.3 | SAND: Grey quartz sand, fine grained, well sorted, sub-rounded. Approx. 25% shell and broken shell (mainly bivalves) up to 5 cm.                                       |                      |
| 19.3             | 20.0 | SAND: Green glauconitic sand, fine to medium grained, sub-angular to sub-rounded, broken shell fragments throughout.                                                   |                      |
| 20.0             | 20.5 | SILTY CLAY: Black clay, fine silt throughout.                                                                                                                          | Pallinup Siltstone   |
| 20.5             | 21.0 | CLAY: Black clay.                                                                                                                                                      |                      |
| 21.0             | 22.4 | SILTY CLAY: Black clay, fine silt throughout.                                                                                                                          |                      |

## 6.5 Hydrogeological data

|                   |                                                     |
|-------------------|-----------------------------------------------------|
| BORE              | BANSWIM-03-20                                       |
| SCREENED INTERVAL | 3 to 20 m bgl                                       |
| AQUIFER           | Superficial                                         |
| WATER LEVEL       | 4.4 m bTOH (m below top of headworks) on 29/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)  | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|------------|------|------------|-------------|-----------|--------|-----------|
| Water tank | 7.97 | 1,175      | 752         | 16.4      | 91.1   | 8.80      |
| Mud        | 7.91 | 1,645      | 1,053       | 16.4      | 85.6   | 8.40      |
| 6          | 7.80 | 1,904      | 1,219       | 17.8      | 11.7   | 0.90      |
| 12         | 7.30 | 11,302     | 7,233       | 20.3      | 6.5    | 0.55      |
| 15         | 7.41 | 13,762     | 8,808       | 21.0      | 16.7   | 0.94      |
| 18         | 8.03 | 3,216      | 2,058       | 22.6      | 5.7    | 0.51      |

\* Calculated TDS (0.64 conversion factor)

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date       | Time  | Depth (m) | L/s | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|------------|-------|-----------|-----|------|------------|-------------|-----------|-----------------|
| 22/05/2020 | 8:10  | 19        | 0.5 | 7.44 | 60,473     | 38,703      | 18.3      | 431             |
| 22/05/2020 | 8:20  | 19        | 0.5 | 7.47 | 60,756     | 38,884      | 18        | 863.9           |
| 22/05/2020 | 8:30  | 19        | 0.5 | 7.44 | 65,494     | 41,916      | 18.3      | 141.2           |
| 22/05/2020 | 8:40  | 19        | 0.5 | 4.48 | 66,637     | 42,648      | 18.1      | 113.2           |
| 22/05/2020 | 8:50  | 19        | 0.5 | 7.46 | 67,027     | 42,897      | 17.8      | 305.3           |
| 22/05/2020 | 9:00  | 19        | 0.5 | 7.45 | 67,586     | 43,255      | 17.9      | 115.81          |
| 22/05/2020 | 9:10  | 19        | 0.5 | 7.44 | 67,676     | 43,313      | 17.9      | 121.56          |
| 22/05/2020 | 9:20  | 19        | 0.5 | 7.44 | 67,184     | 42,998      | 18.4      | 81.68           |
| 22/05/2020 | 9:30  | 19        | 0.5 | 7.44 | 67,482     | 43,188      | 18.2      | 38.87           |
| 22/05/2020 | 9:40  | 19        | 0.5 | 7.46 | 67,660     | 43,302      | 18.4      | 22.56           |
| 22/05/2020 | 9:50  | 19        | 0.5 | 7.45 | 67,083     | 42,933      | 18.7      | 18.87           |
| 22/05/2020 | 10:00 | 19        | 0.5 | 7.44 | 67,056     | 42,916      | 18.7      | 15.54           |

\* Calculated TDS (0.64 conversion factor)

## 6.6 Geophysical data

|              |                                                            |                                               |
|--------------|------------------------------------------------------------|-----------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma          | <input checked="" type="checkbox"/> Induction |
|              | <input type="checkbox"/> Long and Short Normal Resistivity | <input type="checkbox"/> Calliper             |
| LOGGING UNIT | Westlog                                                    |                                               |

## 7 Bore BANSWIM-04-20

### 7.1 Location, maps and photographs

|                              |                                                         |    |         |           |          |           |
|------------------------------|---------------------------------------------------------|----|---------|-----------|----------|-----------|
| OWNER                        | Department of Water and Environmental Regulation        |    |         |           |          |           |
| LOCATION                     | Corner of Simpson St and Effie Turner Dr on road verge. |    |         |           |          |           |
| MGA REF                      | Zone                                                    | 51 | Easting | 397639.68 | Northing | 6255130.9 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                                |    |         |           |          |           |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)                    |    |         |           |          |           |
| PROJECT CODE                 | WA-G-SEAWATERIN                                         |    |         |           |          |           |
| AWRC Ref. Number             | BANSWIM-04-20                                           |    |         | 60140059  |          |           |





Figure 11 BANSWIM-04-20 location map

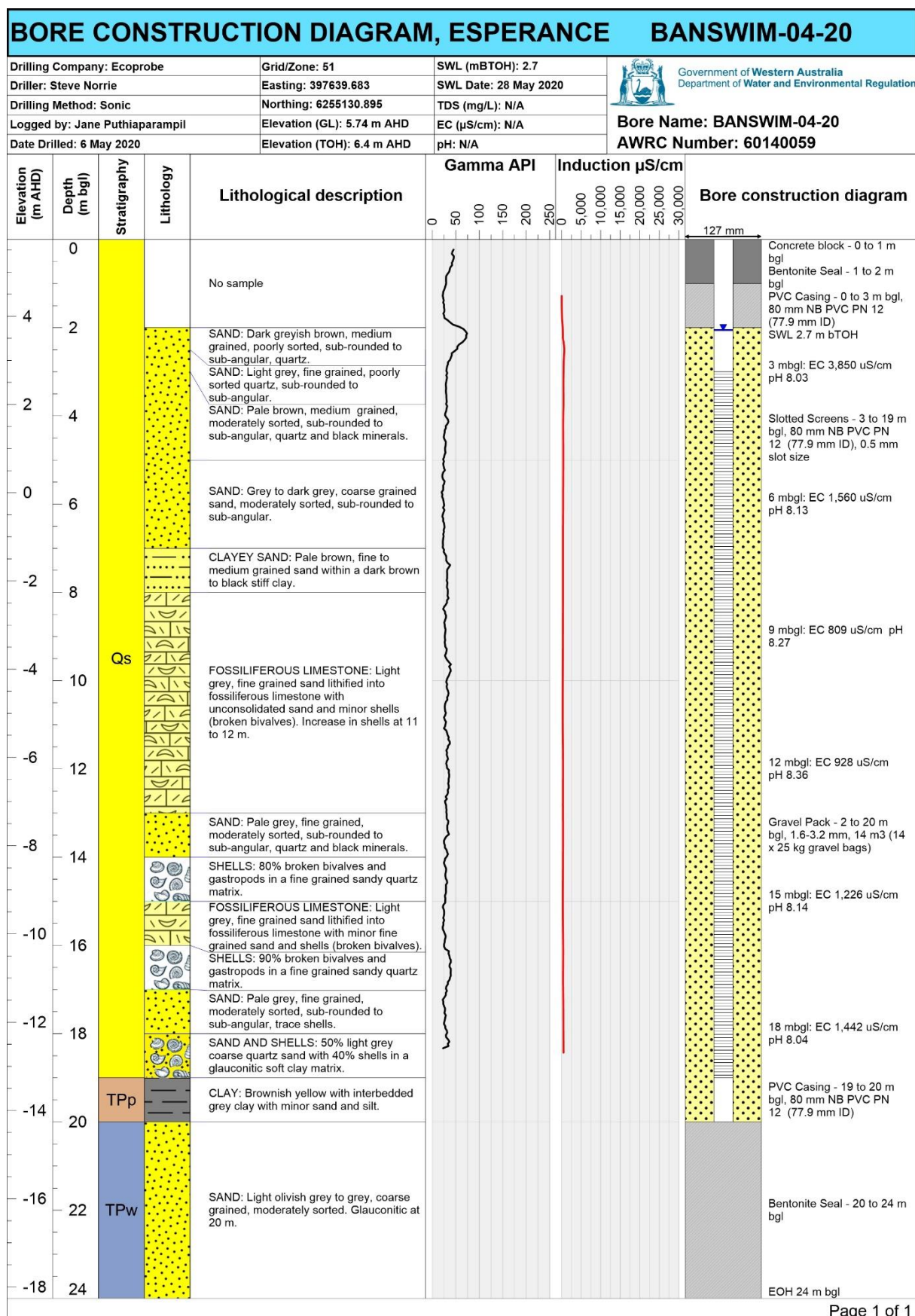




Figure 12 BANSWIM-04-20 photographs



## 7.2 Bore summary diagram



## 7.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Jane Puthiaparampil                                                                           |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 6/05/2020                                                                                     |                                  |                        |
| Drilling complete   | 6/05/2020                                                                                     |                                  |                        |
| Airlifting          | 6/05/2020                                                                                     |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     |                                                                                               | BANSWIM-04-20                    |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 5.74                   |
|                     | Top of casing                                                                                 | -0.53                            | 6.27                   |
|                     | Top of headworks                                                                              | -0.66                            | 6.4                    |
|                     | Cement block                                                                                  | -0.22                            | 5.96                   |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 24                               | 127 (5")               |
| Total depth (m bgl) | 20                                                                                            |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

### CASING AND SCREENS

| Depth (m bgl) |    | Type                            | ID (mm) | OD (mm) |
|---------------|----|---------------------------------|---------|---------|
| From          | To |                                 |         |         |
| 0             | 3  | PN 12 blank PVC                 | 77.93   | 88.9    |
| 3             | 19 | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 19            | 20 | PN 12 blank PVC                 | 77.93   | 88.9    |

### ANNULUS FILL

| Depth (m bgl) |    | Fill type                              |
|---------------|----|----------------------------------------|
| From          | To |                                        |
| 0             | 1  | Concrete seal                          |
| 1             | 2  | Bentonite Seal                         |
| 2             | 20 | Gravel pack (1.6 mm – 3.2 mm diameter) |
| 20            | 24 | Bentonite Seal                         |



## 7.4 Lithological interpretation

| Depth<br>(m bgl) |      | Description                                                                                                                                                                                  | Stratigraphy         |
|------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| From             | To   |                                                                                                                                                                                              |                      |
| 0.0              | 2.0  | No sample                                                                                                                                                                                    | Quaternary sediments |
| 2.0              | 2.5  | SAND: Dark greyish brown, medium grained, poorly sorted, sub-rounded to sub-angular, quartz.                                                                                                 |                      |
| 2.5              | 3.0  | SAND: Light grey, fine grained, poorly sorted quartz, sub-rounded to sub-angular.                                                                                                            |                      |
| 3.0              | 5.0  | SAND: Pale brown, medium grained, moderately sorted, sub-rounded to sub-angular, quartz and black minerals.                                                                                  |                      |
| 5.0              | 7.0  | SAND: Grey to dark grey, coarse-grained sand, moderately sorted, sub-rounded to sub-angular.                                                                                                 |                      |
| 7.0              | 8.0  | CLAYEY SAND: Pale brown, fine to medium-grained sand within a dark brown to black stiff clay.                                                                                                |                      |
| 8.0              | 13.0 | FOSSILIFEROUS LIMESTONE: Light grey, fine-grained sand lithified into fossiliferous limestone with unconsolidated sand and minor shells (broken bivalves). Increase in shells at 11 to 12 m. |                      |
| 13.0             | 14.0 | SAND: Pale grey, fine grained, moderately sorted, sub-rounded to sub-angular, quartz and black minerals.                                                                                     |                      |
| 14.0             | 15.0 | SHELLS: 80% broken bivalves and gastropods in a fine-grained sandy quartz matrix.                                                                                                            |                      |
| 15.0             | 16.0 | FOSSILIFEROUS LIMESTONE: Light grey, fine-grained sand lithified into fossiliferous limestone with minor fine-grained sand and shells (broken bivalves).                                     |                      |
| 16.0             | 17.0 | SHELLS: 90% broken bivalves and gastropods in a fine-grained sandy quartz matrix.                                                                                                            |                      |
| 17.0             | 18.0 | SAND: Pale grey, fine grained, moderately sorted, sub-rounded to sub-angular, trace shells.                                                                                                  |                      |
| 18.0             | 19.0 | SAND AND SHELLS: 50% light grey coarse quartz sand with 40% shells in a glauconitic soft clay matrix.                                                                                        |                      |
| 19.0             | 20.0 | CLAY: Brownish yellow with interbedded grey clay with minor sand and silt.                                                                                                                   | Pallinup Siltstone   |
| 20.0             | 24.0 | SAND: Light olivish grey to grey, coarse grained, moderately sorted. Glauconitic at 20 m.                                                                                                    | Werillup Formation   |

## 7.5 Hydrogeological data

|                   |                                                     |
|-------------------|-----------------------------------------------------|
| BORE              | BANSWIM-04-20                                       |
| SCREENED INTERVAL | 3 to 19 m bgl                                       |
| AQUIFER           | Superficial                                         |
| WATER LEVEL       | 2.7 m bTOH (m below top of headworks) on 28/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)  | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|------------|------|------------|-------------|-----------|--------|-----------|
| Water tank | 8.07 | 1,730      | 1,107       | 15.5      | 60.1   | 9.23      |
| Mud        | 8.85 | 1,818      | 1,164       | 19.9      | 92.7   | 5.65      |
| 3          | 8.03 | 3,850      | 2,464       | 16.1      | 37.0   | 3.14      |
| 6          | 8.13 | 1,560      | 998         | 16.8      | 5.3    | 0.51      |
| 9          | 8.27 | 809        | 518         | 17.0      | 26.4   | 2.53      |
| 12         | 8.36 | 928        | 594         | 20.5      | 6.4    | 0.57      |
| 15         | 8.14 | 1,226      | 785         | 18.9      | 19.2   | 1.76      |
| 18         | 8.04 | 1,442      | 923         | 19.9      | 29.6   | 2.60      |
| 24         | 8.63 | 1,726      | 1,105       | 21.1      | 6.8    | 0.58      |

\* Calculated TDS (0.64 conversion factor)

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date      | Time | Depth (m) | L/s    | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|-----------|------|-----------|--------|------|------------|-------------|-----------|-----------------|
| 8/05/2020 | 7:20 | 10        | v. low | 8.38 | 1,636      | 1,047       | 17.6      | 3,000           |
| 8/05/2020 | 7:30 | 20        | 0.57   | 8.16 | 1,301      | 833         | 12.2      | 1,001           |
| 8/05/2020 | 7:40 | 20        | 0.77   | 7.96 | 1,152      | 737         | 17.9      | 305             |
| 8/05/2020 | 7:50 | 20        | 0.91   | 7.99 | 1,136      | 727         | 17.4      | 162             |
| 8/05/2020 | 8:00 | 20        | 0.95   | 8.02 | 1,120      | 717         | 17.3      | 129             |
| 8/05/2020 | 8:10 | 20        | 0.95   | 7.99 | 1,106      | 708         | 17.5      | 104             |
| 8/05/2020 | 8:20 | 20        | 1      | 7.92 | 1,120      | 717         | 17.8      | 85              |
| 8/05/2020 | 8:30 | 20        | 1.05   | 7.94 | 1,102      | 705         | 17.8      | 71              |
| 8/05/2020 | 8:40 | 20        | 1.05   | 7.94 | 1,097      | 702         | 17.9      | 55              |
| 8/05/2020 | 8:50 | 20        | 1.05   | 7.98 | 1,073      | 687         | 17.3      | 41              |
| 8/05/2020 | 9:00 | 20        | 1.05   | 7.94 | 1,064      | 681         | 17.8      | 34              |
| 8/05/2020 | 9:10 | 20        | 1.05   | 7.91 | 1,051      | 673         | 17.7      | 30              |
| 8/05/2020 | 9:20 | 20        | 1.05   | 8.00 | 1,045      | 669         | 17.5      | 29              |

\* Calculated TDS (0.64 conversion factor)

## 7.6 Geophysical data

|              |                                                            |                                               |
|--------------|------------------------------------------------------------|-----------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma          | <input checked="" type="checkbox"/> Induction |
|              | <input type="checkbox"/> Long and Short Normal Resistivity | <input type="checkbox"/> Calliper             |
| LOGGING UNIT | Westlog                                                    |                                               |



## 8 Bore BANSWIM-05-20

### 8.1 Location, maps and photographs

|                              |                                                      |    |         |           |          |            |
|------------------------------|------------------------------------------------------|----|---------|-----------|----------|------------|
| OWNER                        | Department of Water and Environmental Regulation     |    |         |           |          |            |
| LOCATION                     | Western corner of St Germain Park next to Easton Rd. |    |         |           |          |            |
| MGA REF                      | Zone                                                 | 51 | Easting | 399552.74 | Northing | 6256500.91 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                             |    |         |           |          |            |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)                 |    |         |           |          |            |
| PROJECT CODE                 | WA-G-SEAWATERIN                                      |    |         |           |          |            |
| AWRC Ref. Number             | BANSWIM-05-20                                        |    |         | 60140064  |          |            |



Document Path: J:\gisprojects\Project\330\20000\_29999\33023600\00108\_SWI\_Statewide\mxd\Esperance\Bore Location Maps\Bore\_BANSWIM-05-18.mxd

Figure 13 BANSWIM-05-20 location map

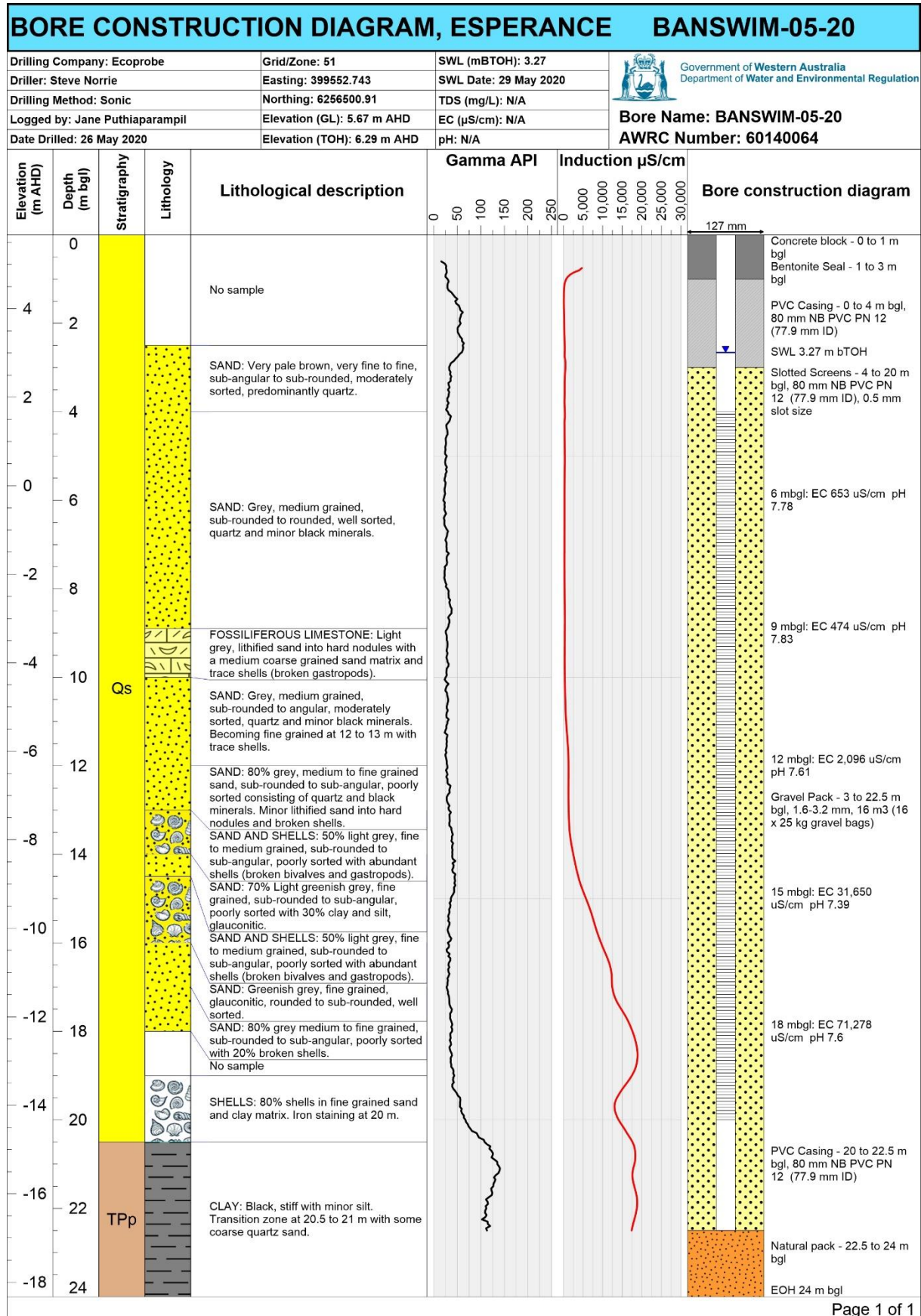




Figure 14 BANSWIM-05-20 photographs



## 8.2 Bore summary diagram





## 8.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Jane Puthiaparampil                                                                           |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 26/05/2020                                                                                    |                                  |                        |
| Drilling complete   | 26/05/2020                                                                                    |                                  |                        |
| Airlifting          | 27/05/2020                                                                                    |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     |                                                                                               | BANSWIM-05-20                    |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 5.67                   |
|                     | Top of casing                                                                                 | -0.46                            | 6.13                   |
|                     | Top of headworks                                                                              | -0.62                            | 6.29                   |
|                     | Cement block                                                                                  | -0.12                            | 5.79                   |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 24                               | 127 (5")               |
| Total depth (m bgl) | 22.5                                                                                          |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

### CASING AND SCREENS

| Depth (m bgl) |      | Type                            | ID (mm) | OD (mm) |
|---------------|------|---------------------------------|---------|---------|
| From          | To   |                                 |         |         |
| 0             | 4    | PN 12 blank PVC                 | 77.93   | 88.9    |
| 4             | 20   | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 20            | 22.5 | PN 12 blank PVC                 | 77.93   | 88.9    |

### ANNULUS FILL

| Depth (m bgl) |      | Fill type                              |
|---------------|------|----------------------------------------|
| From          | To   |                                        |
| 0             | 1    | Concrete seal                          |
| 1             | 3    | Bentonite Seal                         |
| 3             | 22.5 | Gravel pack (1.6 mm – 3.2 mm diameter) |

## 8.4 Lithological interpretation

| Depth<br>(m bgl) |      | Description                                                                                                                                                                               | Stratigraphy         |
|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| From             | To   |                                                                                                                                                                                           |                      |
| 0.0              | 2.5  | No sample                                                                                                                                                                                 | Quaternary sediments |
| 2.5              | 4.0  | SAND: Very pale brown, very fine to fine, sub-angular to sub-rounded, moderately sorted, predominantly quartz.                                                                            |                      |
| 4.0              | 8.9  | SAND: Grey, medium grained, sub-rounded to rounded, well sorted, quartz and minor black minerals.                                                                                         |                      |
| 8.9              | 10.0 | FOSSILIFEROUS LIMESTONE: Light grey, lithified sand into hard nodules with a medium coarse-grained sand matrix and trace shells (broken gastropods).                                      |                      |
| 10.0             | 12.0 | SAND: Grey, medium grained, sub-rounded to angular, moderately sorted, quartz and minor black minerals. Becoming fine grained at 12 to 13 m with trace shells.                            |                      |
| 12.0             | 13.0 | SAND: 80% grey, medium to fine-grained sand, sub-rounded to sub-angular, poorly sorted consisting of quartz and black minerals. Minor lithified sand into hard nodules and broken shells. |                      |
| 13.0             | 14.0 | SAND AND SHELLS: 50% light grey, fine to medium grained, sub-rounded to sub-angular, poorly sorted with abundant shells (broken bivalves and gastropods).                                 |                      |
| 14.0             | 14.5 | SAND: 70% Light greenish grey, fine grained, sub-rounded to sub-angular, poorly sorted with 30% clay and silt, glauconitic.                                                               |                      |
| 14.5             | 16.0 | SAND AND SHELLS: 50% light grey, fine to medium grained, sub-rounded to sub-angular, poorly sorted with abundant shells (broken bivalves and gastropods).                                 |                      |
| 16.0             | 17.0 | SAND: Greenish grey, fine grained, glauconitic, rounded to sub-rounded, well sorted.                                                                                                      |                      |
| 17.0             | 18.0 | SAND: 80% grey medium to fine grained, sub-rounded to sub-angular, poorly sorted with 20% broken shells.                                                                                  |                      |
| 18.0             | 19.0 | No sample                                                                                                                                                                                 |                      |
| 19.0             | 20.5 | SHELLS: 80% shells in fine-grained sand and clay matrix. Iron staining at 20 m.                                                                                                           |                      |
| 20.5             | 24.0 | CLAY: Black, stiff with minor silt. Transition zone at 20.5 to 21 m with some coarse quartz sand.                                                                                         | Pallinup Siltstone   |

## 8.5 Hydrogeological data

|                   |                                                      |
|-------------------|------------------------------------------------------|
| BORE              | BANSWIM-05-20                                        |
| SCREENED INTERVAL | 4 to 20 m bgl                                        |
| AQUIFER           | Superficial                                          |
| WATER LEVEL       | 3.27 m bTOH (m below top of headworks) on 29/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)  | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|------------|------|------------|-------------|-----------|--------|-----------|
| Water tank | 7.89 | 536        | 343         | 15.2      | 95.7   | 9.61      |
| Mud        | -    | -          | -           | -         | -      | -         |
| 6          | 7.78 | 653        | 418         | 17.1      | 25.6   | 2.24      |
| 9          | 7.83 | 474        | 303         | 17.8      | 18.8   | 1.66      |
| 12         | 7.61 | 2096       | 1,341       | 20.3      | 8.1    | 0.68      |
| 15         | 7.39 | 31,650     | 20,256      | 21.1      | 30.9   | 2.40      |
| 18         | 7.60 | 71,278     | 45,618      | 20.0      | 3.9    | 0.27      |

\* Calculated TDS (0.64 conversion factor)

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date       | Time | Depth (m) | L/s | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|------------|------|-----------|-----|------|------------|-------------|-----------|-----------------|
| 27/05/2020 | 8:30 | 20        | 0.8 | 7.47 | 50,466     | 32,298      | 18.1      | 230             |
| 27/05/2020 | 8:40 | 20        | 0.8 | 7.43 | 61,590     | 39,418      | 18.5      | 32              |
| 27/05/2020 | 8:50 | 20        | 0.8 | 7.39 | 63,840     | 40,858      | 18.1      | 19              |
| 27/05/2020 | 9:00 | 20        | 0.8 | 7.45 | 64,289     | 41,145      | 18.7      | 16              |
| 27/05/2020 | 9:10 | 20        | 0.8 | 7.46 | 64,056     | 40,996      | 18.4      | 12              |
| 27/05/2020 | 9:20 | 20        | 0.8 | 7.50 | 63,956     | 40,932      | 18.4      | 12              |
| 27/05/2020 | 9:30 | 20        | 0.8 | 7.43 | 64,208     | 41,093      | 18.4      | 11              |
| 27/05/2020 | 9:40 | 20        | 0.8 | 7.44 | 64,225     | 41,104      | 17.9      | 10              |
| 27/05/2020 | 9:50 | 20        | 0.8 | 7.44 | 64,119     | 41,036      | 18.5      | 8               |

\* Calculated TDS (0.64 conversion factor)



## 8.6 Geophysical data

|              |                                                            |                                               |
|--------------|------------------------------------------------------------|-----------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma          | <input checked="" type="checkbox"/> Induction |
|              | <input type="checkbox"/> Long and Short Normal Resistivity | <input type="checkbox"/> Calliper             |
| LOGGING UNIT | Westlog                                                    |                                               |

## 9 Bore ELMSWIM-01-20

### 9.1 Location, maps and photographs

|                              |                                                  |    |         |           |          |            |
|------------------------------|--------------------------------------------------|----|---------|-----------|----------|------------|
| OWNER                        | Department of Water and Environmental Regulation |    |         |           |          |            |
| LOCATION                     | Located off Barook Rd on track.                  |    |         |           |          |            |
| MGA REF                      | Zone                                             | 51 | Easting | 388398.65 | Northing | 6252135.44 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                         |    |         |           |          |            |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)             |    |         |           |          |            |
| PROJECT CODE                 | WA-G-SEAWATERIN                                  |    |         |           |          |            |
| AWRC Ref. Number             | ELMSWIM-01-20                                    |    |         | 60140065  |          |            |



Document Path: J:\gisprojects\Project\330\20000\_29999\33023600\00108\_SWI\_Statewide\mxd\Esperance\Bore Location Maps\Bore\_ELMSWIM-01-18.mxd

Figure 15 ELMSWIM-01-20 location map

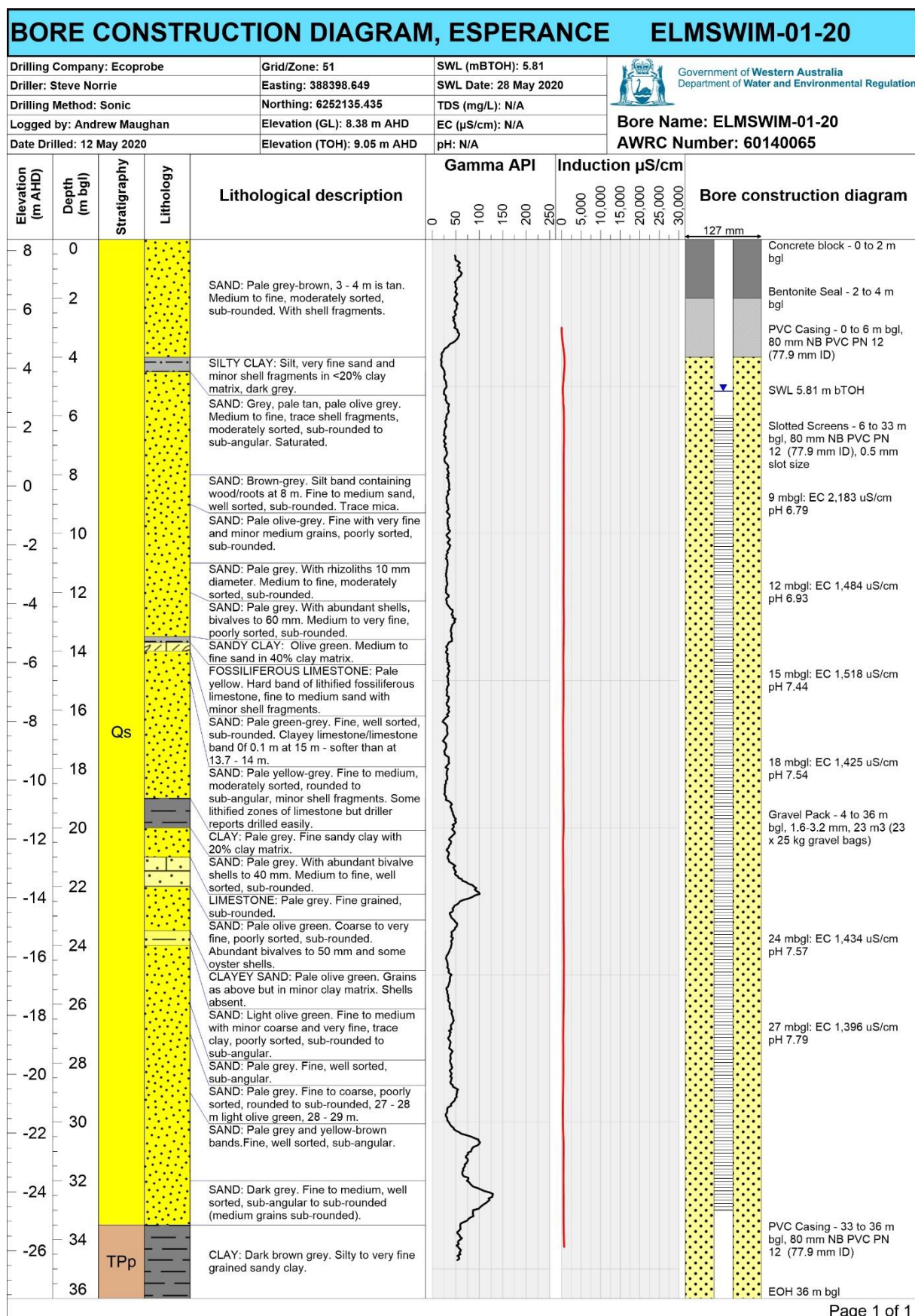




Figure 16 ELMSWIM-01-20 photographs



## 9.2 Bore summary diagram



## 9.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Andrew Maughan                                                                                |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 12/05/2020                                                                                    |                                  |                        |
| Drilling complete   | 12/05/2020                                                                                    |                                  |                        |
| Airlifting          | 16/05/2020                                                                                    |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     | ELMSWIM-01-20                                                                                 |                                  |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 8.38                   |
|                     | Top of casing                                                                                 | -0.56                            | 8.94                   |
|                     | Top of headworks                                                                              | -0.67                            | 9.05                   |
|                     | Cement block                                                                                  | -0.17                            | 8.55                   |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 36                               | 127 (5")               |
| Total depth (m bgl) | 36                                                                                            |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

### CASING AND SCREENS

| Depth (m bgl) |    | Type                            | ID (mm) | OD (mm) |
|---------------|----|---------------------------------|---------|---------|
| From          | To |                                 |         |         |
| 0             | 6  | PN 12 blank PVC                 | 77.93   | 88.9    |
| 6             | 33 | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 33            | 36 | PN 12 blank PVC                 | 77.93   | 88.9    |

### ANNULUS FILL

| Depth (m bgl) |    | Fill type                              |
|---------------|----|----------------------------------------|
| From          | To |                                        |
| 0             | 2  | Concrete seal                          |
| 2             | 4  | Bentonite Seal                         |
| 4             | 36 | Gravel pack (1.6 mm – 3.2 mm diameter) |

## 9.4 Lithological interpretation

| Depth<br>(m bgl) |      | Description                                                                                                                                                                     | Stratigraphy         |
|------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| From             | To   |                                                                                                                                                                                 |                      |
| 0.0              | 4.0  | SAND: Pale grey brown, 3 to 4 m is tan. Medium to fine, moderately sorted, sub-rounded. With shell fragments.                                                                   | Quaternary sediments |
| 4.0              | 4.5  | SILTY CLAY: Silt, very fine sand and minor shell fragments in <20% clay matrix, dark grey.                                                                                      |                      |
| 4.5              | 8.0  | SAND: Grey, pale tan, pale olive grey. Medium to fine, trace shell fragments, moderately sorted, sub-rounded to sub-angular. Saturated.                                         |                      |
| 8.0              | 9.0  | SAND: Brown grey. Silt band containing wood/roots at 8 m. Fine to medium sand, well sorted, sub-rounded. Trace mica.                                                            |                      |
| 9.0              | 11.0 | SAND: Pale olive grey. Fine with very fine and minor medium grains, poorly sorted, sub-rounded.                                                                                 |                      |
| 11.0             | 12.0 | SAND: Pale grey. With rhizoliths 10 mm diameter. Medium to fine, moderately sorted, sub-rounded.                                                                                |                      |
| 12.0             | 13.5 | SAND: Pale grey. With abundant shells, bivalves to 60 mm. Medium to very fine, poorly sorted, sub-rounded.                                                                      |                      |
| 13.5             | 13.7 | SANDY CLAY: Olive green. Medium to fine sand in 40% clay matrix.                                                                                                                |                      |
| 13.7             | 14.0 | FOSSILIFEROUS LIMESTONE: Pale yellow. Hard band of lithified fossiliferous limestone, fine to medium sand with minor shell fragments.                                           |                      |
| 14.0             | 15.0 | SAND: Pale green grey. Fine, well sorted, sub-rounded. Clayey limestone/limestone band of 0.1 m at 15 m - softer than at 13.7 to 14 m.                                          |                      |
| 15.0             | 19.0 | SAND: Pale yellow grey. Fine to medium, moderately sorted, rounded to sub-angular, minor shell fragments. Some lithified zones of limestone but driller reports drilled easily. |                      |
| 19.0             | 20.0 | CLAY: Pale grey. Fine sandy clay with 20% clay matrix.                                                                                                                          |                      |
| 20.0             | 21.0 | SAND: Pale grey. With abundant bivalve shells to 40 mm. Medium to fine, well sorted, sub-rounded.                                                                               |                      |
| 21.0             | 22.0 | LIMESTONE: Pale grey. Fine grained, sub-rounded.                                                                                                                                |                      |
| 22.0             | 23.5 | SAND: Pale olive green. Coarse to very fine, poorly sorted, sub-rounded. Abundant bivalves to 50 mm and some oyster shells.                                                     |                      |
| 23.5             | 24.0 | CLAYEY SAND: Pale olive green. Grains as above but in minor clay matrix. Shells absent.                                                                                         |                      |
| 24.0             | 26.0 | SAND: Light olive green. Fine to medium with minor coarse and very fine, trace clay, poorly sorted, sub-rounded to sub-angular.                                                 |                      |
| 26.0             | 27.0 | SAND: Pale grey. Fine, well sorted, sub-angular.                                                                                                                                |                      |
| 27.0             | 29.0 | SAND: Pale grey. Fine to coarse, poorly sorted, rounded to sub-rounded, 27 - 28 m light olive green, 28 to 29 m.                                                                |                      |



|      |      |                                                                                                       |                    |
|------|------|-------------------------------------------------------------------------------------------------------|--------------------|
| 29.0 | 32.0 | SAND: Pale grey and yellow-brown bands. Fine, well sorted, sub-angular.                               |                    |
| 32.0 | 33.5 | SAND: Dark grey. Fine to medium, well sorted, sub-angular to sub-rounded (medium grains sub-rounded). |                    |
| 33.5 | 36.0 | CLAY: Dark brown grey. Silty to very fine-grained sandy clay.                                         | Pallinup Siltstone |

## 9.5 Hydrogeological data

|                   |                                                      |
|-------------------|------------------------------------------------------|
| BORE              | ELMSWIM-01-20                                        |
| SCREENED INTERVAL | 6 to 33 m bgl                                        |
| AQUIFER           | Superficial                                          |
| WATER LEVEL       | 5.81 m bTOH (m below top of headworks) on 28/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)  | pH         | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|------------|------------|------------|-------------|-----------|--------|-----------|
| Water tank | 7.60       | 1,241      | 794         | 18.5      | 91.0   | 8.4       |
| Mud        | 7.80       | 1,773      | 1,135       | 18.8      | 94.0   | 8.6       |
| 9          | 6.79       | 2,183      | 1,397       | 19.5      | 19.5   | 7.9       |
| 12         | 6.93       | 1,484      | 950         | 18.7      | 17.0   | 1.6       |
| 15         | 7.44       | 1,518      | 972         | 19.0      | 46.0   | 4.2       |
| 18         | 7.54       | 1,425      | 912         | 20.6      | 18.5   | 1.6       |
| 21**       | 7.9 rising | 1,703      | 1,090       | 20.1      | 114.0  | 10.3      |
| 24         | 7.57       | 1,434      | 918         | 19.9      | 40.3   | 3.64      |
| 27         | 7.79       | 1,396      | 893         | 20.0      | 27.6   | 2.5       |
| 30**       | 7.94       | 1,522      | 974         | 22.8      | 68.0   | 5.9       |
| 33**       | 8.01       | 1,716      | 1,098       | 19.8      | 6.6    | 0.5       |

\* Calculated TDS (0.64 conversion factor)

\*\* Sample possibly contaminated with drilling mud

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date       | Time | Depth (m) | L/s | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|------------|------|-----------|-----|------|------------|-------------|-----------|-----------------|
| 16/05/2020 | 7:43 | 33        | 1   | 8.00 | 1,162      | 744         | 19.0      | -               |
| 16/05/2020 | 7:55 | 33        | 1   | 7.86 | 1,107      | 708         | 18.0      | 150             |
| 16/05/2020 | 8:05 | 33        | 1   | 7.83 | 1,092      | 699         | 18.0      | 70              |
| 16/05/2020 | 8:30 | 33        | 1   | 7.79 | 1,086      | 695         | 18.0      | 15              |
| 16/05/2020 | 8:45 | 33        | 1   | 7.92 | 1,081      | 692         | 17.8      | 12              |
| 16/05/2020 | 8:55 | 33        | 1.1 | 0.82 | 1,086      | 695         | 17.9      | 0               |
| 16/05/2020 | 9:05 | 33        | 1.1 | 7.82 | 1,083      | 693         | 17.9      | 0               |
| 16/05/2020 | 9:15 | 33        | 1.1 | 7.82 | 1,082      | 692         | 18.0      | 0               |

\* Calculated TDS (0.64 conversion factor)

## 9.6 Geophysical data

|              |                                                                                                                                                                                                 |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma <input checked="" type="checkbox"/> Induction<br><input type="checkbox"/> Long and Short Normal Resistivity <input type="checkbox"/> Calliper |
| LOGGING UNIT | Westlog                                                                                                                                                                                         |

## 9.7 Palynology data

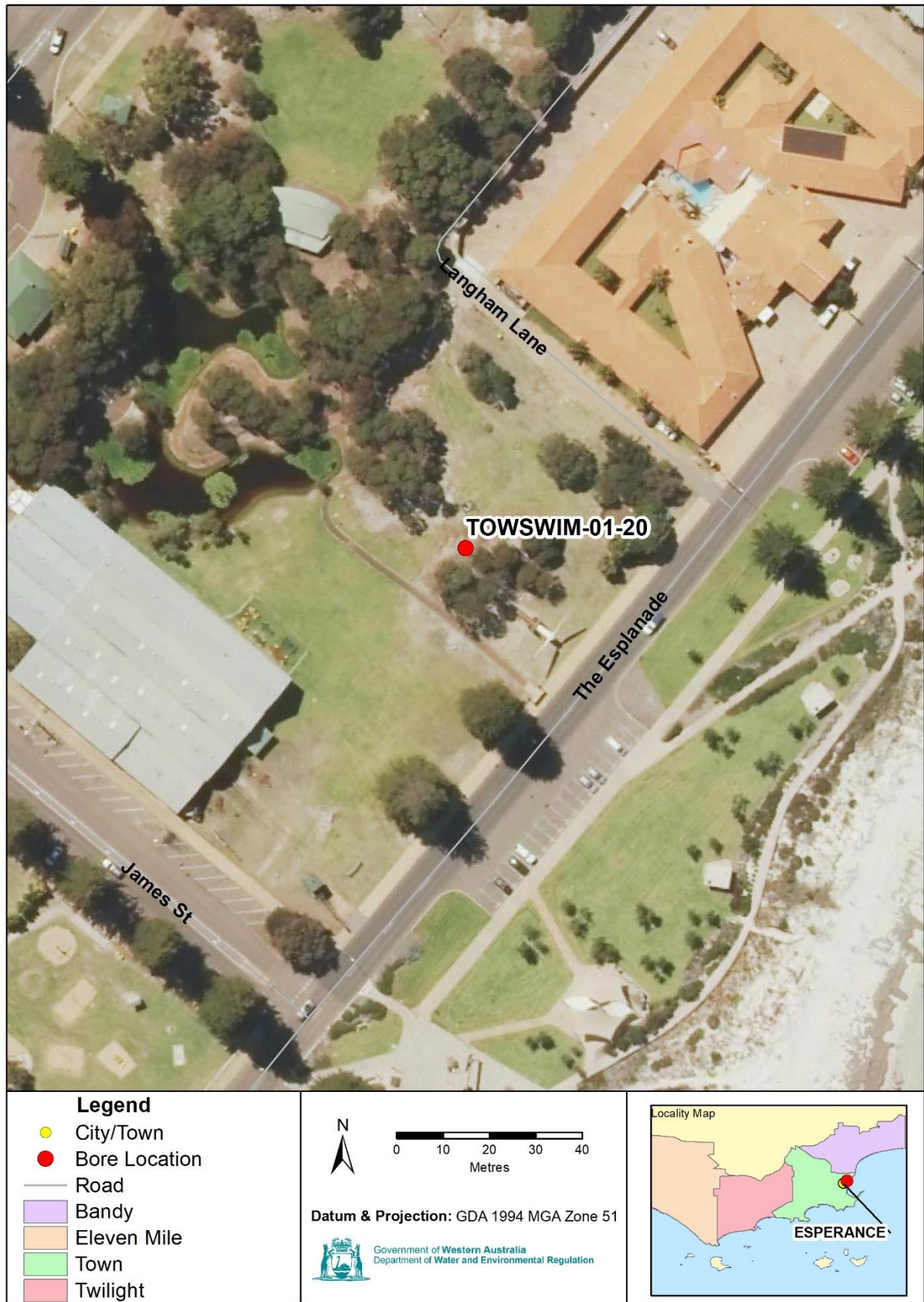
| Sample depth<br>(m bgl) | Spore-Pollen zone                                                                                        | Comments and key species present                                                                                                                                                                                                                                         |
|-------------------------|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 35 to 36                | Holocene to possibly Late Pleistocene. Probably equivalent to informal <i>Fenestrites spinosus</i> Zone. | Marine assemblage with MP 21% of SP + MP count. Abundant <i>Nothofagidites</i> spp. at 23% and LO of <i>Anacolosidites acutullus</i> confirms SP zone assignment. FO of <i>D. heterophlycta</i> with LO of <i>W. hampdenensis</i> dinocysts confirms MP zone assignment. |



## 10 Bore TOWSWIM-01-20

### 10.1 Location, maps and photographs

|                              |                                                                                     |    |         |           |          |           |
|------------------------------|-------------------------------------------------------------------------------------|----|---------|-----------|----------|-----------|
| OWNER                        | Department of Water and Environmental Regulation                                    |    |         |           |          |           |
| LOCATION                     | Located next to the Esperance Museum on the corner of Langham Ln and The Esplanade. |    |         |           |          |           |
| MGA REF                      | Zone                                                                                | 51 | Easting | 397786.56 | Northing | 6252879.5 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                                                            |    |         |           |          |           |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)                                                |    |         |           |          |           |
| PROJECT CODE                 | WA-G-SEAWATERIN                                                                     |    |         |           |          |           |
| AWRC Ref. Number             | TOWSWIM-01-20                                                                       |    |         | 60140053  |          |           |



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Figure 17 TOWSWIM-01-20 location map

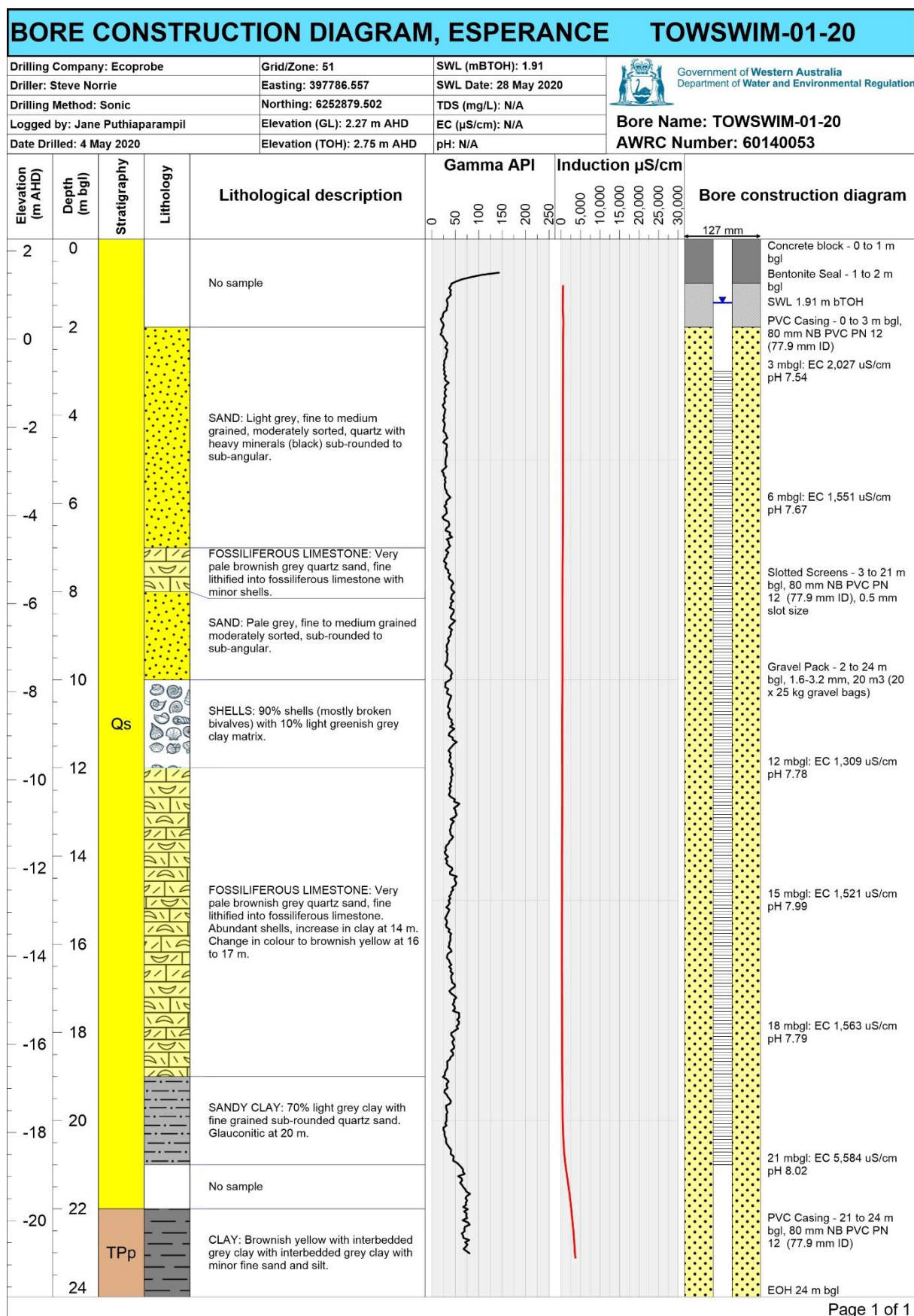




Figure 18 TOWSWIM-01-20 photographs



## 10.2 Bore summary diagram





## 10.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Jane Puthiaparampil                                                                           |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 4/05/2020                                                                                     |                                  |                        |
| Drilling complete   | 4/05/2020                                                                                     |                                  |                        |
| Airlifting          | 4/05/2020                                                                                     |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     |                                                                                               | TOWSWIM-01-20                    |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 2.27                   |
|                     | Top of casing                                                                                 | -0.36                            | 2.63                   |
|                     | Top of headworks                                                                              | -0.48                            | 2.75                   |
|                     | Cement block                                                                                  | -0.16                            | 2.43                   |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 24                               | 127 (5")               |
| Total depth (m bgl) | 24                                                                                            |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

### CASING AND SCREENS

| Depth (m bgl) |    | Type                            | ID (mm) | OD (mm) |
|---------------|----|---------------------------------|---------|---------|
| From          | To |                                 |         |         |
| 0             | 3  | PN 12 blank PVC                 | 77.93   | 88.9    |
| 3             | 21 | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 21            | 24 | PN 12 blank PVC                 | 77.93   | 88.9    |

### ANNULUS FILL

| Depth (m bgl) |    | Fill type                              |
|---------------|----|----------------------------------------|
| From          | To |                                        |
| 0             | 1  | Concrete seal                          |
| 1             | 2  | Bentonite Seal                         |
| 2             | 24 | Gravel pack (1.6 mm – 3.2 mm diameter) |

## 10.4 Lithological interpretation

| Depth<br>(m bgl) |      | Description                                                                                                                                                                                              | Stratigraphy         |
|------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| From             | To   |                                                                                                                                                                                                          |                      |
| 0.0              | 2.0  | No sample                                                                                                                                                                                                | Quaternary sediments |
| 2.0              | 7.0  | SAND: Light grey, fine to medium grained, moderately sorted, quartz with heavy minerals (black) sub-rounded to sub-angular.                                                                              |                      |
| 7.0              | 8.0  | FOSSILIFEROUS LIMESTONE: Very pale brownish-grey quartz sand, fine lithified into fossiliferous limestone with minor shells.                                                                             |                      |
| 8.0              | 10.0 | SAND: Pale grey, fine to medium grained moderately sorted, sub-rounded to sub-angular.                                                                                                                   |                      |
| 10.0             | 12.0 | SHELLS: 90% shells (mostly broken bivalves) with 10% light greenish-grey clay matrix.                                                                                                                    |                      |
| 12.0             | 19.0 | FOSSILIFEROUS LIMESTONE: Very pale brownish-grey quartz sand, fine lithified into fossiliferous limestone. Abundant shells, increase in clay at 14 m. Change in colour to brownish yellow at 16 to 17 m. |                      |
| 19.0             | 21.0 | SANDY CLAY: 70% light grey clay with fine-grained sub-rounded quartz sand. Glauconitic at 20 m.                                                                                                          |                      |
| 21.0             | 22.0 | No sample                                                                                                                                                                                                | Pallinup Siltstone   |
| 22.0             | 24.0 | CLAY: Brownish yellow with interbedded grey clay with interbedded grey clay with minor fine sand and silt.                                                                                               |                      |

## 10.5 Hydrogeological data

|                   |                                                      |
|-------------------|------------------------------------------------------|
| BORE              | TOWSWIM-01-20                                        |
| SCREENED INTERVAL | 3 to 21 m bgl                                        |
| AQUIFER           | Superficial                                          |
| WATER LEVEL       | 1.91 m bTOH (m below top of headworks) on 28/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)  | pH                                  | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|------------|-------------------------------------|------------|-------------|-----------|--------|-----------|
| Water tank | 8.55                                | 1,266      | 810         | 21.1      | 91.5   | 8.09      |
| Mud        | 8.52                                | 1,783      | 1,141       | 21.5      | 95.4   | 8.18      |
| 3          | 7.54                                | 2,027      | 1,297       | 19.4      | 44.2   | 4.23      |
| 6          | 7.67                                | 1,551      | 993         | 21.3      | 53.5   | 4.73      |
| 9          | No sample as limestone was too hard |            |             |           |        |           |
| 12         | 7.78                                | 1,309      | 838         | 21.9      | 48.1   | 4.10      |
| 15         | 7.99                                | 1,521      | 973         | 23.4      | 50.2   | 4.25      |
| 18         | 7.79                                | 1,563      | 1,000       | 24.8      | 6.5    | 0.52      |
| 21         | 8.02                                | 5,584      | 3,574       | 25.0      | 73.9   | 5.99      |

\* Calculated TDS (0.64 conversion factor)

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date      | Time  | Depth (m) | L/s | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|-----------|-------|-----------|-----|------|------------|-------------|-----------|-----------------|
| 4/05/2020 | 15:10 | 10        | 0.6 | 8.05 | 1,696      | 1,085       | 23.9      | -               |
| 4/05/2020 | 15:20 | 10        | 0.7 | 7.91 | 1,519      | 972         | 21.9      | 790             |
| 4/05/2020 | 15:30 | 10        | 0.7 | 7.85 | 1,490      | 954         | 20.4      | -               |
| 4/05/2020 | 15:40 | 20        | 0.9 | 7.83 | 1,395      | 893         | 22.3      | 450             |
| 4/05/2020 | 15:50 | 20        | 0.9 | 7.78 | 1,410      | 902         | 20.0      | 225             |
| 4/05/2020 | 16:00 | 20        | 1.2 | 7.73 | 1,547      | 990         | 19.8      | -               |
| 4/05/2020 | 16:10 | 20        | 1.2 | 7.76 | 1,528      | 978         | 19.6      | 62              |
| 4/05/2020 | 16:20 | 20        | 1.3 | 7.76 | 1,522      | 974         | 19.6      | 40              |
| 4/05/2020 | 16:30 | 20        | 1.3 | 7.74 | 1,523      | 975         | 20.1      | 39              |
| 4/05/2020 | 16:40 | 20        | 1.3 | 7.72 | 1,517      | 971         | 19.2      | 24              |
| 4/05/2020 | 16:50 | 20        | 1.3 | 7.75 | 1,517      | 971         | 19.1      | 23              |
| 4/05/2020 | 17:00 | 20        | 1.3 | 7.74 | 1,518      | 972         | 19.8      | 20              |

\* Calculated TDS (0.64 conversion factor)



## 10.6 Geophysical data

|              |                                                            |                                               |
|--------------|------------------------------------------------------------|-----------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma          | <input checked="" type="checkbox"/> Induction |
|              | <input type="checkbox"/> Long and Short Normal Resistivity | <input type="checkbox"/> Calliper             |
| LOGGING UNIT | Westlog                                                    |                                               |

# 11 Bore TOWSWIM-02-20

## 11.1 Location, maps and photographs

|                              |                                                                                  |    |         |           |          |         |
|------------------------------|----------------------------------------------------------------------------------|----|---------|-----------|----------|---------|
| OWNER                        | Department of Water and Environmental Regulation                                 |    |         |           |          |         |
| LOCATION                     | Located next to the Esperance Hospital on the corner of Hicks St and Randell St. |    |         |           |          |         |
| MGA REF                      | Zone                                                                             | 51 | Easting | 397319.16 | Northing | 6253255 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                                                         |    |         |           |          |         |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)                                             |    |         |           |          |         |
| PROJECT CODE                 | WA-G-SEAWATERIN                                                                  |    |         |           |          |         |
| AWRC Ref. Number             | TOWSWIM-02-20                                                                    |    |         | 60140054  |          |         |



Figure 19 TOWSWIM-02-20 location map

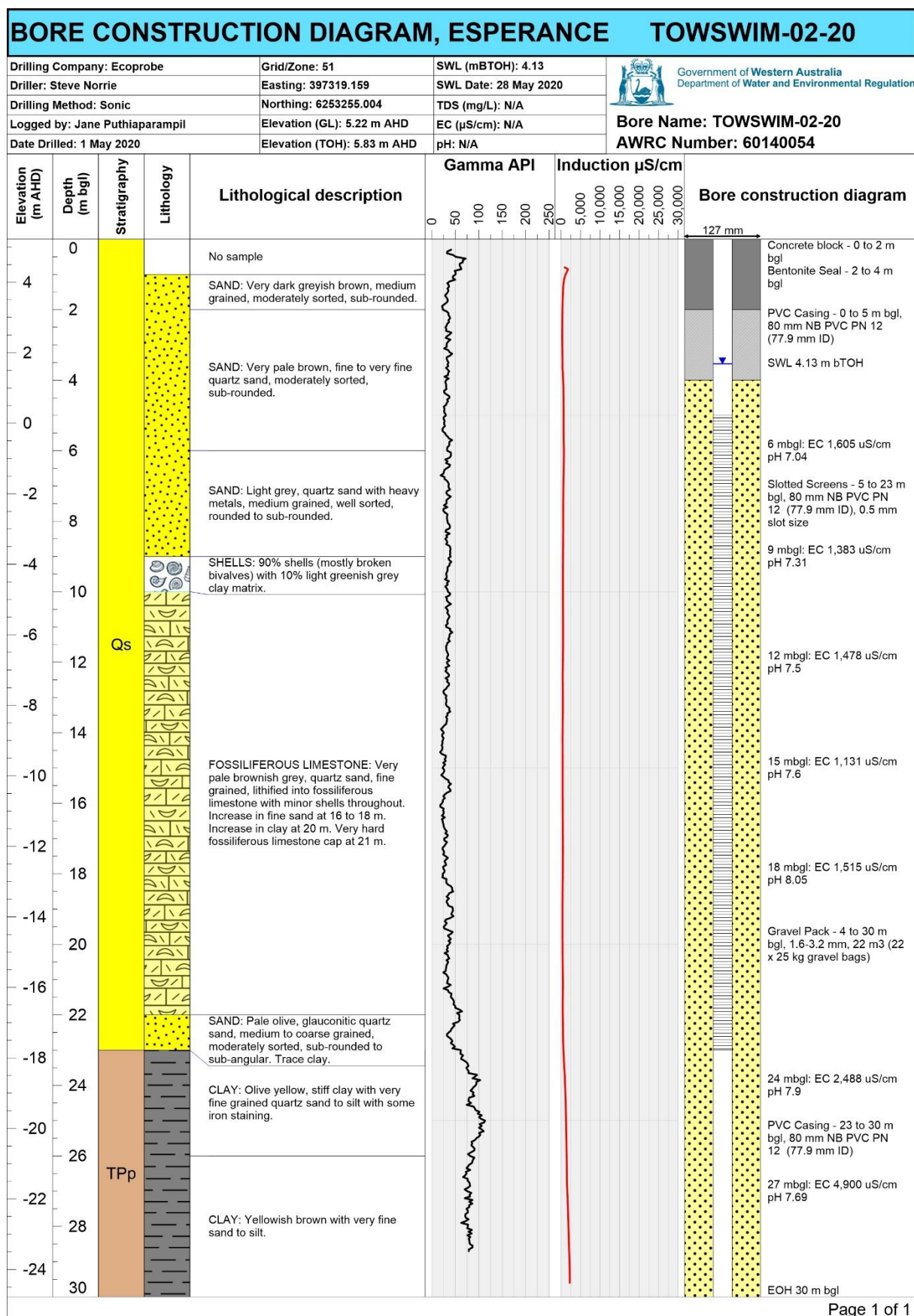




Figure 20 TOWSWIM-02-20 photographs



## 11.2 Bore summary diagram



## 11.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Jane Puthiaparampil                                                                           |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 30/04/2020                                                                                    |                                  |                        |
| Drilling complete   | 1/05/2020                                                                                     |                                  |                        |
| Airlifting          | 1/05/2020                                                                                     |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     | TOWSWIM-02-20                                                                                 |                                  |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 5.22                   |
|                     | Top of casing                                                                                 | -0.45                            | 5.67                   |
|                     | Top of headworks                                                                              | -0.61                            | 5.83                   |
|                     | Cement block                                                                                  | -0.16                            | 5.38                   |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 30                               | 127 (5")               |
| Total depth (m bgl) | 30                                                                                            |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

### CASING AND SCREENS

| Depth (m bgl) |    | Type                            | ID (mm) | OD (mm) |
|---------------|----|---------------------------------|---------|---------|
| From          | To |                                 |         |         |
| 0             | 5  | PN 12 blank PVC                 | 77.93   | 88.9    |
| 5             | 23 | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 23            | 30 | PN 12 blank PVC                 | 77.93   | 88.9    |

### ANNULUS FILL

| Depth (m bgl) |    | Fill type                              |
|---------------|----|----------------------------------------|
| From          | To |                                        |
| 0             | 2  | Concrete seal                          |
| 2             | 4  | Bentonite Seal                         |
| 4             | 30 | Gravel pack (1.6 mm – 3.2 mm diameter) |

## 11.4 Lithological interpretation

| Depth<br>(m bgl) |      | Description                                                                                                                                                                                                                                                     | Stratigraphy         |
|------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| From             | To   |                                                                                                                                                                                                                                                                 |                      |
| 0.0              | 1.0  | No sample                                                                                                                                                                                                                                                       | Quaternary sediments |
| 1.0              | 2.0  | SAND: Very dark greyish brown, medium grained, moderately sorted, sub-rounded.                                                                                                                                                                                  |                      |
| 2.0              | 6.0  | SAND: Very pale brown, fine to very fine quartz sand, moderately sorted, sub-rounded.                                                                                                                                                                           |                      |
| 6.0              | 9.0  | SAND: Light grey, quartz sand with heavy metals, medium grained, well sorted, rounded to sub-rounded.                                                                                                                                                           |                      |
| 9.0              | 10.0 | SHELLS: 90% shells (mostly broken bivalves) with 10% light greenish grey clay matrix.                                                                                                                                                                           |                      |
| 10.0             | 22.0 | FOSSILIFEROUS LIMESTONE: Very pale brownish grey, quartz sand, fine grained, lithified into fossiliferous limestone with minor shells throughout. Increase in fine sand at 16 to 18 m. Increase in clay at 20 m. Very hard fossiliferous limestone cap at 21 m. |                      |
| 22.0             | 23.0 | SAND: Pale olive, glauconitic quartz sand, medium to coarse grained, moderately sorted, sub-rounded to sub-angular. Trace clay.                                                                                                                                 | Pallinup Siltstone   |
| 23.0             | 26.0 | CLAY: Olive yellow, stiff clay with very fine-grained quartz sand to silt with some iron staining.                                                                                                                                                              |                      |
| 26.0             | 30.0 | CLAY: Yellowish brown with very fine sand to silt.                                                                                                                                                                                                              |                      |



## 11.5 Hydrogeological data

|                   |                                                      |
|-------------------|------------------------------------------------------|
| BORE              | TOWSWIM-02-20                                        |
| SCREENED INTERVAL | 5 to 23 m bgl                                        |
| AQUIFER           | Superficial                                          |
| WATER LEVEL       | 4.13 m bTOH (m below top of headworks) on 28/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)  | pH                                                           | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|------------|--------------------------------------------------------------|------------|-------------|-----------|--------|-----------|
| Water tank | 7.01                                                         | 1,251      | 801         | 16.8      | 91.7   | 8.80      |
| Mud        | 6.28                                                         | 1,529      | 979         | 17.4      | 99.4   | 9.21      |
| 6          | 7.04                                                         | 1,605      | 1,027       | 19.8      | 11.6   | 1.04      |
| 9          | 7.31                                                         | 1,383      | 885         | 19.5      | 23.2   | 2.08      |
| 12         | 7.50                                                         | 1,478      | 946         | 20.0      | 54.2   | 4.64      |
| 15         | 7.60                                                         | 1,131      | 724         | 20.1      | 21.1   | 1.79      |
| 18         | 8.05                                                         | 1,515      | 970         | 14.8      | 20.1   | 1.80      |
| 21         | No sample as limestone was too hard to get sampling tool in. |            |             |           |        |           |
| 24         | 7.90                                                         | 2,488      | 1,592       | 18.1      | 55.5   | 5.05      |
| 27         | 7.69                                                         | 4,900      | 3,136       | 19.9      | 46.6   | 4.16      |

\* Calculated TDS (0.64 conversion factor)

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date      | Time  | Depth (m) | L/s | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|-----------|-------|-----------|-----|------|------------|-------------|-----------|-----------------|
| 1/05/2020 | 14:25 | 10        | 0.2 | 8.33 | 1,784      | 1,142       | 18.9      | -               |
| 1/05/2020 | 14:35 | 10        | 0.2 | 8.20 | 1,499      | 959         | 19.3      | -               |
| 1/05/2020 | 14:45 | 10        | 0.2 | 8.03 | 1,345      | 861         | 18.8      | -               |
| 1/05/2020 | 14:55 | 17        | 0.9 | 7.95 | 1,261      | 807         | 18.7      | -               |
| 1/05/2020 | 15:05 | 17        | 0.8 | 7.91 | 1,184      | 758         | 18.7      | -               |
| 1/05/2020 | 15:15 | 17        | 0.8 | 7.87 | 1,170      | 749         | 18.7      | -               |
| 1/05/2020 | 15:25 | 23        | 0.8 | 7.90 | 1,220      | 781         | 18.8      | -               |
| 1/05/2020 | 15:35 | 23        | 1   | 7.88 | 1,204      | 771         | 18.9      | -               |
| 1/05/2020 | 15:45 | 23        | 1   | 7.85 | 1,199      | 767         | 18.8      | -               |
| 1/05/2020 | 15:55 | 23        | 1   | 7.87 | 1,195      | 765         | 18.8      | -               |
| 1/05/2020 | 16:05 | 23        | 1   | 7.87 | 1,190      | 762         | 18.7      | 82              |
| 1/05/2020 | 16:15 | 23        | 1   | 7.87 | 1,190      | 762         | 18.7      | 42              |

\* Calculated TDS (0.64 conversion factor)

## 11.6 Geophysical data

|              |                                                            |                                               |
|--------------|------------------------------------------------------------|-----------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma          | <input checked="" type="checkbox"/> Induction |
|              | <input type="checkbox"/> Long and Short Normal Resistivity | <input type="checkbox"/> Calliper             |
| LOGGING UNIT | Westlog                                                    |                                               |

## 12 Bore TOWSWIM-03-20

### 12.1 Location, maps and photographs

|                              |                                                                                     |    |          |            |          |             |
|------------------------------|-------------------------------------------------------------------------------------|----|----------|------------|----------|-------------|
| OWNER                        | Department of Water and Environmental Regulation                                    |    |          |            |          |             |
| LOCATION                     | Located next to the Adventureland Park in the car park. Accessed off The Esplanade. |    |          |            |          |             |
| MGA REF                      | Zone                                                                                | 51 | Easting  | 397555.503 | Northing | 6251952.839 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                                                            |    |          |            |          |             |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)                                                |    |          |            |          |             |
| PROJECT CODE                 | WA-G-SEAWATERIN                                                                     |    |          |            |          |             |
| AWRC Ref. Number             | TOWSWIM-03-20                                                                       |    | 60140055 |            |          |             |





Figure 21 TOWSWIM-03-20 location map

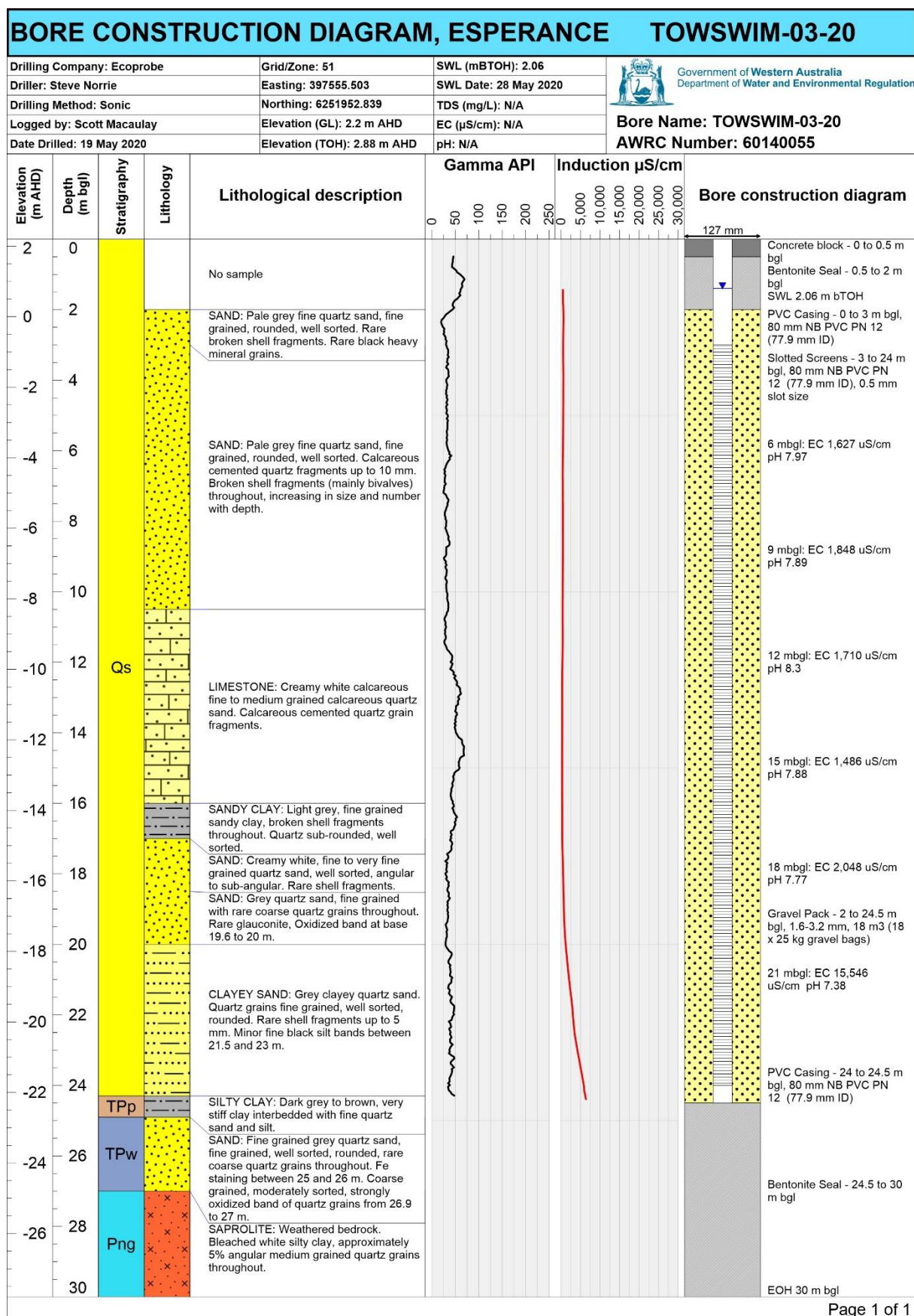




Figure 22 TOWSWIM-03-20 photographs



## 12.2 Bore summary diagram



## 12.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Scott Macaulay                                                                                |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 19/05/2020                                                                                    |                                  |                        |
| Drilling complete   | 19/05/2020                                                                                    |                                  |                        |
| Airlifting          | 22/05/2020                                                                                    |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     | TOWSWIM-03-20                                                                                 |                                  |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 2.2                    |
|                     | Top of casing                                                                                 | -0.55                            | 2.75                   |
|                     | Top of headworks                                                                              | -0.68                            | 2.88                   |
|                     | Cement block                                                                                  | -0.22                            | 2.42                   |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 30                               | 127 (5")               |
| Total depth (m bgl) | 24.5                                                                                          |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

### CASING AND SCREENS

| Depth (m bgl) |      | Type                            | ID (mm) | OD (mm) |
|---------------|------|---------------------------------|---------|---------|
| From          | To   |                                 |         |         |
| 0             | 3    | PN 12 blank PVC                 | 77.93   | 88.9    |
| 3             | 24   | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 24            | 24.5 | PN 12 blank PVC                 | 77.93   | 88.9    |

### ANNULUS FILL

| Depth (m bgl) |      | Fill type                              |
|---------------|------|----------------------------------------|
| From          | To   |                                        |
| 0             | 0.5  | Concrete seal                          |
| 0.5           | 2    | Bentonite Seal                         |
| 2             | 24.5 | Gravel pack (1.6 mm – 3.2 mm diameter) |
| 24.5          | 30   | Bentonite Seal                         |



## 12.4 Lithological interpretation

| Depth<br>(m bgl) |      | Description                                                                                                                                                                                                                      | Stratigraphy                     |
|------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| From             | To   |                                                                                                                                                                                                                                  |                                  |
| 0.0              | 2.0  | No sample                                                                                                                                                                                                                        | Quaternary sediments             |
| 2.0              | 3.0  | SAND: Pale grey fine quartz sand, fine grained, rounded, well sorted. Rare broken shell fragments. Rare black heavy mineral grains.                                                                                              |                                  |
| 3.0              | 10.5 | SAND: Pale grey fine quartz sand, fine grained, rounded, well sorted. Calcareous cemented quartz fragments up to 10 mm. Broken shell fragments (mainly bivalves) throughout, increasing in size and number with depth.           |                                  |
| 10.5             | 16.0 | LIMESTONE: Creamy white calcareous fine to medium-grained calcareous quartz sand. Calcareous cemented quartz grain fragments.                                                                                                    |                                  |
| 16.0             | 17.0 | SANDY CLAY: Light grey, fine-grained sandy clay, broken shell fragments throughout. Quartz sub-rounded, well sorted.                                                                                                             |                                  |
| 17.0             | 18.5 | SAND: Creamy white, fine to very fine-grained quartz sand, well sorted, angular to sub-angular. Rare shell fragments.                                                                                                            |                                  |
| 18.5             | 20.0 | SAND: Grey quartz sand, fine grained with rare coarse quartz grains throughout. Rare glauconite, Oxidized band at base 19.6 to 20 m.                                                                                             |                                  |
| 20.0             | 24.3 | CLAYEY SAND: Grey clayey quartz sand. Quartz grains fine grained, well sorted, rounded. Rare shell fragments up to 5 mm. Minor fine black silt bands between 21.5 and 23 m.                                                      |                                  |
| 24.3             | 24.9 | SILTY CLAY: Dark grey to brown, very stiff clay interbedded with fine quartz sand and silt.                                                                                                                                      | Pallinup Siltstone               |
| 24.9             | 27.0 | SAND: Grey quartz sand, fine grained, well sorted, rounded, rare coarse quartz grains throughout. Fe staining between 25 and 26 m. Coarse grained, moderately sorted, strongly oxidized band of quartz grains from 26.9 to 27 m. | Werillup Formation               |
| 27.0             | 30.0 | SAPROLITE: Weathered bedrock. Bleached white silty clay, approximately 5% angular medium-grained quartz grains throughout.                                                                                                       | Proterozoic basement (weathered) |

## 12.5 Hydrogeological data

|                   |                                                      |
|-------------------|------------------------------------------------------|
| BORE              | TOWSWIM-03-20                                        |
| SCREENED INTERVAL | 3 to 24 m bgl                                        |
| AQUIFER           | Superficial                                          |
| WATER LEVEL       | 2.06 m bTOH (m below top of headworks) on 28/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)  | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|------------|------|------------|-------------|-----------|--------|-----------|
| Water tank | 7.83 | 23         | 15          | 15.50     | 12.02  | 22.50     |
| Mud        | 8.21 | 1,966      | 1,258       | 17.00     | 79.00  | 7.60      |
| 6          | 7.97 | 1,627      | 1,041       | 18.80     | 11.10  | 0.99      |
| 9          | 7.89 | 1,848      | 1,183       | 20.10     | 54.10  | 4.90      |
| 12         | 8.30 | 1,710      | 1,094       | 20.30     | 46.00  | 4.25      |
| 15         | 7.88 | 1,486      | 951         | 22.30     | 3.80   | 0.32      |
| 18         | 7.77 | 2,048      | 1,311       | 21.50     | 5.40   | 0.51      |
| 21         | 7.38 | 15,546     | 9,949       | 21.30     | 7.30   | 0.42      |
| 24**       | 7.51 | 13,545     | 8,669       | 18.90     | 2.30   | 0.20      |

\* Calculated TDS (0.64 conversion factor)

\*\* Sample possibly contaminated with drilling mud

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date       | Time  | Depth (m) | L/s | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|------------|-------|-----------|-----|------|------------|-------------|-----------|-----------------|
| 22/05/2020 | 13:35 | 19        | 1   | 7.77 | 2,643      | 1,692       | 19.6      | 1277.3          |
| 22/05/2020 | 13:45 | 19        | 1   | 7.75 | 2,337      | 1,496       | 18.7      | 838.71          |
| 22/05/2020 | 13:55 | 19        | 1   | 7.74 | 2,689      | 1,721       | 19.0      | 247.45          |
| 22/05/2020 | 14:05 | 19        | 1   | 7.77 | 2,698      | 1,727       | 19.1      | 185.52          |
| 22/05/2020 | 14:15 | 19        | 1   | 7.77 | 2,726      | 1,745       | 20.1      | 230.58          |
| 22/05/2020 | 14:25 | 19        | 1   | 7.46 | 2,743      | 1,756       | 20.7      | 178.59          |
| 22/05/2020 | 14:35 | 19        | 1   | 7.77 | 2,746      | 1,757       | 19.8      | 77.1            |
| 22/05/2020 | 14:45 | 19        | 1   | 7.75 | 2,770      | 1,773       | 20.2      | 30.35           |
| 22/05/2020 | 14:55 | 19        | 1   | 7.76 | 2,759      | 1,766       | 19.8      | 31.49           |
| 22/05/2020 | 15:05 | 19        | 1   | 7.76 | 2,774      | 1,775       | 20.5      | 8.6             |
| 22/05/2020 | 15:15 | 19        | 1   | 7.74 | 2,506      | 1,604       | 19.9      | 6.1             |
| 22/05/2020 | 15:25 | 19        | 1   | 7.74 | 2,726      | 1,745       | 20.3      | 4.99            |
| 22/05/2020 | 15:35 | 19        | 1   | 7.73 | 2,759      | 1,766       | 19.9      | 7.25            |
| 22/05/2020 | 15:45 | 19        | 1   | 7.73 | 2,767      | 1,771       | 20.0      | 6.1             |
| 22/05/2020 | 15:55 | 19        | 1   | 7.74 | 2,787      | 1,784       | 19.6      | 4.77            |
| 22/05/2020 | 16:05 | 19        | 1   | 7.73 | 2,775      | 1,776       | 19.2      | 5.11            |
| 22/05/2020 | 16:15 | 19        | 1   | 7.76 | 2,791      | 1,786       | 18.7      | 5.2             |

\* Calculated TDS (0.64 conversion factor)

## 12.6 Geophysical data

|              |                                                            |                                               |
|--------------|------------------------------------------------------------|-----------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma          | <input checked="" type="checkbox"/> Induction |
|              | <input type="checkbox"/> Long and Short Normal Resistivity | <input type="checkbox"/> Calliper             |
| LOGGING UNIT | Westlog                                                    |                                               |



## 13 Bore TOWSWIM-04-20

### 13.1 Location, maps and photographs

|                              |                                                  |    |          |            |          |             |
|------------------------------|--------------------------------------------------|----|----------|------------|----------|-------------|
| OWNER                        | Department of Water and Environmental Regulation |    |          |            |          |             |
| LOCATION                     | Located in the road reserve off Longbottom Lane. |    |          |            |          |             |
| MGA REF                      | Zone                                             | 51 | Easting  | 393986.004 | Northing | 6254682.695 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                         |    |          |            |          |             |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)             |    |          |            |          |             |
| PROJECT CODE                 | WA-G-SEAWATERIN                                  |    |          |            |          |             |
| AWRC Ref. Number             | TOWSWIM-04-20                                    |    | 60140060 |            |          |             |

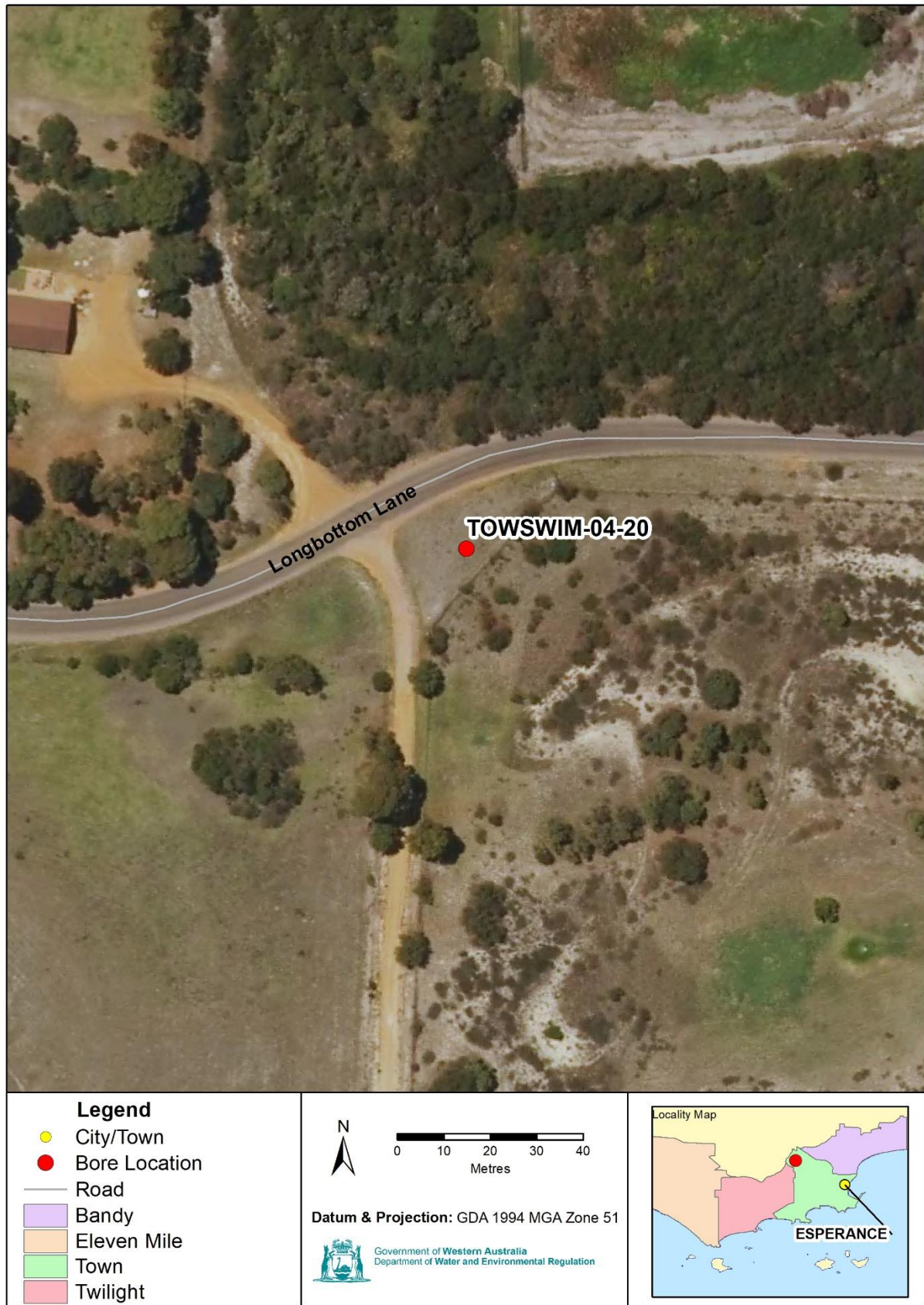


Figure 23 TOWSWIM-04-20 location map

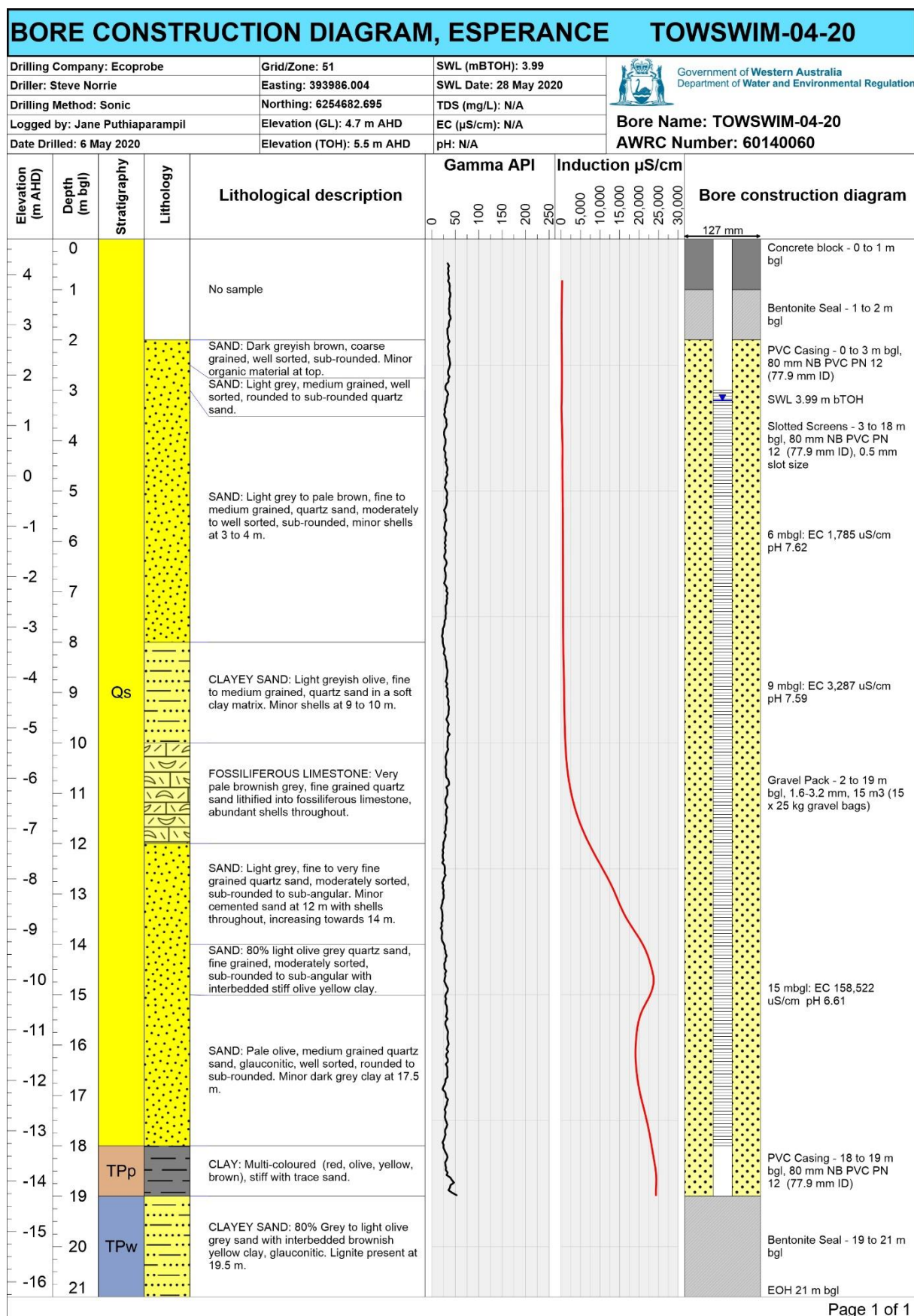




Figure 24 TOWSWIM-04-20 photographs



## 13.2 Bore summary diagram





### 13.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Jane Puthiaparampil                                                                           |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 6/05/2020                                                                                     |                                  |                        |
| Drilling complete   | 6/05/2020                                                                                     |                                  |                        |
| Airlifting          | 6/05/2020                                                                                     |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     | TOWSWIM-04-20                                                                                 |                                  |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 4.7                    |
|                     | Top of casing                                                                                 | -0.71                            | 5.41                   |
|                     | Top of headworks                                                                              | -0.8                             | 5.5                    |
|                     | Cement block                                                                                  | -0.18                            | 4.88                   |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 21                               | 127 (5")               |
| Total depth (m bgl) | 19                                                                                            |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

#### CASING AND SCREENS

| Depth (m bgl) |    | Type                            | ID (mm) | OD (mm) |
|---------------|----|---------------------------------|---------|---------|
| From          | To |                                 |         |         |
| 0             | 3  | PN 12 blank PVC                 | 77.93   | 88.9    |
| 3             | 18 | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 18            | 19 | PN 12 blank PVC                 | 77.93   | 88.9    |

#### ANNULUS FILL

| Depth (m bgl) |    | Fill type                              |
|---------------|----|----------------------------------------|
| From          | To |                                        |
| 0             | 1  | Concrete seal                          |
| 1             | 2  | Bentonite Seal                         |
| 2             | 19 | Gravel pack (1.6 mm – 3.2 mm diameter) |
| 19            | 21 | Bentonite Seal                         |

## 13.4 Lithological interpretation

| Depth<br>(m bgl) |      | Description                                                                                                                                                                          | Stratigraphy         |
|------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| From             | To   |                                                                                                                                                                                      |                      |
| 0.0              | 2.0  | No sample                                                                                                                                                                            | Quaternary sediments |
| 2.0              | 2.5  | SAND: Dark greyish brown, coarse grained, well sorted, sub-rounded. Minor organic material at top.                                                                                   |                      |
| 2.5              | 3.0  | SAND: Light grey, medium grained, well sorted, rounded to sub-rounded quartz sand.                                                                                                   |                      |
| 3.0              | 8.0  | SAND: Light grey to pale brown, fine to medium grained, quartz sand, moderately to well sorted, sub-rounded, minor shells at 3 to 4 m.                                               |                      |
| 8.0              | 10.0 | CLAYEY SAND: Light greyish olive, fine to medium grained, quartz sand in a soft clay matrix. Minor shells at 9 to 10 m.                                                              |                      |
| 10.0             | 12.0 | FOSSILIFEROUS LIMESTONE: Very pale brownish grey, fine-grained quartz sand lithified into fossiliferous limestone, abundant shells throughout.                                       |                      |
| 12.0             | 14.0 | SAND: Light grey, fine to very fine-grained quartz sand, moderately sorted, sub-rounded to sub-angular. Minor cemented sand at 12 m with shells throughout, increasing towards 14 m. |                      |
| 14.0             | 15.0 | SAND: 80% light olive-grey quartz sand, fine grained, moderately sorted, sub-rounded to sub-angular with interbedded stiff olive yellow clay.                                        |                      |
| 15.0             | 18.0 | SAND: Pale olive, medium-grained quartz sand, glauconitic, well sorted, rounded to sub-rounded. Minor dark grey clay at 17.5 m.                                                      |                      |
| 18.0             | 19.0 | CLAY: Multi-coloured (red, olive, yellow, brown), stiff with trace sand.                                                                                                             | Pallinup Siltstone   |
| 19.0             | 21.0 | CLAYEY SAND: 80% Grey to light olive grey sand with interbedded brownish yellow clay, glauconitic. Lignite present at 19.5 m.                                                        | Werillup Formation   |

## 13.5 Hydrogeological data

|                   |                                                      |
|-------------------|------------------------------------------------------|
| BORE              | TOWSWIM-04-20                                        |
| SCREENED INTERVAL | 3 to 18 m bgl                                        |
| AQUIFER           | Superficial                                          |
| WATER LEVEL       | 3.99 m bTOH (m below top of headworks) on 28/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)  | pH        | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|------------|-----------|------------|-------------|-----------|--------|-----------|
| Water tank | 7.84      | 1,231      | 788         | 16.6      | 96.3   | 9.28      |
| Mud        | 8.18      | 1,527      | 977         | 16.7      | 92.3   | 8.27      |
| 6          | 7.62      | 1,785      | 1,142       | 18.3      | 33.2   | 3.04      |
| 9          | 7.59      | 3,287      | 2,104       | 17.8      | 46.5   | 4.43      |
| 12         | No sample |            |             |           |        |           |
| 15         | 6.61      | 158,522    | 101,454     | 20.4      | 20.1   | 0.83      |
| 18         | No sample |            |             |           |        |           |

\* Calculated TDS (0.64 conversion factor)

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date      | Time  | Depth (m) | L/s   | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|-----------|-------|-----------|-------|------|------------|-------------|-----------|-----------------|
| 6/05/2020 | 14:50 | 12        | V low | 8.23 | 5,680      | 3,635       | 18.6      | 6300            |
| 6/05/2020 | 15:00 | 12        | 0.2   | 7.33 | 48,794     | 31,228      | 18.3      | 1770            |
| 6/05/2020 | 15:10 | 12        | 0.2   | 7.31 | 62,890     | 40,250      | 18.2      | 780             |
| 6/05/2020 | 15:20 | 12        | 0.2   | 7.29 | 70,909     | 45,382      | 18.2      | 440             |
| 6/05/2020 | 15:30 | 12        | 0.2   | 7.15 | 107,166    | 68,586      | 18.1      | 671             |
| 6/05/2020 | 15:40 | 12        | 0.2   | 7.13 | 125,677    | 80,433      | 18.0      | 455             |
| 6/05/2020 | 15:50 | 12        | 0.2   | 7.09 | 134,272    | 85,934      | 18.0      | 185             |
| 6/05/2020 | 16:00 | 12        | 0.2   | 7.09 | 136,695    | 87,485      | 17.8      | 92              |
| 6/05/2020 | 16:10 | 12        | 0.2   | 7.05 | 132,981    | 85,108      | 18.0      | 37              |
| 6/05/2020 | 16:20 | 12        | 0.2   | 7.06 | 129,727    | 83,025      | 17.8      | 36              |
| 6/05/2020 | 16:30 | 12        | 0.2   | 7.08 | 126,829    | 81,171      | 17.7      | 32              |
| 6/05/2020 | 16:40 | 12        | 0.2   | 7.02 | 126,901    | 81,217      | 17.5      | 24              |

\* Calculated TDS (0.64 conversion factor)



## 13.6 Geophysical data

|              |                                                            |                                               |
|--------------|------------------------------------------------------------|-----------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma          | <input checked="" type="checkbox"/> Induction |
|              | <input type="checkbox"/> Long and Short Normal Resistivity | <input type="checkbox"/> Calliper             |
| LOGGING UNIT | Westlog                                                    |                                               |

## 14 Bore TOWSWIM-05-20

### 14.1 Location, maps and photographs

|                              |                                                  |    |          |            |          |             |
|------------------------------|--------------------------------------------------|----|----------|------------|----------|-------------|
| OWNER                        | Department of Water and Environmental Regulation |    |          |            |          |             |
| LOCATION                     | Located in the Esperance cemetery car park.      |    |          |            |          |             |
| MGA REF                      | Zone                                             | 51 | Easting  | 394994.316 | Northing | 6253490.604 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                         |    |          |            |          |             |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)             |    |          |            |          |             |
| PROJECT CODE                 | WA-G-SEAWATERIN                                  |    |          |            |          |             |
| AWRC Ref. Number             | TOWSWIM-05-20                                    |    | 60140061 |            |          |             |



Figure 25 TOWSWIM-05-20 location map

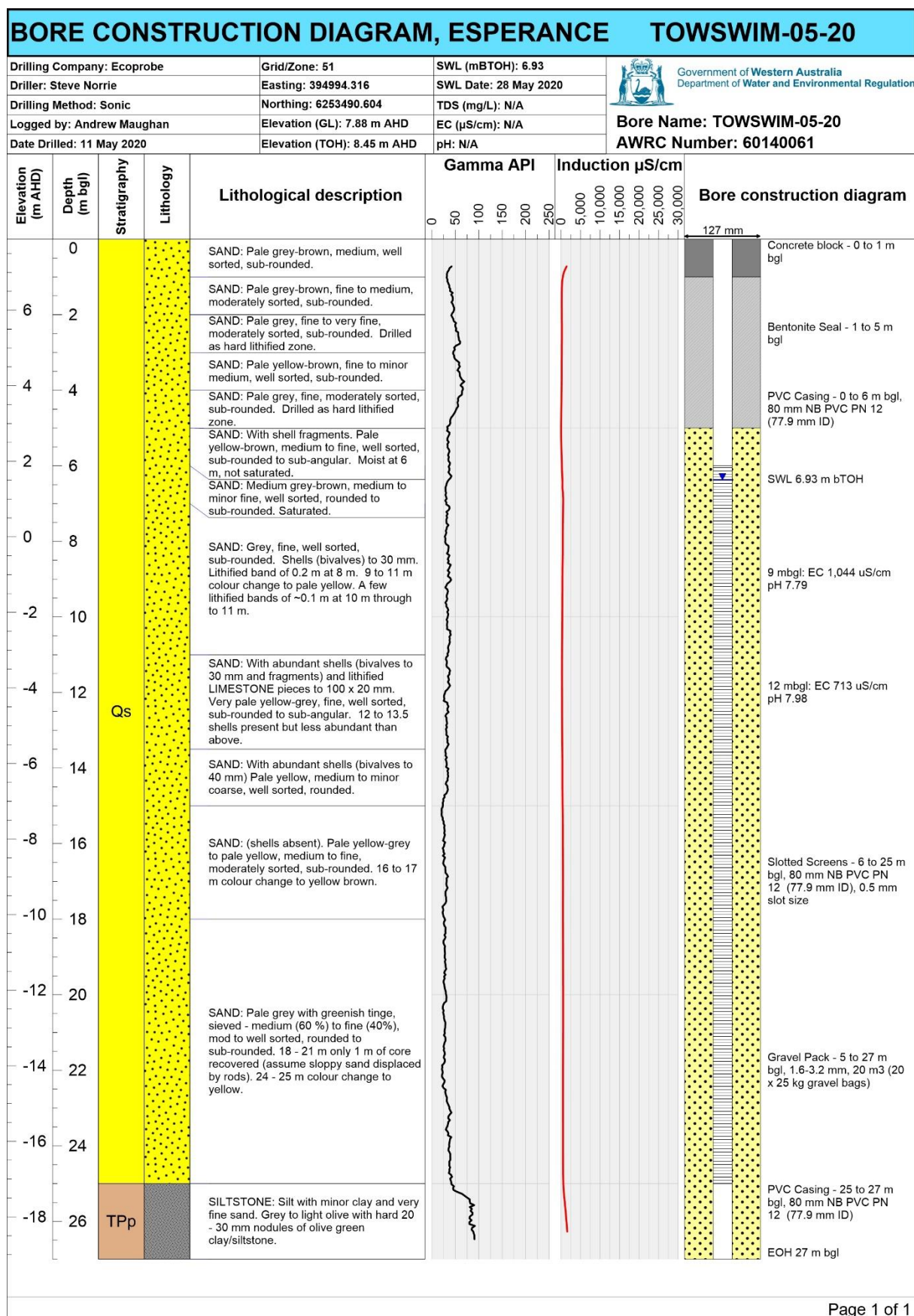




Figure 26 TOWSWIM-04-20 photographs



## 14.2 Bore summary diagram



## 14.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Andrew Maughan                                                                                |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 11/05/2020                                                                                    |                                  |                        |
| Drilling complete   | 11/05/2020                                                                                    |                                  |                        |
| Airlifting          | 16/05/2020                                                                                    |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     | TOWSWIM-05-20                                                                                 |                                  |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 7.88                   |
|                     | Top of casing                                                                                 | -0.40                            | 8.28                   |
|                     | Top of headworks                                                                              | -0.57                            | 8.45                   |
|                     | Cement block                                                                                  | -0.07                            | 7.95                   |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 27                               | 127 (5")               |
| Total depth (m bgl) | 27                                                                                            |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

### CASING AND SCREENS

| Depth (m bgl) |    | Type                            | ID (mm) | OD (mm) |
|---------------|----|---------------------------------|---------|---------|
| From          | To |                                 |         |         |
| 0             | 6  | PN 12 blank PVC                 | 77.93   | 88.9    |
| 6             | 25 | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 25            | 27 | PN 12 blank PVC                 | 77.93   | 88.9    |

### ANNULUS FILL

| Depth (m bgl) |    | Fill type                              |
|---------------|----|----------------------------------------|
| From          | To |                                        |
| 0             | 1  | Concrete seal                          |
| 1             | 5  | Bentonite Seal                         |
| 5             | 27 | Gravel pack (1.6 mm – 3.2 mm diameter) |



## 14.4 Lithological interpretation

| Depth<br>(m bgl) |      | Description                                                                                                                                                                                                                               | Stratigraphy        |
|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| From             | To   |                                                                                                                                                                                                                                           |                     |
| 0.0              | 1.0  | SAND: Pale grey brown, medium, well sorted, sub-rounded.                                                                                                                                                                                  | Quaternary sediment |
| 1.0              | 2.0  | SAND: Pale grey brown, fine to medium, moderately sorted, sub-rounded.                                                                                                                                                                    |                     |
| 2.0              | 3.0  | SAND: Pale grey, fine to very fine, moderately sorted, sub-rounded. Drilled as hard lithified zone.                                                                                                                                       |                     |
| 3.0              | 4.0  | SAND: Pale yellow brown, fine to minor medium, well sorted, sub-rounded.                                                                                                                                                                  |                     |
| 4.0              | 5.0  | SAND: Pale grey, fine, moderately sorted, sub-rounded. Drilled as hard lithified zone.                                                                                                                                                    |                     |
| 5.0              | 6.0  | SAND: Pale yellow brown, medium to fine, well sorted, sub-rounded to sub-angular. With shell fragments. Moist at 6 m, not saturated.                                                                                                      |                     |
| 6.0              | 7.0  | SAND: Medium grey brown, medium to minor fine, well sorted, rounded to sub-rounded. Saturated.                                                                                                                                            |                     |
| 7.0              | 11.0 | SAND: Grey, fine, well sorted, sub-rounded. Shells (bivalves) to 30 mm. Lithified band of 0.2 m at 8 m. 9 to 11 m colour change to pale yellow. A few lithified bands of ~0.1 m at 10 m through to 11 m.                                  |                     |
| 11.0             | 13.5 | SAND: Very pale yellow grey, fine, well sorted, sub-rounded to sub-angular. With abundant shells (bivalves to 30 mm and fragments) and lithified limestone pieces to 100 x 20 mm. 12 to 13.5 shells present but less abundant than above. |                     |
| 13.5             | 15.0 | SAND: Pale yellow, medium to minor coarse, well sorted, rounded. With abundant shells (bivalves to 40 mm).                                                                                                                                |                     |
| 15.0             | 18.0 | SAND: Pale yellow grey to pale yellow, medium to fine, moderately sorted, sub-rounded. 16 to 17 m colour change to yellow brown. Shells absent.                                                                                           |                     |
| 18.0             | 25.0 | SAND: Pale grey with greenish tinge, sieved - medium (60 %) to fine (40%), mod to well sorted, rounded to sub-rounded. 18 - 21 m only 1 m of core recovered (assume sloppy sand displaced by rods). 24 to 25 m colour change to yellow.   |                     |
| 25.0             | 27.0 | SILTSTONE: Grey to light olive with hard 20 to 30 mm nodules of olive green clay/siltstone. Silt with minor clay and very fine sand.                                                                                                      | Pallinup Siltstone  |

## 14.5 Hydrogeological data

|                   |                                                      |
|-------------------|------------------------------------------------------|
| BORE              | TOWSWIM-05-20                                        |
| SCREENED INTERVAL | 6 to 25 m bgl                                        |
| AQUIFER           | Superficial                                          |
| WATER LEVEL       | 6.93 m bTOH (m below top of headworks) on 28/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)                      | pH        | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|--------------------------------|-----------|------------|-------------|-----------|--------|-----------|
| Water tank                     | 7.56      | 1,252      | 801         | 15.0      | 80.0   | 8.00      |
| Mud                            | 7.71      | 1,955      | 1,251       | 17.0      | 79.0   | 8.00      |
| 6                              | No sample |            |             |           |        |           |
| 9                              | 7.79      | 1,044      | 668         | 18.6      | 11.3   | 1.00      |
| 12                             | 7.98      | 713        | 456         | 17.7      | 24.0   | 2.30      |
| Mud with ~1 cup soda ash added | 9.64      | 2,317      | 1,483       | 16.7      | 84.0   | 8.04      |
| 15**                           | 8.62      | 1,770      | 1,133       | 19.8      | 52.5   | 4.75      |
| 18**                           | 8.05      | 1,430      | 915         | 19.9      | 24.5   | 2.04      |
| 21**                           | 8.10      | 1,459      | 934         | 22.1      | 51.0   | 4.40      |
| 24**                           | 8.14      | 1,590      | 1,018       | 19.6      | 38.0   | 3.40      |

\* Calculated TDS (0.64 conversion factor)

\*\* Sample possibly contaminated with drilling mud

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date       | Time  | Depth (m) | L/s | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|------------|-------|-----------|-----|------|------------|-------------|-----------|-----------------|
| 16/05/2020 | 10:20 | 25        | 0.1 | 8.20 | 1,613      | 1,032       | 18.4      | -               |
| 16/05/2020 | 10:35 | 25        | 0.2 | 8.20 | 1,505      | 963         | 18.1      | 400             |
| 16/05/2020 | 11:00 | 25        | 0.2 | 8.00 | 1,454      | 931         | 18.3      | 150             |
| 16/05/2020 | 11:15 | 25        | 0.4 | 7.95 | 1,453      | 930         | 18.3      | 150             |
| 16/05/2020 | 11:30 | 25        | 0.5 | 7.94 | 1,472      | 942         | 18.4      | 100             |
| 16/05/2020 | 11:45 | 25        | 0.4 | 7.97 | 1,477      | 945         | 18.4      | 50              |
| 16/05/2020 | 12:00 | 25        | 0.4 | 7.87 | 1,469      | 940         | 18.3      | -               |
| 16/05/2020 | 12:25 | 25        | 0.4 | 7.88 | 1,466      | 938         | 18.3      | 15              |

\* Calculated TDS (0.64 conversion factor)

## 14.6 Geophysical data

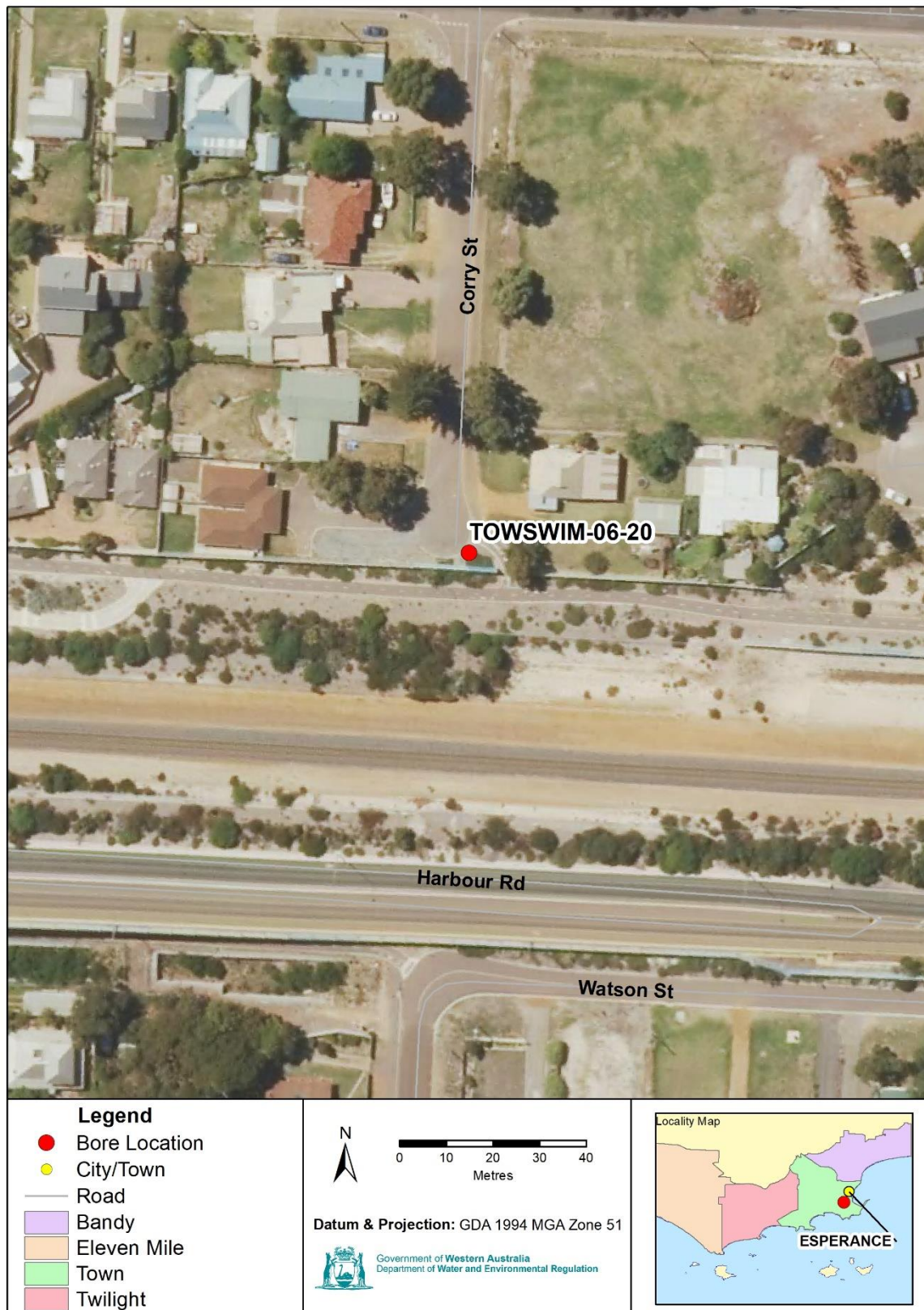
|              |                                                            |                                               |
|--------------|------------------------------------------------------------|-----------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma          | <input checked="" type="checkbox"/> Induction |
|              | <input type="checkbox"/> Long and Short Normal Resistivity | <input type="checkbox"/> Calliper             |
| LOGGING UNIT | Westlog                                                    |                                               |



# 15 Bore TOWSWIM-06-20

## 15.1 Location, maps and photographs

|                              |                                                  |    |          |            |          |             |
|------------------------------|--------------------------------------------------|----|----------|------------|----------|-------------|
| OWNER                        | Department of Water and Environmental Regulation |    |          |            |          |             |
| LOCATION                     | Located at the end of Cory St.                   |    |          |            |          |             |
| MGA REF                      | Zone                                             | 51 | Easting  | 397154.943 | Northing | 6251746.609 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                         |    |          |            |          |             |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)             |    |          |            |          |             |
| PROJECT CODE                 | WA-G-SEAWATERIN                                  |    |          |            |          |             |
| AWRC Ref. Number             | TOWSWIM-06-20                                    |    | 60140063 |            |          |             |



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Figure 27 TOWSWIM-06-20 location map

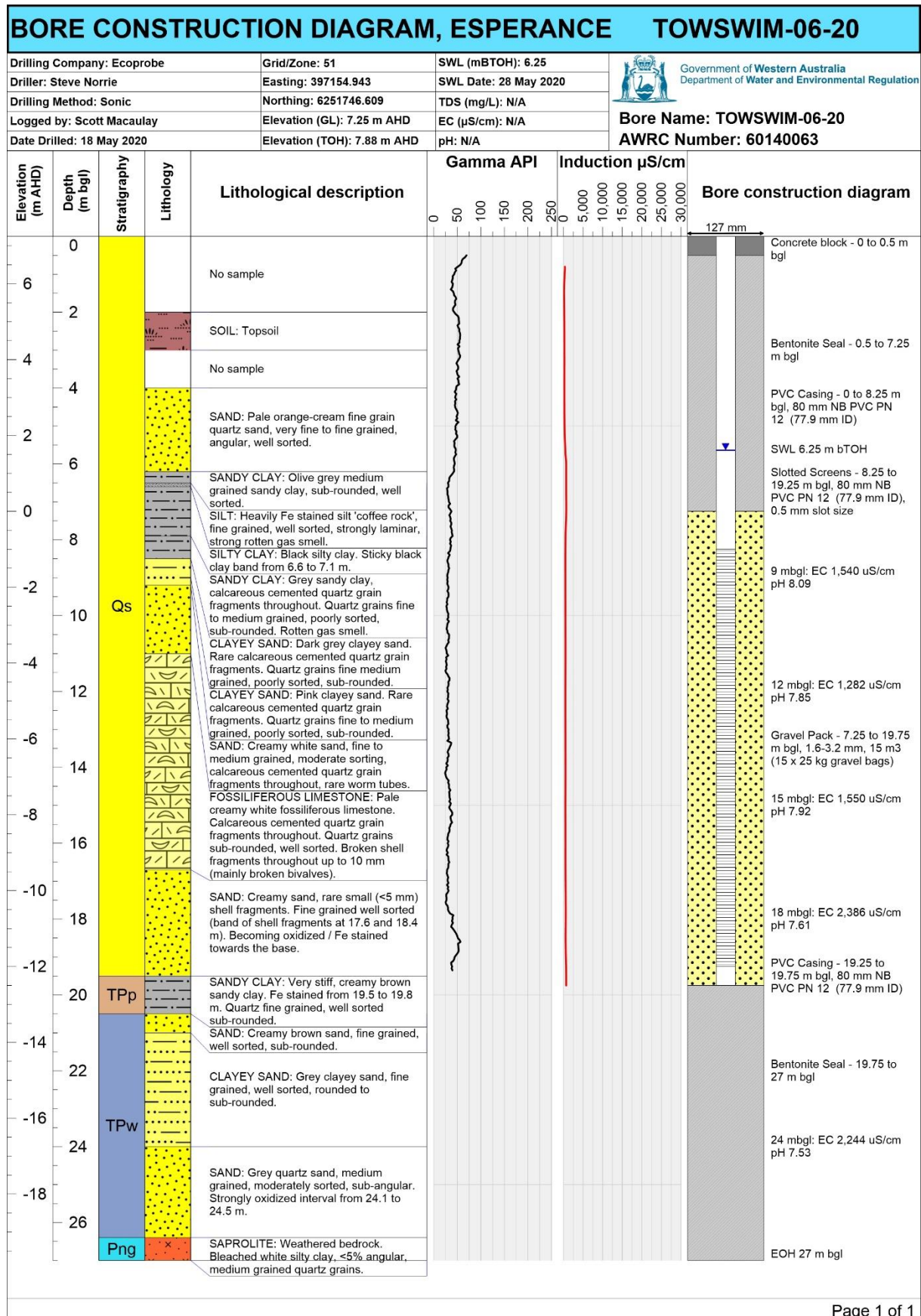




Figure 28 TOWSWIM-06-20 photographs



## 15.2 Bore summary diagram



## 15.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Scott Macaulay                                                                                |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 18/05/2020                                                                                    |                                  |                        |
| Drilling complete   | 18/05/2020                                                                                    |                                  |                        |
| Airlifting          | 22/05/2020                                                                                    |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     | TOWSWIM-06-20                                                                                 |                                  |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 7.25                   |
|                     | Top of casing                                                                                 | -0.42                            | 7.67                   |
|                     | Top of headworks                                                                              | -0.63                            | 7.88                   |
|                     | Cement block                                                                                  | -0.07                            | 7.32                   |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 27                               | 127 (5")               |
| Total depth (m bgl) | 19.75                                                                                         |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

### CASING AND SCREENS

| Depth (m bgl) |       | Type                            | ID (mm) | OD (mm) |
|---------------|-------|---------------------------------|---------|---------|
| From          | To    |                                 |         |         |
| 0             | 8.25  | PN 12 blank PVC                 | 77.93   | 88.9    |
| 8.25          | 19.25 | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 19.25         | 19.75 | PN 12 blank PVC                 | 77.93   | 88.9    |

### ANNULUS FILL

| Depth (m bgl) |       | Fill type                              |
|---------------|-------|----------------------------------------|
| From          | To    |                                        |
| 0             | 0.5   | Concrete seal                          |
| 0.5           | 7.25  | Bentonite Seal                         |
| 7.25          | 19.75 | Gravel pack (1.6 mm – 3.2 mm diameter) |
| 19.75         | 27    | Bentonite Seal                         |

## 15.4 Lithological interpretation

| Depth<br>(m bgl) |      | Description                                                                                                                                                                                                                                | Stratigraphy         |
|------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| From             | To   |                                                                                                                                                                                                                                            |                      |
| 0.0              | 2.0  | No sample                                                                                                                                                                                                                                  | Quaternary sediments |
| 2.0              | 3.0  | SOIL: Topsoil                                                                                                                                                                                                                              |                      |
| 3.0              | 4.0  | No sample                                                                                                                                                                                                                                  |                      |
| 4.0              | 6.2  | SAND: Pale orange cream fine grain quartz sand, very fine to fine grained, angular, well sorted.                                                                                                                                           |                      |
| 6.2              | 6.5  | SANDY CLAY: Olive grey medium-grained sandy clay, sub-rounded, well sorted.                                                                                                                                                                |                      |
| 6.5              | 6.6  | SILT: Heavily Fe-stained silt 'coffee rock', fine grained, well sorted, strongly laminar, strong rotten gas smell.                                                                                                                         |                      |
| 6.6              | 7.9  | SILTY CLAY: Black silty clay. Sticky black clay band from 6.6 to 7.1 m.                                                                                                                                                                    |                      |
| 7.9              | 8.5  | SANDY CLAY: Grey sandy clay, calcareous cemented quartz grain fragments throughout. Quartz grains fine to medium grained, poorly sorted, sub-rounded. Rotten gas smell.                                                                    |                      |
| 8.5              | 9.0  | CLAYEY SAND: Dark grey clayey sand. Rare calcareous cemented quartz grain fragments. Quartz grains fine medium grained, poorly sorted, sub-rounded.                                                                                        |                      |
| 9.0              | 9.2  | CLAYEY SAND: Pink clayey sand. Rare calcareous cemented quartz grain fragments. Quartz grains fine to medium grained, poorly sorted, sub-rounded.                                                                                          |                      |
| 9.2              | 11.0 | SAND: Creamy white sand, fine to medium grained, moderate sorting, calcareous cemented quartz grain fragments throughout, rare worm tubes.                                                                                                 |                      |
| 11.0             | 16.7 | FOSSILIFEROUS LIMESTONE: Pale creamy white fossiliferous limestone. Calcareous cemented quartz grain fragments throughout. Quartz grains sub-rounded, well sorted. Broken shell fragments throughout up to 10 mm (mainly broken bivalves). |                      |
| 16.7             | 19.5 | SAND: Creamy sand, rare small (<5 mm) shell fragments. Fine grained well sorted (band of shell fragments at 17.6 and 18.4 m). Becoming oxidized / Fe-stained towards the base.                                                             | Pallinup Siltstone   |
| 19.5             | 20.5 | SANDY CLAY: Very stiff, creamy brown sandy clay. Fe-stained from 19.5 to 19.8 m. Quartz fine grained, well sorted sub-rounded.                                                                                                             |                      |
| 20.5             | 21.0 | SAND: Creamy brown sand, fine grained, well sorted, sub-rounded.                                                                                                                                                                           | Werillup Formation   |
| 21.0             | 24.0 | CLAYEY SAND: Grey clayey sand, fine grained, well sorted, rounded to sub-rounded.                                                                                                                                                          |                      |
| 24.0             | 26.4 | SAND: Grey quartz sand, medium grained, moderately sorted, sub-angular. Strongly oxidized interval from 24.1 to 24.5 m.                                                                                                                    |                      |



|      |      |                                                                                                     |                                  |
|------|------|-----------------------------------------------------------------------------------------------------|----------------------------------|
| 26.4 | 27.0 | SAPROLITE: Weathered bedrock. Bleached white silty clay, <5% angular, medium-grained quartz grains. | Proterozoic basement (weathered) |
|------|------|-----------------------------------------------------------------------------------------------------|----------------------------------|

## 15.5 Hydrogeological data

|                   |                                                      |
|-------------------|------------------------------------------------------|
| BORE              | TOWSWIM-06-20                                        |
| SCREENED INTERVAL | 8.25 to 19.25 m bgl                                  |
| AQUIFER           | Superficial                                          |
| WATER LEVEL       | 6.25 m bTOH (m below top of headworks) on 28/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)  | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|------------|------|------------|-------------|-----------|--------|-----------|
| Water tank | 8.10 | 1,207      | 772         | 15.9      | 92.7   | 8.45      |
| Mud        | 8.30 | 1,756      | 1,124       | 16.3      | 89.8   | 8.87      |
| 9          | 8.09 | 1,540      | 986         | 20.1      | 5.3    | 0.44      |
| 12         | 7.85 | 1,282      | 820         | 18.6      | 6.1    | 0.60      |
| 15         | 7.92 | 1,550      | 992         | 19.9      | 31.5   | 2.80      |
| 18         | 7.61 | 2,386      | 1,527       | 21.8      | 5.3    | 0.44      |
| 21         | 7.28 | 2,122      | 1,358       | 29.8      | 3.1    | 0.21      |
| 24         | 7.53 | 2,244      | 1,436       | 21.8      | 6.9    | 0.54      |

\* Calculated TDS (0.64 conversion factor)

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date       | Time  | Depth (m) | L/s | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|------------|-------|-----------|-----|------|------------|-------------|-----------|-----------------|
| 22/05/2020 | 10:55 | 19        | 0.5 | 7.91 | 2,697      | 1,726       | 18.5      | 320.9           |
| 22/05/2020 | 11:05 | 19        | 0.5 | 7.83 | 2,313      | 1,480       | 19.2      | 180.19          |
| 22/05/2020 | 11:15 | 19        | 0.5 | 7.83 | 2,309      | 1,478       | 19.1      | 167.37          |
| 22/05/2020 | 11:25 | 19        | 0.5 | 7.81 | 2,318      | 1,484       | 19.3      | 116.38          |
| 22/05/2020 | 11:35 | 19        | 0.5 | 7.82 | 2,312      | 1,480       | 19.2      | 61.5            |
| 22/05/2020 | 11:45 | 19        | 0.5 | 7.78 | 2,305      | 1,475       | 19.3      | 31.5            |
| 22/05/2020 | 11:55 | 19        | 0.5 | 7.78 | 2,314      | 1,481       | 18.9      | 30              |
| 22/05/2020 | 12:05 | 19        | 0.5 | 7.75 | 2,310      | 1,478       | 18.9      | 17.76           |
| 22/05/2020 | 12:15 | 19        | 0.5 | 7.78 | 2,307      | 1,476       | 18.7      | 7.71            |
| 22/05/2020 | 12:25 | 19        | 0.5 | 7.80 | 2,301      | 1,473       | 19.4      | 7.6             |
| 22/05/2020 | 12:35 | 19        | 0.5 | 7.75 | 2,297      | 1,470       | 19.3      | 5.81            |
| 22/05/2020 | 12:45 | 19        | 0.5 | 7.76 | 2,292      | 1,467       | 19.0      | 5.1             |

\* Calculated TDS (0.64 conversion factor)

## 15.6 Geophysical data

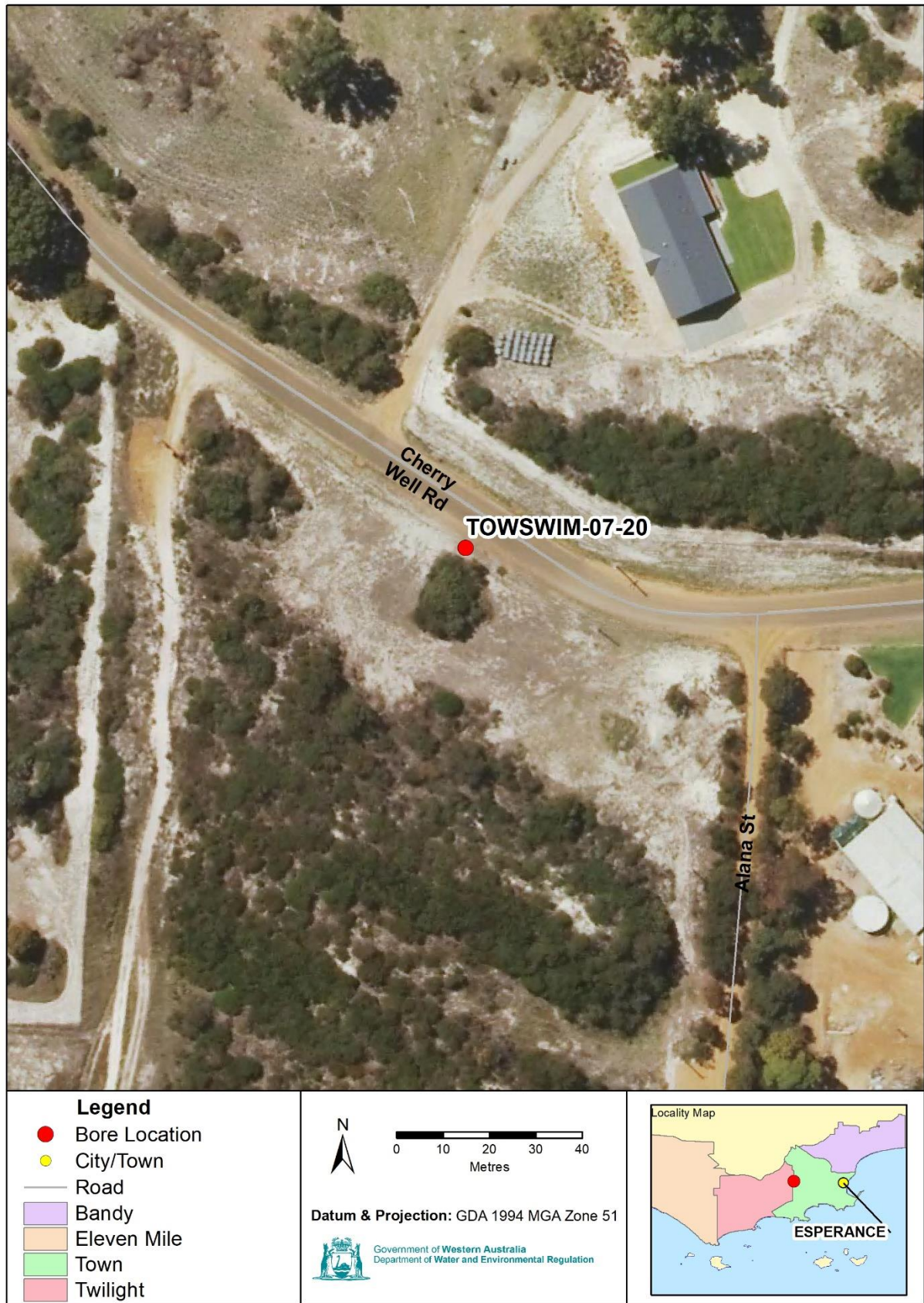
|              |                                                                                                                                                                                                 |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma <input checked="" type="checkbox"/> Induction<br><input type="checkbox"/> Long and Short Normal Resistivity <input type="checkbox"/> Calliper |
| LOGGING UNIT | Westlog                                                                                                                                                                                         |

## 16 Bore TOWSWIM-07-20

### 16.1 Location, maps and photographs

|                              |                                                  |    |          |            |          |             |
|------------------------------|--------------------------------------------------|----|----------|------------|----------|-------------|
| OWNER                        | Department of Water and Environmental Regulation |    |          |            |          |             |
| LOCATION                     | Located in the road reserve off Cherry Well Rd.  |    |          |            |          |             |
| MGA REF                      | Zone                                             | 51 | Easting  | 393967.295 | Northing | 6252754.158 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                         |    |          |            |          |             |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)             |    |          |            |          |             |
| PROJECT CODE                 | WA-G-SEAWATERIN                                  |    |          |            |          |             |
| AWRC Ref. Number             | TOWSWIM-07-20                                    |    | 60140067 |            |          |             |





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Figure 29 TOWSWIM-07-20 location map

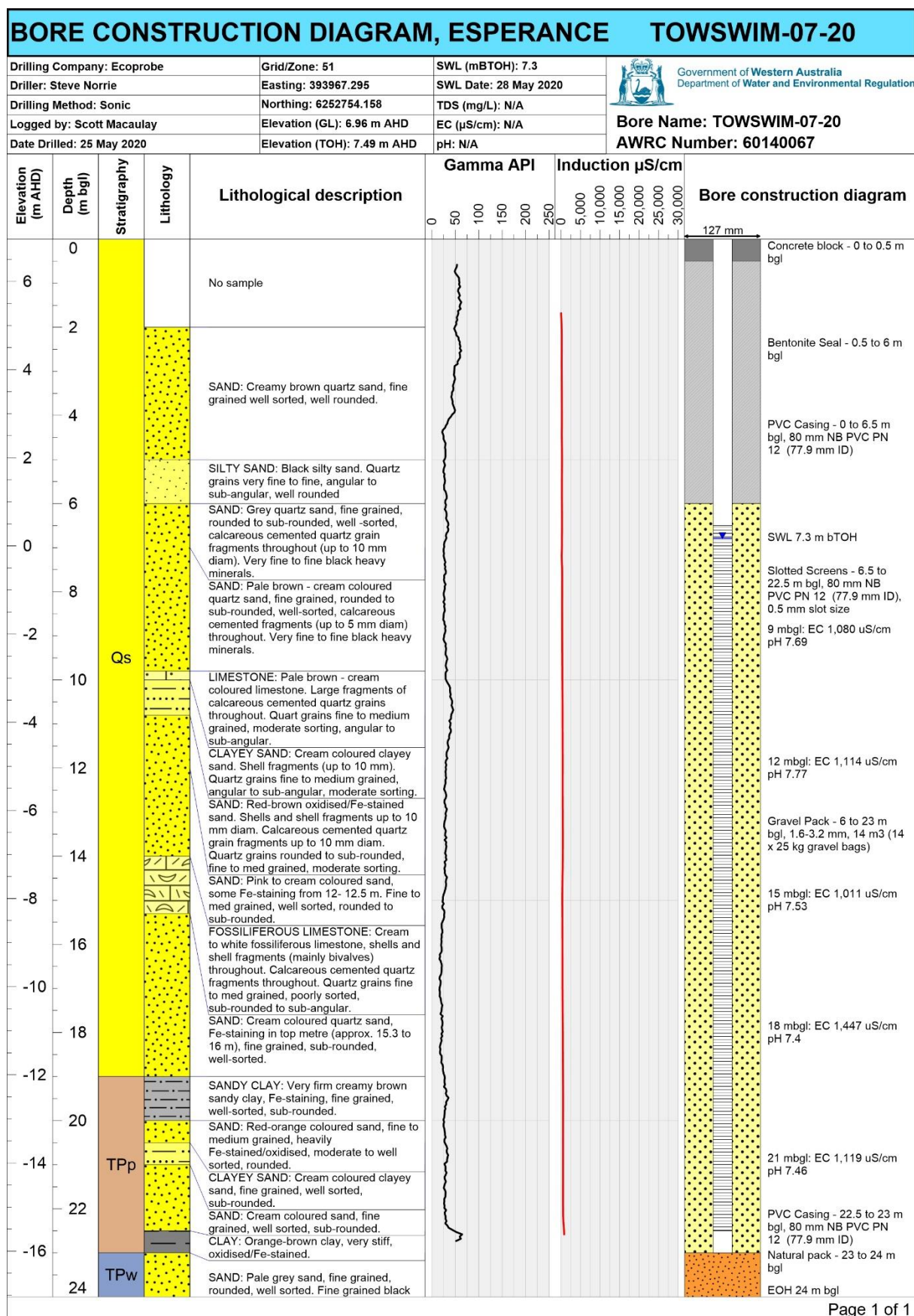




Figure 30 TOWSWIM-07-20 photographs



## 16.2 Bore summary diagram





## 16.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Scott Macaulay                                                                                |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 25/05/2020                                                                                    |                                  |                        |
| Drilling complete   | 25/05/2020                                                                                    |                                  |                        |
| Airlifting          | 25/05/2020                                                                                    |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     | TOWSWIM-07-20                                                                                 |                                  |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 6.96                   |
|                     | Top of casing                                                                                 | -0.41                            | 7.37                   |
|                     | Top of headworks                                                                              | -0.53                            | 7.49                   |
|                     | Cement block                                                                                  | -0.06                            | 7.02                   |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 24                               | 127 (5")               |
| Total depth (m bgl) | 23                                                                                            |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

### CASING AND SCREENS

| Depth (m bgl) |      | Type                            | ID (mm) | OD (mm) |
|---------------|------|---------------------------------|---------|---------|
| From          | To   |                                 |         |         |
| 0             | 6.5  | PN 12 blank PVC                 | 77.93   | 88.9    |
| 6.5           | 22.5 | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 22.5          | 23   | PN 12 blank PVC                 | 77.93   | 88.9    |

### ANNULUS FILL

| Depth (m bgl) |     | Fill type                              |
|---------------|-----|----------------------------------------|
| From          | To  |                                        |
| 0             | 0.5 | Concrete seal                          |
| 0.5           | 6   | Bentonite Seal                         |
| 6             | 23  | Gravel pack (1.6 mm – 3.2 mm diameter) |

## 16.4 Lithological interpretation

| Depth<br>(m bgl) |      | Description                                                                                                                                                                                                                                                 | Stratigraphy         |
|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| From             | To   |                                                                                                                                                                                                                                                             |                      |
| 0.0              | 2.0  | No sample                                                                                                                                                                                                                                                   | Quaternary sediments |
| 2.0              | 5.0  | SAND: Creamy brown quartz sand, fine grained well sorted, well rounded.                                                                                                                                                                                     |                      |
| 5.0              | 6.0  | SILTY SAND: Black silty sand. Quartz grains very fine to fine, angular to sub-angular, well rounded                                                                                                                                                         |                      |
| 6.0              | 7.0  | SAND: Grey quartz sand, fine grained, rounded to sub-rounded, well sorted, calcareous cemented quartz grain fragments throughout (up to 10 mm diam). Very fine to fine black heavy minerals.                                                                |                      |
| 7.0              | 9.8  | SAND: Pale brown - cream coloured quartz sand, fine grained, rounded to sub-rounded, well-sorted, calcareous cemented fragments (up to 5 mm diam) throughout. Very fine to fine black heavy minerals.                                                       |                      |
| 9.8              | 10.0 | LIMESTONE: Pale brown - cream coloured limestone. Large fragments of calcareous cemented quartz grains throughout. Quartz grains fine to medium grained, moderate sorting, angular to sub-angular.                                                          |                      |
| 10.0             | 10.8 | CLAYEY SAND: Cream coloured clayey sand. Shell fragments (up to 10 mm). Quartz grains fine to medium grained, angular to sub-angular, moderate sorting.                                                                                                     |                      |
| 10.8             | 12.0 | SAND: Red-brown oxidised/Fe-stained sand. Shells and shell fragments up to 10 mm diam. Calcareous cemented quartz grain fragments up to 10 mm diam. Quartz grains rounded to sub-rounded, fine to medium grained, moderate sorting.                         |                      |
| 12.0             | 14.0 | SAND: Pink to cream coloured sand, some Fe-staining from 12 to 12.5 m. Fine to medium grained, well sorted, rounded to sub-rounded.                                                                                                                         |                      |
| 14.0             | 15.3 | FOSSILIFEROUS LIMESTONE: Cream to white fossiliferous limestone, shells and shell fragments (mainly bivalves) throughout. Calcareous cemented quartz fragments throughout. Quartz grains fine to medium grained, poorly sorted, sub-rounded to sub-angular. |                      |
| 15.3             | 19.0 | SAND: Cream coloured quartz sand, Fe-staining in top metre (approx. 15.3 to 16 m), fine grained, sub-rounded, well sorted.                                                                                                                                  | Pallinup Siltstone   |
| 19.0             | 20.0 | SANDY CLAY: Very firm creamy brown sandy clay, Fe-staining, fine grained, well sorted, sub-rounded.                                                                                                                                                         |                      |
| 20.0             | 20.5 | SAND: Red-orange coloured sand, fine to medium grained, heavily Fe-stained/oxidised, moderate to well sorted, rounded.                                                                                                                                      |                      |
| 20.5             | 21.0 | CLAYEY SAND: Cream coloured clayey sand, fine grained, well sorted, sub-rounded.                                                                                                                                                                            |                      |

|      |      |                                                                                                         |                    |
|------|------|---------------------------------------------------------------------------------------------------------|--------------------|
| 21.0 | 22.5 | SAND: Cream coloured sand, fine grained, well sorted, sub-rounded.                                      |                    |
| 22.5 | 23.0 | CLAY: Orange-brown clay, very stiff, oxidised/Fe-stained.                                               |                    |
| 23.0 | 24.0 | SAND: Pale grey sand, fine grained, rounded, well sorted. Fine-grained black heavy minerals throughout. | Werillup Formation |



## 16.5 Hydrogeological data

|                   |                                                     |
|-------------------|-----------------------------------------------------|
| BORE              | TOWSWIM-07-20                                       |
| SCREENED INTERVAL | 6.5 to 22.5 m bgl                                   |
| AQUIFER           | Superficial                                         |
| WATER LEVEL       | 7.3 m bTOH (m below top of headworks) on 28/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)  | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|------------|------|------------|-------------|-----------|--------|-----------|
| Water tank | 8.30 | 1,176      | 753         | 14.5      | 93.1   | 9.51      |
| Mud        | 8.05 | 1,720      | 1,101       | 14.8      | 71.4   | 7.73      |
| 9          | 7.69 | 1,080      | 691         | 25.0      | 7.8    | 0.75      |
| 12         | 7.77 | 1,114      | 713         | 17.3      | 10.5   | 1.02      |
| 15         | 7.53 | 1,011      | 647         | 17.9      | 9.1    | 0.90      |
| 18         | 7.40 | 1,447      | 926         | 19.3      | 3.1    | 0.28      |
| 21         | 7.46 | 1,119      | 716         | 19.3      | 2.5    | 0.23      |

\* Calculated TDS (0.64 conversion factor)

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date       | Time  | Depth (m) | L/s   | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|------------|-------|-----------|-------|------|------------|-------------|-----------|-----------------|
| 25/05/2020 | 15:00 | 21        | 0.007 | 8.33 | 1,611      | 1031        | 18.3      | 1150.91         |
| 25/05/2020 | 15:12 | 21        | 0.007 | 7.99 | 1,229      | 787         | 17.8      | 40.78           |
| 25/05/2020 | 15:20 | 21        | 0.007 | 7.98 | 228        | 146         | 17.9      | 988.25          |
| 25/05/2020 | 15:30 | 21        | 0.007 | 7.97 | 1,160      | 742         | 17.5      | 350.45          |
| 25/05/2020 | 15:40 | 21        | 0.007 | 7.93 | 1,103      | 706         | 18.2      | 65.71           |
| 25/05/2020 | 15:50 | 21        | 0.5   | 7.90 | 1,089      | 697         | 18.3      | 16.01           |
| 25/05/2020 | 16:00 | 21        | 0.5   | 7.91 | 1,088      | 696         | 18.4      | 9.23            |
| 25/05/2020 | 16:10 | 21        | 0.5   | 7.91 | 1,085      | 694         | 18.4      | 6.34            |
| 25/05/2020 | 16:20 | 21        | 0.5   | 7.91 | 1,085      | 694         | 18.3      | 4.89            |
| 25/05/2020 | 16:30 | 21        | 0.5   | 7.90 | 1,085      | 694         | 18.1      | 3.78            |
| 25/05/2020 | 16:40 | 21        | 0.5   | 7.90 | 1,084      | 694         | 18.1      | 2.81            |
| 25/05/2020 | 16:50 | 21        | 0.5   | 7.90 | 1,085      | 694         | 18.1      | 2.49            |
| 25/05/2020 | 17:00 | 21        | 0.5   | 7.90 | 1,085      | 694         | 18.3      | 2.36            |

\* Calculated TDS (0.64 conversion factor)

## 16.6 Geophysical data

|              |                                                            |                                               |
|--------------|------------------------------------------------------------|-----------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma          | <input checked="" type="checkbox"/> Induction |
|              | <input type="checkbox"/> Long and Short Normal Resistivity | <input type="checkbox"/> Calliper             |
| LOGGING UNIT | Westlog                                                    |                                               |

## 17 Bore TWLSWIM-01-20

### 17.1 Location, maps and photographs

|                              |                                                  |    |          |            |          |             |
|------------------------------|--------------------------------------------------|----|----------|------------|----------|-------------|
| OWNER                        | Department of Water and Environmental Regulation |    |          |            |          |             |
| LOCATION                     | Located in the road reserve off Helms Dr.        |    |          |            |          |             |
| MGA REF                      | Zone                                             | 51 | Easting  | 389033.979 | Northing | 6252670.019 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                         |    |          |            |          |             |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)             |    |          |            |          |             |
| PROJECT CODE                 | WA-G-SEAWATERIN                                  |    |          |            |          |             |
| AWRC Ref. Number             | TWLSWIM-01-20                                    |    | 60140051 |            |          |             |



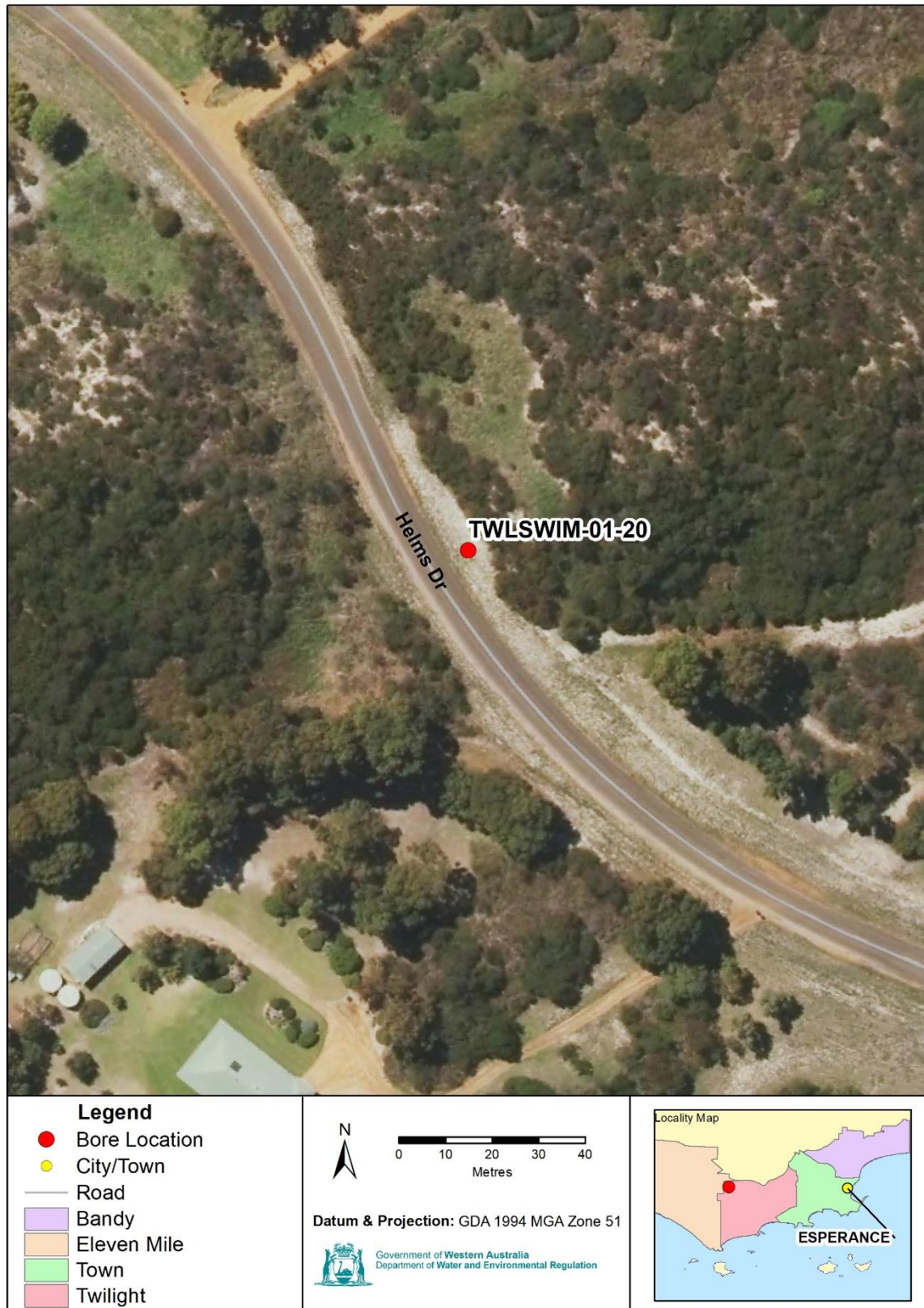


Figure 31 TWLSWIM-01-20 location map

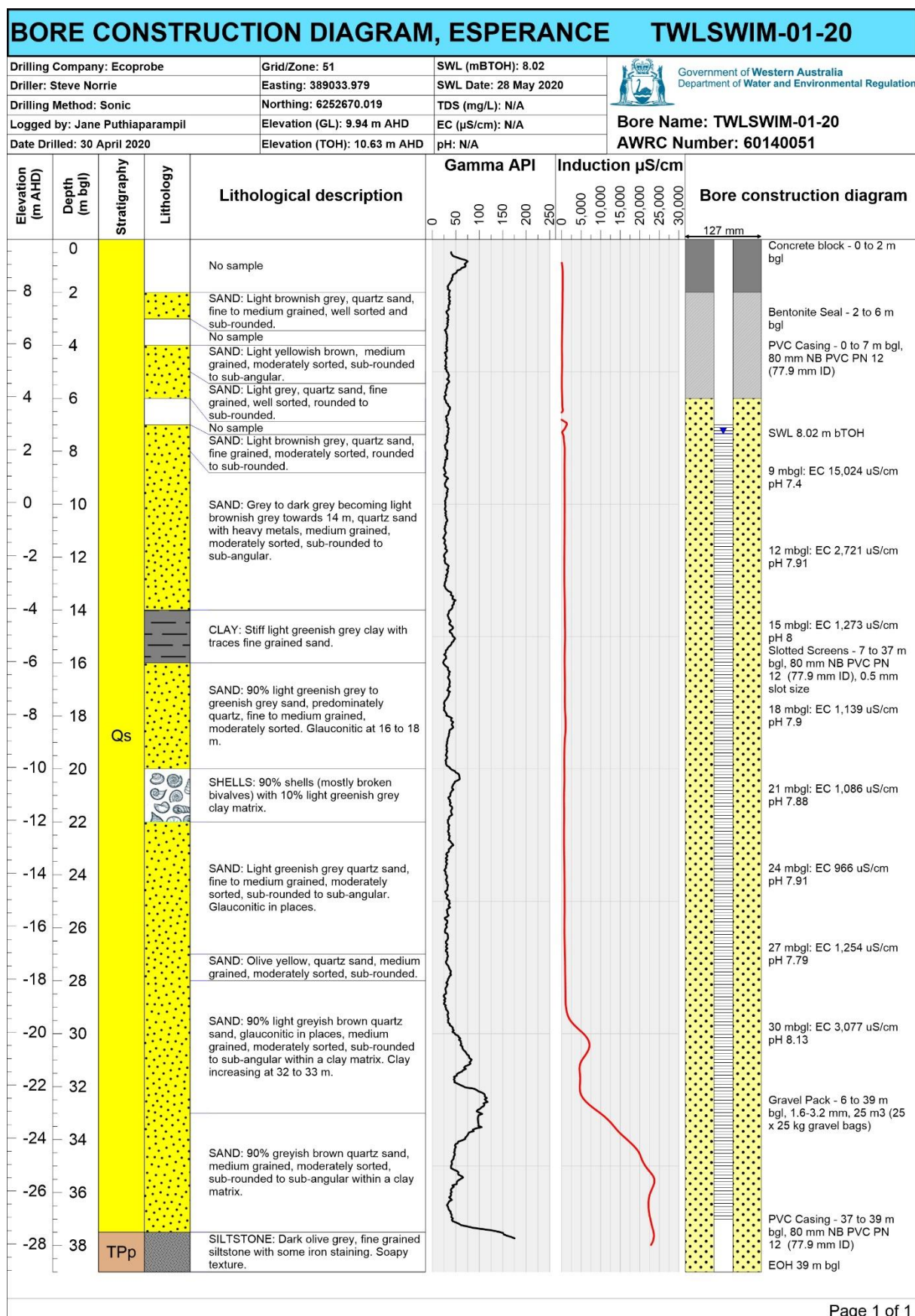




Figure 32 TWLSWIM-01-20 photographs



## 17.2 Bore summary diagram





## 17.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Jane Puthiaparampil                                                                           |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 29/04/2020                                                                                    |                                  |                        |
| Drilling complete   | 30/04/2020                                                                                    |                                  |                        |
| Airlifting          | 2/05/2020                                                                                     |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     | TWLSWIM-01-20                                                                                 |                                  |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 9.94                   |
|                     | Top of casing                                                                                 | -0.58                            | 10.52                  |
|                     | Top of headworks                                                                              | -0.69                            | 10.63                  |
|                     | Cement block                                                                                  | -0.09                            | 10.03                  |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 39                               | 127 (5")               |
| Total depth (m bgl) | 39                                                                                            |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

### CASING AND SCREENS

| Depth (m bgl) |    | Type                            | ID (mm) | OD (mm) |
|---------------|----|---------------------------------|---------|---------|
| From          | To |                                 |         |         |
| 0             | 7  | PN 12 blank PVC                 | 77.93   | 88.9    |
| 7             | 37 | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 37            | 39 | PN 12 blank PVC                 | 77.93   | 88.9    |

### ANNULUS FILL

| Depth (m bgl) |    | Fill type                              |
|---------------|----|----------------------------------------|
| From          | To |                                        |
| 0             | 2  | Concrete seal                          |
| 2             | 6  | Bentonite Seal                         |
| 6             | 39 | Gravel pack (1.6 mm – 3.2 mm diameter) |

## 17.4 Lithological interpretation

| Depth<br>(m bgl) |      | Description                                                                                                                                                                          | Stratigraphy         |
|------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| From             | To   |                                                                                                                                                                                      |                      |
| 0.0              | 2.0  | No sample                                                                                                                                                                            | Quaternary sediments |
| 2.0              | 3.0  | SAND: Light brownish grey, quartz sand, fine to medium grained, well sorted and sub-rounded.                                                                                         |                      |
| 3.0              | 4.0  | No sample                                                                                                                                                                            |                      |
| 4.0              | 5.0  | SAND: Light yellowish brown, medium grained, moderately sorted, sub-rounded to sub-angular.                                                                                          |                      |
| 5.0              | 6.0  | SAND: Light grey, quartz sand, fine grained, well sorted, rounded to sub-rounded.                                                                                                    |                      |
| 6.0              | 7.0  | No sample                                                                                                                                                                            |                      |
| 7.0              | 8.0  | SAND: Light brownish grey, quartz sand, fine grained, moderately sorted, rounded to sub-rounded.                                                                                     |                      |
| 8.0              | 14.0 | SAND: Grey to dark grey becoming light brownish grey towards 14 m, quartz sand with heavy metals, medium grained, moderately sorted, sub-rounded to sub-angular.                     |                      |
| 14.0             | 16.0 | CLAY: Stiff light greenish grey clay with traces fine-grained sand.                                                                                                                  |                      |
| 16.0             | 20.0 | SAND: 90% light greenish grey to greenish grey sand, predominately quartz, fine to medium grained, moderately sorted. Glauconitic at 16 to 18 m.                                     |                      |
| 20.0             | 22.0 | SHELLS: 90% shells (mostly broken bivalves) with 10% light greenish grey clay matrix.                                                                                                |                      |
| 22.0             | 27.0 | SAND: Light greenish grey quartz sand, fine to medium grained, moderately sorted, sub-rounded to sub-angular. Glauconitic in places.                                                 |                      |
| 27.0             | 28.0 | SAND: Olive yellow, quartz sand, medium grained, moderately sorted, sub-rounded.                                                                                                     |                      |
| 28.0             | 33.0 | SAND: 90% light greyish brown quartz sand, glauconitic in places, medium grained, moderately sorted, sub-rounded to sub-angular within a clay matrix. Clay increasing at 32 to 33 m. |                      |
| 33.0             | 37.5 | SAND: 90% greyish brown quartz sand, medium grained, moderately sorted, sub-rounded to sub-angular within a clay matrix.                                                             |                      |
| 37.5             | 39.0 | SILTSTONE: Dark olive grey, fine-grained siltstone with some iron staining. Soapy texture.                                                                                           | Pallinup Siltstone   |

## 17.5 Hydrogeological data

|                   |                                                      |
|-------------------|------------------------------------------------------|
| BORE              | TWLSWIM-01-20                                        |
| SCREENED INTERVAL | 7 to 37 m bgl                                        |
| AQUIFER           | Superficial                                          |
| WATER LEVEL       | 8.02 m bTOH (m below top of headworks) on 28/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)  | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|------------|------|------------|-------------|-----------|--------|-----------|
| Water tank | -    | -          | -           | -         | -      | -         |
| Mud        | 8.11 | 1387       | 888         | 18.7      | 93.2   | 8.45      |
| 9          | 7.40 | 15,024     | 9,615       | 19.5      | 28.2   | 2.46      |
| 12         | 7.91 | 2,721      | 1,741       | 19.4      | 34.2   | 3.12      |
| 15         | 8.00 | 1,273      | 815         | 19.0      | 35     | 3.22      |
| 18         | 7.90 | 1,139      | 729         | 20.1      | 44.3   | 2.98      |
| 21         | 7.88 | 1,086      | 695         | 19.6      | 60.0   | 5.43      |
| 24         | 7.91 | 966        | 618         | 18.3      | 27.3   | 2.47      |
| 27         | 7.79 | 1,254      | 803         | 18.0      | 8.2    | 0.73      |
| 30         | 8.13 | 3,077      | 1,969       | 19.1      | 13.1   | 1.20      |
| 33**       | 8.01 | 3,570      | 2,285       | 18.1      | 3.6    | 0.30      |

\* Calculated TDS (0.64 conversion factor)

\*\* Sample possibly contaminated with drilling mud

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date      | Time  | Depth (m) | L/s   | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|-----------|-------|-----------|-------|------|------------|-------------|-----------|-----------------|
| 2/05/2020 | 13:50 | 20        | V low | 8.15 | 8,540      | 5,466       | 19.7      | -               |
| 2/05/2020 | 14:00 | 30        | 0.9   | 8.11 | 6,840      | 4,378       | 19.2      | -               |
| 2/05/2020 | 14:10 | 30        | 0.9   | 7.87 | 25,287     | 16,184      | 19.2      | -               |
| 2/05/2020 | 14:20 | 30        | 0.9   | 7.79 | 31,735     | 20,310      | 19.3      | -               |
| 2/05/2020 | 14:30 | 30        | 0.9   | 7.81 | 33,640     | 21,530      | 18.9      | -               |
| 2/05/2020 | 14:40 | 30        | 0.9   | 7.80 | 33,920     | 21,709      | 19.1      | -               |
| 2/05/2020 | 14:50 | 30        | 0.9   | 7.74 | 33,742     | 21,595      | 18.7      | -               |
| 2/05/2020 | 15:00 | 37        | 0.9   | 7.43 | 65,278     | 41,778      | 18.8      | -               |
| 2/05/2020 | 15:10 | 37        | 0.9   | 7.41 | 70,806     | 45,316      | 18.4      | -               |
| 2/05/2020 | 15:20 | 37        | 0.9   | 7.38 | 68,941     | 44,122      | 18.2      | -               |
| 2/05/2020 | 15:30 | 37        | 0.9   | 7.39 | 66,790     | 42,746      | 18.4      | 28              |
| 2/05/2020 | 15:40 | 37        | 0.9   | 7.42 | 65,435     | 41,878      | 18.6      | 22              |
| 2/05/2020 | 15:50 | 37        | 0.9   | 7.36 | 64,460     | 41,254      | 18.7      | 17              |
| 2/05/2020 | 16:00 | 37        | 0.9   | 7.41 | 62,937     | 40,280      | 18.0      | 16              |

\* Calculated TDS (0.64 conversion factor)



## 17.6 Geophysical data

|              |                                                                                                                                                                                                 |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma <input checked="" type="checkbox"/> Induction<br><input type="checkbox"/> Long and Short Normal Resistivity <input type="checkbox"/> Calliper |
| LOGGING UNIT | Westlog                                                                                                                                                                                         |

## 17.7 Palynology data

| Sample depth<br>(m bgl) | Spore-Pollen zone                                                                                        | Comments and key species present                                                                                                                                                                                                                                                           |
|-------------------------|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 39                      | Holocene to possibly Late Pleistocene. Probably equivalent to informal <i>Fenestrites spinosus</i> Zone. | Marine assemblage with MP 13% of SP + MP count. Abundant <i>Nothofagidites</i> spp. at 23% and LO of <i>Proteacidites asperopolus</i> confirms SP zone assignment. FO of <i>Deflandrea heterophlycta</i> with LO of <i>Wetzeliella hampdenensis</i> dinocysts confirms MP zone assignment. |

## 18 Bore TWLSWIM-02-20

### 18.1 Location, maps and photographs

|                              |                                                          |    |          |            |          |            |
|------------------------------|----------------------------------------------------------|----|----------|------------|----------|------------|
| OWNER                        | Department of Water and Environmental Regulation         |    |          |            |          |            |
| LOCATION                     | Located at the end of Kingsmill Retreat in road reserve. |    |          |            |          |            |
| MGA REF                      | Zone                                                     | 51 | Easting  | 390366.296 | Northing | 6252188.69 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                                 |    |          |            |          |            |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)                     |    |          |            |          |            |
| PROJECT CODE                 | WA-G-SEAWATERIN                                          |    |          |            |          |            |
| AWRC Ref. Number             | TWLSWIM-02-20                                            |    | 60140052 |            |          |            |



Figure 33 TWLSWIM-02-20 location map

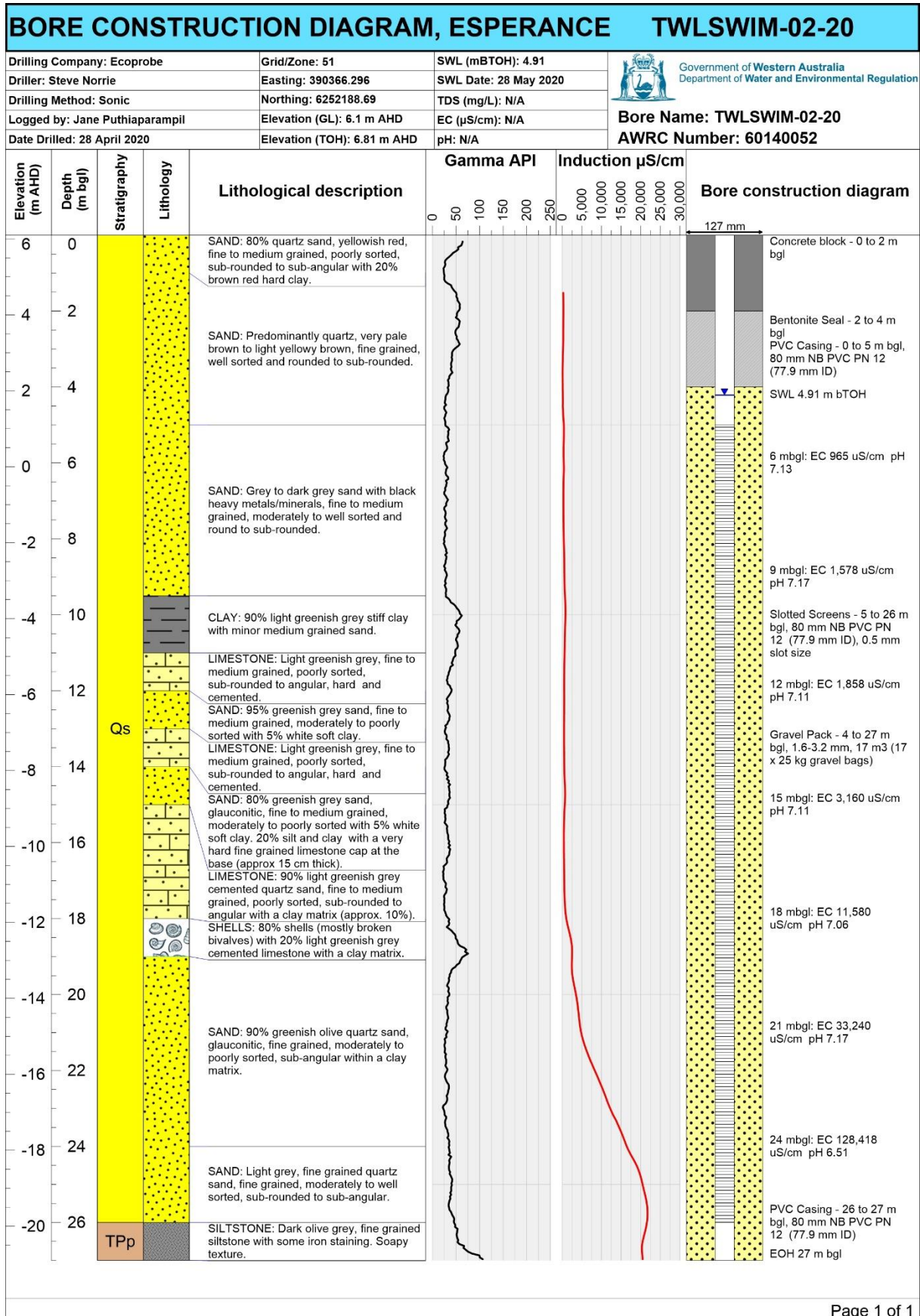




Figure 34 TWLSWIM-02-20 photographs



## 18.2 Bore summary diagram



## 18.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Jane Puthiaparampil                                                                           |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 28/04/2020                                                                                    |                                  |                        |
| Drilling complete   | 28/04/2020                                                                                    |                                  |                        |
| Airlifting          | 2/05/2020                                                                                     |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     | TWLSWIM-02-20                                                                                 |                                  |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 6.1                    |
|                     | Top of casing                                                                                 | -0.55                            | 6.65                   |
|                     | Top of headworks                                                                              | -0.71                            | 6.81                   |
|                     | Cement block                                                                                  | -0.17                            | 6.27                   |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 27                               | 127 (5")               |
| Total depth (m bgl) | 27                                                                                            |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

### CASING AND SCREENS

| Depth (m bgl) |    | Type                            | ID (mm) | OD (mm) |
|---------------|----|---------------------------------|---------|---------|
| From          | To |                                 |         |         |
| 0             | 5  | PN 12 blank PVC                 | 77.93   | 88.9    |
| 5             | 26 | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 26            | 27 | PN 12 blank PVC                 | 77.93   | 88.9    |

### ANNULUS FILL

| Depth (m bgl) |    | Fill type                              |
|---------------|----|----------------------------------------|
| From          | To |                                        |
| 0             | 2  | Concrete seal                          |
| 2             | 4  | Bentonite Seal                         |
| 4             | 27 | Gravel pack (1.6 mm – 3.2 mm diameter) |



## 18.4 Lithological interpretation

| Depth<br>(m bgl) |      | Description                                                                                                                                                                                                             | Stratigraphy         |
|------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| From             | To   |                                                                                                                                                                                                                         |                      |
| 0.0              | 1.0  | SAND: 80% quartz sand, yellowish red, fine to medium grained, poorly sorted, sub-rounded to sub-angular with 20% brown-red hard clay.                                                                                   | Quaternary sediments |
| 1.0              | 5.0  | SAND: Predominantly quartz, very pale brown to light yellowy brown, fine grained, well sorted and rounded to sub-rounded.                                                                                               |                      |
| 5.0              | 9.5  | SAND: Grey to dark grey sand with black heavy metals/minerals, fine to medium grained, moderately to well sorted and round to sub-rounded.                                                                              |                      |
| 9.5              | 11.0 | CLAY: 90% light greenish grey stiff clay with minor medium-grained sand.                                                                                                                                                |                      |
| 11.0             | 12.0 | LIMESTONE: Light greenish grey, fine to medium grained, poorly sorted, sub-rounded to angular, hard and cemented.                                                                                                       |                      |
| 12.0             | 13.0 | SAND: 95% greenish grey sand, fine to medium grained, moderately to poorly sorted with 5% white soft clay.                                                                                                              |                      |
| 13.0             | 14.0 | LIMESTONE: Light greenish grey, fine to medium grained, poorly sorted, sub-rounded to angular, hard and cemented.                                                                                                       |                      |
| 14.0             | 15.0 | SAND: 80% greenish grey sand, glauconitic, fine to medium grained, moderately to poorly sorted with 5% white soft clay. 20% silt and clay with a very hard fine-grained limestone cap at the base (approx 15 cm thick). |                      |
| 15.0             | 18.0 | LIMESTONE: 90% light greenish grey cemented quartz sand, fine to medium grained, poorly sorted, sub-rounded to angular with a clay matrix (approx. 10%).                                                                |                      |
| 18.0             | 19.0 | SHELLS: 80% shells (mostly broken bivalves) with 20% light greenish grey cemented limestone with a clay matrix.                                                                                                         |                      |
| 19.0             | 24.0 | SAND: 90% greenish olive quartz sand, glauconitic, fine grained, moderately to poorly sorted, sub-angular within a clay matrix.                                                                                         |                      |
| 24.0             | 26.0 | SAND: Light grey, fine-grained quartz sand, moderately to well sorted, sub-rounded to sub-angular.                                                                                                                      |                      |
| 26.0             | 27.0 | SILTSTONE: Dark olive grey, fine-grained siltstone with some iron staining. Soapy texture.                                                                                                                              | Pallinup Siltstone   |

## 18.5 Hydrogeological data

|                   |                                                      |
|-------------------|------------------------------------------------------|
| BORE              | TWLSWIM-02-20                                        |
| SCREENED INTERVAL | 5 to 26 m bgl                                        |
| AQUIFER           | Superficial                                          |
| WATER LEVEL       | 4.91 m bTOH (m below top of headworks) on 28/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)  | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|------------|------|------------|-------------|-----------|--------|-----------|
| Water tank | 7.30 | 1,382      | 884         | 18.6      | 78.0   | 7.44      |
| Mud        | 7.21 | 1,050      | 672         | 18.6      | 76.0   | 7.09      |
| 6          | 7.13 | 965        | 618         | 18.5      | 44.7   | 3.56      |
| 9          | 7.17 | 1,578      | 1,010       | 18.1      | 22.2   | 1.96      |
| 12         | 7.11 | 1,858      | 1,189       | 18.0      | 40.0   | 3.57      |
| 15         | 7.11 | 3,160      | 2,022       | 20.2      | 42.6   | 3.53      |
| 18         | 7.06 | 11,580     | 7,411       | 19.2      | 48.9   | 4.07      |
| 21         | 7.17 | 33,240     | 21,274      | 19.8      | 5.3    | 0.41      |
| 24         | 6.51 | 128,418    | 82,188      | 20.0      | 23.1   | 1.11      |

\* Calculated TDS (0.64 conversion factor)

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date      | Time  | Depth (m) | L/s | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|-----------|-------|-----------|-----|------|------------|-------------|-----------|-----------------|
| 2/05/2020 | 10:40 | 20        | 0.6 | 7.44 | 30,309     | 19,398      | 17.5      | -               |
| 2/05/2020 | 10:50 | 15        | 0.3 | 7.56 | 32,236     | 20,631      | 18.0      | -               |
| 2/05/2020 | 11:00 | 15        | 1   | 7.91 | 18,050     | 11,552      | 18.1      | -               |
| 2/05/2020 | 11:10 | 15        | 1   | 8.08 | 11,116     | 7,114       | 18.5      | -               |
| 2/05/2020 | 11:20 | 20        | 1   | 7.70 | 27,185     | 17,398      | 18.8      | -               |
| 2/05/2020 | 11:30 | 26        | 1   | 7.02 | 69,264     | 44,329      | 18.2      | -               |
| 2/05/2020 | 11:40 | 26        | 1   | 3.34 | 72,652     | 46,497      | 18.8      | -               |
| 2/05/2020 | 12:30 | 26        | 1   | 7.13 | 78,124     | 49,999      | 19.2      | -               |
| 2/05/2020 | 12:40 | 26        | 1   | 7.21 | 76,154     | 48,739      | 19.2      | -               |
| 2/05/2020 | 12:50 | 26        | 1   | 7.28 | 67,931     | 43,476      | 19.1      | -               |
| 2/05/2020 | 13:00 | 26        | 1   | 7.27 | 68,855     | 44,067      | 19.2      | 12.0            |
| 2/05/2020 | 13:10 | 26        | 1   | 7.18 | 67,701     | 43,329      | 18.8      | 9.5             |
| 2/05/2020 | 13:20 | 26        | 1   | 7.23 | 68,375     | 43,760      | 19.0      | 7.4             |

\* Calculated TDS (0.64 conversion factor)

## 18.6 Geophysical data

|              |                                                            |                                               |
|--------------|------------------------------------------------------------|-----------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma          | <input checked="" type="checkbox"/> Induction |
|              | <input type="checkbox"/> Long and Short Normal Resistivity | <input type="checkbox"/> Calliper             |
| LOGGING UNIT | Westlog                                                    |                                               |



## 19 Bore TWLSWIM-03-20

### 19.1 Location, maps and photographs

|                              |                                                                                                                                                                                                |    |          |            |          |             |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----------|------------|----------|-------------|
| OWNER                        | Department of Water and Environmental Regulation                                                                                                                                               |    |          |            |          |             |
| LOCATION                     | Located in the Esperance Water Corporation Borefield. Accessed from Thompson St. <b>Access restricted to authorised personnel only – contact Esperance Water Corporation office 9071 0920.</b> |    |          |            |          |             |
| MGA REF                      | Zone                                                                                                                                                                                           | 51 | Easting  | 391622.879 | Northing | 6251302.803 |
| COORDINATE ASSESSMENT METHOD | Surveyed                                                                                                                                                                                       |    |          |            |          |             |
| PURPOSE / STATUS             | Seawater interface monitoring (SWIM)                                                                                                                                                           |    |          |            |          |             |
| PROJECT CODE                 | WA-G-SEAWATERIN                                                                                                                                                                                |    |          |            |          |             |
| AWRC Ref. Number             | TWLSWIM-03-20                                                                                                                                                                                  |    | 60140062 |            |          |             |

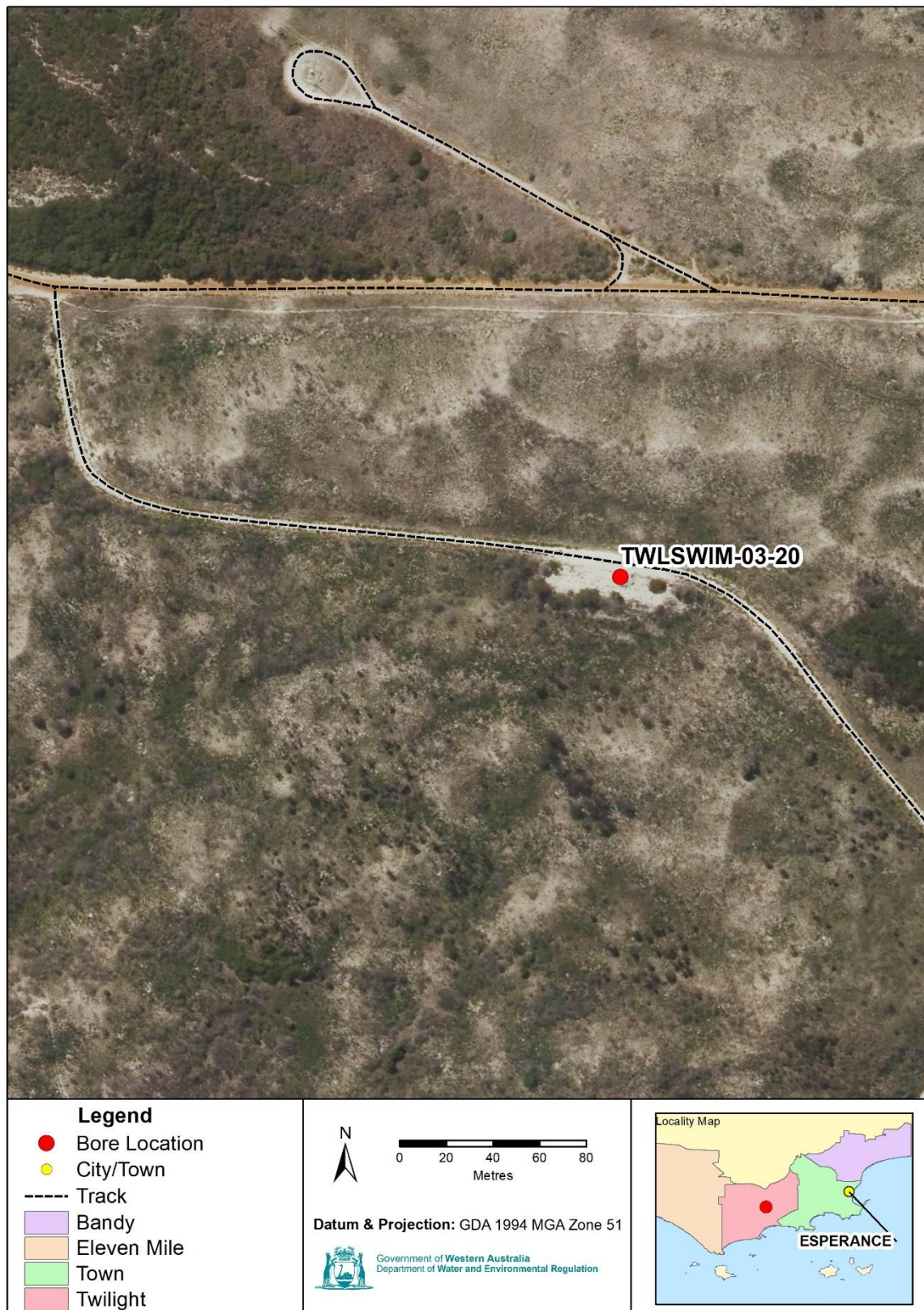


Figure 35 TWLSWIM-03-20 location map

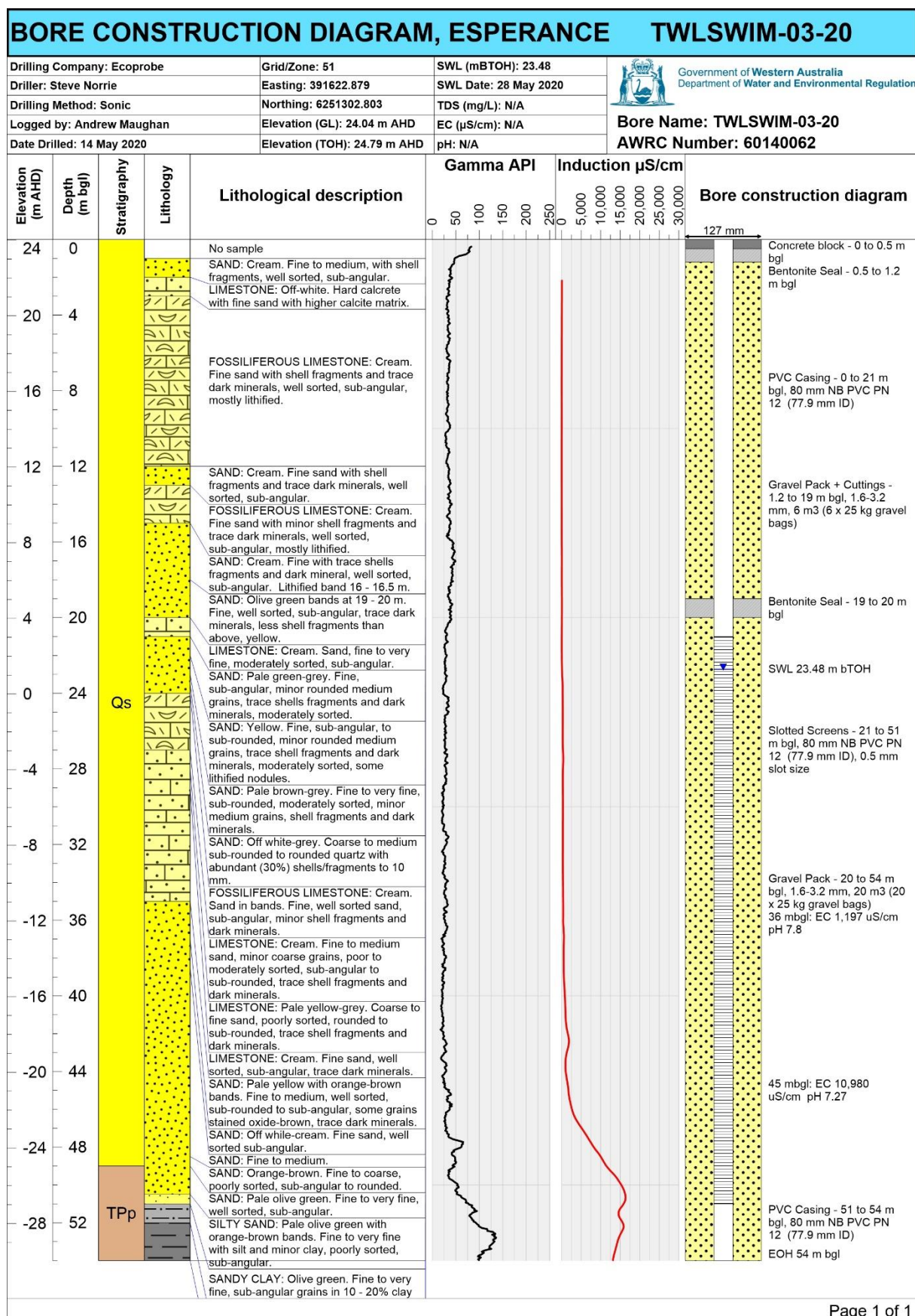




Figure 36 TWLSWIM-03-20 photographs



## 19.2 Bore summary diagram



## 19.3 Drilling and construction

|                     |                                                                                               |                                  |                        |
|---------------------|-----------------------------------------------------------------------------------------------|----------------------------------|------------------------|
| Sampling interval   | Sonic core samples were taken from the ground level to the base of the bore.                  |                                  |                        |
| Logged by           | Andrew Maughan                                                                                |                                  |                        |
| Drilled by          | Ecoprobe                                                                                      |                                  |                        |
| Driller             | Steve Norrie                                                                                  |                                  |                        |
| Drill rig           | CompactRotoSonic                                                                              |                                  |                        |
| Method              | Sonic                                                                                         |                                  |                        |
| Drilling start      | 13/05/2020                                                                                    |                                  |                        |
| Drilling complete   | 14/05/2020                                                                                    |                                  |                        |
| Airlifting          | 16/05/2020                                                                                    |                                  |                        |
| Elevation           | (NOTE: points measured above ground are NEGATIVE relative to the datum plane – ground level). |                                  |                        |
|                     | TWLSWIM-03-20                                                                                 |                                  |                        |
|                     |                                                                                               | Relative to ground level (m bgl) | Surveyed levels (mAHD) |
|                     | Ground level                                                                                  | 0                                | 24.04                  |
|                     | Top of casing                                                                                 | -0.66                            | 24.70                  |
|                     | Top of headworks                                                                              | -0.75                            | 24.79                  |
|                     | Cement block                                                                                  | -0.11                            | 24.15                  |
| Drilled diameter    | Bit Type                                                                                      | Depth (m bgl)                    | Bit Size in mm (inch)  |
|                     | Sonic vibration oscillator output force                                                       | 54                               | 127 (5")               |
| Total depth (m bgl) | 54                                                                                            |                                  |                        |
| Drilling fluid      | Guar Gum                                                                                      |                                  |                        |

### CASING AND SCREENS

| Depth (m bgl) |    | Type                            | ID (mm) | OD (mm) |
|---------------|----|---------------------------------|---------|---------|
| From          | To |                                 |         |         |
| 0             | 21 | PN 12 blank PVC                 | 77.93   | 88.9    |
| 21            | 51 | PN 12 slotted PVC, 0.5 mm slots | 77.93   | 88.9    |
| 51            | 54 | PN 12 blank PVC                 | 77.93   | 88.9    |

### ANNULUS FILL

| Depth (m bgl) |     | Fill type                              |
|---------------|-----|----------------------------------------|
| From          | To  |                                        |
| 0             | 0.5 | Concrete seal                          |
| 0.5           | 1.2 | Bentonite Seal                         |
| 1.2           | 19  | Gravel pack (1.6 mm – 3.2 mm diameter) |
| 19            | 20  | Bentonite Seal                         |
| 20            | 54  | Gravel pack (1.6 mm – 3.2 mm diameter) |

## 19.4 Lithological interpretation

| Depth<br>(m bgl) |      | Description                                                                                                                                                      | Stratigraphy         |
|------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| From             | To   |                                                                                                                                                                  |                      |
| 0.0              | 1.0  | No sample                                                                                                                                                        | Quaternary sediments |
| 1.0              | 2.0  | SAND: Cream. Fine to medium, with shell fragments, well sorted, sub-angular.                                                                                     |                      |
| 2.0              | 3.0  | LIMESTONE: Off-white. Hard calcrete with fine sand with higher calcite matrix.                                                                                   |                      |
| 3.0              | 12.0 | FOSSILIFEROUS LIMESTONE: Cream. Fine sand with shell fragments and trace dark minerals, well sorted, sub-angular, mostly lithified.                              |                      |
| 12.0             | 13.0 | SAND: Cream. Fine sand with shell fragments and trace dark minerals, well sorted, sub-angular.                                                                   |                      |
| 13.0             | 15.0 | FOSSILIFEROUS LIMESTONE: Cream. Fine sand with minor shell fragments and trace dark minerals, well sorted, sub-angular, mostly lithified.                        |                      |
| 15.0             | 18.0 | SAND: Cream. Fine with trace shells fragments and dark mineral, well sorted, sub-angular. Lithified band 16 to 16.5 m.                                           |                      |
| 18.0             | 20.0 | SAND: Olive green bands at 19 to 20 m. Fine, well sorted, sub-angular, trace dark minerals, less shell fragments than above, yellow.                             |                      |
| 20.0             | 21.0 | LIMESTONE: Cream. Sand, fine to very fine, moderately sorted, sub-angular.                                                                                       |                      |
| 21.0             | 22.0 | SAND: Pale green grey. Fine, sub-angular, minor rounded medium grains, trace shells fragments and dark minerals, moderately sorted.                              |                      |
| 22.0             | 23.0 | SAND: Yellow. Fine, sub-angular to sub-rounded, minor rounded medium grains, trace shell fragments and dark minerals, moderately sorted, some lithified nodules. |                      |
| 23.0             | 23.5 | SAND: Pale brown grey. Fine to very fine, sub-rounded, moderately sorted, minor medium grains, shell fragments and dark minerals.                                |                      |
| 23.5             | 24.0 | SAND: Off white grey. Coarse to medium sub-rounded to rounded quartz with abundant (30%) shells/fragments to 10 mm.                                              |                      |
| 24.0             | 27.0 | FOSSILIFEROUS LIMESTONE: Cream. Sand in bands. Fine, well sorted sand, sub-angular, minor shell fragments and dark minerals.                                     |                      |
| 27.0             | 28.0 | LIMESTONE: Cream. Fine to medium sand, minor coarse grains, poor to moderately sorted, sub-angular to sub-rounded, trace shell fragments and dark minerals.      |                      |
| 28.0             | 29.0 | LIMESTONE: Pale yellow grey. Coarse to fine sand, poorly sorted, rounded to sub-rounded, trace shell fragments and dark minerals.                                |                      |
| 29.0             | 35.0 | LIMESTONE: Cream. Fine sand, well sorted, sub-angular, trace dark minerals.                                                                                      |                      |



|      |      |                                                                                                                                                           |                    |
|------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| 35.0 | 37.0 | SAND: Pale yellow with orange-brown bands. Fine to medium, well sorted, sub-rounded to sub-angular, some grains stained oxide-brown, trace dark minerals. |                    |
| 37.0 | 38.5 | SAND: Off white cream. Fine sand, well sorted sub-angular.                                                                                                |                    |
| 38.5 | 48.5 | SAND: Fine to medium.                                                                                                                                     |                    |
| 48.5 | 49.0 | SAND: Orange brown. Fine to coarse, poorly sorted, sub-angular to rounded.                                                                                |                    |
| 49.0 | 50.5 | SAND: Pale olive green. Fine to very fine, well sorted, sub-angular.                                                                                      | Pallinup Siltstone |
| 50.5 | 51.0 | SILTY SAND: Pale olive green with orange-brown bands. Fine to very fine with silt and minor clay, poorly sorted, sub-angular.                             |                    |
| 51.0 | 52.0 | SANDY CLAY: Olive green. Fine to very fine, sub-angular grains in 10 to 20% clay matrix, mica evident.                                                    |                    |
| 52.0 | 54.0 | CLAY: Dark brown grey. Hard, fine to very fine sand and silt, with mica, in a 30 to 40% clay matrix.                                                      |                    |

## 19.5 Hydrogeological data

|                   |                                                       |
|-------------------|-------------------------------------------------------|
| BORE              | TWLSWIM-03-20                                         |
| SCREENED INTERVAL | 21 to 51 m bgl                                        |
| AQUIFER           | Superficial                                           |
| WATER LEVEL       | 23.48 m bTOH (m below top of headworks) on 28/05/2020 |

### DRILLING WATER QUALITY MEASUREMENTS

| Depth (m)  | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | DO (%) | DO (mg/L) |
|------------|------|------------|-------------|-----------|--------|-----------|
| Water tank | 6.94 | 1,236      | 791         | 17.0      | -      | -         |
| Mud        | 7.60 | 1,729      | 1,107       | 17.4      | -      | -         |
| 27**       | 7.67 | 1,718      | 1,100       | 20.4      | 114.0  | 10.20     |
| 29**       | 8.02 | 1,763      | 1,128       | 20.4      | 83.0   | 7.50      |
| 30**       | 8.01 | 1,700      | 1,088       | 23.8      | 100.0  | 8.50      |
| 36         | 7.80 | 1,197      | 766         | 25.4      | 3.5    | 0.25      |
| 39**       | 8.07 | 1,886      | 1,207       | 23.6      | 2.0    | 0.16      |
| 45         | 7.27 | 10,980     | 7,027       | 24.7      | 1.6    | 0.13      |
| 51         | 7.62 | 3,028      | 1,938       | 24.1      | 44.0   | 3.70      |

\* Calculated TDS (0.64 conversion factor)

\*\* Sample possibly contaminated with drilling mud

### AIRLIFTING WATER QUALITY MEASUREMENTS

| Date       | Time  | Depth (m) | L/s      | pH   | EC (µS/cm) | TDS* (mg/L) | Temp (°C) | Turbidity (NTU) |
|------------|-------|-----------|----------|------|------------|-------------|-----------|-----------------|
| 15/05/2020 | 17:00 | 48        | Very low | 7.42 | 27,700     | 17,728      | -         | -               |
| 15/05/2020 | 17:05 | 48        | Very low | 7.62 | 37,700     | 24,128      | 19.1      | -               |
| 15/05/2020 | 17:10 | 48        | Very low | 7.68 | 39,400     | 25,216      | 18.7      | -               |
| 15/05/2020 | 17:20 | 48        | Very low | 7.78 | 39,460     | 25,254      | 18.2      | -               |
| 16/05/2020 | 13:35 | 47        | Very low | 7.93 | 4,719      | 3,020       | 19.2      | -               |
| 16/05/2020 | 13:45 | 49        | low      | 7.67 | 19,368     | 12,396      | 8.2       | 201.0           |
| 16/05/2020 | 13:55 | 49        | 0.2      | 7.68 | 27,635     | 17,686      | 18.0      | 153.0           |
| 16/05/2020 | 14:00 | 49        | 0.2      | 7.43 | 39,850     | 25,504      | 18.3      | 69.0            |
| 16/05/2020 | 14:10 | 49        | 0.2      | 7.38 | 46,351     | 29,665      | 18.5      | 24.0            |
| 16/05/2020 | 14:20 | 49        | 0.2      | 7.57 | 46,050     | 29,472      | 18.2      | 8.1             |
| 16/05/2020 | 14:35 | 49        | 0.2      | 7.43 | 44,935     | 28,758      | 18.3      | 7.9             |
| 16/05/2020 | 14:55 | 49        | 0.3      | 7.43 | 3,825      | 2,448       | 18.5      | -               |
| 16/05/2020 | 15:15 | 49        | 0.2      | 7.47 | 43,710     | 27,974      | 18.1      | 6.2             |
| 16/05/2020 | 15:35 | 49        | 0.3      | 7.44 | 43,800     | 28,032      | 18.2      | 6.2             |

\* Calculated TDS (0.64 conversion factor)

## 19.6 Geophysical data

|              |                                                                                                                                                                                                 |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOGS RUN     | <input checked="" type="checkbox"/> Natural Gamma <input checked="" type="checkbox"/> Induction<br><input type="checkbox"/> Long and Short Normal Resistivity <input type="checkbox"/> Calliper |
| LOGGING UNIT | Westlog                                                                                                                                                                                         |

## 19.7 Palynology data

| Sample depth<br>(m bgl) | Spore-Pollen zone                                                                                        | Comments and key species present                                                                                                                                                                                                                                                |
|-------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 52 to 53                | Holocene to possibly Late Pleistocene. Probably equivalent to informal <i>Fenestrites spinosus</i> Zone. | Marine assemblage with MP 12% of SP + MP count. Abundant <i>Nothofagidites</i> spp. at 22% within a similar microflora to other samples favours same SP zone assignment, while FO of <i>D. heterophlycta</i> with LO of <i>W. hampdenensis</i> dinocysts confirms MP zone pick. |



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