POWER AND WATER AUTHORITY

BORE COMPLETION REPORT
BORE 30250
WARRANYIN OUTSTATION

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Darwin
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Report 34 /1996 D
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Aboriginal and Torres Strait Islander Commission, Nhulunbuy 1
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Hydrogeology Section, Darwin 2
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<thead>
<tr>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>AMG</td>
<td>Australian Map Grid</td>
</tr>
<tr>
<td>°C</td>
<td>degree Celsius</td>
</tr>
<tr>
<td>ID</td>
<td>internal diameter</td>
</tr>
<tr>
<td>km</td>
<td>kilometres</td>
</tr>
<tr>
<td>L/s</td>
<td>litres per second</td>
</tr>
<tr>
<td>L/c/d</td>
<td>litres per capita per day</td>
</tr>
<tr>
<td>m</td>
<td>metre</td>
</tr>
<tr>
<td>mm</td>
<td>millimetre</td>
</tr>
<tr>
<td>m$^3$/d</td>
<td>cubic metres per day</td>
</tr>
<tr>
<td>mg/L</td>
<td>milligrams per litre</td>
</tr>
<tr>
<td>pH</td>
<td>acidity</td>
</tr>
<tr>
<td>SWL</td>
<td>standing water level</td>
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1. INTRODUCTION

The objective of this work was to drill and construct two production bores providing an adequate water supply for the community. The work was carried out by Water Resources Division of Power and Water Authority, Darwin on behalf of the Ngadangaay Homeland Resource Centre.

A desktop study was conducted and aboriginal sacred site clearance gained, followed by field reconnaissance during which prospective sites were pegged and access checked. Drilling and bore construction were undertaken in September 1995 and test pumping followed in November 1995.

The Warranyin is an outstation of Gapuwiyak - Ngadangaay Homeland Resource Centre. It is located approximately 30 km north of Gapuwiyak - Lake Evella and accessed via a dirt road throughout the year. It is covered by topographic map of Buckingham Bay 1: 100 000 map sheet 6073 (AMG Grid Reference 588200 - 8 650700).

The geomorphology of Arnhem Land was divided into eight categories (Lynch. B.T., et al., 1996) based on association between geology and landforms. The project area lies within two major geomorphology units of Arnhem Land;

-Coastal floodplains

-Steep rocky plateaux and hills (mostly quartz sandstone)

The "Coastal floodplains" are extended along the coastal margin of Arnhem Land. During the Quaternary age the sea level rose an estimated 35 m and major river valleys, for example Buckingham River, were drowned. This resulted in deposition of estuarine, littoral mud in drowned areas and the alluvial sediments further inland. The sea level rise was followed by coastal emergence in the region and a fall in sea level of approximately 7 m. As a result of this the broad coastal floodplains formed on exposed estuarine sediments.

The "Steep rocky plateaux and hills (mostly quartz sandstone)" developed south of the Warranyin outstation and cover 80% of the area. This unit is formed over quartz sandstone with elevation rising up to 120 m. The landscape with joint patterns, series of strike ridges and gorges strongly reflected the nature of quartz sandstone. Some sandy soils were accumulated in drainage depressions and on colluvial footslopes.

The climate of the region is monsoonal with hot, humid summers and mild dry winters. Average annual rainfall is approximately 1600 mm and average annual evaporation greater than 2400 mm.
2. HYDROGEOLOGY

The regional geology is covered by the 1:100,000 map of Buckingham Bay Sheet 6273 completed by Northern Territory Geological Survey (Fig. 1) and the 1:250,000 Geological Series Map Arnhem Bay/Gove, NT Sheet SD/53-3/4 and associated explanatory notes (Dunnet, D., 1965).

Warranyin is located on the northeast part of the Arafura Basin. It is underlain by the outcropping Buckingham Bay sandstone of the Neoproterozoic age Wessel Group. The Cainozoic age sediments in the vicinity of the outstation is mainly developed as gravel, sand, silt, clay and black soil.

2.1 AQUIFER OCCURRENCE

The Neoproterozoic Buckingham Bay sandstone is considered to be a low yielding aquifer controlled by secondary porosity. Previous drilling in this formation shows that a supply of up to 0.5 L/s can be obtained in selected places for example Bore 30254 Bunhunarra outstation. Production bores for the Warranyin Outstation encountered shallow aquifers between 16.0 m and 28.0 m with supplies up to 0.7 L/s (cumulative airlift).

The aquifers developed in the Cretaceous are the high yielding groundwater sources in the Gulf Region. The groundwater potential is related to the intergranular porosity of the rock. More than 80% of successful bores obtain water from the sandstone between 35 and 65 m depth. Water supplies from this formation vary from 3.0 L/s (Bore 30070 at Spring Camp Outstation) to 8.0 L/s (Bore 30046 at Garrathya Outstation).

The Cainozoic age sediments in the area develop limited aquifers, supply is controlled by primary porosity and extent and thickness of sediments. Aquifers of capacity 0.05 to 0.5 L/s can be located.
LEGEND

Gravel, sand, silt: active channel, flood plain and swamp deposits

Black soil: old vegetated coastal deposits

Sand, silt, clay, commonly shelly: active intertidal and supratidal sediments

Gravel, sand, silt, clay, ferruginous cemented detritus: undifferentiated Cainozoic deposits

Ferricrete

Sand, shelly sand: cheniers and beach ridges

Sandstone white to red, fine-to coarse-grained, mostly medium-to thick-bedded, commonly cross-bedded, rare mudstone interbeds; common basal breccia or conglomerate

Mudstone: red purple and green, distinctive graded silt laminae, weathered outcrops ferruginised; minor fine-grained sandstone and silty dololite; large cocritions common in places

Sandstone white to pale grey and pale pink, medium-grained, medium-to thick-bedded, cross-bedded to flat-bedded and massive, quartz-rich

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- 30044

Bore with registered number

Geological boundary

Trend-line

Trend-line showing dip 5° to 15°

Strike and dip of strata

Watercourse

Track
2.2 SURFACE WATER

A small spring of fresh water was located in the vicinity of the outstation. It is not known if the spring flows throughout the year or if it is seasonal phenomena.
3. WATER QUALITY

The quality of groundwater (Table 1) from bore 30250 is suitable for human consumption being within acceptable limits according to guidelines for potable water published by the Australian Water Resources Council/National Health and Medical Research Council (AWRC/NHMRC), 1987. Water from bore 30250 is corrosive (Fig. 3) with pH 6.0 alkalinity 26 mg/L and total dissolved solids concentration 180 mg/L. This water will cause corrosion to conventional copper or brass plumbing fittings. Consideration should be given to the use of corrosion resistant materials (including PVC pipes) in the storage, head works and reticulation system.
<table>
<thead>
<tr>
<th>BORE REGISTERED NUMBER</th>
<th>DATE OF SAMPLING</th>
<th>pH</th>
<th>ELECTRICAL CONDUCTIVITY (µS at 25 deg C)/Field/cell</th>
<th>TOTAL DISSOLVED SOLIDS (mg/l by evaporation at 180 deg C)</th>
<th>SODIUM, Na</th>
<th>POTASSIUM, K</th>
<th>CALCIUM, Ca</th>
<th>MAGNESIUM, Mg</th>
<th>IRON (TOTAL), Fe</th>
<th>TOTAL HARDNESS (as CaCO₃)</th>
<th>SILICA, SiO₂</th>
<th>CHLORIDE Cl⁻</th>
<th>SULPHATE, SO₄²⁻</th>
<th>NITRATE, NO₃⁻</th>
<th>BICARBONATE, HCO₃⁻</th>
<th>CARBONATE, CO₃⁻</th>
<th>FLUORIDE, F⁻</th>
<th>NaCl (calc from chloride)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30250</td>
<td>24/11/95</td>
<td>6.0</td>
<td>357</td>
<td>180</td>
<td>52</td>
<td>8</td>
<td>2</td>
<td>6</td>
<td>0.2</td>
<td>30</td>
<td>26</td>
<td>14</td>
<td>81</td>
<td>13</td>
<td>1</td>
<td>32</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>**</td>
<td>6.5-8.5</td>
<td>1000</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.3</td>
<td>500</td>
<td></td>
<td>400</td>
<td>400</td>
<td>10</td>
<td></td>
<td></td>
<td>0.6-0.8</td>
</tr>
</tbody>
</table>

Analyses in milligrams per litre (unless otherwise stated)

** - Maximum recommended levels for potable water. (AWRC/NHMRC, 1987)

Levels exceed non-health related limits.

** TABLE 1 - WATER QUALITY DATA **
RELATIONSHIP BETWEEN pH VALUE AND ALKALINITY
The present and future water demand for Warranyin outstation could be met with a supply from bore 30250. Based on a population of 50, and an assumed demand of 250 L/c/d (Draft “Guidelines for levels of service to rural communities and outstations” PAWA, 1995), the calculated consumption would be 12.5 m³/d compared to a potential supply from bore 30250 of 17.2 m³/d.
5. RESULTS

During this project four bores were drilled:

- Bore 30250 located at AMG co-ordinates 588200 - 8 650400
- Bore 30251 located at AMG co-ordinates 588300 - 8 650100
- Bore 30252 located at AMG co-ordinates 588200 - 8 650600
- Bore 30253 located at AMG co-ordinates 589000 - 8 650000

but only one bore was constructed as a production bore.

Bore 30250 was drilled to a total depth of 31.0 m and encountered 0.7 L/s (cumulative airlift) of potable water from 16.7 to 28.3 m. The bore was constructed with PVC class 12 casing and slotted casing with 1 mm slots from 16.5 m to 22.0 m. For the construction detail see attached Composite Log of Bore 30250.

An eight hours constant discharge test and recovery test were performed on the bore to establish the maximum rate and pump setting. The test report (see attached Test Report Bore 30250) indicated that a pumping rate of 0.2 L/s and a pump setting of 16.0 m below ground level should be adopted.

Bore 30251 encountered sandstone to a depth of 30.0 m. Drilling was unsuccessful.

Bore 30252 encountered sandstone to a depth of 27 m and drilling was unsuccessful.

Bore 30253 encountered sandstone to a depth of 35 m and drilling was unsuccessful.

The quality of groundwater from bore 30250 is suitable for human consumption. However, the water will cause corrosion to conventional plumbing materials. Consideration should be given to the use of PVC pipes in the supply and reticulation system.
It is recommended that:

- Bore 30250 be equipped as a production bore;

- pump setting depth for Bore 29687 should be 16.0 m below ground level for a pumping rate of 0.2 L/s;

- consideration should be given to the use of corrosion resistant fittings in the water supply and reticulation;

- absorption trenches and septic tanks should not be constructed within 100 m of the bore.
REFERENCES


4. Lynch, B.T.&Wilson, P.L., "Land Systems of Arnhem Land" Department of Lands, Planning and Environment, Darwin, NT.
<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>BORE CONSTRUCTION LOG</th>
<th>STRATA DESCRIPTION</th>
<th>AQUIFERS (WATER STRUCK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.77m</td>
<td>CEMENT</td>
<td>Clay brown</td>
<td>SWL 2.70 m 23-11-95</td>
</tr>
<tr>
<td>1.87m</td>
<td>142mm ID PVC CASING CLASS 12</td>
<td>Sandstone: white</td>
<td></td>
</tr>
<tr>
<td>3.17m</td>
<td>203mm ID STEEL CASING</td>
<td>Clay: brown sandy</td>
<td></td>
</tr>
<tr>
<td>4.77m</td>
<td></td>
<td>Sandstone: white</td>
<td></td>
</tr>
<tr>
<td>10.17m</td>
<td></td>
<td>Sandstone: white; bands Sandy Clay</td>
<td></td>
</tr>
<tr>
<td>13.07m</td>
<td></td>
<td>Sandstone: fractured (small)</td>
<td>0.5 l/s</td>
</tr>
<tr>
<td>23.97m</td>
<td></td>
<td>Sandstone: white</td>
<td></td>
</tr>
<tr>
<td>26.87m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33.47m</td>
<td></td>
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**COMPOSITE LOG OF BORE 30250**
Bore Location: WARRANYIN
Map: BUCKINGHAM BAY 1:100,000 Sheet 6073
Grid Reference: 882 - 504.

Client: ATSIC
Purpose: Domestic

RECOMMENDATION:
Pumping Rate: 0.2 L/s.
Pump Setting: 16 m.

For alternative pumping rates or settings contact:-
General recommendations are on the reverse side.
In all correspondence please quote bore RN 30250.

BORE DATA:
Finished depth: 23.5 m. Completion Date: 29.09.95.
Standing Water Level: 2.70 m on 23.11.95.
Construction Details:

<table>
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<th>Interval</th>
<th>Description</th>
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<tbody>
<tr>
<td>0 - 2.0 m</td>
<td>203 mm ID steel casing.</td>
</tr>
<tr>
<td>0 - 16.5 m</td>
<td>142 mm ID PVC class 12 casing</td>
</tr>
<tr>
<td>16.5 - 22.0 m</td>
<td>142 mm ID PVC class 12 casing with 1 mm slots</td>
</tr>
<tr>
<td>22.0 - 23.5 m</td>
<td>142 mm ID PVC class 12 casing</td>
</tr>
</tbody>
</table>

Notes: 1. Top of casing as constructed was 0.77 m above ground.
2. All depths are measured from natural ground level.
3. Test rates are not indicative of safe long term pumping rates.

WARNING: MINIMUM INTERNAL BORE DIAMETER IS 142 mm.
MINIMUM INTERNAL BORE DIAMETER TO RECOMMENDED PUMP SETTING IS 142 mm.

COMMENTS:
1. The above recommendations are based on an 8 hour constant rate test at 0.3 L/s and assume hydrological conditions remain constant.
2. Provision to monitor water levels and obtain water samples while pumping should be incorporated when equipping this bore.
3. This bore should not be pumped for more than an 8 hour cycle per day.
4. Water quality analysis indicates a corrosive nature due to low pH and TDS which will affect pumping equipment and reticulation fittings of a ferrous composition.

WATER ANALYSIS: 95/96/0759

Prepared by: B. Thatcher
21.12.95

Checked by: D Karp
15.03.96
RECOMMENDATIONS FOR FINISHING, OPERATING AND PROTECTING GROUNDWATER BORES.

Attention to the following points will ensure a long and safe life for the bore supply and help prevent pollution of the groundwater resource.

1. Construct a concrete apron around the bore head to prevent surface flow, seepage and waste from entering the bore.

2. Seal the space between the casing and pump equipment to prevent entry of vermin, dirt and pollutants.

3. Prevent spillage of fuel and oil on the ground around the bore. Store fertilizer and other chemicals at least 50 m. away.

4. Keep stock away from the bore head. Discourage domestic activity at the bore.

5. If the bore is no longer required the casing is to be securely capped.

IN ADDITION, please ensure that the BORE IDENTIFICATION TAG is retained securely at all times. The registered bore number is Water Resources Division's only reference to the scientific and engineering data on this bore and hence important to WRD's further advice to bore owners.
CONSTANT DISCHARGE TEST
24.11.95

TIME IN MINUTES

DRAWDOWN IN METRES

WARRANTYIN RN 30250

Recovery $t_{r1}$

$Q = 0.14 \text{ L/s}$

$Q = 0.35 \text{ L/s.}$