POWER AND WATER AUTHORITY

BORE COMPLETION REPORT
RN 15379 AND RN 15380
NEWHAVEN EXCISION

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Alice Springs
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Report 122.5 R1
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### LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>millimetre</td>
</tr>
<tr>
<td>m</td>
<td>metre</td>
</tr>
<tr>
<td>km</td>
<td>kilometre</td>
</tr>
<tr>
<td>PL</td>
<td>Pastoral Lease</td>
</tr>
<tr>
<td>RN</td>
<td>Registered Number of the bore</td>
</tr>
<tr>
<td>m³/d</td>
<td>cubic metre per day</td>
</tr>
<tr>
<td>L/s</td>
<td>litre per second</td>
</tr>
<tr>
<td>L/c/d</td>
<td>litre per capita per day</td>
</tr>
<tr>
<td>L/d</td>
<td>litre per day</td>
</tr>
<tr>
<td>pH</td>
<td>Index of acidity or alkalinity</td>
</tr>
<tr>
<td>µS/cm</td>
<td>Specific Conductance</td>
</tr>
<tr>
<td>km²</td>
<td>square kilometre</td>
</tr>
<tr>
<td>TDS</td>
<td>Total dissolved solids</td>
</tr>
</tbody>
</table>
1.0 INTRODUCTION

Notification was received from the Department of Lands and Housing during late July 1988, that an agreement in principle had been reached to allow groundwater search to be conducted on a portion of Newhaven Station for a possible aboriginal land excision.

Following receipt of funding a field reconnaissance was undertaken in early August 1988. Contact was made with Mr A Coppock (owner/manager, Newhaven) who showed the general area considered to be mutually agreeable to the relevant parties for excision, subject to locating a potable water supply - namely the area to the north and east of Castle Bore - see figure 1. This area basically agreed with the directive forwarded by Department of Land and Housing.

Two drill sites were selected on the sand-covered terrain using geologic logic after an extended search of available literature and data. Both sites were drilled in early October, 1988 by Gorey and Cole Contract Drillers Pty Ltd. No prepared access to the sites was required.
2.0 PHYSIOGRAPHY (PHYSICO–GEOGRAPHY)

Newhaven Station, PL 884, occupying area of 2621 km$^2$, is remotely located approximately 300 km north-west of Alice Springs and 80 km south-west of Yuendumu settlement. Tanami Road provides the main access through the region, linking Alice Springs with Yuendumu and continuing north-westerly via The Granites to Halls Creek in the Kimberley region of Western Australia. Access to the station property is provided by a graded road, branching southerly from Tanami road, approximately 180 km from Alice Springs, passing westerly through Central Mount Wedge Station to Newhaven. Another road linking Yuendumu and Papunya intersects the graded road on Central Mount Wedge Station.

The region is subjected to a semi-arid climate where average annual rainfall is less than 250 mm, produced by irregular, sporadic summer cyclonic depressions. Summer maximum temperatures often exceed 40°C and there are marked diurnal and seasonal temperature fluctuations. Frosts are common during the mid-winter months.

A broken, discontinuous, narrow range, capped with resistant quartzite overlying a granitic basement, extends westward through Newhaven. On the east side of the property the range rises over 30 m above the level of the surrounding plain, but to the west the range peters out to low isolated rises.

To the north of the range the region is occupied by sand plain, traversed by widely spaced, subparallel, latitudinally trending dunes up to 10 m high. To the south the country is represented by a broad shallow depression occupied by saline playa lakes and claypans, fringed by calcrete developments overlying red soils and granite.

Shallow ephemeral drainages trend mostly to the north from the range. Short drainages feed into the playa/claypan country.
3.0 GEOLOGY

Newhaven Station occupies an area which straddles the southern limit of the Ngalia Basin, a geologic province comprised of Upper Proterozoic and Palaeozoic sediments preserved in an intracratonic downwarp in the Lower to Middle Proterozoic igneous and metamorphic basement rocks. Sediments within the basin are represented by discontinuous sequences, up to 5 km thick, which bear record of several unconformities indicating nine alternate periods of sedimentation and diastrophism between Adelaidean (Upper Proterozoic) and late Palaeozoic time. A major orogeny in the late Carboniferous folded and thrusted the sediments and then Tertiary sediments were deposited on the eroded basin surface. Except for a belt of folded sediments along parts of the northern margin, and narrow quartzite ridges along the southern margin, the basin sequence is concealed by superficial Cainozoic deposits.

The stratigraphy of the Ngalia Basin sequence and overlying superficial sediments is summarised in Table 1. Sedimentary rocks of Adelaidean, Cambrian, Ordovician, Devonian and Carboniferous ages are divided into eleven formations and four members. Most formations are bounded by unconformities and a complete sequence is not present in any one area.

The area of excision interest is located on a plain represented by a veneer of sand, minor calcrite and series of east-west trending fixed dunes. It is underlain by one undefined shallowly north-dipping sedimentary rock sequence of the Ngalia Basin.

In the south, rock exposure is restricted to a low hill, nominally named "Castle Hill", comprised of thickly bedded to massive quartzite representing the basal Vaughan Spring Quartzite sediments of the Ngalia Basin, with dips 15° - 30° to the north below the sand plain.

In the north, beyond the area of interest a low line of outcropping Mount Eclipse Sandstone is represented by a weathered coarse-grained sandstone and pebble conglomerate with a shallow 15° - 20° northerly dip.

The paucity of rock exposure and drilling information in the designated area necessitated a search of available literature to ascertain the stratigraphy and structural setting of the sand-covered southern Ngalia Basin sediments. A synthesis of all information relating to the Ngalia Basin including surface mapping, stratigraphic drilling, palontology (palynology), isotope dating, seismic, gravity and aeromagnetic data, is collated with reinterpretation in BMR Bulletin 212 (1983). A complete appreciation of the stratigraphy and structure of the basin is constrained by sparse surface outcrop, absence of deep drill holes, presence of many unconformities and overlapping sedimentary sequences and difficulty in correlating seismic data across major faults.
<table>
<thead>
<tr>
<th>Age</th>
<th>Formation (FM)</th>
<th>Maximum thickness</th>
<th>Lithology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Member (N)</td>
<td>approximate</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(BMR measured</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>sections)</td>
<td></td>
</tr>
<tr>
<td>Cainozoic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>guaternary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Creek alluvium, dune sand, evaporates</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>calcite and colluvium</td>
</tr>
<tr>
<td>Tertiary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carboniferous to Devonian</td>
<td>Mount Eclipsa Sandstone</td>
<td>2100 – 2400 m</td>
<td>Pale brown and red-brown coarse grained, poorly sorted sandstone and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>subgraywacke, cobble, boulder beds common, Interbeds of red</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>micaceous siltstone and shale</td>
</tr>
<tr>
<td>Devonian to</td>
<td>Kerridy Sandstone</td>
<td>700m</td>
<td>Red-brown medium to coarse grained sandstone and subgraywacke, silty,</td>
</tr>
<tr>
<td>Ordovician</td>
<td></td>
<td></td>
<td>pararkosic and calcareous. Commonly cross-bedded,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>interbedded with siltstone.</td>
</tr>
<tr>
<td>Ordovician</td>
<td>Ojagamara FM</td>
<td>320m</td>
<td>Silicaceous grey, white sandstone with abundant</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>clay pellets later bedded with green and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>grey siltstone</td>
</tr>
<tr>
<td>Cambrian</td>
<td>Bloodwood FM</td>
<td>270m</td>
<td>Red brown and pale green siltstone interbeds of red sandstone.</td>
</tr>
<tr>
<td></td>
<td>Walbiri Dolomite</td>
<td>250m</td>
<td>Grey, pink and red massive dolomite interbedded with green and grey</td>
</tr>
<tr>
<td>Cambrian</td>
<td>Tuendumu Sandstone</td>
<td>&gt;700m</td>
<td>Red-brown to pale brown, fine to coarse grained sandstone in part</td>
</tr>
<tr>
<td>to Adelaidean</td>
<td></td>
<td></td>
<td>arkosic and micaceous, cross bedded and slumped.</td>
</tr>
<tr>
<td>Adelaidian</td>
<td>Mount Doreen FM</td>
<td>17m</td>
<td>Red to yellow-brown shale</td>
</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>-----</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Newhaven Shale M</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wanapu Dolomite M</td>
<td>&gt;4m</td>
<td>Pink, fine-grained, partly silicified,stromatolitic dolomite</td>
<td></td>
</tr>
<tr>
<td>Mount Davenport</td>
<td>77m</td>
<td>Diamictite - polymictic boulder, pebble, cobble erratic in blue-green siltstone matrix.</td>
<td></td>
</tr>
<tr>
<td>Diamictite M</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rinkesbena Shale</td>
<td>100m</td>
<td>Green and grey siltstone micaceous, laminated, in part calcareous</td>
<td></td>
</tr>
<tr>
<td>Naburula FM</td>
<td>0m</td>
<td>Grey to black shale and diamictite (green siltstone) and grey to yellow dolomite</td>
<td></td>
</tr>
<tr>
<td>Albinia FM</td>
<td>150 - 500m</td>
<td>White, siltstone, shale and grey, black cherty dolomite</td>
<td></td>
</tr>
<tr>
<td>Vaughan Springs Quartzite</td>
<td>300 - 2500m</td>
<td>White, pink orthoquartzite conglomerate, sandstone; minor siltstone, shale</td>
<td></td>
</tr>
<tr>
<td>Trurc M</td>
<td>&lt;50-700m</td>
<td>White siltstone, cherty interbedded evaporates White sandstone, silicious, micaceous, clay pellets.</td>
<td></td>
</tr>
</tbody>
</table>
4.0 SELECTION OF DRILL SITES

The BMR re-interpretation of the geology of Ngalia Basin indicates that the majority of the area selected for excision consideration is underlain by Adelaidean sediments of the: (1) Vaughan Springs Quartzite, comprised of massive orthquartzite and interbedded sandstone and siltstone and (2) Mount Doreen Formation, comprised dominantly of diamictite (tillite), siltstone, shales and minor dolomite. Contact between these formations is covered and unknown. It is not known if the Albinia Formation, Naburula formation and Rinkabeena Shale are also represented in this sequence. Drilling of RN 14634 located to the north-west of Castle Bore demonstrates the sediments of the Mount Doreen Formation yield highly saline water and low supplies (0.1 L/s; 24,540 mg/L).

Of particular interest are the interpreted extensions of the Cambrian-Devonian groups of Palaeozoic sediments which have been correlated throughout the basin using seismic reflection data and identified in widely separated drill holes. This zone is shown to trend across the northern boundary of Newhaven Station, north of Castle Bore (see figure 2). Groundwater of qualities 1990 mg/L and 5850 mg/L have been correlated with these sediments in exploratory drill holes RN 6712 and RN 6713 respectively.

Using the interpreted position of the Palaeozoic sediments a drill site was selected within 70 m of Newhaven northern boundary, 6 km north of Castle Bore, with the intent of intersecting either Walkivi Dolomite and/or Yuendumu Sandstone - both are potential aquifers.

A second drill site was selected north of Castle Hill at approximately 220 m north of the quartzite outcrop. This site was aimed to test the sandstone units overlying the massive basal quartzite (Vaughan Springs Quartzite) with the concept that recharge was possible from the gentle northern slopes of Castle Hill.
5.0 HYDROGEOLOGY

Previous drilling activities in the district, about the area for excision consideration, have indicated that ground water is shallow and of very saline quality. Figure 1 displays the spread of drilling in the vicinity of the area of interest. Details of groundwater intersections, aquifer types and water analysis are tabulated in Table 2. Most drilling has tested the Cainozoic sediments both within the limits of the Ngalia Basin and to the south. An east-west line of saline playa lakes and claypans flank the southern limits of the Ngalia Basin and represent a catchment zone for shallow ephemeral drainage from the north.

Of particular interest is the intersection of groundwater in RN 6712, reported to be capable of a supply of 10 L/s of approximately 1990 mg/L total dissolved solids.

A scan of previous drilling records of limited groundwater search and mineral exploration efforts within the Ngalia Basin indicate that of the eleven sedimentary formations available, only the Mount Eclipse Sandstone, Kerridy Sandstone and Yuendumu Sandstone have yielded indications or supplies of potable water.

Scant records from mineral exploration activities indicted that the Mount Eclipse Sandstone contains zones of high salinity with waters containing greater than 10,000 mg/L total dissolved solids and other zones of lower salinity of 1000 to 3000 mg/L total dissolved solids - suggesting separated aquifer horizons, possibly related to varying depositional environments.

Drilling of the Kerridy Sandstone at the Yuendumu Settlement has demonstrated the value of this formation as a medium to long term source of potable water. Drilling log records indicate water flows from intervals of low penetration rates, suggesting joints may be best developed in the hard, brittle, sandstone beds and provide the best aquifer environment within the formation.

Initial water supplies for the Yuendumu Settlement were drawn from the Yuendumu Sandstone - water quality is marginal for drinking purposes and further investigation determined the supply to be limited.

Other sedimentary formations with potential for potable water supplies and worthy of exploration effort include the Walbiri Dolomite and Djagamara Formation. Previous drilling has produced stock quality water supplies from the Walbiri Dolomite. The Djagamara Formation has had little exploration effort due to hard drilling.
Mineral explorers have drilled into isolated, ill-defined Tertiary sub-basinal sediments and have revealed potable to marginal ground waters in sandy/clay aquifers. Recent ground water search for isolated aboriginal outstations has located potable waters associated with sandy creek alluvium (eg, Waite Creek area).
<table>
<thead>
<tr>
<th>REG'D NUMBER</th>
<th>BORE NAME</th>
<th>TOTAL DEPTH (m)</th>
<th>WATER STRIKE (m)</th>
<th>S.W.L (m)</th>
<th>SUPPLY (L/s)</th>
<th>TOTAL DEGLVD SOLIDS (mg/L)</th>
<th>NO3/P</th>
<th>AQUIFER TYPE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1802</td>
<td>Boundary Bore</td>
<td>9.14</td>
<td>4.57</td>
<td>3.96</td>
<td>1.125</td>
<td>6853</td>
<td>44/3.1</td>
<td>Calcrete</td>
<td></td>
</tr>
<tr>
<td>1803</td>
<td>No 2 Bore</td>
<td>18.29</td>
<td>13.71</td>
<td>12.19</td>
<td>Large</td>
<td>13556</td>
<td>8/4.0</td>
<td>Clay Sediments</td>
<td>Cainozoic (Tertiary)</td>
</tr>
<tr>
<td>1804</td>
<td>No 3 Bore</td>
<td>9.14</td>
<td>3.96</td>
<td>3.96</td>
<td>N/A</td>
<td>3023</td>
<td>42/1.3</td>
<td>Sandstone &amp; Clays</td>
<td>Tertiary sediments underlying calcrete</td>
</tr>
<tr>
<td>4317</td>
<td>No 10 Bore</td>
<td>N/R</td>
<td>3.35</td>
<td>3.35</td>
<td>1.25</td>
<td>3362</td>
<td>57/1.4</td>
<td>N/R</td>
<td></td>
</tr>
<tr>
<td>4318</td>
<td>No 9 Bore</td>
<td>18.29</td>
<td>4.88</td>
<td>4.88</td>
<td>1.89</td>
<td>2170</td>
<td>73/1.9</td>
<td>Calcrete</td>
<td>Calcrete overlying Tertiary clay and sand</td>
</tr>
<tr>
<td></td>
<td>Homestead Bore</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4319</td>
<td>Claypan Bore</td>
<td>12.19</td>
<td>5.18</td>
<td>5.18</td>
<td>0.75</td>
<td>8700</td>
<td>52/3.5</td>
<td>Calcrete</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4320</td>
<td>No 11 Bore</td>
<td>8.84</td>
<td>5.79</td>
<td>5.79</td>
<td>Good supply</td>
<td>5513</td>
<td>27/1.4</td>
<td>Calcrete</td>
<td>Calcrete and Tertiary clays &amp; lime clays</td>
</tr>
<tr>
<td></td>
<td>Castle Bore</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4312</td>
<td>No 7 Bore</td>
<td>12.19</td>
<td>6.22</td>
<td>N/R</td>
<td>V small supply</td>
<td>N/R</td>
<td>N/R</td>
<td>Red sandy clay</td>
<td>Cainozoic clays over-lying granite</td>
</tr>
</tbody>
</table>

Table 2: Water Bore Data - Castle Hill District, Newhaven Station

Notes:
- Reg'd Number 1602 to 4320
- Boundary Bore: 9.14m, 4.57m, 3.96m, 1.125 L/s, 6853 mg/L, 44/3.1
- No 2 Bore: 18.29m, 13.71m, 12.19m, Large, 13556 mg/L, 8/4.0
- No 3 Bore: 9.14m, 3.96m, 3.96m, N/A, 3023 mg/L, 42/1.3
- No 10 Bore: N/R, 3.35m, 3.35m, 1.25 L/s, 3362 mg/L, 57/1.4
- No 11 Bore: 8.84m, 5.79m, 5.79m, Good supply, 5513 mg/L, 27/1.4
- No 7 Bore: 12.19m, 6.22m, N/R, V small supply, N/R, N/R
- Cainozoic clays over-lying granite
<table>
<thead>
<tr>
<th>Bore Number</th>
<th>Bore Name</th>
<th>Depth (m)</th>
<th>Diameter (m)</th>
<th>Quality</th>
<th>Depth (m)</th>
<th>Depth (m)</th>
<th>Depth (m)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4322</td>
<td>No 4 Bore</td>
<td>10.67</td>
<td>10.67</td>
<td>6.4</td>
<td>1.0</td>
<td>5282</td>
<td>37/1.1</td>
<td>Calcrete</td>
</tr>
<tr>
<td></td>
<td>Gap Bore</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4323</td>
<td>No 6 Bore</td>
<td>11.58</td>
<td>8.53</td>
<td>N/R</td>
<td>32210</td>
<td>N/R</td>
<td>Red sand clay</td>
<td>Tertiary clays</td>
</tr>
<tr>
<td></td>
<td>Seawater Bore</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>4324</td>
<td>No 11 Bore</td>
<td>24.38</td>
<td>23.16</td>
<td>Good</td>
<td>21260</td>
<td>N/R</td>
<td>Sandy clay</td>
<td>Tertiary sediments - sands, clays</td>
</tr>
<tr>
<td>6712</td>
<td>M.M.R. HD8</td>
<td>216.4</td>
<td>48.78</td>
<td>N/R</td>
<td>1990</td>
<td>N/R</td>
<td>Grey dolomite</td>
<td>Either Walbiri or Mount Doreen formation; favour Mt Doreen formation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>6713</td>
<td>M.M.R. HD8</td>
<td>220.0</td>
<td>N/R</td>
<td>18.75</td>
<td>6500</td>
<td>N/R</td>
<td>Cobble Congl.</td>
<td>Mount Eclipse sandstone</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>14779</td>
<td></td>
<td>75.0</td>
<td>31.0</td>
<td>26.0</td>
<td>0.1</td>
<td>24540</td>
<td>N/R</td>
<td>Siltstone</td>
</tr>
</tbody>
</table>
6.0 WATER DEMAND

The water requirement for the proposed community is estimated to be about 30 m\(^3\)/day which can be met by a bore capable of a supply of 0.5 L/s.

Water quality is measured against the guidelines of the Australian Water Resources Council/National Health and Medical Research Council, particularly the health-related parameters of nitrate content (less than 45 mg/L) and fluoride content (less than 1.7 mg/L).
7.0 DRILLING RESULTS

Bore RN 15379 was drilled with the intent of intersecting sediments of the Palaeozoic sequence, stratigraphically located between the silty environments of the Mount Doreen Formation (Adelaideran age) and the Mount Eclipse Sandstone (Devonian – Carboniferous age). It was sited within an interpreted/projected zone outlined in BMR Bulletin 212, which was compiled after collation of all available geologic data for the region.

Drilling was terminated at 100 m after striking a saline water supply at 96m. The water supply was tested by air lift to be 1.0 L/s.

Examination of the drill cuttings indicated the drilling penetrated the upper portion of the Mount Doreen Formation below a shallow cover of Cainozoic sediment represented by dune sand, salt, clay and minor gravel. A detailed scrutiny of the cuttings suggests a correlation:
- Newhaven Shale Member (15 - 45 m)
- Wanapi Dolomite Member (45 - 75 m)
- Mount Davenport Diamictite (75 - 100 m)

A composite log of RN 15379 is presented as Figure 4A.

RN 15380 was drilled to test the anticipated sandstone environment overlying the gently north-sloping massive orthoquartzite of the Vaughan Springs Quartzite constituting Castle Hill. This site was selected where ground water recharge is possible down the slope of Castle Hill and through a thin cover of dunal sand.

Drilling was terminated after intersecting a saline water supply, air-lift tested at 0.5 L/s between 11 - 14 m. Below a shallow sand cover the drilling intersected calcrete, clay and white sandstone. The white sandstone is correlated with the Truer Member of the Vaughan Springs Quartzite which is known to carry high contents of evaporitic minerals (gypsum, anhydrite and halite) elsewhere in the Ngalia Basin.

A composite log of RN 15380 is presented in Figure 4B.

Both holes were backfilled; geological logs for both bores are supplied in an Appendix.
8.0 WATER QUALITY

Water samples were collected and field conductivity tests were carried out on-site at the drill location.

Both bores intersected very saline waters which fail to comply with the required standards. Limited chemical analyses of both water samples were carried out by the East Point Laboratory of the Water Resources Branch, Darwin. Results are given in Table 3.

The waters from both bores are considered to be associated with aquifers carrying high contents of evaporite minerals in the original sediments.
## Water Quality Data

### Table 3

<table>
<thead>
<tr>
<th>Date of Sampling</th>
<th>Specific Conductance (μS/cm at 25°C)</th>
<th>pH</th>
<th>Sodium, Na</th>
<th>Potassium, K</th>
<th>Calcium, Ca</th>
<th>Magnesium, Mg</th>
<th>Total Hardness (as CaCO₃)</th>
<th>Total Alkalinity (as CaCO₃)</th>
<th>Iron, Total, Fe</th>
<th>Silica, SiO₂</th>
<th>Chloride, Cl⁻</th>
<th>Sulfate, SO₄²⁻</th>
<th>Nitrate, NO₃⁻</th>
<th>Bicarbonate, HCO₃⁻</th>
<th>Fluoride, F⁻</th>
<th>Sodium Chloride (as Cl⁻)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>15379 1.10.88</td>
<td>81500</td>
<td>7.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2550</td>
<td>195</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15380 3.10.88</td>
<td>14750</td>
<td>7.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1140</td>
<td>579</td>
<td>4673</td>
<td>238</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The drilling of RN 15379 and RN 15380 has demonstrated highly saline ground water to be associated with sediments of the Mount Doreen formation and the Vaughan Springs Quartzite respectively.

Information from both bores has assisted in clarifying the sub-surface geology in the southern portion of Ngalia Basin.

Cuttings from RN 15379 suggest the drilling penetrated the upper portion of the Mount Doreen Formation below a shallow cover of Cainozoic sediment. A likely correlation of the geologic log is Newhaven Shale Member (15 - 45 m) Wanapi Dolomite Member (45 - 75 m) and Mount Davenport Diamictite Member (75 - 100 m).

White fine-grained sandstone intersected at the base of RN15380 is correlated with the Truer Member of the Vaughan Springs Quartzite. This unit is known to contain high gypsum, anhydrite and possibly halite elsewhere in the Ngalia basin, and it offers a suitable explanation for the associated highly saline ground water.

The interpreted position and width of the Palaeozoic sediments as presented in B.M.R. Bulletin 212 requires further revision. It is possible that Mount Eclipse Sandstone rests unconformably on Adelaidean sediments of the Mount Doreen Formation in the region north of Castle Bore.

High gypsum, anhydrite and possibly halite contents within the Truer Member of Vaughan Springs Quartzite and in the Wanapi Dolomite Member of Mount Doreen Formation are likely sources for the high ground water salinities. These high salinity groundwaters spread through the Cainozoic calcrete and broad playa lake environments to the south which flank the limits of the Ngalia Basin.

The pervasive spread of saline waters and associated geologic environments on Newhaven Station offer poor prospects for continued potable ground water search.

Further selection of drill sites in the region is dependent on the geological structural setting and geomorphic aspect to avoid areas of high salinity produced by weathering of the Truer and Wanapi Dolomite Members.
REFERENCES

1. Topographic Map, Mount Doreen Sheet SF52-12, 1:250,000


POWER AND WATER AUTHORITY
WATER RESOURCES BRANCH

DEPTH CONSTRUCTION GRAPHIC LOG STRATA DESCRIPTION AQUIFERS (WATER STRUCK)

SAND: red/brown medium grained dune sand, minor gravels.
CLAYSTONE: yellow/brown claystone scattered gypsum flakes.
SANDY SILT: brown sandy silt with grits of grey/white quartz.
CLAYSTONE: light brown claystone
GRAVELS/CLAYSTONE: coarse gravels of grey quartzite with claystone

CLAY: yellow brown clay

CLAY/SILTSTONE: brown clay with weathered, brown/grey siltstone.
SILTSTONE: weathered, brown/grey micaceous (biotite) siltstone

CLAYS: light grey limy clays (weathered/ altered dolomitic limestone)
DOLOMITE: weathered, thinly bedded fissile, broken grey dolomite - dolomitic limestone
SILTSTONE: light brown thinly bedded, fissile siltstone

S.W.L. 11m
1:0LS

COMPOSITE LOG OF BORE RN 15379
Newhaven Excision

FIGURE 4A
2629-23-47
**POWER AND WATER AUTHORITY**
**WATER RESOURCES BRANCH**

<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>BORE CONSTRUCTION</th>
<th>GRAPHIC LOG</th>
<th>STRATA DESCRIPTION</th>
<th>AQUIFERS (WATER STRUCK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td>SAND: red/brown dune sand overlying pink silt - sandy silt</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>CALCRETE: white/grey and pale pink massive calcrete</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>CLAYSTONE: pale yellow/brown silty claystone</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td>SANDSTONE: white/grey fine grained silty sandstone (weathered Truer Member)</td>
<td></td>
</tr>
</tbody>
</table>

**COMPOSITE LOG OF BORE RN 15380**

Newhaven Excision

FIGURE 4B
2630-23-48
**GEOLOGICAL LOG OF WATER BORE - BW 15379**

**Locality**  
Newhaven Station, FL 884

**Bore Name**  
R.N. 15379

**Tenure**  
Drilled for A.E.S for Aboriginal

**Excision**

**1:250000 Sheet**  
Mount Doreen SF 52-12

**DATA File:** 132.5C

**Grid Reference:** 386 176

**Summary Log:**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Lithology</th>
<th>Stratigraphic Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 3</td>
<td>Sand/gravel</td>
<td>Alluvium (Dune Sand) Qs Quaternary</td>
</tr>
<tr>
<td>3 - 9</td>
<td>Silt, Clay, Gravel</td>
<td>Alluvium Qa Quaternary</td>
</tr>
<tr>
<td>9 - 30</td>
<td>Claystone</td>
<td>Clays Ts Tertiary</td>
</tr>
<tr>
<td>30 - 100</td>
<td>Siltstone, dolomite</td>
<td>Mount Doreen Formation Puq Proterozoic</td>
</tr>
</tbody>
</table>

**GEOPHYSICAL LOGS AVAILABLE TO**

**Major Aquifers**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Yield (Ls1)</th>
<th>Approx SWL 11.0m</th>
</tr>
</thead>
<tbody>
<tr>
<td>96.0</td>
<td>1.0</td>
<td>Siltstone</td>
</tr>
</tbody>
</table>

**Field conductivity**  
> 10,000µS/cm

**Drilling Technique**

Percussion - Air drilling to 100 metres using Gorey & Cole Contact Drillers Pty Ltd

**Hole Abandoned - Backfilled**

**Detailed Log**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Lithology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 3</td>
<td>Sand/gravel</td>
<td>Red/brown fine to medium grained dune sand overlying sands and ravel's of white rounded quartzite.</td>
</tr>
<tr>
<td>3 - 6</td>
<td>Claystone</td>
<td>Yellow brown soft claystone with scattered flakes of gypsum</td>
</tr>
<tr>
<td>6 - 9</td>
<td>Sandy Silt</td>
<td>Light brown sandy silt with gravel/grit of grey/white quartz</td>
</tr>
<tr>
<td>9 - 12</td>
<td>Claystone</td>
<td>Light brown claystone</td>
</tr>
<tr>
<td>12 - 15</td>
<td>Gravel</td>
<td>Coarse subgrounded gravels of grey quartzite with silt/claystone</td>
</tr>
<tr>
<td>15 - 27</td>
<td>Clay</td>
<td>Yellow brown clay</td>
</tr>
<tr>
<td>27 - 30</td>
<td>Clay/siltstone</td>
<td>Brown clay with weathered brown/grey siltstone</td>
</tr>
<tr>
<td>30 - 45</td>
<td>Siltstone</td>
<td>Weathered brown/grey micaceous (biotite) siltstone</td>
</tr>
<tr>
<td>45 - 54</td>
<td>Clays</td>
<td>Grey linsey clays</td>
</tr>
<tr>
<td>54 - 75</td>
<td>Dolomitic limestone</td>
<td>Weathered, broken/fractured, thinly bedded, dolomitic limestone.</td>
</tr>
<tr>
<td>75 - 100</td>
<td>Siltstone</td>
<td>Brown/red finely bedded siltstone</td>
</tr>
</tbody>
</table>

**LOGGED BY:** K Warne
GEOLOGICAL LOG OF WATER BORE - RN15380

Locality
Newhaven Station PL 884

Bore Name
RN15380

Tenure
Drilled for A.E.S. for Aboriginal

Excision

1:250000 Sheet
Mount Doreen SF 52.12

Grid Reference:
394-171

DATA FILE: 122.5C

Summary Log:

<table>
<thead>
<tr>
<th>Depth(m)</th>
<th>Lithology</th>
<th>Stratigraphic Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 3</td>
<td>Sand</td>
<td>Alluvium (dune sand) Qs Quaternary</td>
</tr>
<tr>
<td>3 - 9</td>
<td>Calcrete</td>
<td>Calcrete Ql Quaternary Tertiary</td>
</tr>
<tr>
<td>9 - 12</td>
<td>Claystone</td>
<td>Tertiary</td>
</tr>
<tr>
<td>12 - 15</td>
<td>Sandstone</td>
<td>Proterozoic</td>
</tr>
</tbody>
</table>

GEOPHYSICAL LOGS AVAILABLE TO

Major Aquifers

Depth (m) Yield (LsL) Approx SWL 9.0m
10 - 14 0.5 Clay/sandstone interface

Type Clay/sandstone interface

Field conductivity > 10,000 µS/cm

Drilling Technique

Percussion - Air drilling to 15m using Gorey & Cole Contract Drillers Pty Ltd

Detailed Log

<table>
<thead>
<tr>
<th>Depth(m)</th>
<th>Lithology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 3</td>
<td>Sand/Silt</td>
<td>Thin, red/brown, dune sand and fine, pink silt overlying massive grey/white calcrite</td>
</tr>
<tr>
<td>3 - 9</td>
<td>Calcrete</td>
<td>White/grey and pink, massive Calcrite</td>
</tr>
<tr>
<td>9 - 12</td>
<td>Claystone</td>
<td>Pale yellow/brown claystone</td>
</tr>
<tr>
<td>12 - 15</td>
<td>Sandstone</td>
<td>White/grey, fine-grained, silty sandstone</td>
</tr>
</tbody>
</table>

LOGGED BY: K Warne
POWER AND WATER AUTHORITY

BORE COMPLETION REPORT
RN 15379 AND RN 15380
NEWHAVEN EXCISION

Prepared by: K.R. Warne
Hydrogeologist
Water Resources Branch
Alice Springs
October, 1988

Report 122.5 RL
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2.0 Physiography
3.0 Geology
4.0 Selection of Drill Sites
5.0 Hydrogeology
6.0 Water Demand
7.0 Drilling Results
8.0 Water Quality
9.0 Conclusions
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2. Water bore Data, Castle Hill District, Newhaven
3. Water Quality Data (Limited Analysis Only)

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2. Interpreted Geological Map, Newhaven Region
3. Newhaven Excision - Bore Locations
4 A. Log of Bore RN 15379
4 B. Log of Bore RN 15380

APPENDIX

Geological logs of bores RN 15379, RN 15380
**LIST OF ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>mm</td>
<td>millimetre</td>
</tr>
<tr>
<td>m</td>
<td>metre</td>
</tr>
<tr>
<td>km</td>
<td>kilometre</td>
</tr>
<tr>
<td>PL</td>
<td>Pastoral Lease</td>
</tr>
<tr>
<td>RN</td>
<td>Registered Number of the bore</td>
</tr>
<tr>
<td>m$^3$/d</td>
<td>cubic metre per day</td>
</tr>
<tr>
<td>L/s</td>
<td>litre per second</td>
</tr>
<tr>
<td>L/c/d</td>
<td>litre per capita per day</td>
</tr>
<tr>
<td>L/d</td>
<td>litre per day</td>
</tr>
<tr>
<td>pH</td>
<td>Index of acidity or alkalinity</td>
</tr>
<tr>
<td>$\mu$/cm</td>
<td>Specific Conductance</td>
</tr>
<tr>
<td>km$^2$</td>
<td>square kilometre</td>
</tr>
<tr>
<td>TDS</td>
<td>Total dissolved solids</td>
</tr>
</tbody>
</table>
1.0 INTRODUCTION

Notification was received from the Department of Lands and Housing during late July 1988, that an agreement in principle had been reached to allow groundwater search to be conducted on a portion of Newhaven Station for a possible aboriginal land excision.

Following receipt of funding a field reconnaissance was undertaken in early August 1988. Contact was made with Mr A Coppock (owner/manager, Newhaven) who showed the general area considered to be mutually agreeable to the relevant parties for excision, subject to locating a potable water supply - namely the area to the north and east of Castle Bore - see figure 1. This area basically agreed with the directive forwarded by Department of Land and Housing.

Two drill sites were selected on the sand-covered terrain using geologic logic after an extended search of available literature and data. Both sites were drilled in early October, 1988 by Gorey and Cole Contract Drillers Pty Ltd. No prepared access to the sites was required.
2.0 PHYSIOGRAPHY (PHYSICO-GEOGRAPHY)

Newhaven Station, PL 884, occupying area of 2621 km$^2$, is remotely located approximately 300 km north-west of Alice Springs and 80 km south-west of Yuendumu settlement.

Tanami Road provides the main access through the region, linking Alice Springs with Yuendumu and continuing north-westerly via The Granites to Halls Creek in the Kimberley region of Western Australia. Access to the station property is provided by a graded road, branching southerly from Tanami road, approximately 180 km from Alice Springs, passing westerly through Central Mount Wedge Station to Newhaven. Another road linking Yuendumu and Papunya intersects the graded road on Central Mount Wedge Station.

The region is subjected to a semi-arid climate where average annual rainfall is less than 250 mm, produced by irregular, sporadic summer cyclonic depressions. Summer maximum temperatures often exceed 40°C and there are marked diurnal and seasonal temperature fluctuations. Frosts are common during the mid-winter months.

A broken, discontinuous, narrow range, capped with resistant quartzite overlying a granitic basement, extends westward through Newhaven. On the east side of the property the range rises over 30 m above the level of the surrounding plain, but to the west the range peters out to low isolated rises.

To the north of the range the region is occupied by sand plain, traversed by widely spaced, subparallel, latitudinally trending dunes up to 10 m high. To the south the country is represented by a broad shallow depression occupied by saline playa lakes and claypans, fringed by calcrete developments overlying red soils and granite.

Shallow ephemeral drainages trend mostly to the north from the range. Short drainages feed into the playa/claypan country.
Newhaven Station occupies an area which straddles the southern limit of the Ngalia Basin, a geologic province comprised of Upper Proterozoic and Palaeozoic sediments preserved in an intracratonic downwarp in the Lower to Middle Proterozoic igneous and metamorphic basement rocks. Sediments within the basin are represented by discontinuous sequences, up to 5 km thick, which bear record of several unconformities indicating nine alternate periods of sedimentation and diastrophism between Adelaidean (Upper Proterozoic) and late Palaeozoic time. A major orogeny in the late Carboniferous folded and thrust the sediments and then Tertiary sediments were deposited on the eroded basin surface. Except for a belt of folded sediments along parts of the northern margin, and narrow quartzite ridges along the southern margin, the basin sequence is concealed by superficial Cainozoic deposits.

The stratigraphy of the Ngalia Basin sequence and overlying superficial sediments is summarised in Table 1. Sedimentary rocks of Adelaidean, Cambrian, Ordovician, Devonian and Carboniferous ages are divided into eleven formations and four members. Most formations are bounded by unconformities and a complete sequence is not present in any one area.

The area of excision interest is located on a plain represented by a veneer of sand, minor calcrete and series of east-west trending fixed dunes. It is underlain by one undefined shallowly north-dipping sedimentary rock sequence of the Ngalia Basin.

In the south, rock exposure is restricted to a low hill, nominally named "Castle Hill", comprised of thickly bedded to massive quartzite representing the basal Vaughan Spring Quartzite sediments of the Ngalia Basin, with dips 15° - 30° to the north below the sand plain.

In the north, beyond the area of interest a low line of outcropping Mount Eclipse Sandstone is represented by a weathered coarse-grained sandstone and pebble conglomerate with a shallow 15° - 20° northerly dip.

The paucity of rock exposure and drilling information in the designated area necessitated a search of available literature to ascertain the stratigraphy and structural setting of the sand-covered southern Ngalia Basin sediments. A synthesis of all information relating to the Ngalia Basin including surface mapping, stratigraphic drilling, paleontology (palynology), isotope dating, seismic, gravity and aeromagnetic data, is collated with reinterpretation in BMR Bulletin 212 (1983). A complete appreciation of the stratigraphy and structure of the basin is constrained by sparse surface outcrop, absence of deep drill holes, presence of many unconformities and overlapping sedimentary sequences and difficulty in correlating seismic data across major faults.
### Stratigraphy of the Ngala Basin

<table>
<thead>
<tr>
<th>Age</th>
<th>Formation (FM)</th>
<th>Maximum thickness</th>
<th>Lithology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Member (M)</td>
<td>approximate</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(UWR measured sections)</td>
<td></td>
</tr>
<tr>
<td>Cenozoic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quaternary</td>
<td></td>
<td></td>
<td>Creek alluvium, dune sand, evaporates, calcite and colluvium</td>
</tr>
<tr>
<td>Tertiary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carboniferous to</td>
<td>Mount Eclipse Sandstone</td>
<td>2200 - 2400 m</td>
<td>Pale brown and red-brown coarse grained, poorly sorted sandstone and subgreywacke cobble, bedded.common, interbeds of red micaceous siltstone and shale</td>
</tr>
<tr>
<td>Devonian</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devonian to</td>
<td>Kerridy Sandstone</td>
<td>700m</td>
<td>Red-brown medium to coarse grained sandstone and subgreywacke. Silty, pararkosic and calcareous. Commonly cross-bedded, interbedded with siltstone.</td>
</tr>
<tr>
<td>Ordovician</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ordovician</td>
<td>Djugamara FM</td>
<td>320m</td>
<td>Siliceous grey, white sandstone with abundant clay pellets later bedded with green and grey siltstone</td>
</tr>
<tr>
<td>Cambrian</td>
<td>Bloodwood FM</td>
<td>270m</td>
<td>Red brown and pale green siltstone interbeds of red sandstone. Grey, pink and red massive dolomite interbedded with green and grey siltstone</td>
</tr>
<tr>
<td>Cambrian to</td>
<td>Yuendumu Sandstone</td>
<td>&gt;700m</td>
<td>Red-brown to pale brown, fine to coarse grained sandstone in part arkosic and micaceous, cross bedded and slumped.</td>
</tr>
<tr>
<td>Adelaidaan</td>
<td>Mount Doreen FM</td>
<td>17m</td>
<td>Red to yellow-brown shale</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------------------------</td>
<td>-----</td>
<td>--------------------------</td>
</tr>
<tr>
<td></td>
<td>Newhaven Shale M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wanapi Dolomite M</td>
<td>34m</td>
<td></td>
<td>Pink, fine-grained, partsilicificied, stromatolitic dolomite</td>
</tr>
<tr>
<td>Mount Ravenport</td>
<td>Diamictite M</td>
<td>77m</td>
<td>Diamictite - polymictic boulder, pebble, cobble erratics in blue-green siltstone matrix.</td>
</tr>
<tr>
<td></td>
<td>Rinkabeena Shale</td>
<td>100m</td>
<td>Green and grey siltstone micaceous, laminated, in part calcareous</td>
</tr>
<tr>
<td></td>
<td>Naburula FM</td>
<td>8m</td>
<td>Grey to black shale and diamictite (green siltstone) and grey to yellow dolomite</td>
</tr>
<tr>
<td></td>
<td>Albinia FM</td>
<td>150 - 500m</td>
<td>White, siltstone, shale and grey, black cherty Dolomite.</td>
</tr>
<tr>
<td></td>
<td>Vaughan Springs Quartzite</td>
<td>300 - 2500m</td>
<td>White, pink orthoquartzite conglomerate, sandstone; minor siltstone, shale</td>
</tr>
<tr>
<td></td>
<td>Truer M</td>
<td>&lt;50-700m</td>
<td>White siltstone, cherty interbedded evaporates White sandstone, siliceous, micaceous, clay pellets.</td>
</tr>
</tbody>
</table>
4.0 SELECTION OF DRILL SITES

The BMR re-interpretation of the geology of Ngalkia Basin indicates that the majority of the area selected for excision consideration is underlain by Adelaidean sediments of the: (1) Vaughan Springs Quartzite, comprised of massive orthquartzite and interbedded sandstone and siltstone and (2) Mount Doreen Formation, comprised dominantly of diamictite (tillite), siltstone, shales and minor dolomite. Contact between these formations is covered and unknown. It is not known if the Albinia Formation, Naburula formation and Rinkabeena Shale are also represented in this sequence. Drilling of RN 14634 located to the north-west of Castle Bore demonstrates the sediments of the Mount Doreen Formation yield highly saline water and low supplies (0.1 L/s; 24,540 mg/L).

Of particular interest are the interpreted extensions of the Cambrian-Devonian groups of Palaeozoic sediments which have been correlated throughout the basin using seismic reflection data and identified in widely separated drill holes. This zone is shown to trend across the northern boundary of Newhaven Station, north of Castle Bore (see figure 2). Groundwater of qualities 1990 mg/L and 5850 mg/L have been correlated with these sediments in exploratory drill holes RN 6712 and RN 6713 respectively.

Using the interpreted position of the Palaeozoic sediments a drill site was selected within 70 m of Newhaven northern boundary, 6 km north of Castle Bore, with the intent of intersecting either Walkivi Dolomite and/or Yuendumu Sandstone - both are potential aquifers.

A second drill site was selected north of Castle Hill at approximately 220 m north of the quartzite outcrop. This site was aimed to test the sandstone units overlying the massive basal quartzite (Vaughan Springs Quartzite) with the concept that recharge was possible from the gentle northern slopes of Castle Hill.
5.0 HYDROGEOLOGY

Previous drilling activities in the district, about the area for excision consideration, have indicated that ground water is shallow and of very saline quality. Figure 1 displays the spread of drilling in the vicinity of the area of interest. Details of groundwater intersections, aquifer types and water analysis are tabulated in Table 2. Most drilling has tested the Cainozoic sediments both within the limits of the Ngalia Basin and to the south. An east-west line of saline playa lakes and claypans flank the southern limits of the Ngalia Basin and represent a catchment zone for shallow ephemeral drainage from the north.

Of particular interest is the groundwater in RN 6712, reported to be capable of a supply of 10 L/s of approximately 1990 mg/L total dissolved solids.

A scan of previous drilling records of limited groundwater search and mineral exploration efforts within the Ngalia Basin indicate that of the eleven sedimentary formations available, only the Mount Eclipse Sandstone, Kerridy Sandstone and Yuendumu Sandstone have yielded indications or supplies of potable water.

Scant records from mineral exploration activities indicated that the Mount Eclipse Sandstone contains zones of high salinity with waters containing greater than 10,000 mg/L total dissolved solids and other zones of lower salinity of 1000 to 3000 mg/L total dissolved solids - suggesting separated aquifer horizons, possibly related to varying depositional environments.

Drilling of the Kerridy Sandstone at the Yuendumu Settlement has demonstrated the value of this formation as a medium to long term source of potable water. Drilling log records indicate water flows from intervals of low penetration rates, suggesting joints may be best developed in the hard, brittle, sandstone beds and provide the best aquifer environment within the formation.

Initial water supplies for the Yuendumu Settlement were drawn from the Yuendumu Sandstone - water quality is marginal for drinking purposes and further investigation determined the supply to be limited.

Other sedimentary formations with potential for potable water supplies and worthy of exploration effort include the Walbiri Dolomite and Djagamara Formation. Previous drilling has produced stock quality water supplies from the Walbiri Dolomite. The Djagamara Formation has had little exploration effort due to hard drilling.
Mineral explorers have drilled into isolated, ill-defined Tertiary sub-basinal sediments and have revealed potable to marginal ground waters in sandy/clay aquifers. Recent ground water search for isolated aboriginal outstations has located potable waters associated with sandy creek alluvium (eg, Waite Creek area).
### Water Bore Data - Castle Hill District, Newhaven Station

<table>
<thead>
<tr>
<th>REG'D NUMBER</th>
<th>BORE NAME</th>
<th>TOTAL WATER DEPTH (m)</th>
<th>WATER STRIKE (m)</th>
<th>S.W.L. (m)</th>
<th>SUPPLY (L/s)</th>
<th>TOTAL DSSWD</th>
<th>NO₃/F</th>
<th>SOLIDS (mg/L)</th>
<th>AQUIFER TYPE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1802</td>
<td>Boundary Bore</td>
<td>9.14</td>
<td>4.57</td>
<td>3.96</td>
<td>1.125</td>
<td>6893</td>
<td>44/3.1</td>
<td>Calcrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1803</td>
<td>No 2 Bore</td>
<td>10.29</td>
<td>13.71</td>
<td>12.19</td>
<td>Large</td>
<td>13556</td>
<td>8/4.0</td>
<td>Clay Sediments</td>
<td>Cainozoic (Tertiary)</td>
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</tr>
<tr>
<td>1804</td>
<td>No 3 Bore</td>
<td>9.14</td>
<td>3.96</td>
<td>3.96</td>
<td>N/A</td>
<td>3023</td>
<td>42/1.3</td>
<td>Sandstone &amp; Clays</td>
<td>Tertiary sediments underlying calcrete</td>
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<tr>
<td>4317</td>
<td>No 10 Bore</td>
<td>N/R</td>
<td>3.35</td>
<td>3.35</td>
<td>1.25</td>
<td>3362</td>
<td>57/1/8</td>
<td>N/R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4318</td>
<td>No 9 Bore</td>
<td>10.29</td>
<td>4.88</td>
<td>4.86</td>
<td>1.89</td>
<td>2470</td>
<td>73/1.9</td>
<td>Calcrete</td>
<td>Calcrete overlying Tertiary clay and sand</td>
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</tr>
<tr>
<td></td>
<td>Homestead Bore</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4319</td>
<td>Claypan Bore</td>
<td>12.19</td>
<td>5.18</td>
<td>5.18</td>
<td>0.75</td>
<td>8700</td>
<td>52/3.5</td>
<td>Calcrete</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25900</td>
<td>6/3.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4320</td>
<td>No 11 Bore</td>
<td>8.84</td>
<td>5.79</td>
<td>5.79</td>
<td>Good supply</td>
<td>5513</td>
<td>27/1.4</td>
<td>Calcrete and Tertiary clays</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Castle Bore</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>4312</td>
<td>No 7 Bore</td>
<td>12.19</td>
<td>8.22</td>
<td>N/R</td>
<td>V small supply</td>
<td>N/R</td>
<td>N/R</td>
<td>Red sandy clay</td>
<td>Cainozoic clays over-lying granite</td>
<td></td>
</tr>
<tr>
<td>Bore No</td>
<td>Bore Type</td>
<td>Depth (m)</td>
<td>Permeability</td>
<td>Condition</td>
<td>Recovery (m)</td>
<td>Formation</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>---------</td>
<td>--------------</td>
<td>-----------</td>
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<td>------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4322</td>
<td>No 4 Bore</td>
<td>10.67</td>
<td>6.4</td>
<td>1.0</td>
<td>5282</td>
<td>Calcrete</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Gap Bore</td>
<td></td>
<td></td>
<td></td>
<td>37/1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4323</td>
<td>No 6 Bore</td>
<td>11.58</td>
<td>8.53</td>
<td>N/R</td>
<td>32218</td>
<td>Red sand clay</td>
<td></td>
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<tr>
<td></td>
<td>Seawater Bore</td>
<td></td>
<td></td>
<td></td>
<td>N/R</td>
<td>Tertiary clays</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4324</td>
<td>No 11 Bore</td>
<td>24.38</td>
<td>23.16</td>
<td>Good</td>
<td>21268</td>
<td>Sandy clay</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N/R</td>
<td>Tertiary sediments - sands, clays</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6712</td>
<td>B.M.R. MD68</td>
<td>216.4</td>
<td>48.78</td>
<td>N/R</td>
<td>1950</td>
<td>Grey dolomite</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N/R</td>
<td>Either Walbiri or Mount Doreen Formation; favour Mt Doreen formation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6713</td>
<td>B.M.R. MD8</td>
<td>220.0</td>
<td>N/R</td>
<td>18.75</td>
<td>6500</td>
<td>Cobble Congl.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N/R</td>
<td>Mount Eclipse sandstone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>N/R</td>
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<td></td>
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<tr>
<td>14779</td>
<td></td>
<td>75.0</td>
<td>31.0</td>
<td>26.0</td>
<td>24540</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.1</td>
<td>N/R</td>
<td>possibly Mount Doreen formation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.0 WATER DEMAND

The water requirement for the proposed community is estimated to be about 30 m³/day L which can be met by a bore capable of a supply of 0.5 L/s.

Water quality is measured against the guidelines of the Australian Water Resources Council/National Health and Medical Research Council, particularly the health-related parameters of nitrate content (less than 45 mg/L) and fluoride content (less than 1.7 mg/L).
7.0 DRILLING RESULTS

Bore RN 15379 was drilled with the intent of intersecting sediments of the Palaeozoic sequence, stratigraphically located between the silty environments of the Mount Doreen Formation (Adelaidean age) and the Mount Eclipse Sandstone (Devonian - Carboniferous age). It was sited within an interpreted/projected zone outlined in BMR Bulletin 212, which was compiled after collation of all available geologic data for the region.

Drilling was terminated at 100 m after striking a saline water supply at 96m. The water supply was tested by air lift to be 1.0 L/s.

Examination of the drill cuttings indicated the drilling penetrated the upper portion of the Mount Doreen Formation below a shallow cover of Cainozoic sediment represented by dune sand, salt, clay and minor gravel. A detailed scrutiny of the cuttings suggests a correlation:

- Newhaven Shale Member (15 - 45 m)
- Wanapi Dolomite Member (45 - 75 m)
- Mount Davenport Diamictite (75 - 100 m)

A composite log of RN 15379 is presented as Figure 4A.

RN 15380 was drilled to test the anticipated sandstone environment overlying the gently north-sloping massive orthoquartzite of the Vaughan Springs Quartzite constituting Castle Hill. This site was selected where ground water recharge is possible down the slope of Castle Hill and through a thin cover of dunal sand.

Drilling was terminated after intersecting a saline water supply, air-lift tested at 0.5 L/s between 11 - 14 m. Below a shallow sand cover the drilling intersected calcrete, clay and white sandstone. The white sandstone is correlated with the Truer Member of the Vaughan Springs Quartzite which is known to carry high contents of evaporitic minerals (gypsum, anhydrite and halite) elsewhere in the Ngalia Basin.

A composite log of RN 15380 is presented in Figure 4B.

Both holes were backfilled; geological logs for both bores are supplied in an Appendix.
8.0 WATER QUALITY

Water samples were collected and field conductivity tests were carried out on-site at the drill location.

Both bores intersected very saline waters which fail to comply with the required standards. Limited chemical analyses of both water samples were carried out by the East Point Laboratory of the Water Resources Branch, Darwin. Results are given in Table 3.

The waters from both bores are considered to be associated with aquifers carrying high contents of evaporite minerals in the original sediments.
<table>
<thead>
<tr>
<th>Analysis (in milligrams per litre - unless otherwise stated)</th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>WATER QUALITY DATA</strong> Table 3</td>
<td></td>
</tr>
<tr>
<td><strong>Bore Registered Number</strong></td>
<td></td>
</tr>
<tr>
<td>Date of Sampling</td>
<td></td>
</tr>
<tr>
<td>Specific Conductance (μS/cm at 25°C)</td>
<td></td>
</tr>
<tr>
<td>Total Dissolved Solids (mg/l by evap. at 180°C)</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td></td>
</tr>
<tr>
<td>Sodium, Na</td>
<td></td>
</tr>
<tr>
<td>Potassium, K</td>
<td></td>
</tr>
<tr>
<td>Calcium, Ca</td>
<td></td>
</tr>
<tr>
<td>Magnesium, Mg</td>
<td></td>
</tr>
<tr>
<td>Total Hardness (as CaCO₃)</td>
<td></td>
</tr>
<tr>
<td>Total Alkalinity (as CaCO₃)</td>
<td></td>
</tr>
<tr>
<td>Iron (Total), Fe</td>
<td></td>
</tr>
<tr>
<td>Silica, SiO₂</td>
<td></td>
</tr>
<tr>
<td>Chloride, Cl</td>
<td></td>
</tr>
<tr>
<td>Sulfate, SO₄</td>
<td></td>
</tr>
<tr>
<td>Nitrate, NO₃</td>
<td></td>
</tr>
<tr>
<td>Bicarbonate, HCO₃</td>
<td></td>
</tr>
<tr>
<td>Fluoride, F</td>
<td></td>
</tr>
<tr>
<td>NaCl (calc from chloride)</td>
<td></td>
</tr>
<tr>
<td>Comments</td>
<td></td>
</tr>
<tr>
<td><strong>Limited Analysis Only</strong></td>
<td></td>
</tr>
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</table>
9.0 CONCLUSIONS

The drilling of RN 15379 and RN 15380 has demonstrated highly saline ground water to be associated with sediments of the Mount Doreen formation and the Vaughan Springs Quartzite respectively.

Information from both bores has assisted in clarifying the sub-surface geology in the southern portion of Ngalia Basin.

Cuttings from RN 15379 suggest the drilling penetrated the upper portion of the Mount Doreen Formation below a shallow cover of Cainozoic sediment. A likely correlation of the geologic log is Newhaven Shale Member (15 - 45 m) Wanapi Dolomite Member (45 - 75 m) and Mount Davenport Diamictite Member (75 - 100 m).

White fine-grained sandstone intersected at the base of RN15380 is correlated with the Truer Member of the Vaughan Springs Quartzite. This unit is known to contain high gypsum, anhydrite and possibly halite elsewhere in the Ngalia basin, and it offers a suitable explanation for the associated highly saline ground water.

The interpreted position and width of the Palaeozoic sediments as presented in B.M.R. Bulletin 212 requires further revision. It is possible that Mount Eclipse Sandstone rests unconformably on Adelaidean sediments of the Mount-Doreen Formation in the region north of Castle Bore.

High gypsum, anhydrite and possibly halite contents within the Truer Member of Vaughan Springs Quartzite and in the Wanapi Dolomite Member of Mount Doreen Formation are likely sources for the high ground water salinities. These high salinity groundwaters spread through the Cainozoic calcrete and broad playa lake environments to the south which flank the limits of the Ngalia Basin.

The pervasive spread of saline waters and associated geologic environments on Newhaven Station offer poor prospects for continued potable ground water search.

Further selection of drill sites in the region is dependent on the geological structural setting and geomorphic aspect to avoid areas of high salinity produced by weathering of the Truer and Wanapi Dolomite Members.
REFERENCES

1. Topographic Map, Mount Doreen Sheet SF52-12, 1:250,000


GEOLOGICAL INTERPRETATION SHOWING SOUTHERN LIMIT OF NGALIA BASIN, PROJECTED FAULT ZONES, PROJECTED ZONE OF PALAEOZOIC SEDIMENTS (AFTER BMR BULL 212)

NEWHAVEN
ABORIGINAL EXCISION
INTERPRETED GEOLOGICAL MAP

Scale 1:250,000 FIGURE 2
2627-23-45
## Depth Bore Graphic

### Construction Log

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Bore Graphic Log</th>
<th>Stratigraphic Description (Water Struck)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>SAND: red/brown medium grained dune sand, minor gravels.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CLAYSTONE: yellow/brown claystone scattered gypsum flakes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SANDY SILT: brown sandy silt with grits of grey/white quartz.</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>CLAYSTONE: light brown claystone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GRAVELS/CLAYSTONE: coarse gravels of grey quartzite with claystone</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>CLAY: yellow brown clay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CLAY/SILTSTONE: brown clay with weathered, brown/grey siltstone.</td>
</tr>
<tr>
<td>30</td>
<td></td>
<td>SILTSTONE: weathered, brown/grey micaceous (biotite) siltstone</td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>CLAYS: light grey limey clays (weathered/ altered dolomitic limestone)</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td>DOLOMITE: weathered, thinly bedded fissile, broken grey dolomite — dolomitic limestone</td>
</tr>
<tr>
<td>60</td>
<td></td>
<td>SILTSTONE: light brown thinly bedded, fissile siltstone</td>
</tr>
<tr>
<td>70</td>
<td></td>
<td>S.W.L: 11m</td>
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</tbody>
</table>

### Composite Log of Bore RN 15379

Newhaven Excision

**FIGURE 4A**

2629-23-47
<table>
<thead>
<tr>
<th>DEPTH (m)</th>
<th>BORE CONSTRUCTION</th>
<th>GRAPHIC LOG</th>
<th>STRATA DESCRIPTION</th>
<th>AQUIFERS (WATER STRUCK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td>SAND: red/brown dune sand overlying pink silt - sandy silt</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>CALCRETE: white/grey and pale pink massive calcrete</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>CLAYSTONE: pale yellow/brown silty claystone</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td>SANDSTONE: white/grey fine grained silty sandstone (weathered Truer Member)</td>
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S.W.L. 9 m

COMPOSITE LOG OF BORE RN 15380

Newhaven Excision

FIGURE 4B
2630-23-48
GEOLOGICAL LOG OF WATER BORE – RN 15379

<table>
<thead>
<tr>
<th>Locality</th>
<th>Newhaven Station, PL 884</th>
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<tr>
<td>Bore Name</td>
<td>R.N. 15379</td>
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<tr>
<td>Tenure</td>
<td>Drilled for A.E.S for Aboriginal Excision</td>
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<tr>
<td>1:250000 Sheet</td>
<td>Mount Doreen SF 52-12</td>
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<td></td>
<td>DATA File: 122.5C</td>
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Grid Reference: 186 176

Summary Log:

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Lithology</th>
<th>Stratigraphic Unit</th>
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</thead>
<tbody>
<tr>
<td>0 - 3</td>
<td>Sand/gravel</td>
<td>Alluvium (Dune Sand)</td>
</tr>
<tr>
<td>3 - 9</td>
<td>Silt, Clay, Gravel</td>
<td>Alluvium</td>
</tr>
<tr>
<td>9 - 30</td>
<td>Claystone</td>
<td>Clays</td>
</tr>
<tr>
<td>30 - 100</td>
<td>Silstone, dolomite</td>
<td>Mount Doreen Formation Puq Proterozoic</td>
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</table>

GEOPHYSICAL LOGS AVAILABLE TO

Major Aquifers

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Yield (L/s)</th>
<th>Approx SML 11.0m</th>
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<tbody>
<tr>
<td>96.0</td>
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</tbody>
</table>

Field conductivity > 10,000µS/cm

Drilling Technique

Percussion – Air drilling to 100 metres using Gorey & Cole Contact Drillers Pty Ltd

Hole Abandoned – Backfilled

Detailed Log

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Lithology</th>
<th>Stratigraphic Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 3</td>
<td>Sand/gravel</td>
<td></td>
</tr>
<tr>
<td>3 - 6</td>
<td>Claystone</td>
<td></td>
</tr>
<tr>
<td>6 - 9</td>
<td>Sandy Silt</td>
<td></td>
</tr>
<tr>
<td>9 - 12</td>
<td>Claystone</td>
<td></td>
</tr>
<tr>
<td>12 - 15</td>
<td>Gravel</td>
<td></td>
</tr>
<tr>
<td>15 - 27</td>
<td>Clay</td>
<td></td>
</tr>
<tr>
<td>27 - 30</td>
<td>Clay/siltstone</td>
<td></td>
</tr>
<tr>
<td>30 - 45</td>
<td>Silstone</td>
<td>Weathered brown/grey micaceous (biotite) siltstone</td>
</tr>
<tr>
<td>45 - 54</td>
<td>Clays</td>
<td>Grey limy clays</td>
</tr>
<tr>
<td>54 - 75</td>
<td>Dolomitic limestone</td>
<td>Weathered, broken/fractured, thinly bedded, dolomitic limestone.</td>
</tr>
<tr>
<td>75 - 100</td>
<td>Silstone</td>
<td>Brown/red finely bedded siltstone</td>
</tr>
</tbody>
</table>

LOGGED BY: K Warne
GEOL O GICAL LOG OF WATER BO RE - EN 15380

Locality
Newhaven Station FL 84

Bore Name
RN15380

Tenure
Drilled for A.E.S. for Aboriginal Excision

Grid Reference:
Mount Doreen SF 52.12

Summary Log:

<table>
<thead>
<tr>
<th>Depth(m)</th>
<th>Lithology</th>
<th>Stratigraphic Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 3</td>
<td>Sand</td>
<td>Alluvium (dune sand) Q5 Quaternary</td>
</tr>
<tr>
<td>3 - 9</td>
<td>Calcrete</td>
<td>Calcrete Q1 Quaternary</td>
</tr>
<tr>
<td>9 - 12</td>
<td>Claystone</td>
<td>Claystone Ts Tertiary</td>
</tr>
<tr>
<td>12 - 15</td>
<td>Sandstone</td>
<td>Truer Member Put Proterozoic of Vaughan Spring Quarzit</td>
</tr>
</tbody>
</table>