DEPARTMENT OF THE NORTHERN TERRITORY
WATER RESOURCES BRANCH

BASIN MANAGEMENT REPORT
PINE GAP

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Alice Springs
February 1976
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1. **INTRODUCTION**

This report looks at the water resources of the Pine Gap area and aims to determine a long-term program to manage these resources.

Pine Gap obtains its water supply from the Mereenie Sandstone, the same aquifer from which Alice Springs draws its water. Ideally the management of this aquifer should encompass not only Pine Gap but the whole area underlain by the Mereenie Sandstone. However at the present time neither the data or staff are available to enable such a wide area to be studied and hence this report will be confined to the area immediately surrounding the Joint Defence Space Research Facility (J.D.S.R.F.) at Pine Gap. However mutual interference of the Pine Gap and Alice Springs bore fields has been considered and evaluated.

2. **HISTORY OF THE WATER SUPPLY**

Investigation drilling to find a water supply for Pine Gap commenced in late 1966, the major objective being to determine sites for production bores in the Mereenie Sandstone. Construction Bore (RN 5758) was drilled in early 1967 and was presumably used as a water supply during the construction of the J.D.S.R.F. complex. The present production bores, Prod. No. 1 (RN 6098) and Prod. No. 2 (RN 5797), were drilled in 1967 and early 1968. The location of all bores in the Pine Gap area can be seen in Fig. 1. Many difficulties were experienced while drilling and operating Prod. Nos. 1 and 2 but all these problems were eventually overcome.

Although the exact date when the production bores commenced operation is not known it appears that Construction Bore started pumping in March 1967. Prod. No. 1 and Prod. No. 2 probably commenced routine pumping in about May 1968.

3. **WATER DEMAND**

A fairly uniform pattern of water usage has developed since the J.D.S.R.F. began operation (see Fig. 2 and Table I). Maximum, minimum and average water consumption are shown in Table II. It can be seen that average annual consumption is about 170 megalitres per month whereas that of Alice Springs is about 5000 megalitres; thirty-five times that of Pine Gap.
### TABLE I

**J.D.S.R.F. WATER USAGE - SEPTEMBER 1970 TO DECEMBER 1975**

**AVERAGE WATER USAGE (kilolitres per week)** *

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>4290</td>
<td>4640</td>
<td>4510</td>
<td>2190</td>
<td>4020</td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>5750</td>
<td>5300</td>
<td>4340</td>
<td>1990</td>
<td>3590</td>
<td></td>
</tr>
<tr>
<td>March</td>
<td>3970</td>
<td>4280</td>
<td>4980</td>
<td>2060</td>
<td>3000</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>3650</td>
<td>3320</td>
<td>4540</td>
<td>1770</td>
<td>3580</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>2780</td>
<td>2940</td>
<td>3290</td>
<td>1520</td>
<td>3270</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>2610</td>
<td>2480</td>
<td>2660</td>
<td>1790</td>
<td>3170</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>1960</td>
<td>2090</td>
<td>2470</td>
<td>1950</td>
<td>2940</td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>2770</td>
<td>2710</td>
<td>1940</td>
<td>1920</td>
<td>2080</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>2460</td>
<td>3640</td>
<td>3080</td>
<td>2430</td>
<td>1760</td>
<td>2640</td>
</tr>
<tr>
<td>October</td>
<td>3200</td>
<td>4030</td>
<td>5070</td>
<td>4030</td>
<td>2070</td>
<td>2620</td>
</tr>
<tr>
<td>November</td>
<td>3970</td>
<td>4970</td>
<td>5270</td>
<td>4480</td>
<td>3940</td>
<td>2930</td>
</tr>
<tr>
<td>December</td>
<td>4040</td>
<td>5030</td>
<td>4370</td>
<td>4080</td>
<td>3710</td>
<td>2800</td>
</tr>
</tbody>
</table>

* Note: Usage is expressed as kilolitres per week to enable more meaningful comparison between months.

### TABLE II

**J.D.S.R.F. WATER DEMAND**

**WATER DEMAND (kilolitres)**

<table>
<thead>
<tr>
<th></th>
<th>Maximum</th>
<th>Minimum</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearly</td>
<td>200000</td>
<td>115000</td>
<td>170000</td>
</tr>
<tr>
<td>Monthly</td>
<td>23000</td>
<td>6700</td>
<td>14300</td>
</tr>
<tr>
<td>Weekly</td>
<td>5100</td>
<td>1800</td>
<td>3300</td>
</tr>
<tr>
<td>Daily</td>
<td>800</td>
<td>170</td>
<td>470</td>
</tr>
</tbody>
</table>

Note: Weekly and daily values were obtained indirectly from monthly values.
4. PRESENT WATER SUPPLY

4.1 Bores and Pumps
Prod. Nos. 1 and 2 are both used to pump water to the Base. Some details of these bores are shown in Table III and Fig. 3. These bores are both controlled automatically by telegraphic equipment coupled to a water-level measuring device on the tank at the Base.

TABLE III
PRODUCTION BORE DATA

<table>
<thead>
<tr>
<th>Name</th>
<th>Prod. No. 1</th>
<th>Prod. No. 2</th>
<th>Construction Bore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Names</td>
<td>Prod. No. 1</td>
<td>Job 380</td>
<td>PG 3 Job 356</td>
</tr>
<tr>
<td></td>
<td>(2nd attempt)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Job 379</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PG 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prod 1A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RN</td>
<td>6098</td>
<td>5797</td>
<td>5758</td>
</tr>
<tr>
<td>Depth (metres)</td>
<td>146</td>
<td>170</td>
<td>183</td>
</tr>
<tr>
<td>Casing (metres)</td>
<td>0 - 128(10\text{\textm})</td>
<td>0 - 94(10\text{\textm})</td>
<td>0 - 114 (6\text{\textm})</td>
</tr>
<tr>
<td>Discharge (litres per second)</td>
<td>19</td>
<td>19</td>
<td>7</td>
</tr>
<tr>
<td>Pump setting (metres)</td>
<td>125</td>
<td>122</td>
<td>Not known</td>
</tr>
</tbody>
</table>

All bores and pumps are enclosed in weather-proof iron or brick sheds and appear to be well maintained and in good condition. The top of the casing in all production bores are sealed.

During summer Prod. Nos. 1 and 2 operate for a combined time of about 70 hours per week which is only about 20 percent of the maximum available time. Winter sees the combined operation time drop to about 20 hours per week. Hence enough water should always be available even if one of the two pumps breaks down.

Construction Bore does not usually pump to the J.D.S.R.F. but is used to maintain the water in an earth tank on Owen Springs station. This bore can be used to pump water to the Base in an emergency although because of the large capacity of the other two bores such a situation would be unlikely.
4.2 Storage
An 800-kilolitre underground tank at the Base should hold enough water to last one or two days, under average conditions. The swimming pool is connected such that its water can be used for emergency fire-fighting purposes.

4.3 Water Treatment
All water on the Base is gas chlorinated before use, the chlorinator being situated in the surface pumping station within the main Base complex. Deionising is carried out on water used for cooling purposes.

5. SURFACE WATER RESOURCES

The J.D.S.R.F. is located near Laura Creek in the Todd River catchment (006). Fig. 4 shows the catchment of Roe Creek at G.S. 006008 which is some 10 kilometres east of Pine Gap. At Pine Gap Laura Creek has a catchment area of about 140 square kilometres.

Some idea of the frequency and size of flows in Laura Creek can be gained by comparison with G.S. 006008 since the catchment appears to be relatively homogeneous. Various methods of hydrologic analysis suggest that the peak discharge of a stream is proportional to the area raised to the 0.7 power, i.e.

\[ q_{\text{peak}} \propto A^{0.7} \]

With Laura and Roe Creeks having catchment areas of 140 and 570 square kilometres respectively this relationship then becomes;

\[ q_{\text{Laura}} = 0.36 q_{\text{Roe}} \]

Using this equation a preliminary rating curve can be constructed for Laura Creek (see Fig. 5). Caution should be exercised in interpreting this curve because (a) the Roe Creek rating curve is based on only about twenty gaugings and is itself not reliable, (b) the equation relating discharge to catchment area has not been substantiated, and (c) a small inaccuracy in the cease-to-flow level could have a significant effect on the rating curve. Nevertheless the relationship shown in Fig. 5 at least gives an indication of the magnitude of flows in Laura Creek.

It is virtually impossible at the present time to state the frequency of flows in Laura Creek but it would seem that a flood with a peak flow of about 60 cubic metres per second would have a return period of about 5 years.
For the Todd River at G.S. 006009 average annual run off coefficient is about 5 percent. Since the catchments of the Todd River and Roe Creek (including Laura Creek) are fairly similar it would seem valid to assume the same run off coefficient. On this basis average annual stream-flow in Roe Creek at G.S. 006008 would be about $7 \times 10^6$ cubic metres and that of Laura Creek near the J.D.S.R.F. would be about $2 \times 10^6$ cubic metres (compared with water usage at the base of 0.2 $x 10^6$ cubic metres per year). See Table IV.

**TABLE IV**

**SURFACE HYDROLOGY NEAR PINE GAP**

<table>
<thead>
<tr>
<th></th>
<th>Laura Creek (near JDSRF)</th>
<th>Roe Creek (at G.S. 006008)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catchment Area (square kilometres)</td>
<td>140</td>
<td>570</td>
</tr>
<tr>
<td>Peak Discharge of 1-in-5-year Flood (cubic metres per second)</td>
<td>60</td>
<td>160</td>
</tr>
<tr>
<td>Average Annual Runoff (cubic metres)</td>
<td>$2 \times 10^6$</td>
<td>$7 \times 10^6$</td>
</tr>
</tbody>
</table>

Before the construction of the vehicular bridge over Roe Creek flooding often caused traffic between Pine Gap and Alice Springs to be stopped. To enable some warning of such disruptions to be made this Branch set up temporary gauge boards on Roe Creek at Simpsons Gap causeway and Honeymoon Gap (both upstream of the Roe Creek crossing) which the J.D.S.R.F. utilised.

6. **GROUNDWATER RESOURCES**

6.1 **Geology**

Pine Gap is located on the northern edge of the Amadeus Basin. The basic geology of the region is shown in Fig. 6.

All production bores for the Base obtain their water from the Mereenie Sandstone which outcrops to the east as far as Roe Creek and about 2 kilometres to the west. Bores drilled in the region of Jay Creek (about 25 kilometres west of Pine Gap) have not uncountered the Mereenie Sandstone and hence it appear to lens out somewhere between Pine Gap and Jay Creek.

It is possible that other formations in the Pine Gap area contain usable supplies of water. These include the Pertnjarra Formation and Pacoota
Sandstone which in other localities have produced dependable supplies of good quality water.

Fig. 7 shows a geological cross section through the area of the production bores which are located almost on a straight line along the strike.

6.2 Aquifer Characteristics
Bores in the Merrenee Sandstone in the vicinity of Pine Gap all produce reasonable supplies of water although less than that obtained in some of the more recent Alice Springs production bores in the vicinity of Roe Creek.

Pumping tests of bores near Pine Gap have given several values of transmissivity. The results of the pumping test of Prod. No. 1 are unfortunately not available; the only results available for Prod. No. 2 indicate a transmissivity of about 2500 square metres per day. Pumping of Construction Bore show it to have a transmissivity of about 450 square metres per day but the observation bore (PG 4, RN 5730) used during this test indicated a transmissivity of about 2000 square metres per day. Hence transmissivities in the vicinity of the bores can range from 450 to 2500 square metres per day.

Analysis of the fall of water level in PG 4 (RN 5730) since pumping commenced indicated a transmissivity of only 11 square metres per day (see appendix).

Table V shows the variation in transmissivity and storage coefficient as determined from pumping tests for individual bores and from long-term water-level monitoring of the aquifer. Both the Pine Gap and Alice Springs production bore-field figures are given for comparison.

**TABLE V**

<table>
<thead>
<tr>
<th>Aquifer Characteristics</th>
<th>Transmissivity (m²/day)</th>
<th>Storage Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine Gap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bores</td>
<td>450-2500</td>
<td>0.002</td>
</tr>
<tr>
<td>Regional</td>
<td>11</td>
<td>0.25</td>
</tr>
<tr>
<td>Merrenee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bores</td>
<td>300-4000</td>
<td>-</td>
</tr>
<tr>
<td>Regional</td>
<td>600</td>
<td>0.011</td>
</tr>
</tbody>
</table>
6.3 Bore Yields

Curves showing the drawdown-yield relationship for Prod. Nos. 1 and 2 Construction Bore are to be found in Figs. 6, 7 and 8.

These curves are not accurate since much of the basic pumping-test data for the bores has been lost or is of a dubious standard. As mentioned previously Prod. Nos. 1 and 2 are pumping at about 19 litres per second while Construction Bore is equipped to produce about 7 litres per second.

TABLE VI

WATER QUALITY

(all concentrations in milligrams per litre except pH and specific conductance).

<table>
<thead>
<tr>
<th>Bore R.N.</th>
<th>Prod. No. 1</th>
<th>Prod. No. 2</th>
<th>Construction Bore</th>
<th>P10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of sampling</td>
<td>6986</td>
<td>5797</td>
<td>5758</td>
<td>6986</td>
</tr>
<tr>
<td>28.11.75</td>
<td>28.11.75</td>
<td>3.5.74</td>
<td>25.11.75</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>7.4</td>
<td>7.4</td>
<td>7.8</td>
<td>7.1</td>
</tr>
<tr>
<td>Specific conductance</td>
<td>1150</td>
<td>1150</td>
<td>1140</td>
<td>740</td>
</tr>
<tr>
<td>(microsiemens/cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total dissolved solids</td>
<td>650</td>
<td>650</td>
<td>630</td>
<td>390</td>
</tr>
<tr>
<td>(by evaporation at 180°C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium chloride</td>
<td>250</td>
<td>242</td>
<td>246</td>
<td>99</td>
</tr>
<tr>
<td>Chloride</td>
<td>152</td>
<td>147</td>
<td>149</td>
<td>60</td>
</tr>
<tr>
<td>Sulphate</td>
<td>78</td>
<td>80</td>
<td>78</td>
<td>46</td>
</tr>
<tr>
<td>Nitrate</td>
<td>9</td>
<td>6</td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>339</td>
<td>342</td>
<td>356</td>
<td>275</td>
</tr>
<tr>
<td>Nitrate</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.5</td>
</tr>
<tr>
<td>Fluoride</td>
<td>278</td>
<td>281</td>
<td>292</td>
<td>226</td>
</tr>
<tr>
<td>Total alkalinity</td>
<td>250</td>
<td>255</td>
<td>265</td>
<td>179</td>
</tr>
<tr>
<td>Total hardness</td>
<td>145</td>
<td>145</td>
<td>140</td>
<td>79</td>
</tr>
<tr>
<td>Sodium</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>Potassium</td>
<td>54</td>
<td>56</td>
<td>60</td>
<td>42</td>
</tr>
<tr>
<td>Total hardness</td>
<td>0.2</td>
<td>0.1</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Iron (total)</td>
<td>20</td>
<td>20</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>Magnesium</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>18</td>
</tr>
</tbody>
</table>
6.4 Water Quality
Water from each of the three producing bores at Pine Gap is classified as being chemically suitable for human consumption. The most recent water analyses are shown in Table VI together with an analysis from P10 (HN 6986), one of the main production bores supplying Alice Springs, which, like the Pine Gap bores, obtains its water from the Nereenie Sandstone.

From Table V and the results of analyses from other bores in the area it appears that there is a gradual deterioration of water quality from Alice Springs to Pine Gap.

There is no evidence of any change in chemical quality of the Pine Gap bores since they were drilled in 1968.

In 1970 concern was expressed about presence of bacteria in water from the production bores. Remedial action, such as sealing of all bores and upgrading of the sewage system, was undertaken and the contamination problem cleared quickly.

6.5 Potentiometric Surface
Of the bores in the Nereenie Sandstone there is less than one metre difference in the original potentiometric surface at Pine Gap and the Alice Springs production bore field near Roe Creek, a horizontal distance of about 10 kilometres. (Refs 1 and 2).

Before pumping from the Pine Gap bores began there was evidence of a fall in potentiometric level from north to south, that is from the Nereenie Sandstone to the Purtunjara (see Fig. 11). This is a similar situation to that existing in the vicinity of the Alice Springs production bore field (Ref. 2). Hence it would appear that the major movement of water would be from north to south.

Water samples from both the Alice Springs and Pine Gap areas have been taken for Carbon-14 age determinations and it is hoped that these will assist in determining the rate and passage of groundwater movement. Preliminary dating indicated the age of the Pine Gap water was about 8000 years and that of the Roe Creek borefield about 1000 years.

6.6 Recharge
No evidence of local recharge into the Nereenie Sandstone has been found which is not surprising because of the fairly large depth (over 100 metres) to the aquifer.
It has been noticed in the past that the water level in observation bores tends to recover during the winter months. This is not a sign of recharge into the aquifer but is a response to the lower pumping rates during the cooler months.

Analysis of pumping from the Town production field near Roe Creek indicates that a large proportion of the water extracted from the Mereenie Sandstone aquifer could be coming from storage and hence the water is not being replenished. It is probable that similar geohydrologic conditions occur near Pine Gap.

6.7 Effects of Pumping

Water levels recorded in investigation bore PG4 (RN 5730) since April 1968 show a reasonably steady and continuous decline of potentiometric surface which is now about 7 metres below the unpumped level (Table VII). Bore PG4 is located about 100 metres east of Prod. No. 1 and 500 metres west of Prod. No. 2 (see Fig. 1). The level of the top of casing in PG 4 is about one metre higher than that of Prod. Nos. 1 and 2.

The fall in water level is however not purely a result of local pumping. Reference 2 (Fig. 47) estimates that pumping for the Alice Springs water supply would (even though the bores are 10 kilometres away) have an effect of about 3 metres at Pine Gap in 1975. Hence before the water level fall at Pine Gap can be analysed the effects of other pumping need to be eliminated. This has been done in Fig. 12 which shows the water level fall after subtracting the effect of the Town bore field. The aquifer in the vicinity of Pine Gap thus has a transmissivity of 11 square metres per day and a storage coefficient of 0.25.

The resultant water-level fall at Pine Gap can then be extrapolated, assuming that the aquifer behaves in accordance with the Jacob approximation, as shown in Fig. 12. At this stage the effects of pumping the Town field need to be reintroduced to allow prediction of the Pine Gap water levels. The value of the drawdown caused by the Town bore field has been estimated from Ref. 2 and assumes that the recommendations of that report are implemented; that is that pumping of the Town bore field be held constant at the 1983/84 value of about 1200 megalitres per annum. Based on this assumption by 1990
the additional drawdown at Pine Gap caused by pumping of the Town field will be about 12 metres and this value will remain constant after 1990; this allows several years for the full effects to be felt at Pine Gap.

TABLE VII
WATER LEVEL PG4 RN 5730
Highest water level in month (metres from top of casing).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>106.48</td>
<td>107.59</td>
<td>110.01</td>
<td>112.72</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>114.09</td>
</tr>
<tr>
<td>Feb</td>
<td>107.63</td>
<td>110.27</td>
<td></td>
<td>112.77</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar</td>
<td>107.66</td>
<td>110.27</td>
<td>110.76</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>108.13</td>
<td>106.69</td>
<td>109.01</td>
<td>112.78</td>
<td>111.10</td>
<td></td>
<td></td>
<td></td>
<td>112.78</td>
</tr>
<tr>
<td>May</td>
<td>106.89</td>
<td></td>
<td>109.07</td>
<td></td>
<td>112.78</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun</td>
<td>106.49</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>112.78</td>
</tr>
<tr>
<td>Jul</td>
<td></td>
<td>106.60</td>
<td>109.03</td>
<td></td>
<td></td>
<td>112.78</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug</td>
<td>106.95</td>
<td></td>
<td>110.64</td>
<td>111.23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep</td>
<td></td>
<td>107.24</td>
<td></td>
<td></td>
<td>111.80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct</td>
<td>106.37</td>
<td>109.56</td>
<td>110.94</td>
<td></td>
<td></td>
<td>112.90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov</td>
<td></td>
<td>109.66</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Dec</td>
<td>107.16</td>
<td>109.91</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>112.56</td>
</tr>
</tbody>
</table>

6.8 Predicted Aquifer Behaviour

To be able to predict the life of a bore in an area of declining water level it is necessary to know not only the regional fall in water level but also the drawdowns which could be expected each time the pumps are operated.

Considering that water usage at Pine Gap is only a small proportion of the total bore capacity it would seem reasonable to assume that no bore would operate continuously for a period greater than one day. Hence the drawdown after one day has been taken as the maximum that would occur each time the pumps are started.

Table VIII shows the expected life of the three producing bores at Pine Gap under two set of circumstances; firstly when the pumps remain at their present settings and secondly when the pumps are lowered to their maximum level. This maximum level is determined by the construction of the bore (Fig. 3) and dimensions of the pump. The maximum pumps settings given in Table VIII are subject to the dimensions and capacity of the individual pumps.
TABLE VIII
EXPECTED LIFE OF PINE GAP BORES

<table>
<thead>
<tr>
<th>Name RN</th>
<th>Prod. 1</th>
<th>Prod. 2</th>
<th>Construction Bore</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6098</td>
<td>5797</td>
<td>5758</td>
</tr>
<tr>
<td>Present water level (m)</td>
<td>113</td>
<td>113</td>
<td>113</td>
</tr>
<tr>
<td>Present discharge (l/sec)</td>
<td>19</td>
<td>19</td>
<td>7</td>
</tr>
<tr>
<td>One-day drawdown (m)</td>
<td>7</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Present pump setting (m)</td>
<td>125</td>
<td>122</td>
<td>Not known</td>
</tr>
<tr>
<td>Present maximum allowable water level (m)</td>
<td>118</td>
<td>120</td>
<td>-</td>
</tr>
<tr>
<td>Life expectancy at present setting</td>
<td>1980</td>
<td>1982</td>
<td>-</td>
</tr>
<tr>
<td>Maximum pump setting (m)</td>
<td>128</td>
<td>134</td>
<td>163</td>
</tr>
<tr>
<td>Life expectancy at maximum setting</td>
<td>1983</td>
<td>2000+</td>
<td>2000+</td>
</tr>
</tbody>
</table>

From Table VIII it can be seen that at its present setting the pump in Prod. No. 1 will fail in 1980 and even if lowered to its maximum level it will only last an additional three years. In Prod. No. 2 the pump would fail about 1982 but lowering it should avoid any possibility of failure within the foreseeable future. Although the present pump setting in Construction Bore is not known there is adequate drawdown available if necessary.

Lowering of the pumps to their maximum levels will, in the case of Prod. No. 2 and Construction Bore, involve having the pump inlet below the casing; however as this is already the case in these two bores no difficulties are anticipated.

7. PRESENT BASIN MANAGEMENT PRACTICES

7.1 Rainfall
A daily-read raingauge (for which a summary record is shown in Table IX) is kept at the J.D.S.R.F. Locations of other raingauges in the area are shown in Fig. 4.


**TABLE IX**

**PINE GAP RAINFALL**

Rainfall at J.D.S.R.F. in millimetres.

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>1.2</td>
<td>20.4</td>
<td>49.8</td>
<td>415.1</td>
<td>12.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>February</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>March</td>
<td>29.8</td>
<td>219.2</td>
<td>2.2</td>
<td>50.0</td>
<td>59.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>14.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>8.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>9.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>12.8</td>
<td>10.4</td>
<td>77.8</td>
<td>47.6</td>
<td>31.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>15.2</td>
<td>0.8</td>
<td>5.6</td>
<td>11.6</td>
<td>61.0</td>
<td>60.6</td>
<td></td>
</tr>
<tr>
<td>October</td>
<td>4.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>25.2</td>
<td>32.6</td>
<td>19.0</td>
<td>90.4</td>
<td>9.2</td>
<td>72.2</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>79.2</td>
<td>32.6</td>
<td>0.6</td>
<td>91.2</td>
<td>39.0</td>
<td>163.4</td>
<td></td>
</tr>
</tbody>
</table>

7.2 **Streamflow**

As mentioned previously GS 006008, which has been in operation since March 1967, is located on Roe Creek about 10 kilometres east of Pine Gap. Some gaugings of this stream have been made and a preliminary rating curve is available. Water Resources Branch are presently undertaking tests of a hydraulic model of Roe Creek near GS 006008 which may enable a more accurate rating curve to be compiled.

7.3 **Groundwater levels**

Measurements of water level in investigation bore PG4 (RN 5730) have been taken since April 1968 (see Table VII) when an automatic recorder was installed on the bore. Unfortunately the output of this recorder cannot be assumed to be correct because of lack of control in setting and maintaining the instrument; that is the standing water level in the bore and the punch-out of the recorder do not always agree and it is not known which, if either, is correct.

In June 1974 the recorder was removed with the intention being to manually measure the water level at monthly intervals. For unknown reasons this was never carried out with the result that no records are available for the period June 1974 to January 1976 when manual measurements were commenced; the readings are presently being taken at weekly intervals by Mr Burns of the J.D.S.R.F. who will forward the records to Water Resources Branch. Such current measurements
are taken early each Wednesday, before the pumps commence operation, and hence should indicate the non-pumping water level in bore PG 4; it has been noted during the past that the drawdown in PG 4 as a result of pumping the production bores is about 0.5 metres.

7.4 Water Usage

Both Prod No 1 and Prod No 2 are equipped with water metres reading in U.S. gallons. These metres are read each week by staff at the J.D.S.R.F. Monthly water usage at the Base since September 1970, the earliest date from which accurate statistics have been retained, are shown in Table II. It should be noted that the figure given by the J.D.S.R.F. as a monthly total is in fact the sum of the weekly readings for that month and includes the water usage for either four or five complete weeks. The values shown in Table II and Fig. 2 have been corrected and, for ease of comparison, have been presented as average volume per week.

8. Future Development of Water Resources

Average annual discharge in Laura Creek is estimated to be about ten times annual water usage (see Section 5) and hence it would be possible for the J.D.S.R.F. to obtain its water supply from streamflow. However it has generally been accepted that, in the southern part of the Northern Territory, groundwater is a better source.

It would thus appear that in the future bores are going to form the basis of the water supply for Pine Gap. But it should be kept in mind that surface water may be a practical proposition, providing a site for a dam is available, if it is necessary.

As mentioned in Section 1.7 the fall in water level will necessitate the lowering, over the next few years, of the pumps in the production bores. It would seem that because of pump and bore dimensions Prod No 1 will probably be unusable after about 1983.

Assuming that a replacement bore will be required it would probably be best to site such a bore close to Prod No 1 (say 10 metres away). Casing (10-inch diameter) should be run to at least 135 metres so that the pump will always be operating within the casing. Should the need arise it may be necessary to perforate some of the casing below water level. However if the bore is deep enough (say 180 to 200 metres) this should not be necessary since sufficient aquifer will have been penetrated below the bottom of the casing to enable efficient extraction of water.
The replacement bore should be all that is required for the foreseeable future since water consumption is only a small proportion of possible bore yield.

9. FUTURE MONITORING OF THE BASIN

Generally the present system of measuring and recording information on the operation of the water supply appear to be adequate.

9.1 Rainfall

The current system to be continued; that is the standard raingauge at the J.D.S.R.F. and other stations to be maintained.

9.2 Streamflow

GS 006008 on Roe Creek should be sufficient for any foreseeable application. If any more detailed information is required for Laura Creek much of it could be obtained by transposition of data from GS 006008.

9.3 Groundwater levels

It has been arranged for the water level in PG 4 to be measured at weekly intervals by personnel from the J.D.S.R.F., who will also measure, every three months, the water levels in PG 1 (R.N. 5731) and PG 5 (R.N. 5798). Such measurements will enable not only the drawdown in the area to be known but also the development of the cone of depression.

At present it is not possible to measure water levels in the production bores. It would be advisable that airlines be attached to the pumps when they are next removed from the bores so that routine measurements of water level can be commenced. Such airlines should be set with their outlet 0.10 metres above the column-pump coupling and their depth from the surface should be accurately determined.

9.4 Water Usage

Weekly readings of water meters are taken by J.D.S.R.F. personnel and are available if required.

9.5 Water Quality

Samples for chemical analysis should be taken by Water Resources Branch at approximately six-monthly intervals.
10. SUMMARY AND CONCLUSIONS

10.1 Pine Gap obtains its water supply from bores in the Mereenie Sandstone.

10.2 In the vicinity of Pine Gap the Mereenie Sandstone is not as efficient an aquifer as it is near the Town production bores at Roe Creek.

10.3 Three bores are equipped at Pine Gap. The two production bores (Prod No 1 and Prod No 2) normally used to supply water to the J.D.S.R.F. are only used for approximately 20 percent of the time; hence the water supply is more than adequate for present and future demand. Construction Bore is normally used only to supply water to a dam on Owen Springs station.

10.4 Quality of groundwater at Pine Gap is slightly poorer than that in the same aquifer further to the east but is still well within the standards as set out by the World Health Organisation.

10.5 Potentiometric gradients in the Pine Gap area are slight but indicate water moving from north to south.

10.6 Water level in the Pine Gap bores has fallen by about seven metres since pumping commenced in 1968. Approximately three metres of this drawdown would have come about as a result of large-scale pumping from the Alice Springs production bores near Roe Creek.

10.7 Analysis has indicated that by 1995 standing water level in the Pine Gap production bores will be in the vicinity of 126 metres; about 20 metres below the original (1968) level.

10.8 This fall in water level will require the pumps in the bores being lowered below their present settings.

10.9 It may be necessary to drill a replacement bore for Prod No 1 before 1983.

10.10 Laura Creek, where it passes the J.D.S.R.F., has an average annual flow of about 2 million cubic metres, or about ten times current water usage.
RECOMMENDATIONS

11.1 Weekly water-level measurements be continued to be taken in bore PG 4 by J.D.S.R.F. personnel and passed onto Water Resources Branch at six to eight week periods. Water levels in PG 1 and PG 5 should be measured every three months.

11.2 Production bores be equipped with airlines when pumps are removed from bores.

11.3 Chemical and bacteriological water samples should be taken from the production bores at six-monthly intervals by Water Resources Branch.

11.4 If a replacement bore for Prod No 1 is required it should be drilled close to Prod No 1 and cased below any anticipated pump setting.

11.5 The present system of operating Prod No 1 and Prod No 2 in rotation should be continued.

11.6 The water resources of the Pine Gap region should be reassessed in 1978 by which time more data should have become available.
REFERENCES


GEOHYDROLOGIC ANALYSIS

Long-term water-level records are available for bore PG 4 (R.N. 5730) at Pine Gap. This observation bore is located between Prod No 1 and Prod No 2; distance to Prod No 1 is about 100 metres and to Prod No 2 about 500 metres.

Both Prod No 1 and Prod No 2 are pumping approximately the same amount of water from the aquifer (i.e. about 85 megalitres per year each). Construction Bore, because it is only pumping at a low rate for short periods, would have very little effect on observation bore PG 4 and hence can be neglected in any drawdown analysis.

Let the pumping rate from each of the production bores be "Q" (this is the average rate over a relatively long period such that the effect of intermittent pumping has been damped out).

The general drawdown equation for each bore at time "t" can be written:

\[
s = \frac{2.30 Q}{4 \Pi T} \log \left( \frac{2.25 T}{S r^2} \right)
\]

where  \( T \) = aquifer transmissivity
where  \( S \) = aquifer storage coefficient
where  \( r \) = distance from pumped bore
where  \( s \) = drawdown after time "t"

Hence the drawdown in PG 4 can be described thus:

\[
s = \frac{2.30 Q}{4 \Pi T} \left( \log \left( \frac{2.25 T}{S r_1^2} \right) + \log \left( \frac{2.25 T}{S r_2^2} \right) \right)
\]

where  \( r_1 \) = distance to Prod No 1
where  \( r_2 \) = distance to Prod No 2

\( Q \) = discharge from Prod No 1 = discharge from Prod No 2

If the effects on PG 4 of both production bores are equated to that of a single bore a solution to the above time-drawdown equation is possible.
The discharge from this imaginary bore would be $2q$ (i.e. the combined discharge of Prod Nos 1 and 2) and its distance to PG4 would be $r_3$ where:

$$r_3 = \sqrt{r_1 \times r_2}$$

In the case under consideration:

\[
\begin{align*}
  r_1 &= 100 \text{ metres} \\
  r_2 &= 500 \text{ metres} \\
  \text{therefore } r_3 &= 220 \text{ metres}
\end{align*}
\]

Hence the drawdown measured in PG 4 can be related to that caused by an imaginary bore at a distance of 200 metres pumping at a rate of 170 megalitres per year (see Table II).

This above method of analysis has been applied in Fig. 12.
BORE CONSTRUCTION - PINE GAP

PROD. No. 1  R.N. 6098

Interval (m)  Description

0 - 111  10\% inch & blank casing

111 - 126  10\% inch & casing with 6 inch perforations

128 - 135  Open hole reduces from 9 to 6 inch &

135 - 137  Open hole reduces from 6\% to 7\% inch &

137 - 143  Open hole reduces from 7\% to 7 inch &

143 - 144  Open hole reduces from 7 to 6\% inch &

PROD. No. 2  R.N. 5797

Interval (m)  Description

0 - 53  10\% inch & blank casing

53 - 94  10\% inch blank casing with cement behind

94 - 107  5 inch & hole with 9\% inch & cemented annulus

107 - 134  Open hole: 9 inch &

134 - 148  Open hole: 6\% inch &

148 - 170  Open hole reduces from 6\% inch to 5\% inch

CONSTRUCTION BORE  R.N. 5758

Interval (m)  Description

0 - 111  6 inch & blank casing

111 - 183  Open hole: 5\% inch &
FROM: G. Ride  "Geohydrological results of preliminary Pine Gap Investigation 1967"  
WRB. Report No. R4
These curves are based on several short-term pumping tests of dubious accuracy, and hence the curves should be regarded as approximate only.
These curves are based on several short-term pumping tests of dubious accuracy and hence the curves should be regarded as approximate only.
These curves are based on pumping tests of dubious accuracy and hence the data should be regarded as approximate only.
### R.N. | NAME
---|---
5715 | P.G. 2 JOB 355
5730 | P.G. 4 JOB 377 Recorder hole
5731 | P.G. 1 JOB 354
5758 | P.G. 3 JOB 356 Recorder hole (known as construction bore)
5759 | P.G. 3A JOB 356
5796 | JOB 379 PROD. No.1 1st attempt (abandoned)
5797 | JOB 380 PROD. No.2 Pine Gap
5798 | P.G. 5 JOB 378
6098 | JOB 379 PROD. No.1 2nd attempt also known as P.G. 6 and PROD. No. 1A now referred to as PROD. No. 1

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**NOTES**

1. Grid Lines refer to Mereenie 1000 ft. grid
2. Bore locations are approximate only

**SCALE** 1:5000

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**DEPARTMENT OF THE NORTHERN TERRITORY**

**WATER RESOURCES BRANCH**

**PINE GAP**

**POTENTIOMETRIC CONTOURS**

**1967**

**Fig. 11**

**DRAWING NO.** 1322 - 5 - 27