POWER AND WATER AUTHORITY

HORTICULTURAL WATER SUPPLY
INVESTIGATION

TENNANT CREEK AREA
NORTHERN TERRITORY

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SUMMARY

The investigation area of 71,000 square kilometres centred on Tennant Creek comprises a central strip of basement ranges (the Tennant Creek Block) and portions of major sedimentary basins to the east and west (the Georgina and Wiso Basins, respectively). Only the basins are likely to yield adequate groundwater supplies for large horticultural projects. They contain potentially high-yielding limestone and sandstone aquifers of Cambrian age.

Based on information from existing bores, six areas have been identified as having wide extent of low-salinity groundwater and the potential to produce adequate quantities of groundwater. Four are in the Georgina Basin and two are in the Wiso Basin. The area selected as having the best prospects lies on Helen Springs station in the north-central part of the investigation area. It is near the western margin of the Georgina Basin. The soil type is Black Soil.

In the preferred area the aquifers are within the Gum Ridge Formation and/or the Anthony Lagoon Beds. These are indicated to contain groundwater of 400 to 700 milligrams per litre Total Dissolved Solids, at least locally, and low Sodium Adsorption Ratios. They extend to more than 120 metres depth and have water levels of 50 to 60 metres below ground surface.

Drilling and test-pumping will be required if the yields of the aquifers and the persistence of low-salinity groundwater are to be determined. This will extend the information from stock bores by penetrating deeper into the aquifers.
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1. INTRODUCTION

This study assesses potential areas for obtaining irrigation water supplies for horticultural projects in an area bounded by latitudes 18° and 20° 30' South, and longitudes 133° and 135° 30' East. The area includes the Tennant Creek and Helen Springs 1:250 000 map sheets, and portions of the South Lake Woods, Brunette Downs, Green Swamp Well, Alroy, Lander River, Bonney Well and Frew River 1:250 000 sheet areas.

Tennant Creek is a major regional centre, situated approximately at the centre of the study area. Gold mining and cattle raising are the main industries in the region.

The Stuart Highway runs approximately north-south through the study area from Darwin, 955 km north-north-west of Tennant Creek, to Alice Springs, 504 km to the south. The Barkly Highway runs east from the Stuart Highway about 25 km north of Tennant Creek.

The study was carried out by Rockwater personnel in the Darwin and Alice Springs offices of the Power and Water Authority (PAWA), where relevant bore data and reports were collated and assessed. Geological information was obtained from the Mines Department of the Northern Territory, and information on soil types was collected from the Conservation Commission. Air photographs and a satellite image of the main areas of interest were examined and interpreted. Areas with prospects for groundwater development were inspected in the field.

The study commenced in October 1989 and was completed in December 1989. This report presents the results of the study, including a hydrogeological map which shows prospective areas for horticultural projects, ranked according to groundwater prospects and ease of access. A programme for detailed investigation of the groundwater resources in the most prospective area is included.

1.1 PREVIOUS STUDIES

The study area covers two 1:250,000 scale geological maps and parts of seven others (figure 1). The Explanatory Notes to these maps include brief descriptions of groundwater resources.

A number of groundwater exploration and development programmes have been undertaken by Northern Territory Government departments. The results of these programmes, including the geology and hydrogeology of the existing borefields (Kelly Well, Kelly Well West and Cabbage Gum) and of the Tennant Creek West groundwater prospect, have been summarised by Verhoeven and Knott (1979) and Verhoeven and Russell (1980).

The Gosse River Floodout was investigated as a potential groundwater source for Tennant Creek town water supplies (Verhoeven, 1976).

A synthesis of the geology of the Wiso Basin by Kennewell and Hueleatt (1980) summarises the available groundwater resources information. Groundwater yield and salinity were tested in stratigraphic holes drilled for the study.

Randal (1967) presents the results of a survey of water bore records and a summary of hydrogeology and hydrochemistry for the Barkly Tableland area.
2. PHYSICAL ENVIRONMENT

2.1 TOPOGRAPHY

The topography of the sheet area is dominated by the central ranges formed by Proterozoic basement rocks. The ranges include the Ashburton Range in the north, the central Whittington and McDouall Ranges, and the southern Murchison Range. Elevations are highest near the southern end of the Murchison Range (maximum 555 m AHD) and generally decrease to the north-north-west to a maximum of 315 m AHD at Mt Grayling in the Ashburton Range.

The ranges are flanked by plains of low relief; these are underlain by the Wiso Basin to the west and the Georgina Basin to the east. On the western side, the plains decrease in elevation from about 300 m in the south to 195 m (AHD) in the north (near Lake Woods). East of the ranges, the Barkly Tablelands range in elevation from 270 m in the south to 220 m AHD in the north.

2.2 PHYSIOGRAPHY

The physiography of the study area is closely related to underlying rock types and structure. The central ranges contain strike ridges, mesas and buttes. Quartz veins form sharp ridges, whereas the granites form tors. Drainages arising in the ranges are all ephemeral and terminate in floodouts on the adjacent sand plains. The largest of the drainage systems are the westerly-flowing Bonney and Tomkinson Creeks, and the north-easterly flowing Gosse River. The northerly-flowing Hanson River discharges into sand plains near the south-western corner of the study area. The catchment areas for the larger drainages are shown on the hydrogeological map.

Sand plains extend over large areas of the sheet, especially adjacent to the ranges. They support spinifex, scrub, and low trees. Parallel and sub-parallel sand dunes with a west-north-westerly orientation cover the south-western part of the study area. Spinifex has largely stabilised the dunes. Black soil plains ("Downs Country") have developed to east of the sand plains that flank the central ranges. They are generally developed on carbonate rocks. Outcrops of Tertiary to Cambrian sediments usually form small rubbly mounds that may be capped by laterite. Drainage in the Downs Country is well-developed and dendritic. Water courses are widely spaced due to the low runoff, and are ephemeral. They drain into closed basins such as Tarrabool Lake in the north-eastern corner of the study area.

2.3 VEGETATION

Vegetation types largely reflect the sub-tropical and arid climate. They consist of mainly grasses, with scattered trees and shrubs.

Spinifex (Triodia pungens) is the dominant grass type, especially on sand plains, although Mitchell Grass predominates on the black soil plains. Various Eucalyptus species including snappy gum (Eucalyptus brevifolia) and ghost gums (E. papuana), and Acacias including mulga (Acacia aneura) and turpentine (Acacia lysiophiia) grow on rocky slopes in the central part of study area. River red gums (E. camaldulensis) are found along the water courses and around water holes.

2.4 CLIMATE

The study area lies within the border zone between two climatic zones recognized by the Bureau of Meteorology. The northern zone is characterized by a summer 'wet season' of heavy periodic rains and generally high temperatures. Usually there is low rainfall during the winter, with mild to warm temperatures. The southern zone is characterized by low summer rainfall with high to extreme temperatures. In winter there is irregular rainfall with mild to warm temperatures.

2.4.1 Rainfall
The bulk of the rainfall is associated with the north-west monsoons, and thunder storms that precede and follow the wet season. Rainfall is mostly on several successive days interspersed with longer periods of dry weather.

<table>
<thead>
<tr>
<th>STATION</th>
<th>YEARS OF RECORD</th>
<th>MEAN ANNUAL AVERAGE</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
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<th>JUL</th>
<th>AUG</th>
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<td>431</td>
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<td>13</td>
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<td>7</td>
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<td>3</td>
<td>12</td>
<td>19</td>
<td>38</td>
<td>59</td>
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</tbody>
</table>

The mean annual rainfall from the recording stations in the study area is summarized in Table 1.

The mean annual rainfall for Tennant Creek is 446 mm; on average, 370 mm (83 per cent) of this falls between November and March.

The variability of the annual rainfall is important in assessing the viability of horticultural projects. Table 2 presents a break-down of rainfall distribution. It highlights the fact that rainfall is variable. There may be no rainfall in the months May to October, or conversely they can be quite wet.

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Mean Monthly (mm) | 104 | 105 | 64  | 16  | 8   | 8   | 8   | 3   | 11  | 22  | 33  | 63  |
| Rain Days       | 10  | 9   | 7   | 2   | 2   | 2   | 1   | 1   | 2   | 4   | 6   | 7   |
| High Monthly (mm) | 280 | 340 | 190 | 85  | 51  | 85  | 74  | 16  | 56  | 75  | 111 | 216 |
| Low Monthly (mm) | 2   | 1   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 2   | 2   | 2   |
| High 24-hour (mm) | 138 | 108 | 89  | 85  | 23  | 46  | 62  | 9   | 30  | 52  | 42  | 88  |
2.4.2 Evaporation
Pan evaporation has been measured at the Tennant Creek meteorological station since July 1969. Monthly average rates range from 232 mm in June to 441 mm in December.

The average annual pan evaporation is 4142 mm.

2.4.3 Temperature
Temperature data are only available for the Tennant Creek station. Mean daily maximum temperatures range from 24.2 degrees Celsius in July to 37.6 degrees Celsius in December. The mean daily minimum temperature is 11.8 degrees Celsius in July and 24.8 degrees Celsius in December and January. The lowest minimum temperature of 4.5 degrees Celsius indicates that frosts can occur in the study area. Temperature data are presented in Table 3.

<table>
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<tr>
<th>JAN</th>
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<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
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<td>15.1</td>
<td>16.1</td>
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<td>31.4</td>
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<td>20.9</td>
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<td>6.7</td>
<td>7.4</td>
<td>11.6</td>
<td>10.7</td>
</tr>
</tbody>
</table>
3. SOILS

There is a wide variety of soil types in the study area. The soils reflect lithology of underlying rocks as well as weathering processes and transportation of material by wind and water. They range from skeletal soils between outcrops of crystalline rock to heavy black soil.

Classification of the soils of the Barkly Tableland in the Northern Territory and Queensland was conducted in 1974 and 1984 by the CSIRO (Christian et al, 1954). A subsequent survey was undertaken in 1966-67.

3.1 SOIL TYPES
The soils in the study area can be divided into four general types, and these are described below. A soil map is presented as Figure 2.

3.1.1 Skeletal Soils
Skeletal sand soils have developed between outcrops of metamorphic rocks in the central ranges (Tennant Creek Block). They are predominantly thin layers of coherent sand, and gravel with a sandy matrix.

3.1.2 Laterite Soils
Laterite soils, or ironstone gravels with a red earth matrix, cover most of the south-eastern part of the study area; they occur to the south of the Barkly Highway and extend to the north as far as Rockhampton Downs homestead (Figure 2). They include red, gravelly, lateritic soils on slopes and rises, and red-brown alluvial soils in the shallow depressions.

3.1.3 Black Soils
Black soils have developed on the Barkly Tableland in the north-eastern part of the study area. They are deep, dark grey, clayey soils of heavy texture that crack when dry, and have formed on carbonate rocks or basalts. They are moderately to weakly leached, and include residual carbonate horizons.

3.1.4 Sand Soils
Sand soils of minimal development surface the Wiso Basin in the western part of the study area, and occur on the eastern side of the Tennant Creek Block. They are several metres thick, and consist of fine to coarse-grained, moderately sorted quartz sand. Staining from iron-oxides has resulted in a red-brown colour.
Figure 2 DISTRIBUTION OF SOILS (GENERALISED)
4. GEOLOGY

4.1 GEOLOGICAL SETTING
The study area covers a large part of the Lower Proterozoic Tennant Creek Block, as well as the eastern edge of the Palaeozoic Wiso Basin and the western edge of the Palaeozoic Georgina Basin (Figure 1).

The lower Proterozoic rocks form the basement of the area. They strike in a north-north-westerly direction and comprise mainly metamorphosed and moderately deformed clastic sediments of marine origin.

Tholeiitic basalts were deposited during the Lower Cambrian, and occur locally at the base of the Palaeozoic basins, and at the northern end of the Tennant Creek Block. The basins contain shallow water marine and continental facies.

There are significant thicknesses of Mesozoic and Cainozoic sediments of lacustrine and fluvial origin on the flanks of the Tennant Creek Block.

The stratigraphy of the Proterozoic basement rocks, and sediments in the Wiso and Georgina Basins is shown in Figure 3. Formations and rock types in each of the three main structural areas are described below. They are based on descriptions from the explanatory notes for the several 1:250,000 geological sheets by Dodson and Gardener (1978), Kennewell (1977 and 1978), Kennewell and Huleatt (1980), Kennewell and Offe (1979), Randal (1966a and 1966b) Randal and Brown (1969), Verhoeven and Knott (1979), Walley (1987), and Wyche and Symons (1987).

4.2 TENNANT CREEK BLOCK

4.2.1 Stratigraphy
The Warramunga Group crops out sparsely in the central and southern parts of the Tennant Creek 1:250,000 map sheet area. It consists of mainly siltstone, greywacke and shale, metamorphosed to lower greenschist facies.

The Tomkinson Creek Beds consist mainly of sandstone and siltstone, and form the northern part of the Tennant Creek Block.

The Hatches Creek Group crops out in the southern part of the study area, where it overlies the Warramunga Group. It consists of a sequence of shallow marine to fluvial sedimentary rocks, and subaerial to subaqueous volcanic rocks.

Proterozoic granite intrudes the Warramunga Group in the north-eastern part of the Bonney Well and southern part of the Tennant Creek map sheet areas. Outcrops range from small, isolated tors to low hills of weathered granite.

Geophysical survey results indicate that the granites are extensive beneath the superficial sediments.

4.2.2 Structure
The Tomkinson Creek Beds and the Hatches Creek Beds overlie the Warramunga Group with angular unconformity.

The Warramunga Group is moderately to tightly folded with complex folds, and the folds extend into the overlying Tomkinson Creek Beds. The group is faulted with the major faults trending north-west and believed to predate the main phase of folding.
Four structurally distinct blocks are recognised in the Tomkinson Creek Beds with northerly and north-westerly trending boundary faults. Folds and faults within the blocks also trend in these directions. The southern block extends into the Wiso Basin as a basement high.

The major structural feature of the Hatches Creek Group are large scale west-north-westerly to north-westerly trending folds that are many kilometres long and several kilometres across. Most faulting probably occurred during the folding, with large displacement faults generally parallel to the strike.

4.3 GEORGINA BASIN

4.3.1 Stratigraphy

**Helen Springs Volcanics**  
Lower Cambrian Age  
The Helen Springs Volcanics are mainly massive, coarse-grained basalt which occurs in some areas at the base of the Georgina Basin. They have been correlated with the Antrim Plateau Volcanics which occur at the base of the Ord, Daly River and Wiso Basins.

**Gum Ridge Formation**  
Early Middle Cambrian Age  
The Gum Ridge Formation lies with angular unconformity on the Helen Springs Volcanics and Proterozoic rocks of the Tennant Creek Block. It consists of siliceous siltstone, chert, silified sandy limestone, calcareous sandstone, and fine-grained sandstone. Water bores in the formation in the south-eastern corner of the study area (Frew River map sheet) intersected silty dolomite, limestone and chert.

The formation crops out discontinuously over extensive areas in the eastern part of the Tennant Creek map sheet area, and along the eastern edge of the Tennant Creek Block in the Helen Springs map sheet area. In outcrop the rocks are silicified shale, sandstone, limestone and chert.

Holes drilled in the Gosse River floodout during the P.A.W.A water supply investigation intersected strata of the Gum Ridge Formation: mainly clastic rocks to about 50 m depth, overlying grey dolomite and silicified limestone to depths of up to 150 metres. They bottomed in Warramunga Group basement rocks.

**Anthony Lagoon Beds**  
Middle Cambrian Age  
The Anthony Lagoon Beds consist of sandstone, dolomitic siltstone and limestone. They crop out in the Helen Springs and the western part of the Brunette Downs map sheet areas, and occupy the same stratigraphic position as the Gum Creek Formation to the west. Middle Cambrian rocks mapped as the Wonarah Beds on the Alroy map sheet area (Randal, 1966) are probably also equivalent to the Anthony Lagoon Beds.

Drillers' logs for bores in the study area on the Helen Springs, Brunette Downs and Alroy sheets indicate that the proportion of clastic sediments to chemical sediments in the formation decreases to the east. For example, west of Brunchilly Station homestead, the formation is described as interbedded sandstone, siltstone, and limestone, whereas to the east it is mainly interbedded limestone and clay.

In the eastern part of the study area on the Alroy map sheet, the Frewena No. 1 oil-well intersected dolomite and red shale of the Anthony Lagoon Beds to 312 metres depth, (Shergold and Druce, 1980.)

**Mullaman Beds**  
Lower Cretaceous Age  
The Mullaman Beds form an extensive cover in the northern part of the Georgina Basin. They thin to the south, and only just extend into the study area in the northern parts of the Helen Springs and Brunette Downs sheet areas. The unit comprises non-marine sandstone and other sediments, and an upper marine siltstone and claystone.
Rocks of this formation outcropping in the study area are mainly basal units, consisting of non-marine quartz sandstone.

**Superficial Deposits**

**Cainozoic Age**

The Brunette Limestone, of probable Miocene age, consists of nodular limestone deposited as a thin layer on Mesozoic and Palaeozoic rocks. It crops out in the northern half of the study area, and is up to 5 m thick on the Helen Springs map sheet area. It increases in thickness to the north, and to the east on the Brunette Downs sheet area.

Thick deposits of unconsolidated alluvium and colluvium occur on the flanks of the Tennant Creek Block. Water bores on Epinara Station in the south-eastern corner of the study area intersected up to 20 metres of these deposits. Three holes in the Gosse River floodout that were logged by P.A.W.A. geologists, intersected 10 to 20 metres of alluvium and gravelly clay.

Drillers' logs indicate that unconsolidated sandy and gravelly alluvium adjacent to creeks and floodouts on the eastern margin of the Tennant Creek Block, in the Helen Springs sheet area, are less than 5 metres thick.

**4.3.2 Structure**

There has been little deformation of the Cambrian sediments, only gentle down-warping as the basin subsided. In most areas the contact with underlying Proterozoic rocks is obscured; however, near the Tennant Creek floodout, basin sediments onlap the Proterozoic rocks.

The basement surface generally slopes gently away from the Tennant Creek Block, although there are substantial variations in basement topography. Bores in the Attack Creek floodout and at Brunchilly Station homestead intersected Cambrian sediments to depths of 125 to 160 metres relatively close to Proterozoic outcrops. In the Gosse River floodout (which occupies an embayment in the Tennant Creek Block) up to 180 metres of Cambrian sediments were intersected during exploratory drilling.

Frewena No. 1 intersected more than 300 metres thickness of Cambrian sediments near the eastern edge of the study area.

**4.4 WISO BASIN**

**4.4.1 Stratigraphy**

**Upper Proterozoic Sediments**

Upper Proterozoic (Adelaidean) sedimentary rocks of the Central Mount Stuart Formation are inferred from seismic data to unconformably overlie the Hatches Creek Group in the south-western corner of the study area (Lander River map sheet). The nearest outcrop is about 65 km to the south-east where the formation contains up to 250 metres thickness of sandstone, arkose, and greywacke with minor conglomerate and dolomite.

The Rising Sun Conglomerate, comprising conglomerate, quartzite, grit, sandstone and siltstone, is preserved in small, east-west trending, fault-bounded pockets within the Warramunga Group near Tennant Creek. The formation has been tentatively assigned to the Adelaidean era by Dodson and Gardener (1978).

Up to 26 metres of porous sandstone was intersected locally beneath the Montejinni Limestone during extensive drilling on the Tennant Creek West groundwater prospect. The age and relationship of this unit is uncertain (Verhoeven and Knott, 1979).
Diamond drillholes at the Geopeko Rover 1 Prospect near Point Wakefield intersected 20 to 35 metres thickness of weakly cemented medium to coarse-grained sandstone and poorly sorted conglomerate. These sediments are apparently conformable with overlying carbonate rocks of Cambrian age and are underlain by Warramunga Group sediments. They are absent in holes drilled on the nearby Rover 4 Prospect.

Montejinni Limestone

Early Middle Cambrian Age

The Montejinni Limestone is the basal Cambrian unit of the Wiso Basin. It is believed to be an equivalent of the Gum Ridge Formation of the Georgina Basin and the Tindall Limestone of the Daly River Basin.

A BMR stratigraphic hole, just beyond the western edge of the study area, Green Swamp Well No. 6 (GSW 6), intersected an incomplete section of 151 metres of the formation. Three distinct units were recognized, similar to those in outcrops in the northern Wiso Basin: upper and lower units of grey-white dolomite with gypsum infilling veins and cavities, and a middle 16-metre thick unit of dolomitic siltstone.

Twelve kilometres west of the eastern edge of the basin and 40 kilometres west of Warrego Mine, Green Swamp Well No. 1, a BMR bore, intersected the limestone from 27 to 82 metres depth. In this bore, the limestone is vuggy, fractured and porous.

Hooker Creek Formation

Middle Cambrian Age

The Hooker Creek Formation conformably overlies the Montejinni Limestone. The maximum recorded thickness is 161 metres in bore GSW 6, where the formation consists of interbedded siltstone, sandstone and dolomite. Sandstone beds are fine-grained, silty, and micaceous, and some have a dolomitic matrix.

Diamond drillholes on the Geopeko Rover 1 and 4 prospects intersected up to 110 metres thickness of conformable Cambrian sediments. At the base there were about 20 metres of limestone, calcarenite, calcilutite and dolomite that were porous and vuggy in part (Montejinni Limestone). Overlying these carbonate rocks were interbedded dolomitic mudstones and siltstones of the Hooker Creek Formation.

Lothari Hill Sandstone

Middle Cambrian Age

The Lothari Hill Sandstone conformably overlies the Hooker Creek Formation, with a gradational contact. It comprises a thickly bedded, fine to medium grained, moderately sorted, weakly consolidated quartz sandstone. It was intersected between 3 and 24 metres depth in bore GSW 6.

Drilling at the Geopeko Ranger prospect near Point Wakefield intersected 105 metres thickness of the formation, overlying 90 metres of Hooker Creek Formation and 70 metres of Montejinni Limestone.

Point Wakefield Beds

Upper Cambrian Age

The Point Wakefield Beds crop out only at the type locality, which is near the south-eastern corner of the Green Swamp Well map sheet area. They consist of interbedded siltstone, claystone, and fine-grained sandstone. They unconformably overlie the older Cambrian formations.

In the BMR stratigraphic holes GSW 1 to 3, up to 30 metres thickness of the formation was intersected at the top of the holes. In this area the unit comprises mainly claystone and siltstone with some well-sorted fine sandstone, and interbedded siltstone/sandstone intervals.

In the BMR Lander River No.s 4 and 5 stratigraphic holes, the Beds comprise soft to hard (silicified) claystone.
In the Tennant Creek West investigation area, the formation has been divided into three conformable units. The lower unit consists of up to 55 metres of micaceous siltstone. It is overlain by a white, friable, well-sorted, medium-grained sandstone of 15 to 20 metres thickness. The upper unit consists of at least 60 metres of weakly-indurated siltstones.

Hanson River Beds
The Hanson River Beds unconformably overlie the Point Wakefield Beds, and have been intersected in the BMR Lander River stratigraphic holes. Most of the formation consists of moderately to well sorted, fine to medium grained quartz sandstone, poorly sorted sandstone/sandy siltstone, and fissile siltstone. There is also at least 28 metres of interbedded limestone, dolomite, and mudstone at the top of the formation.

Thin-section descriptions of sandstone beds within the formation indicate a primary porosity of 10 to 20 percent.

Lake Surprise Sandstone
The Lake Surprise Sandstone unconformably overlies the Hanson River Beds, and only occurs in outcrop in the extreme south-western corner of the study area. It is a well-sorted, well-rounded, very fine to medium grained, weakly consolidated sandstone, and in some places has a silty and clayey matrix. Low-angle cross-bedding is common.

Buchanan Hills Beds
The Buchanan Hills Beds form a discontinuous layer of fine to coarse fluvial sand, with a maximum exposed thickness of 4 metres in the study area.

Superficial Deposits
Calcrite forms a capping up to 4 metres thick in outcrop on top of Palaeozoic limestone and dolomite. It also occurs along a north-north-westerly trending palaeodrainage west of the Tennant Creek Block on the Bonney Well map sheet area, where it probably extends below the water-table.

Alluvial silt, sand, gravel and calcrite of 15 to 70 metres thickness were intersected in the Tennant Creek West investigation area and in the Kelly Well borefields. The calcrite lenses are up to 6 metres thick.

Bores drilled in the embayment within the Tennant Creek Block at McLaren Creek Station intersect up to 20 metres of generally clayey alluvium overlying a sandstone of unknown age.

4.4.2 Structure
The conformable Middle Cambrian formations: the Montejinni Limestone, Hooker Creek Formation, and Lothari Hill Sandstone, form a broad north-trending syncline in the northern part of the Wiso Basin. An average dip of about 0.1º to the west is indicated from drilling data and the elevation of outcrops immediately north of the study area. The elevations of Cambrian outliers on topographic highs in the Tennant Creek sheet area indicate a similar dip (Kennewell and Huleatt, 1980).

In the southern part of the basin, the strike swings around to the south-east or south, and the dip increases to more than two degrees, on the northern flank of the Lander Trough.

The Hanson River Beds and the Point Wakefield Beds overlie an unconformity on the top of the Lothari Hill Sandstone. The unconformity is flat-lying, except on the flanks of the Lander Trough where dips of up to two degrees are inferred.

The Lander Trough is a half-graben which is bounded to the south by a series of east-south-easterly trending faults with a total displacement of more than 2,000 metres. It is located to the south of the present area of investigation.
The results of drilling for groundwater exploration at Tennant Creek West and the Warrego Mine borefield, and mineral exploration drilling near Point Wakefield, have indicated that extensional faulting has affected the Cambrian strata (Verhoeven and Knott, 1979). At the Warrego Mine borefield, about 60 metres displacement is inferred on a north-striking fault close to the outcropping unconformity at the base of the Montejinni Limestone.

During the Tennant Creek West groundwater investigations, detailed drilling and geophysical studies defined a deep north-westerly trending graben bounded by northerly and north-easterly trending faults. Two phases of faulting are indicated: a minor phase when there was vertical displacement of up to 10 metres between deposition of the Montejinni Limestone and the Point Wakefield Beds, and a second phase with displacement of up to 120 metres post-dating deposition of the Point Wakefield Beds.
Figure 3  Stratigraphy, and relationship between formations.  
Wiso and Georgina Basins.
5. HYDROGEOLOGY

5.1 POTENTIAL AQUIFERS
Crystalline rocks of the Tennant Creek Block are generally poor aquifers. Very few bores yield more than 3 l/sec, and most yield less than 1 l/sec. The water is often saline. Sediments of Mesozoic or Cainozoic age occurring within the Tennant Creek Block are also considered to be unprospective because of limited thickness or areal extent.

Potential aquifers for irrigation of horticultural projects are therefore limited to the Wiso and Georgina Basins. The Cambrian sediments are the most prospective, but also the underlying basalts and the Cainozoic alluvium have the potential to yield moderate supplies.

In the Wiso Basin, potential aquifers include vuggy and fractured Montejinni Limestone, the Hooker Creek Formation, Lothari Hill Sandstone, Point Wakefield Beds, and Hanson River Beds, which locally contain carbonate sediments and sandstones with primary porosity.

In the Georgina Basin, there are potential aquifers in the Gum Ridge Formation and Anthony Lagoon Beds. The permeability of these carbonate rocks is variable. Prospective formations and rock units are discussed in more detail in Section 5.3.

5.2 BORE CENSUS
Available data on bores and drill holes in those parts of the Wiso and Georgina Basins in the study area were collated and assessed as part of the study.

The main source of information was PAWA records of drilling for stock bores, most of which are on the Barkly Tableland north of the Barkly Highway and east of the Stuart Highway. These records contain location, casing details, depth, yield, aquifer depths, static water level, groundwater salinity, and a drillers' log; they are commonly incomplete.

The yields stated in the records generally underestimate the aquifer potential, as they are usually determined by airlifting (which is an inefficient means of pumping), and because most of the bores only partly penetrate the aquifers.

Apart from stock water bores, PAWA records include the results of drilling for the Warrego Mine borefield (20 km west of the mine) and for exploration camp and outstation supplies in the Point Wakefield area. The PAWA has carried out extensive groundwater exploration and development programmes in the Kelly Creek floodout for the Tennant Creek town water supply, and in the Gosse River floodout. Also, nine BMR stratigraphic holes drilled in the central west and south-western parts of the study area were tested for groundwater yield and salinity.

The results of the census were used in assessing prospective areas for development, and in preparation of the hydrogeological map. Data for each of the prospective areas for horticultural development are included in Tables 4 to 9. The hydrogeology of the two major basins are discussed below.

5.3 GEORGINA BASIN
Middle Cambrian sediments of the Gum Ridge Formation and the Anthony Lagoon Beds contain sandstone, limestone, and dolomite beds which form the main aquifers of the Georgina Basin. Also, basalt of the Helen Springs Volcanics that underlie the Georgina Basin has been intersected by a few bores in the eastern part of the basin; its potential is uncertain.
5.3.1 Barkly Tableland
All stock bores in the Barkly Tableland yield sufficient water for stock supplies from the Cambrian sediments. They typically intersect 20 to 50 metres of saturated sediments, and yield between 1.5 to 2.5 l/sec by airlifting. This indicates that the Cambrian sediments are at least moderately permeable throughout the area. The records of one pumping test in this area has been obtained for bore RN23594, located 7 km south of Rockhampton Downs homestead. The bore was drilled to 67 metres below static water level (SWL) in cavernous limestone. The test results indicate that the bore is capable of yielding 13 l/sec, and this compares with an airlift yield of only 2.2 l/sec measured in another bore at the site, drilled to 40 metres below SWL. Groundwater levels in the Barkly Tableland range from about 80 metres below ground level in the south-west, to about 40 metres in the north-east.

5.3.2 Gosse River
Bores drilled during the Gosse River groundwater investigation, south of the Barkly Highway, intersected up to 160 metres thickness of limestone of the Gum Ridge Formation. In this area the limestone is silicified and of low permeability (probably because of the silicification).

5.3.3 South-Eastern Area
Stock bores drilled in the south-eastern corner of the study area (Epenarra Station) indicate that the Cambrian sediments have variable permeability in this area. Thirteen of the bores were drilled in Cambrian sediments to more than 8 metres below SWL. Of these, seven were successful, with average airlift yields of 2 l/sec, five were abandoned due to indications of insufficient yield, and two were abandoned because of drilling problems. Indications of low yield were either low airlift yields or low back-pressure during air drilling. Records have been obtained for two pumping tests carried out in this area, on bores in the Kurundi Creek floodout. Bore RN2608, 35 km west-north-west of Epenarra Station homestead, intersected 23 metres of dolomite below SWL, which was 79 metres below ground level. The drawdown was only 0.29 metre at a pumping rate of 1.8 l/sec. Bore RN2614, 5 km west of RN2608, intersected chert and siltstone to 35 metres below the SWL of 87 metres below ground level. This bore could not sustain a pumping rate of only 0.2 l/sec.

5.3.4 Groundwater Salinity
Groundwater salinities range generally from 500 to 4,000 milligrams per litre Total Dissolved Solids, being highest in the central part of the basin within the study area (Fig. 1). At some localities the values are outside the general range. It is noted that the information is taken from bores constructed to different depths, and this factor might cause variability of data, for example if there is salinity increase with depth.

There is a 25-kilometre wide strip of low-salinity water along the western margin of the basin, i.e. on the eastern side of the Tennant Creek Block. It is attributed to recharge of fresh water along this margin. A similar situation arises at the very southern part of the basin in the map area.

A low-salinity zone along the Barkly Highway at the eastern edge of the map area has no explanation except local recharge of fresh water.

The remaining low-salinity zone, on the western side of the Tarrabool Lake, is not easily explained because it would appear to be down-gradient from more saline groundwater. It might be caused by the local structural configuration of the basin, higher aquifer permeability in this area, or local recharge by fresh water.
5.4 WISO BASIN

The Montejinni Limestone is the main aquifer in the north-western part of the Wiso Basin where it is developed for stock water supplies. It is a lateral equivalent of the Tindall Limestone which is a major aquifer in the northern part of the Georgina Basin and in the Daly River Basin. The underlying basalt and sandstone of the Helen Springs Volcanics also contain useful aquifers. Records are available for eight bores on the South Lake Woods map sheet; five of the sites drilled on Newcastle Waters Station were successful, and two bores further south on Muckaty Station produce from shallow depths below the water table.

The aquifers supplying water for the Warrego Mine are the Montejinni Limestone and an underlying sandstone of unknown age. The borefield is located 25 km west of the mine on the eastern edge of the Wiso Basin. Three production bores produce a total of 30 l/sec or nearly 1 x 10^6 cubic metres per annum.

In the Tennant Creek West area, and in the Tennant Creek borefields (Kelly Well West, Kelly Well and Cabbage Gum areas) groundwater occurs in the Montejinni Limestone, the Point Wakefield Beds and an underlying sandstone. The main aquifers are in the Point Wakefield Beds, but one pumping test indicated a transmissivity of 250 sq m/day for the lower sandstone unit. Four pumping tests of bores intersecting the Point Wakefield Beds gave an average transmissivity of 200 sq m/day for the 15-20 metres-thick middle sandstone member. Also, the upper siltstone unit of the Point Wakefield Beds is a good aquifer in the Kelly Well and Cabbage Gum areas, where it is vuggy.

The Point Wakefield Beds yield small to moderate supplies of groundwater to shallow outstation and exploration camp bores, south of Point Wakefield. In the western and north-western parts of the study area, the formation is above the water table.

The Hooker Creek Formation and Lothari Hill Sandstone which conformably overlie the Montejinni Limestone produced variable yields from the BMR stratigraphic holes in the Green Swamp Well map sheet area.

In the south-western part of the study area, BMR Lander River stratigraphic holes intersected yields of 1 to 2 l/sec in the Hanson River Beds, overlying the Point Wakefield Beds.

Generally, groundwater salinities in the Wiso Basin increase with distance west of the Tennant Creek Block. Bores in the north-western part of the study area yield low-salinity groundwater (less than 1,000 mg/l TDS) from the Montejinni Limestone and underlying volcanic rocks, within about 10 kilometres of the Tennant Creek Block. In the Tennant Creek West area, water in the Montejinni Limestone ranges from 1,000 to 3,000 mg/l TDS, whereas there is fresh water (720 to 780 mg/l TDS) in the underlying sandstone. In the Warrego Mine borefield, the salinity of water in the Montejinni Limestone is generally between 2,000 and 2,300 mg/l TDS; it varies seasonally in response to recharge and pumpage.

In the Green Swamp Well area, west of the Warrego Mine borefield, groundwater in the Hooker Creek Formation and Lothari Hill Sandstone are generally greater than 2,000 mg/l TDS.

South of Point Wakefield, groundwater in the Point Wakefield Beds is mostly between 1,000 and 3,000 mg/l TDS.

In the south-western part of the study area, groundwater in the Hanson River Beds ranges in salinity from about 2,000 to 9,000 mg/l TDS.

5.5 CAINOZOIC DEPOSITS

Calcrite crops out on a north-north-westerly trending line in the western part of the Bonney Well Sheet, on the margin of the Tennant Creek Block. It was probably deposited in a Tertiary drainage, followed in part by the present-day Bonney Creek.
Three bores are recorded along this line of outcrop: Chaluba Bore (RN 2787), Sugarbag Bore (RN 10859) and Limestone Bore (RN 10858). Chaluba Bore intersects gravel and sand alluvium; the strata intersected by the other two bores are not recorded, but both bores are situated on calcrite outcrops. They yield 1.8 (Chaluba Bore) to 3.1 (Sugarbag and Limestone Bores) litres per second of brackish water (2,000 to 3,000 mg/l TDS).

Unconsolidated alluvium and colluvium are generally up to 20 metres thick adjacent to the Tennant Creek Block, where they occur as fan deposits. The sediments are mostly sand, silty clay and gravel, and are considered unprospective for large irrigation supplies because of limited extent, small saturated thickness, or high salinity.
6. PROSPECTIVE AREAS FOR HORTICULTURAL WATER SUPPLIES

The following parameters were used to assess and rank the potential areas for development of horticultural water supplies:

(i) Aquifer characteristics
   • permeability
   • lateral extent
   • thickness below the water table

(ii) Groundwater chemistry
   • salinity
   • sodium adsorption ratio

(iii) Recharge

(iv) Proximity to roads

Extensive aquifers of moderate or high permeability are relatively widespread in the Palaeozoic basins, although there are local variations in porosity and permeability. Groundwater quality is the main limiting factor in selecting areas for further testing and development. The upper limit of salinity that most crops will tolerate is in the range 700 to 2,000 mg/l TDS. Also, some allowance must be made for the possible infiltration and recycling of irrigation water, thereby increasing salt concentrations. The sodium hazard to plants is very high where sodium adsorption ratios (SAR) are greater than about 15 in irrigation water of marginal salinity (Linsley and Franzini, 1972).

The prospective areas are described below, in ranked order, and shown on the Hydrogeological Map.

6.1 PROSPECT NUMBER 1: NORTHERN HELEN SPRINGS STATION

Prospect No 1 is on the western margin of the Barkly Tableland in the northern part of the study area, immediately south of the Barkly Stock Route on Helen Springs Station. It extends 25 km north-south and 20 km east-west and includes a topographically low area, surfaced by "black soils": deep grey and yellow-grey cracking clays.

Six stock bores are located within or close to the Prospect (Table 4). The drilling results indicate that beds of limestone dolomite and sandstone of the Gum Ridge Formation and/or Anthony Lagoon Beds extend to more than 122 metres depth. Static water level is between 50 and 56 metres depth. Two of the bores near the eastern and western edges of the prospect yield water of marginal quality, around 1,100 mg/l total dissolved solids. The others yield fresh water of less than 800 mg/l TDS. Sodium Adsorption Ratios (SAR) are generally low, except for water from the northern-most bore.

Aquifers in the area are probably recharged by infiltration of water discharging from the Renner, Koo-Nana and McKinlay Creeks which drain the Ashburton Range and discharge onto the tableland. There is also drainage into the area from elevated areas to the north and east.

Without test-pumping, it is difficult to assess likely bore yields. However, from the lithologies and saturated thicknesses of Middle Cambrian sediments, there is good probability of obtaining irrigation water supplies in the area. This will need to be tested by exploratory drilling and test-pumping, to determine yields and changes in water quality with long-term pumping at high rates. A test programme is proposed in Section 7.
6.2 PROSPECT NUMBER 2: BARKLY HIGHWAY—FREWENA
Prospect No. 2 covers an area of about 25 km by 15 km, on and immediately north of the Barkly Highway. It is on Rockhampton Downs Station, in the eastern part of the study area. Soils are mainly “Black Soil” or deep grey self-mulching cracking clay, typical of the Barkly Tableland; there are also some lateritic soils in marginal areas of the prospect: ironstone gravels with red earth matrix.

The ground slopes very gently to the north-east towards Lake De Burgh, which is immediately east of the study area.

There are four bores in the prospect area. The limited information provided in records for these bores (Table 5) indicates that the Middle Cambrian sediments extend to more than 100 m depth, and that water has been intersected in limestone and sandstone beds. Limestone is the dominant rock type and aquifer in this area. The water table is 43 to 47 metres deep, and the water is of low salinity (230 to 860 mg/l TDS - based on electrical conductivity measurements). The lowest salinity water is from bores that extend to shallow depths below the water table, and so the salinity could be higher if deeper irrigation bores are constructed. No information is available on sodium adsorption ratios.

Airlift yields range from 2.5 to 3.5 l/sec. As the bores only partly penetrate potential aquifers, there are good prospects of obtaining suitable irrigation water supplies in this area. There is good access, although the lateritic soils in marginal areas may be unsuitable for horticulture, and quality of water from deep high-yielding bores may be poorer than that from stock bores.

6.3 PROSPECT NUMBER 3: TARRABOOL LAKE WEST
Prospect No. 3 occupies a topographically low area on Eva Downs Station, west of Tarrabool Lake. It covers an area of about 25 km (east-west) by 15 km (north-south), and has similar soils (deep yellow-grey “Black Soil”) to Prospects Nos. 1 and 2.

Records of eight stock bores drilled within or adjacent to the prospect are summarized in Table 6. The bores intersect mainly carbonate rocks, and these are cavernous in at least two of the bores, with cavities extending as deep as 48 metres or more below the water table. Airlift yields were 1.9 to 2.5 l/sec, except for one bore which intersected mainly shale and yielded 0.2 l/sec. There are good prospects for obtaining larger yields by pumping, as air was probably lost to the formation during airlifting.

Groundwater salinities are in the range of 320 to 650 mg/l TDS, and SAR values range from 4 to 14, except for one bore immediately south of the area which has a very high SAR value (84).

It is presumed that the area is recharged directly by the infiltration of rainfall, and water flowing from an elevated area to the north where the Brunette Limestone crops-out.

There are good prospects for obtaining irrigation water in this area, although the access is less favourable than for the other areas considered.

6.4 PROSPECT NUMBER 4: TOMKINSON CREEK FLOODOUT—LAKE WOODS
Prospect No. 4 is on the eastern margin of the Wiso Basin, between Lake Woods in the north and the Tomkinson Creek floodout in the south. It is between 10 km and 30 km wide, and about 65 km long. It is surfaced by red sand soils with an earthy fabric and weak pedologic development.

Thirteen bores have been drilled in the area; the data for these are presented in Table 7. Most of the bores produce water from carbonate, sandstone, and minor basalt aquifers with airlift yields of up to 3.8 l/sec. Only two were abandoned because of low yield, and one of these was situated close to the edge of the Wiso Basin and encountered cavernous rocks above the water table.

The groundwater salinity is suitable for irrigation of crops, ranging from about 450 to 900 mg/l total dissolved solids. The low salinities suggest relatively high rates of recharge from water discharging from creeks on the western side of the Ashburton Range.
The saturated thickness of the Montejinni Limestone is irregular. In the northern half of the prospect area, particularly on the eastern side, the formation is commonly thin, and in places unsaturated. The underlying basalt is generally less permeable than limestone and sandstone of the Montejinni Limestone, and so the highest yields are likely to be in western and southern parts of the prospect. Even so, intensive exploration may be needed to locate suitable bore sites.

Geophysical methods such as gravity surveying could be useful in defining the top of the Antrim Plateau Volcanics, and therefore, the thickness of Cambrian sediments.

6.5 PROSPECT NUMBER 5: BRUNCHILLY STATION WEST
The prospect covers an area of about 25 km (east-west) by 20 km (north-south) between Whittington Range to the west and an outlier of Proterozoic basement to the east, near Brunchilly Station homestead. The area is surfaced by similar soils to those in Prospect No. 4: weakly developed red sand soils with an earthy fabric.

Six bores have been drilled in the prospect area (Table 8). They indicate that Middle Cambrian sediments, mainly Limestone, extend to depths of between 116 and 160+ metres. One bore (RN 5935) bottomed in basalt of the Helen Springs Volcanics, and another (RN 21119) in slate of the Tomkinson Creek Beds.

Airlift yields were all 1.3 to 2.3 l/sec, except for one bore (RN 680) in the eastern part of the prospect area. The water was intersected in limestones, and in at least one bore (RN 23908) there are cavities below the water table.

The water table is deep (75 to 91 metres below ground level), and so the best prospects for moderate or large supplies are in the eastern part of the area where the saturated thickness of Cambrian sediments is greatest. Groundwater is of variable salinity, and of marginal quality for irrigation use. Salinities range from 980 to 1430 mg/l TDS, and SAR values range from 14 to 32.

Water discharging in the Attack Creek and Morphett Creek floodouts should provide good recharge to the aquifers, via the sandy surface soils.

This area is of low priority for further investigation because of relatively high salinity and SAR values, and the deep water table.

6.6 PROSPECT NUMBER 6: MCLAREN CREEK STATION
Prospect No. 6 covers an area of about 30 km (east-west) by 18 km (north-south) near McLaren Creek Station homestead. It is in a low-lying area within an embayment in the Tenant Creek Block, marginal to the Wiso Basin.

Soils are mainly weakly developed, sandy, with an earthy fabric, but there are some areas of lateritic soils which may be unsuitable for horticulture.

Records for 14 water bores drilled at 7 locations in the prospect area are shown in Table 9. The bores were drilled to depths of 21.6 to 54.1 metres depth and intersect mainly sandstone which is probably either a unit of the Point Wakefield Beds, or the Hanson River Beds. There is also up to 23 metres thickness of Quaternary alluvium and colluvium which may contribute to bore yields.

Additional Palaeozoic sediments are likely to occur at greater depths, overlying the Proterozoic basement.

All except one (unsuccessful) bore yielded between 1.0 and 11.3 litres per second. Bore RN 14563 (bore 7 on the hydrogeological map) was test-pumped, indicating a high aquifer transmissivity of 470 sq m/day for the 33 metres of saturated sandstone intersected by the bore.
Static water levels range from 5.5 metres depth in the west, to 13 metres in the east. Taking into account increased surface elevations to the east, there is a westerly hydraulic gradient of about $2 \times 10^{-3}$ m/m.

Groundwater quality in the area is marginal to poor for horticulture, with salinities ranging from 780 to 3310 mg/l TDS. Excluding two bores that are close to the edges of the prospect, the maximum salinity is 1410 mg/l TDS. SAR values are high, ranging from 15 to 48.

There are good prospect of obtaining moderate to large groundwater supplies in this area, but the quality may not be suitable for horticultural purposes. The prospect is in a similar embayment in the Proterozoic bedrock to that used for the Tennant Creek borefields, and so there are likely to be deeper, untested Middle Cambrian sediments that may contain water of better (or poorer) quality. This prospect has the lowest priority for further investigation of the six nominated, because of the relatively poor water quality, and the areas of lateritic soil.
### Table 4

**Bore Records for Prospect No. 1**

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<th>Depth Drilled (m)</th>
<th>Aquifer Depth (m)</th>
<th>Aquifer Yield (L/s)</th>
<th>+SWL (m)</th>
<th>Depth (m)</th>
<th>Lithology</th>
<th>Salinity (mg/l)</th>
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* *RN*-PAWA Registered Numbers
+SWL-Static water level
### TABLE 5

**BORE RECORDS FOR PROSPECT NO. 2**

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<th>Salinity (mg/l) TDS</th>
<th>SAR</th>
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*RN—PAWA Registered Numbers
+SWL—Static water level
### Table 6

**Bore Records for Prospect No. 3**

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* RN—PAWA Registered Numbers
+SWL—Static water level
### Table 7a

**Bore Records for Prospect No. 4**

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* *RN*—FAWA Registered Numbers
+SWL—Static water level
### Table 7b

**Bore Records For Prospect No. 4**

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* RN—PAWA Registered Numbers
+SWL—Static water level
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<td>Clay and quartz</td>
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<td>Clay and gravels</td>
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</table>

* RN—PAWA Registered Numbers
+SWL—Static water level
## TABLE 9

**Bore Records for Prospect No. 6**

<table>
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<tr>
<th>Map Location</th>
<th><em>RN</em></th>
<th>Date Drilled (m)</th>
<th>Depth Drilled (m)</th>
<th>Aquifer Depth (m)</th>
<th>Aquifer Yield (l/s)</th>
<th>+SWL (m)</th>
<th>Depth (m)</th>
<th>Lithology</th>
<th>Salinity (mg/ml)</th>
<th>SAR</th>
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<td>21.6</td>
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<td>-</td>
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<td>Cemented coarse sand</td>
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<td>29</td>
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<td>2</td>
<td>6361</td>
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<td>26.0</td>
<td>8.5-25.9</td>
<td>1.3</td>
<td>-</td>
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<td>11874</td>
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<td>17-36</td>
<td>Sandstone</td>
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</table>

*RN—PAWA Registered Numbers
+SWL—Static water level
7. **RECOMMENDED INVESTIGATION PROGRAMME**

This assessment is based largely on the drilling information and drillers’ logs from stock water bores which produce at lower rates than would be expected of irrigation bores. Six areas in which irrigation water supplies could possibly be developed have been delineated, and ranked from one to six on the basis of groundwater prospects and ease of access. Soil type has also been considered, but determining their suitability for horticulture was not within the scope of this study.

Once an area has been selected based on the findings in this report, soil suitability and land tenure, a groundwater investigation will need to be carried out to determine whether water of suitable quantity and quality for horticulture is indeed available. The following programme is recommended:

1. Carry out a gravity survey, to determine depth to Proterozoic basement, and basement topography.

2. Drill about six exploratory holes to basement, measuring airlift yields and salinity variations with depth. Reverse-circulation air-rotary methods may prove to be the most suitable, to restrict circulation losses in limestone and to obtain good lithological samples.

3. At three sites, construct test-production bores, and carry out pumping tests to determine long-term duty pumping rates, drawdown interference effects, and whether there are likely to be changes in groundwater quality during pumping.
8. CONCLUSIONS

An assessment of existing hydrogeological information including bore records and published geological reports indicates that there are areas within the Wiso and Georgina sedimentary basins where groundwater of suitable quality and quantity is likely to be available for irrigating land for horticulture. Limestone and sandstone beds of Middle Cambrian age are the most prospective aquifers.

Groundwater is recharged by infiltration of rainfall and runoff, particularly from infiltration in "floodouts" where creeks draining the central basement ranges discharge onto the flat-lying surfaces of the basins. Consequently, groundwater salinity generally increases with distance from the central ranges. There are areas of low-salinity groundwater away from the ranges, probably where there are favourable recharge conditions and more highly permeable aquifers.

The most prospective area for horticultural groundwater supplies is east of the Ashburton Range and south of the Barkly Stock Route on Helen Springs Station. In this area, which is surfaced by the "Black Soils" typical of the Barkly Tableland, interbedded carbonate and clastic sediments of the Gum Ridge Formation and/or Anthony Lagoon Beds extend to more than 122 metres depth. The water-table is 50 to 56 metres deep. Stock bores yield water with salinity less than 800 mg/l total dissolved solids, and of generally low sodium adsorption ratios. Also, there is good potential for recharge from water discharging in the Renner, Koo-Nana and McKinlay Creek floodouts.

Most of the previous drilling in the study area has been for stock water bores, and so there is little information on actual bore capacities and variations in salinity with depth. The selected area will need to be investigated in more detail by exploratory drilling to basement, and the construction and test-pumping of test/production bores.
ACKNOWLEDGEMENTS

The assistance of offices of the Power and Water Authority in Darwin and Alice Springs is gratefully acknowledged. Valuable assistance was provided by P. Jolly, P. Mc Donald, W. Steen, J. Wischusen, and C Garner. We also wish to thank D. Little of the Department of Primary Industries and Fisheries, Tennant Creek and B. Woods of the Conservation Commission, Darwin, for information provided.

DATED: 20TH DECEMBER 1989
ROCKWATER PTY LTD

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J. R. PASSMORE
PRINCIPAL HYDROGEOLOGIST
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