4. HYDROLOGY

4.1 Deep Leads

The Avoca Deep Lead (Fig. 7) drains a large area from the Tertiary divide near Tunstalls in the north to Beaufort in the south. Branches from these areas join west of Rathscar before flowing eastwards as the main trunk through the Bet Bet valley towards its confluence with the Loddon Lead system at Betley. It is joined by the Homebush Lead south of Rathscar and the Alma, Timor and Maryborough Leads at Timor. Shallow tributary leads enter along its entire course.

The palaeosurface of the Bet Bet valley can be extrapolated from bore logs of Government and mining company drilling traverses set across the main lead. The most recent work done on lead mapping by the Department of Minerals and Energy (Deep Lead Dunolly 1:100,000 scale mapsheet, 1984), shows the deep lead course running north of the present Bet Bet Creek course until it conforms with the present stream at Timor. The Ordovician basement shelves from a maximum depth of 70 metres in the lead to less than 20 metres over much of the area to the north.

The Avoca Lead, called the Bet Bet Lead through the study area, has a maximum depth of seventy metres at Wareek to less than fifty metres near Carmanuel Creek with section of 'deep ground' (>68 m) located at Timor and near the Bet Bet township (40 chains to one inch, Bet Bet Parish Geological Map).

The water carrying capacity of the lead can be estimated from mining company reports. The three major mines on the Bet Bet lead from 1869 to 1909 were the Grand Duke at Timor, the Duke United and North Duke, north of Timor. The Grand Duke Company pumped an average of 11.8 million litres per day over a seven year period, and the North Duke mine 6.8 million litres per day. The effect was to substantially lower the water level in the lead, as happened in the Homebush Lead (Homebush Lead level was lowered from 28' to 60' in six months of pumping – "Deep Leads of Victoria", Mines Department 1937). Water levels for a considerable radius around the shaft were lowered and some considerable time was taken for the original levels to be restored once pumping had ceased. The Grand Duke mine for example, which ceased operation in 1889, had after twenty years not reached its original water level (S. B. Hunter, Deep Leads of Victoria, 1909).

Groundwater velocity in the leads rarely exceeds eighty metres per year and water quality can be extremely variable within the same lead. Bores one hundred metres apart, drilled by CRA Australia, across the Avoca Lead revealed groundwater salinities of 11 100 mg/L and 2 670 mg/L. A Soil Conservation Authority bore penetrating the main lead at Timor West (June 1984) yielded water of 909.6 mg/L salinity and in a Department of Minerals and Energy bore into the same lead some 5 km upstream the salinity was 1 800 mg/L.

4.2 Other Groundwaters

The second influence on the hydrology of the Timor West region is the effect of local groundwater. Groundwater data are available from scattered farm bores in the Bet Bet valley, five piezometer nests at Timor West and mining company records. There are insufficient bores to complete a map of piezometric levels. However a general impression of groundwater conditions can be gained.

Much of the valley area conformable with the buried basalt trace possesses a water table at between two and five metres depth. A zone of about one hundred and twenty hectares adjacent to Emu Creek at Timor West has groundwater levels consistently within one and a half metres of ground surface. Local landholders claim that groundwater has been rising over the past fifty years. J. McKinley (1978) at Timor West, for example, has reported a rise of eight metres over the last forty years, to within one metre of the surface. The bore water was salty enough to kill peach trees in one year of watering.

Borehole data from piezometers monitored since January 1981 (Hydrographs 1-5 Appendix I, and Timor West Map Fig. 8) shows groundwater rising to within twenty centimetres of the surface in Piezometers 2 and 5 (nearest Emu Creek) during the winter of 1981. A drop of between 1.2 and 1.5 metres occurred during the 1982/83 drought. However throughout the three and a half years of monitoring, salinity levels have been quite stable with a low seasonal salinity fluctuation (often varying by less than 600 mg/L throughout the year). The piezometers with the deeper groundwater levels have

the highest recorded salinities and the zone of higher groundwater (<1.5 metres) has recorded salinities of less than 2 100 mg/L. The threat as the highly saline groundwater levels continue to rise is of concern at Timor West. The potentiometric surface estimated from piezometer groundwater levels indicates a relationship between the deep lead and the groundwater of the valley.

During the 1982/83 drought, Emu Creek maintained a constant flow with salinity levels of about 3 000 mg/L. Farm bores at Burkinshaws Swamp remained reliable water sources during this time and piezometric levels remained fairly stable after the initial dry season drop. This indicates that the groundwater of the Timor West/Bet Bet valley is maintained at a constant head either from bedrock aquifers or deep lead discharge.

4.2.1 Drilling program, June 1984

Three six inch diameter bore holes were drilled in late May and June of 1984. Two shallow holes 15 m and 30 m deep respectively were drilled near the salting at Emu Creek. A third hole 72 metres deep intersected the main Bet Bet lead south of Timor West. (Drill hole locations can be seen in Fig. 8 and bore hole logs are recorded in Appendix II.) Bore water levels have been monitored for four months and pumping tests conducted.

Indications are that levels in piezometers and the deep bore are comparable. This implies that water in the lead influences groundwater conditions at Timor West, although a shallow lead (intersected in drill hole No. 1) and the effect of local recharge from the alluvium and neighbouring Ordovician bedrock are expected to play a role as well. An extension of both deep lead and shallow drilling is strongly recommended to consolidate and extend current information.

4.3 Surface drainage

The drainage between the Loddon and Avoca catchments lies in the centre of the study area, running down through Dunluce and the Black Ranges. The major streams draining the region are Green Hill Creek, Emu and Carmanuel Creeks which are tributaries of the Bet Bet Creek in the Loddon River catchment. Homebush and Brown Hill Creeks which drain the slopes of the Dunluce granodiorite and the Black Ranges are tributaries of the Avoca River. Fig. 9 shows the streams and catchment divides. The largest sub-catchment, that of Emu Creek (over 100 sq. km), is bounded by Mt Hooghly, Dunluce and the eastern ridge of the Black Ranges. The size of this catchment with consequent runoff and subsurface flow is expected to be an important factor influencing groundwater conditions at Timor West.

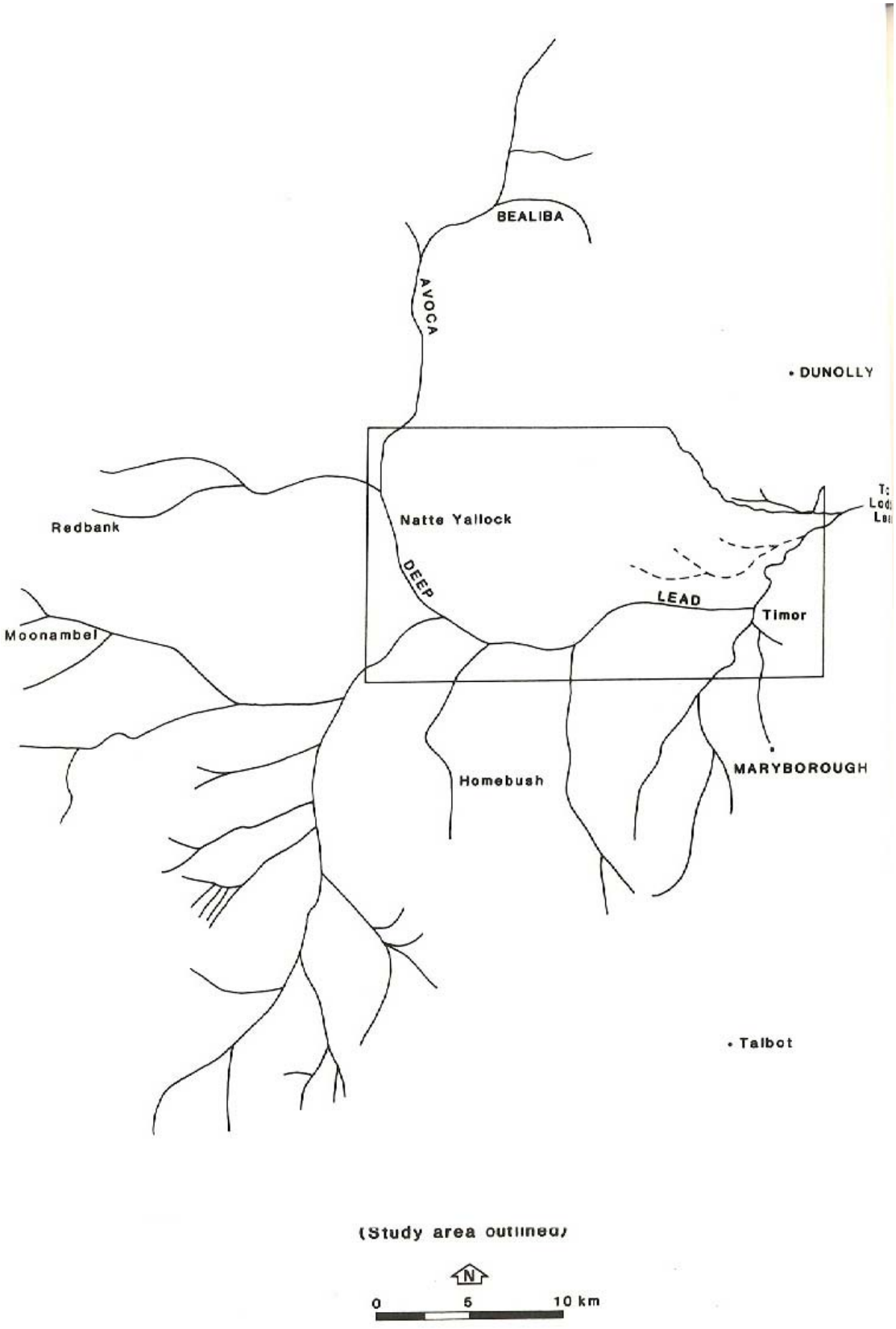
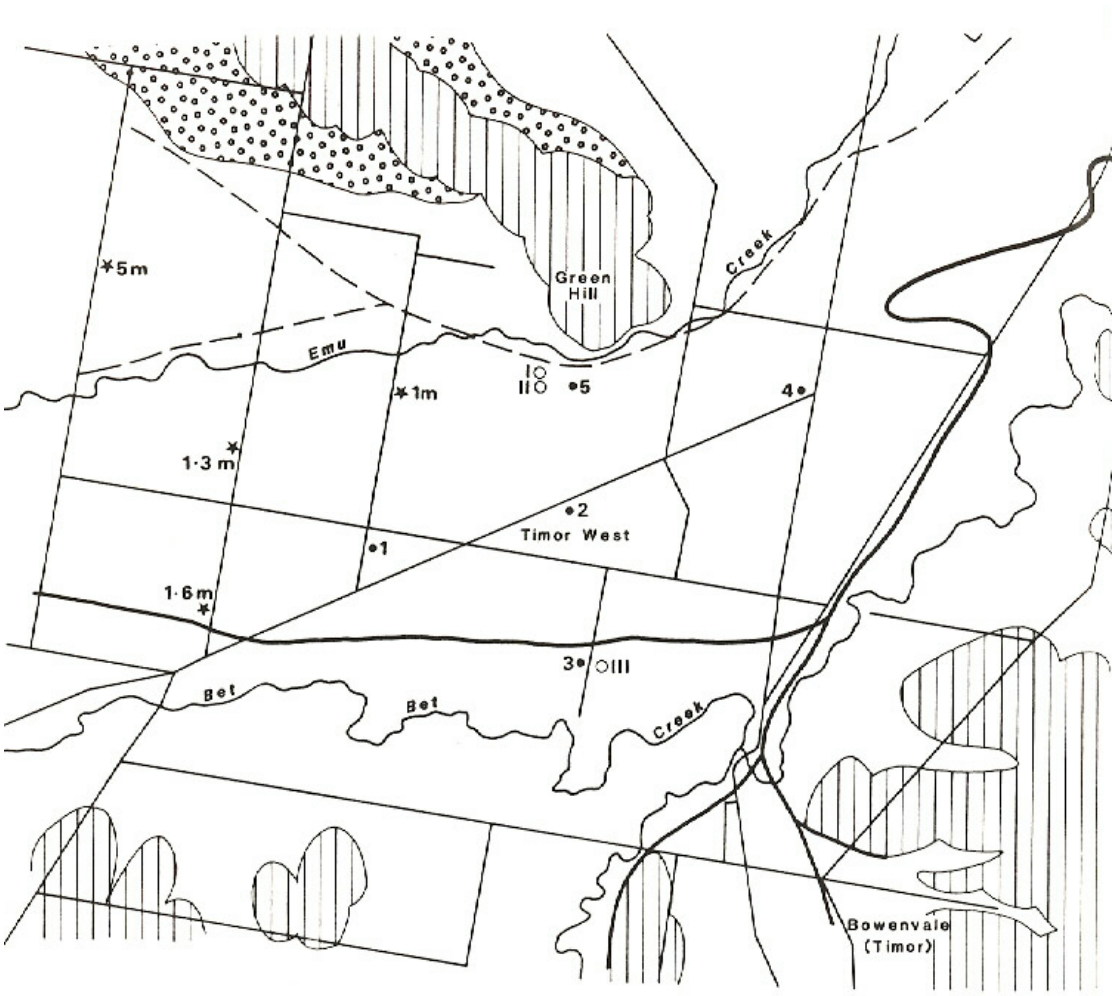


Fig. 7 – The Avoca Deep Lead System
(Study area outlined)



TIMOR WEST AREA

N

0 1km

Ordovician sediments | Colluvium | Alluvium

Deep Leads | Tributary Lead | *1m Farm bore water level

• 3 Piezometer | OII Deep Borehole

PIEZOMETER DATA

Bore No.	Winter 9/7/81 Groundwater Level (m)	Winter 9/7/81 Salinity (ppm)	Summer 30/12/82 Groundwater Level (m)	Summer 30/12/82 Salinity (ppm)	Relative Level (M.ASL)
1. Deep	1.2	1226	2.0	1141	190.46
2. Shallow	0.4	3223	1.8	3684	188.82
3. Inter.	3.1	9167	3.2	9108	189.44
4. Deep	5.4	808	5.8	6552	186.34
4. Deep	0.4	1048	1.2	1926	187.19

Fig. 8 – Timor West Piezometer Map

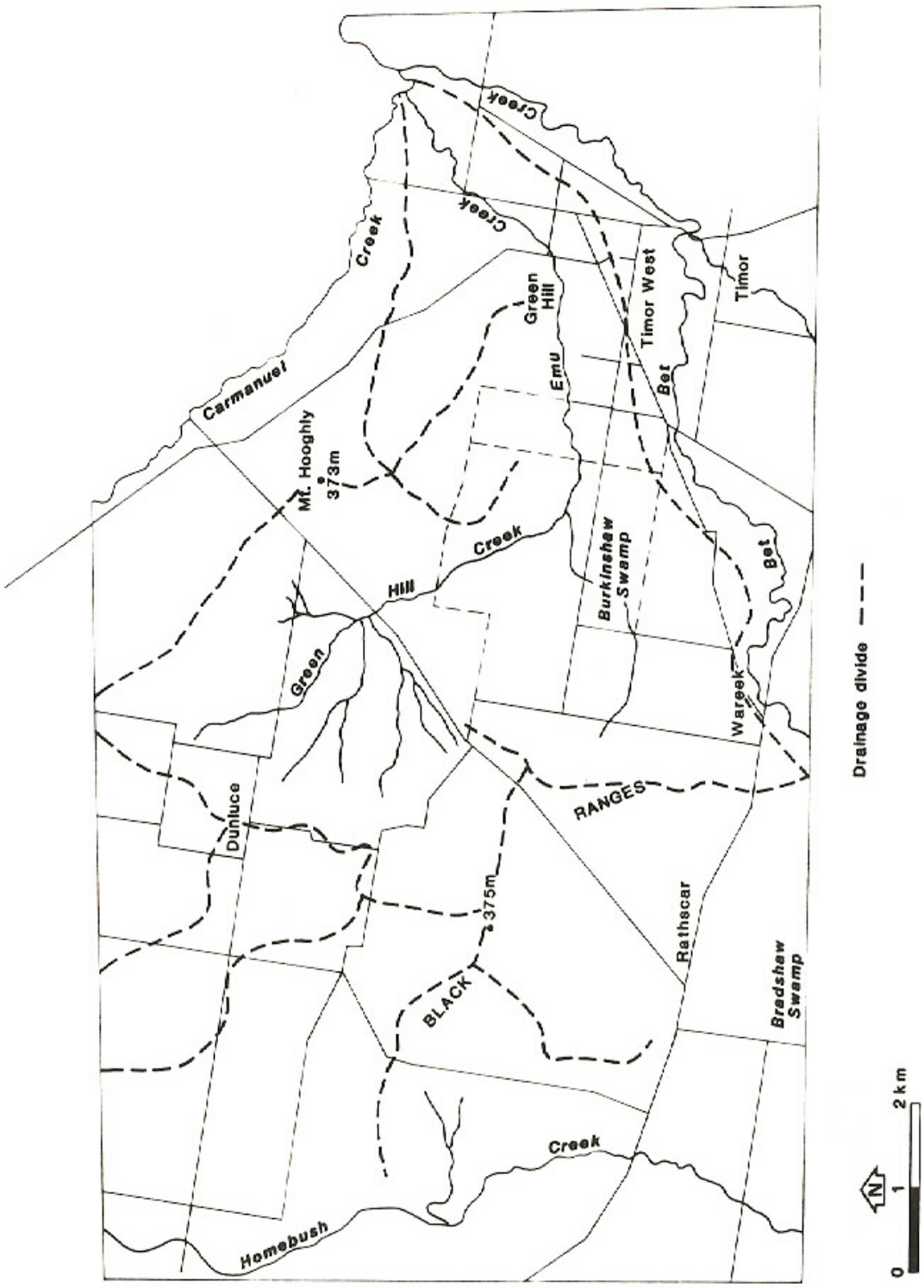


Fig. 9 – Catchments