

1973/74

Representative basin study: Birralee Creek, eastern Tasmania.

W.L. Matthews

The geohydrology of the Birralee Creek catchment area (about 33 km²) which is situated in the Lemont district about 18 km east of Oatlands was studied at the request of the Rivers and Water Supply Commission and forms part of the Representative Basin Programme of the Australian Water Resources Council. A stream gauge has been installed by the Rivers and Water Supply Commission in Birralee Creek about 0.5 km from its confluence with Kittys Rivulet.

Access to the catchment area is good. No points in the area lie more than about 1.5 km from a road.

PHYSIOGRAPHY AND LAND USE

The western and northern parts of the catchment area are steep due to the presence of dolerite which is resistant to erosion. The remainder of the area generally consists of gently undulating country with a few low steep slopes and a few almost flat areas, particularly around the streams.

The land is used almost entirely for grazing of sheep and cattle. A small amount of arable land is used for green-feed growing for stock. Some dams have been built within the catchment which are capable of being used for irrigation on various scales. About 80-90% of the area is cleared or semi-cleared, the remainder being the steeper areas underlain by dolerite.

GEOLOGY

The rock units represented in the area (fig.29) are Triassic sandstone and shale, Jurassic dolerite, Tertiary sediments, Tertiary basalt and Quaternary deposits of various kinds. Two areas of indurated sediments are almost certainly of Triassic age and have been the source of aboriginal implements found scattered throughout the area.

Triassic sediments

These sediments dip at about 10-12° NW and consist of white to cream quartz sandstone, feldspathic or lithic sandstone and shale. The quartz sandstone is usually massively bedded and contains abundant cross-bedded horizons. The examination of a thin section of a specimen of this rock indicated that it had a low porosity. The feldspathic sandstone and shale which apparently overlie the quartz sandstone do not crop out as strongly as the quartz sandstone and where they occur at higher levels they are covered by dolerite talus. Landslips, both present day and past have developed in these areas. The feldspathic sandstone is a speckled, brown rock. The shale is usually of a medium brown colour and contains plant fossils; a small area of black carbonaceous shale was located in a stream bed.

Jurassic dolerite

Fine- to medium-grained dolerite is exposed in the area. At some locations the dolerite appears to be concordant with the intruded sediments and at others it appears to be discordant. Areas of fine-grained dolerite near the centre of the main valley are probably intruded along faults.

Tertiary basalt

Basalt occurs mainly in the eastern part of the catchment. Some of

GEOLOGICAL MAP OF BIRRALEE CREEK CATCHMENT AREA.

GEOLOGIST W.L.MATTHEWS. 1973

Scale 1 : 50 000

LEGEND

QUATERNARY

-  *Alluvium.*
-  *Windblown and locally derived sand.*
-  *Basalt talus.*
-  *Dolerite talus.*

TERTIARY

-  *Basalt, tuff and volcanic breccia.*
-  *Limonite boulders and lateritic material.*
-  *Sediments (greybilly).*

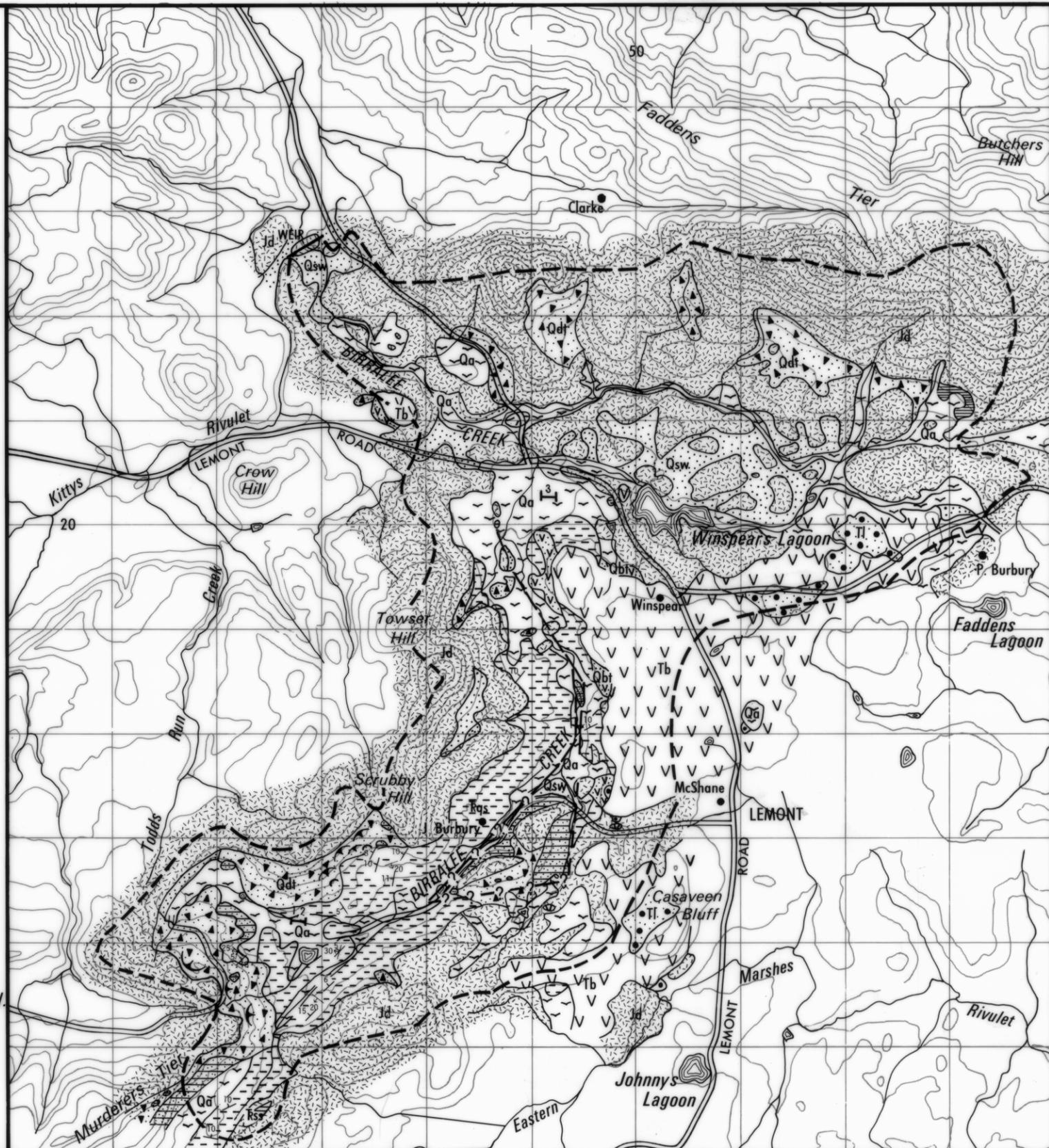
JURASSIC

-  *Dolerite.*

TRIASSIC

-  *Baked sandstone and shale.*
-  *Feldspathic sandstone and shale.*
-  *Quartz sandstone.*

-  *Geological boundary (approximate).*
-  *Fault, mainly obscured (approximate position).*
-  *Strike and dip of bedding.*
-  *Dip of current bedding.*
-  *Old landslip.*
-  *Active landslip.*
-  *Clarke Rainfall data.*
-  *Boundary of catchment area.*



the basalt is vesicular but it is mainly a dense black rock with abundant phenocrysts and nodules of olivine. A volcanic centre occurs on the eastern margin and areas of volcanic breccia and tuff can be found in addition to the lava flows.

Tertiary sediments

Gravel fragments can be seen around the base of the basalt at some locations. These deposits are probably thin and consist of quartz, silicified wood fragments and occasional agates. Just east of the catchment, small areas of grey-billy have been noted. One area is of silicified sand and the other is of cemented Triassic sandstone blocks. Zones of limonite boulders have been mapped at the base of the basalt, where it overlies dolerite. Lag deposits of pisolitic limonite overlie the basalt at some localities. Although these limonitic deposits probably have different origins, they have been mapped as one unit.

Quaternary deposits

Dolerite talus covers considerable areas of the steeper slopes. This usually consists of angular dolerite boulders in a clay soil and in most cases probably overlies Triassic sediments although some may overlie *in situ* dolerite.

Small areas of basalt talus occur around the steeper slopes of areas underlain by basalt.

Areas of windblown and locally derived sand occur at several points in the catchment. This is usually even-grained sand that has been derived from the weathering of Triassic sandstone beds.

Alluvium which consists mainly of clay with some dolerite boulders and some sand occurs along the floors of the valleys. The thickness is unknown but older rocks probably occur at shallow depths at most locations.

The table below indicates the approximate areas of each unit.

| Rock Type | Area (km ²) | Percentage of Catchment area |
|------------------------------------|----------------------------|---------------------------------|
| Triassic: Quartz sandstone | 3.39 | 10.4 |
| Feldspathic sandstone and shale | 0.54 | 1.7 |
| Jurassic dolerite | 15.46 | 47.3 |
| Tertiary basalt | 3.68 | 11.3 |
| Limonitic deposits | 0.24 | 0.7 |
| Dolerite talus | 2.93 | 9.0 |
| Basalt talus | 0.23 | 0.7 |
| Windblown and locally derived sand | 1.76 | 5.4 |
| Alluvium | 4.48 | 13.7 |

In addition to these areas about 0.21 km² is covered with water in the form of dams.

Structure

In the middle of the catchment area, a block of feldspathic sandstone and shale has been faulted down with an apparent vertical movement of about 150 m. A fault probably extends north along the floor of the valley where a number of small areas of dolerite occur. The faulting and the intrusion of the dolerite have given the Triassic sediments their dominantly north-

westerly dip.

HYDROLOGY

As much of the catchment area is used for agriculture, the permeability or infiltration capacity of soils should be good if the land is being used to the limit of its potential. No measurements of soil permeability have been made but comments on likely rock permeabilities are made below.

Triassic sediments

The quartz sandstone beds where thick are regarded as a reliable source of stock water. Bores yield an average of about 23 l/min. Water is probably stored mainly in joints but although the unfractured rock has a low porosity it would provide a supplementary water storage. As there is a storage capability and a capacity to yield water in bores, there must also be some infiltration capacity. The feldspathic sandstone and shale horizons tend to be a less reliable source of water in bores and therefore its infiltration capacity is probably lower.

Jurassic dolerite

Few bores have been drilled in dolerite in Tasmania, but these indicate that it is a fairly unreliable source of water. Within the catchment area some of the dolerite is closely jointed (e.g. in some small quarries) and some of it is weathered: in both cases increased infiltration is likely. Where dolerite occurs on steep slopes however, proportion of run-off would be high.

Tertiary basalt and sediments

In most of the catchment, the basalt unit is thin except perhaps in the east around the volcanic centre. Vesicular basalt has good storage and permeability characteristics and therefore good infiltration. Dense basalt can also store large quantities of water because jointing is often closely spaced and open. As much of the basalt areas are relatively flat, the proportion of infiltration would be high. There appear to be few if any springs from the base of the basalt within the catchment area, suggesting that the pre-basalt topography falls towards the east. The underlying gravel and limonite are probably very permeable but these deposits appear to be thin. The gravel, if clean, could allow the rapid transmission of water. The quartzite or grey-billy, on the other hand, has a low permeability.

Quaternary deposits

The windblown sand areas could be regarded as having fairly high infiltration capacities but in most areas they are probably no more than a few metres thick. Less permeable material underlies the sand so the effect would be largely a retardation of run-off.

The basalt and dolerite talus deposits are relatively permeable but again do not attain great thicknesses and their effect on rainfall distribution is to slow the rate of run-off. A farmer in the south-west of the catchment area indicated the spring line after heavy rain at the foot of the talus areas and on top of quartz sandstone.

The alluvium in the valleys is dominantly of clay and the rate of infiltration is very low. Run-off would therefore account for a large proportion of the rainfall.

Table 1. RAINFALL RECORDS, LEMONT AREA, 1958-1972

| | R. McShane | | P. Burbury | | G. Clarke | | J. Burbury | | R. Winspear | |
|-----------|------------|------|------------|------|-----------|------|------------|------|-------------|------|
| | mm | pt | mm | pt | mm | pt | mm | pt | mm | pt |
| 1972 | | | | | | | | | | |
| January | 86 | 339 | 101 | 398 | 112 | 440 | 109 | 429 | | |
| February | 15 | 61 | 19 | 73 | 30 | 117 | 19 | 75 | | |
| March | 5 | 18 | 9 | 35 | 9 | 37 | 6 | 24 | | |
| April | 45 | 177 | 40 | 157 | 46 | 182 | 52 | 204 | | |
| May | 4 | 17 | 5 | 21 | 4 | 17 | 9 | 36 | | |
| June | 20 | 78 | 20 | 77 | 29 | 113 | 22 | 85 | | |
| July | 56 | 222 | 55 | 215 | 62 | 245 | 61 | 239 | | |
| August | 64 | 252 | 40 | 156 | 34 | 134 | 40 | 157 | | |
| September | 29 | 116 | 27 | 107 | 32 | 127 | 27 | 108 | | |
| October | 20 | 80 | 17 | 66 | 22 | 85 | 26 | 101 | | |
| November | 40 | 159 | 39 | 152 | 49 | 193 | 46 | 180 | | |
| December | 19 | 75 | 15 | 59 | 19 | 73 | 21 | 81 | | |
| Total | 405 | 1594 | 385 | 1516 | 448 | 1763 | 437 | 1719 | | |
| 1971 | | | | | | | | | | |
| January | 70 | 277 | 73 | 288 | 86 | 338 | | | 71 | 281 |
| February | 52 | 204 | 72 | 283 | 70 | 277 | | | 58 | 228 |
| March | 28 | 112 | 30 | 120 | 30 | 117 | | | 31 | 122 |
| April | 16 | 64 | 20 | 79 | 26 | 101 | | | 24 | 95 |
| May | 106 | 419 | 115 | 451 | 125 | 494 | | | 127 | 500 |
| June | 30 | 118 | 26 | 103 | 32 | 127 | | | - | - |
| July | 10 | 39 | 14 | 54 | 10 | 39 | | | 28 | 110 |
| August | 61 | 239 | 55 | 218 | 68 | 268 | | | 65 | 255 |
| September | 79 | 311 | 79 | 312 | 82 | 321 | | | 103 | 407 |
| October | 76 | 298 | 86 | 337 | 77 | 304 | | | 19 | 75 |
| November | 122 | 479 | 109 | 431 | 110 | 435 | | | 113 | 443 |
| December | 54 | 211 | 50 | 195 | 58 | 230 | | | 54 | 212 |
| Total | 704 | 2771 | 729 | 2871 | 775 | 3051 | 610 | 2400 | 693 | 2728 |
| 1970 | | | | | | | | | | |
| January | 68 | 269 | 75 | 296 | 70 | 276 | | | | |
| February | 34 | 133 | 41 | 161 | 36 | 140 | | | | |
| March | 125 | 494 | 161 | 634 | 180 | 709 | | | | |
| April | 27 | 108 | 24 | 96 | 26 | 103 | | | | |
| May | 37 | 144 | 43 | 168 | 43 | 170 | | | | |
| June | 122 | 479 | 156 | 614 | 157 | 620 | | | | |
| July | 45 | 178 | 40 | 157 | 39 | 152 | | | | |
| August | 145 | 571 | 180 | 710 | 157 | 618 | | | | |
| September | 34 | 132 | 36 | 143 | 41 | 163 | | | | |
| October | 64 | 252 | 60 | 235 | 55 | 216 | | | | |
| November | 56 | 221 | 45 | 178 | 50 | 196 | | | | |
| December | 121 | 478 | 134 | 527 | 136 | 537 | | | | |
| Total | 879 | 3459 | 995 | 3919 | 991 | 3900 | 1118 | 4400 | | |

Table 1. (continued)

| | R. McShane | | P. Burbury | | G. Clarke | |
|-----------|------------|------|------------|------|-----------|------|
| | mm | pt | mm | pt | mm | pt |
| 1969 | | | | | | |
| January | 42 | 166 | 36 | 142 | 38 | 148 |
| February | 105 | 414 | 128 | 503 | 134 | 526 |
| March | 33 | 130 | 45 | 179 | 52 | 205 |
| April | 37 | 147 | 41 | 161 | 40 | 157 |
| May | 107 | 420 | 204 | 802 | 201 | 791 |
| June | 61 | 241 | 21 | 84 | 15 | 61 |
| July | 37 | 145 | 36 | 141 | 37 | 145 |
| August | 72 | 282 | 57 | 224 | 68 | 268 |
| September | 18 | 71 | 21 | 82 | 20 | 80 |
| October | 30 | 119 | 34 | 134 | 46 | 183 |
| November | 77 | 304 | 87 | 342 | 84 | 329 |
| December | 71 | 278 | 84 | 331 | 61 | 242 |
| Total | 690 | 2717 | 794 | 3125 | 796 | 3135 |
| 1968 | | | | | | |
| January | 14 | 56 | 12 | 46 | 13 | 50 |
| February | 19 | 74 | 20 | 80 | 23 | 90 |
| March | 54 | 212 | 45 | 177 | 52 | 203 |
| April | 30 | 117 | 35 | 138 | 32 | 126 |
| May | 48 | 188 | 53 | 209 | 54 | 213 |
| June | 60 | 238 | 48 | 188 | 58 | 227 |
| July | 16 | 64 | 19 | 74 | 16 | 63 |
| August | 47 | 186 | 47 | 185 | 51 | 201 |
| September | 23 | 91 | 22 | 85 | 29 | 113 |
| October | 56 | 222 | 53 | 209 | 49 | 191 |
| November | 53 | 210 | 41 | 160 | 54 | 214 |
| December | 41 | 163 | 52 | 205 | 50 | 196 |
| Total | 463 | 1821 | 446 | 1756 | 479 | 1887 |
| 1967 | | | | | | |
| January | 24 | 93 | 24 | 95 | | |
| February | 7 | 29 | 7 | 26 | | |
| March | 16 | 63 | 16 | 62 | | |
| April | 12 | 48 | 12 | 47 | | |
| May | 13 | 52 | 16 | 62 | | |
| June | 8 | 32 | 9 | 37 | | |
| July | 109 | 431 | 113 | 446 | | |
| August | 95 | 375 | 93 | 367 | | |
| September | 57 | 224 | 64 | 253 | | |
| October | 19 | 74 | 13 | 50 | | |
| November | 43 | 169 | 47 | 187 | | |
| December | 46 | 182 | 53 | 209 | | |
| Total | 450 | 1772 | 468 | 1841 | 432 | 1700 |

Table 1. (continued)

| | 1966 | | | | 1965 | | | | | |
|------------|------------|------|------------|------|------------|------|------------|------|------|------|
| | R. McShane | | P. Burbury | | R. McShane | | P. Burbury | | | |
| | mm | pt | mm | pt | mm | pt | mm | pt | | |
| January | 5 | 21 | 10 | 41 | 74 | 290 | 85 | 333 | | |
| February | 57 | 225 | 65 | 257 | 7 | 27 | 3 | 10 | | |
| March | 94 | 371 | 96 | 378 | 35 | 137 | 44 | 173 | | |
| April | 55 | 216 | 57 | 225 | 185 | 728 | 197 | 775 | | |
| May | 23 | 92 | 22 | 87 | 38 | 149 | 41 | 161 | | |
| June | 14 | 54 | 17 | 65 | 18 | 72 | 11 | 43 | | |
| July | 75 | 296 | 69 | 273 | 19 | 75 | 15 | 61 | | |
| August | 44 | 175 | 44 | 175 | 55 | 217 | 54 | 214 | | |
| September | 103 | 404 | 101 | 396 | 36 | 140 | 41 | 160 | | |
| October | 83 | 325 | 85 | 335 | 20 | 80 | 18 | 70 | | |
| November | 25 | 97 | 27 | 108 | 48 | 190 | 48 | 190 | | |
| December | 47 | 186 | 44 | 172 | 44 | 174 | 44 | 175 | | |
| Total | 625 | 2462 | 638 | 2512 | 579 | 2279 | 601 | 2365 | | |
| | 1964 | | | | 1963 | | | | | |
| | R. McShane | | P. Burbury | | R. McShane | | P. Burbury | | | |
| | mm | pt | mm | pt | mm | pt | mm | pt | | |
| January | 15 | 58 | 14 | 56 | - | - | 58 | 230 | | |
| February | 164 | 645 | 170 | 670 | - | - | 30 | 118 | | |
| March | 54 | 214 | 55 | 217 | 28 | 112 | 47 | 186 | | |
| April | 38 | 148 | 38 | 150 | 6 | 23 | 9 | 38 | | |
| May | 35 | 136 | 37 | 146 | 38 | 150 | 38 | 149 | | |
| June | 70 | 274 | 77 | 303 | 26 | 103 | 22 | 86 | | |
| July | 55 | 215 | 51 | 200 | 55 | 215 | 52 | 204 | | |
| August | 40 | 156 | 43 | 170 | 45 | 176 | 39 | 152 | | |
| September | 40 | 158 | 43 | 169 | 61 | 242 | 57 | 223 | | |
| October | 31 | 121 | 38 | 148 | 49 | 194 | 49 | 194 | | |
| November | 27 | 107 | 38 | 150 | 35 | 138 | 27 | 108 | | |
| December | 70 | 275 | 87 | 343 | 24 | 93 | 20 | 79 | | |
| Total | 637 | 2507 | 691 | 2722 | 367 | 1446 | 449 | 1767 | | |
| P. Burbury | 1962 | | 1961 | | 1960 | | 1959 | | 1958 | |
| | mm | pt | mm | pt | mm | pt | mm | pt | mm | pt |
| | January | 26 | 102 | 14 | 54 | 60 | 238 | 54 | 214 | 14 |
| February | 32 | 126 | 7 | 29 | 12 | 48 | 34 | 134 | 85 | 336 |
| March | 33 | 131 | 32 | 126 | 18 | 69 | 8 | 33 | 29 | 114 |
| April | 35 | 139 | 67 | 265 | 242 | 954 | 66 | 259 | 52 | 203 |
| May | 71 | 281 | 32 | 126 | 116 | 457 | 12 | 47 | 122 | 481 |
| June | 26 | 101 | 23 | 89 | 56 | 222 | 19 | 73 | 29 | 114 |
| July | 101 | 399 | 52 | 206 | 112 | 440 | 38 | 150 | 44 | 173 |
| August | 59 | 233 | 30 | 120 | 33 | 130 | 40 | 157 | 119 | 470 |
| September | 29 | 115 | 29 | 115 | 86 | 337 | 47 | 185 | 27 | 105 |
| October | 91 | 357 | 23 | 92 | 34 | 134 | 39 | 152 | 133 | 523 |
| November | 21 | 81 | 40 | 156 | 51 | 200 | 18 | 71 | 63 | 248 |
| December | 26 | 101 | 24 | 94 | 5 | 21 | 100 | 395 | 116 | 455 |
| Total | 550 | 2166 | 374 | 1472 | 826 | 3250 | 475 | 1870 | 832 | 3276 |

Effect of faulting

Although faults with considerable movements are present which would cause fracturing of the rocks, and increase infiltration, they appear to be located mainly along valleys which are underlain by alluvium. This would tend to act as a seal against infiltration.

CONCLUSIONS

Considerable variations in rock type and physiographic relief will produce wide variations in the rates of infiltration and run-off.

Siting of observation bores

Three observation bores are recommended: two in Triassic sandstone and the other in basalt which would almost certainly pass into Triassic sediments at depth. The one entering basalt is at a higher level and could be expected to show the greatest variation in water levels. The other two are in or near the valley floor.

Rainfall figures taken by various farmers within the catchment and just beyond it are given in Table 1. They show considerable variations from place to place. Some of these variations may be due to the quality of recording but most are probably real.

[28 September 1973]

APPENDIX 1

Seismic survey, Birralee Creek catchment area.

Three seismic spreads were fired at positions where bore holes were recommended for observation of water table fluctuations. Their positions are shown on Figure 29. The widespread distribution of dolerite suggests that it could underlie the Triassic sediments.

Spreads 1 and 2 have coincident shot points at their western ends; Spread 1 having a 3 m, and Spread 2 a 7.6 m, geophone spacing. An extension shot 91 m west of Spread 2 was fired to probe to a greater depth. Interpreted sections are shown on Figure 30 and a summary of the results is given below.

Spread 1

| Velocity (m/s) | Thickness (m) | Depth to Basement (m) | Intpretation |
|-------------------|------------------|--------------------------|---------------------------|
| 275 | 1.2-1.5 | | Soil, loose sand. |
| 610 | 1.5-3 | | Compacted or clayey sand. |
| 1920 | - | 3.7-4.3 | Triassic sediments. |

Spread 2

| | | | |
|------|---------|---------|--|
| 460 | 3 | | Soil and sand. |
| 1220 | 4.6-6.1 | | Wet sand, clayey sand or very weathered rock. |
| 2290 | - | 7.6-9.1 | Triassic sediments. |

The extension shot indicated a seismic velocity for the basement of 2835 m/s which also suggests Triassic sediments to the depth probed. Un-weathered dolerite, if it occurs, is unlikely to be encountered at depths of less than 45-50 m.

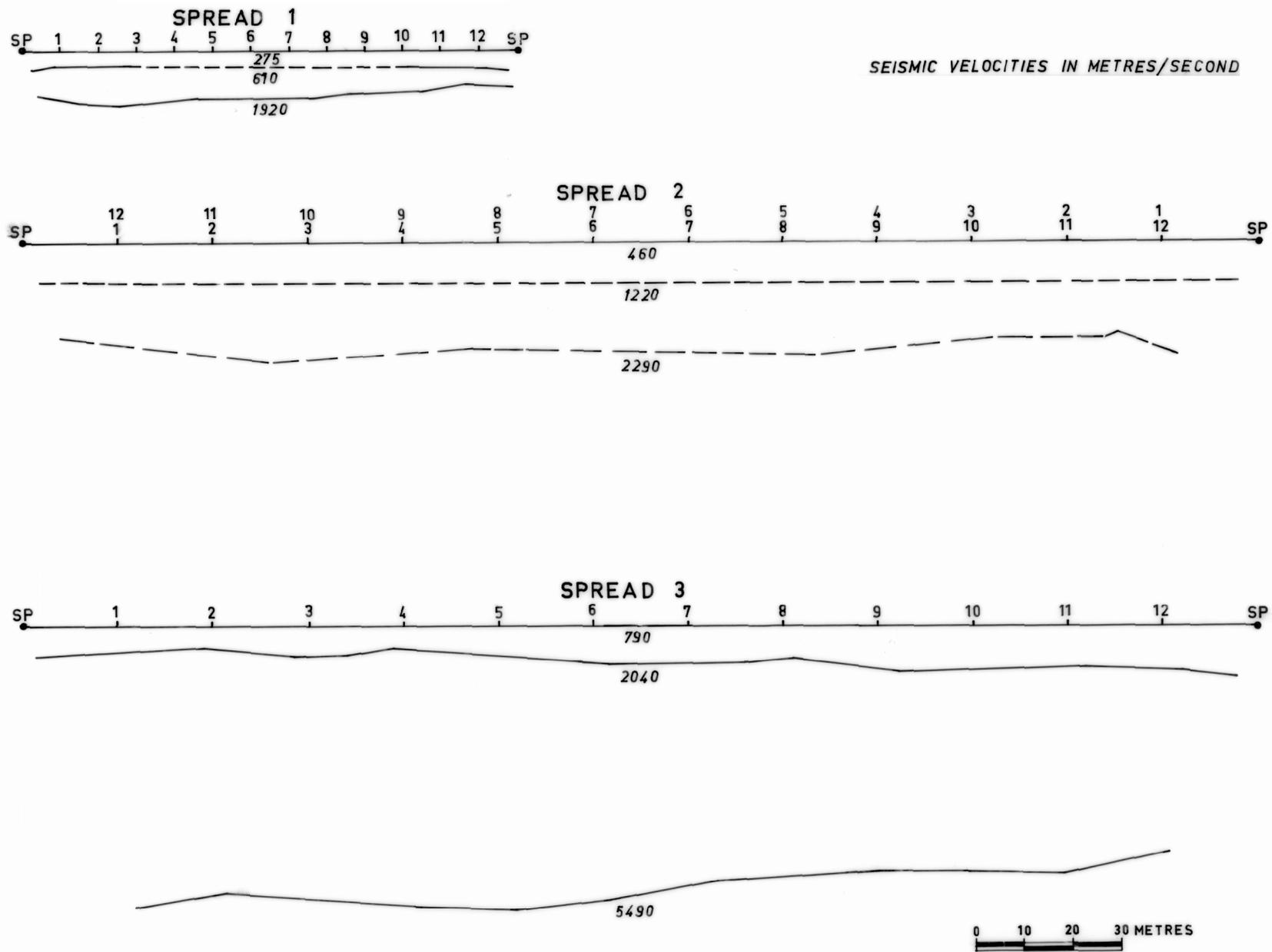


Figure 2. Seismic spreads, Birralee Creek

There are some differences in the ^(HEAD) interpretation of the seismic velocities and layer thicknesses between Spreads 1 and 2. The top layer in Spread 2 (fig. 30) may be the equivalent of the top two layers of Spread 1. The interpretation of the middle layer in Spread 2 is based on data from only two geophones at the west end of the spread. The variation in the velocity for the basement may be due to less weathered rock with less open joints being encountered with deeper probing.

Spread 3 had a geophone spacing of 7.6 m and was fired on both ends with an extension shot 96 m west of the spread. The interpretation is summarised below.

| Velocity (m/s) | Thickness (m) | Depth to Dolerite (m) | Interpretation |
|-------------------|------------------|--------------------------|---|
| 790 | 1.8-3.7 | | Damp sand or clayey sand. |
| 2040 | 15.9-20.7 | | Triassic sandstone and, or mudstone. |
| 5490 | - | 19.5-22.6 | Dolerite. |

CONCLUSIONS

A bore in the vicinity of Spreads 1 and 2 would probably penetrate Triassic sediments for most of its depth *i.e.* at least to 45-50 m and the water table would probably be encountered before these depths were reached.

Dolerite almost certainly underlies the Triassic sediments under Spread 3. The intrusion will have baked and perhaps reduced the porosity of the sediments. The extent of this alteration will depend on the size of the dolerite body. There is a reasonable chance that water would be obtained in the overlying sediments because the nature of the relief suggests that if a water table exists, it would probably be at shallow depth.

[11 January 1974]