

TR18. 126-134

18. Representative basin study: Birralee Creek, eastern Tasmania.

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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

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	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	54
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, Birrale 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

Velocity (m/s)	Thickness (m)	Depth to Basement (m)	Intpretation
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.

Reports 17-19 are concerned with areas investigated at the request of the Rivers and Water Supply Commission as part of the Australian Water Resources Council's Representative Basin Program. The location of the catchment areas is shown in Figure 28.

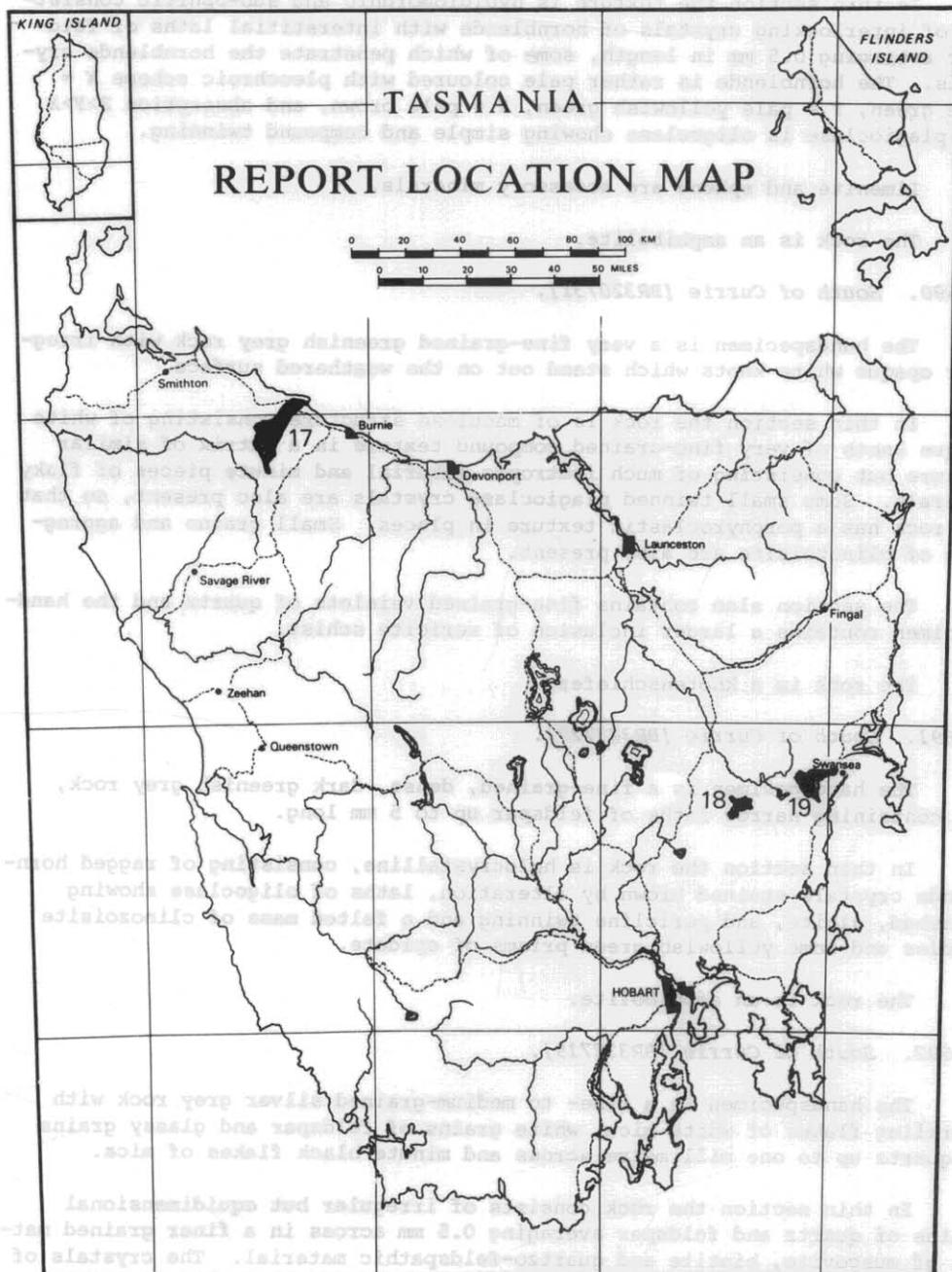
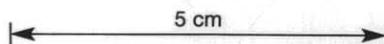


Figure 28. Location of catchment areas: 17 Flowerdale River, 18 Birrallee Creek, 19 Meredith River.



GEOLOGICAL MAP OF BIRRALEE CREEK CATCHMENT AREA.

GEOLOGIST W.L.MATTHEWS. 1973

Scale 1 : 50 000

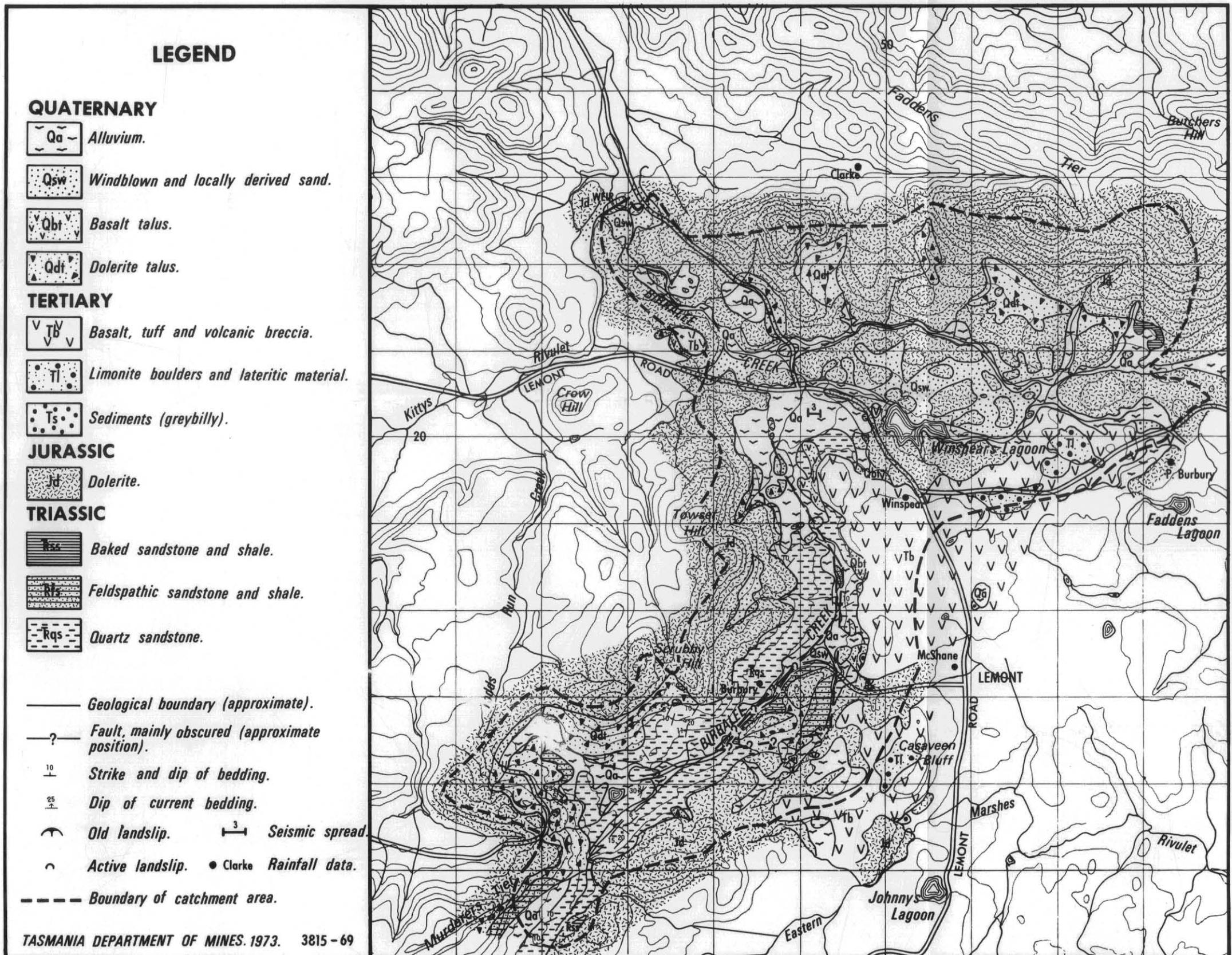


Figure 29.

5 cm

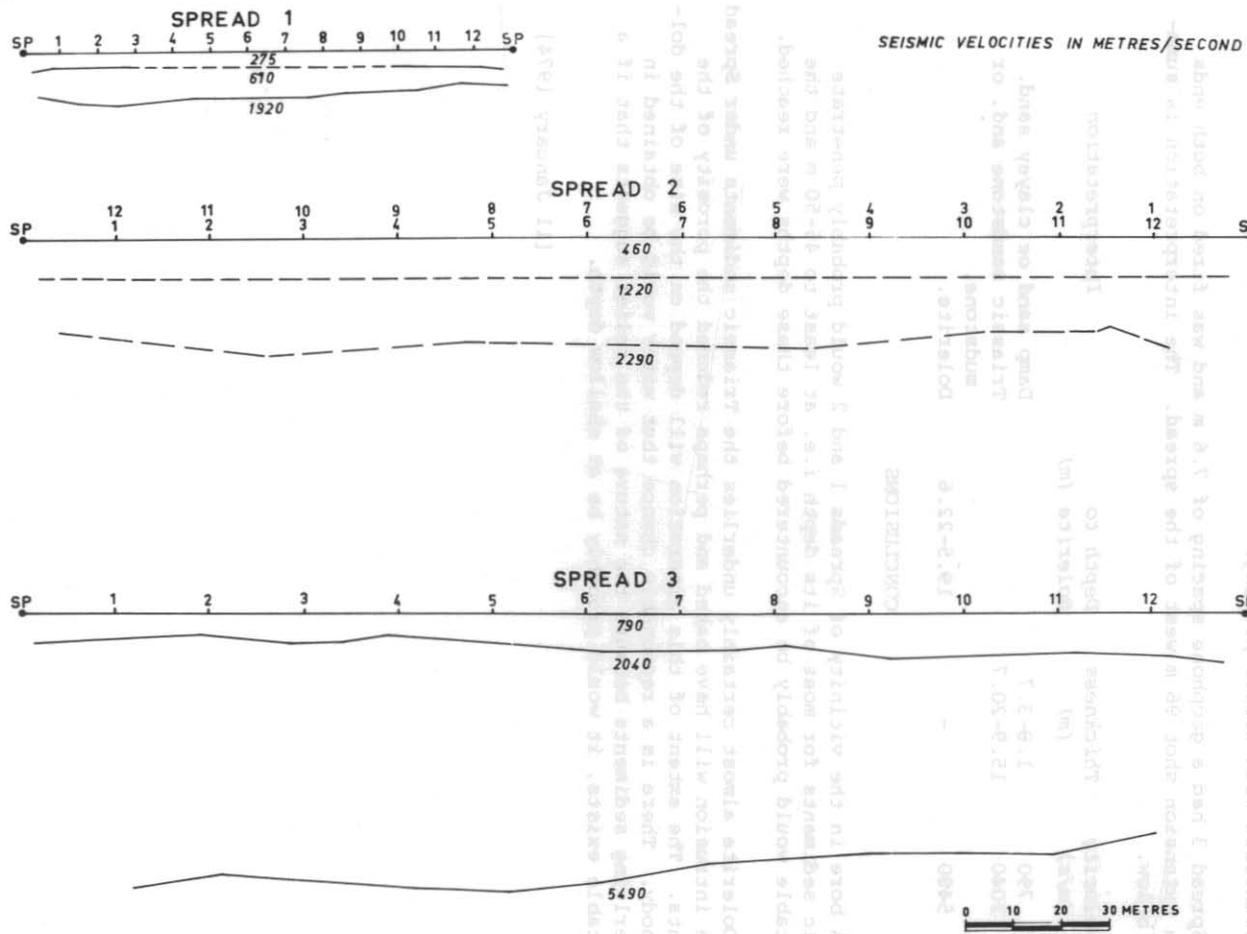


Figure 30. Seismic spreads, Birrale Creek.

There are some differences in the 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]