

Results of diamond drilling at the Patersonia Rivulet dam site

by W. L. Matthews

Five diamond-drill holes have been drilled along the centreline of the proposed dam site on Patersonia Rivulet, about two kilometres north of Nunamara, and the core obtained has been logged. Where possible, water pressure testing was carried out during the drilling, each test being made over a ten-foot length of the borehole; permeabilities have been calculated from these measurements of water losses. If the investigation of the dam site is to be continued a scheme of investigation is suggested.

DETAILS OF DRILLING RESULTS

The position of each drill hole is marked on Figure 1. Holes 1, 3 and 5 were drilled vertically, while holes 2 and 4 were inclined at 45° to the NE and SW respectively, along the axis of the dam.

Hole 1

The first 6-7 feet penetrated dolerite boulders with some clay. Below this level the drill entered Permian rocks which consisted of interbedded grey mudstone, sandy mudstone and minor sandstone bands with mica. Pebbles were noted at some horizons below about 30 feet. Fossils occurred at four main horizons and consisted mainly of bryozoans with some brachiopods in one zone. Calcite was common on joint planes, bedding planes and in the matrix of the coarser grained beds, throughout the Permian. Some thin weathered zones were noted.

Hole 2

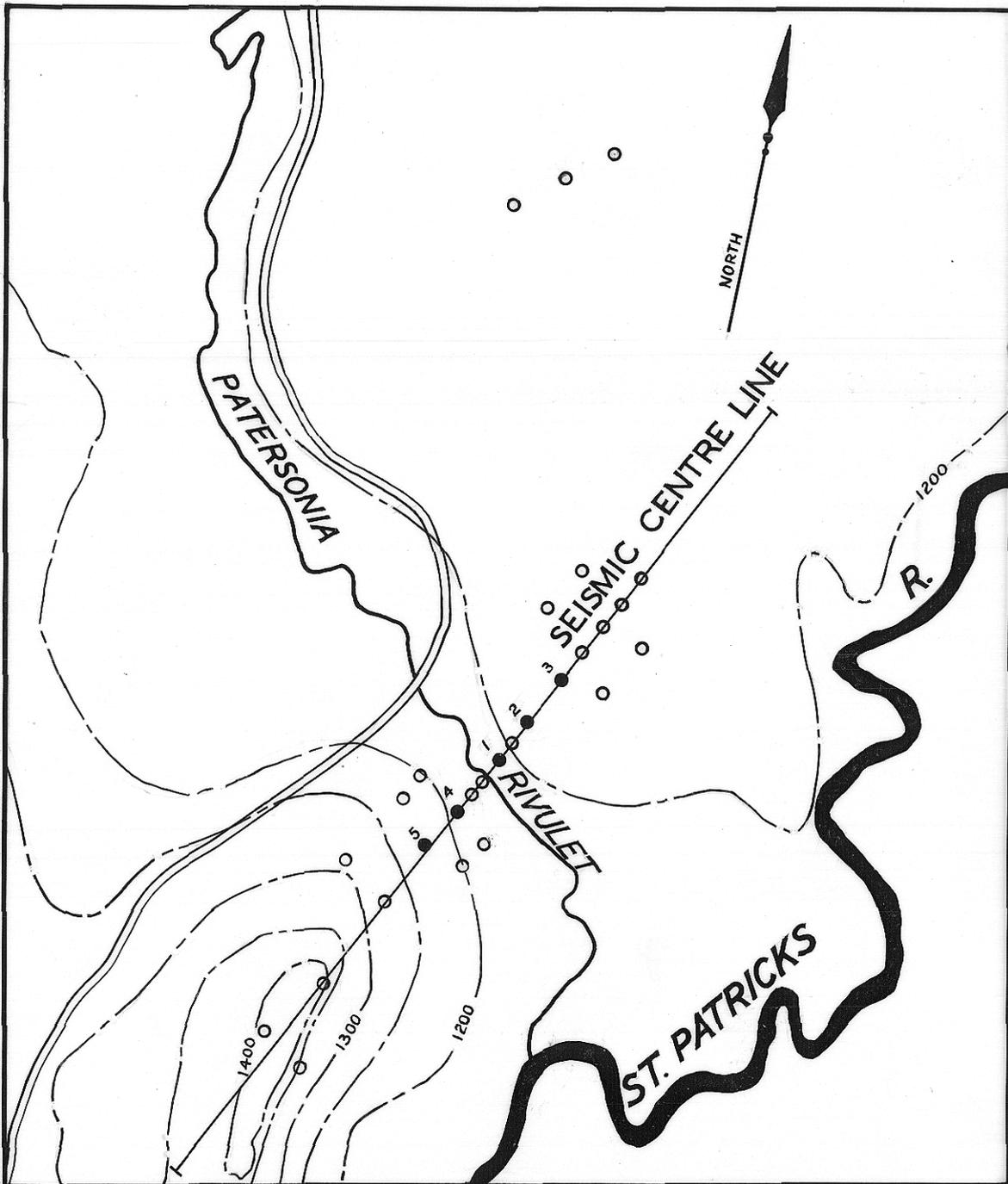
The top 15 feet 7 inches consisted of dolerite boulders, quartz pebbles, sand and clay, the lower part consisting of clay with quartz pebbles which might be weathered Permian rock. Undoubted Permian rocks were entered at about 15 feet 7 inches. As in Hole 1, these rocks consisted of mudstone, sandy mudstone and thin sandstone beds. The upper 39 feet of the core was limonite stained; the lower boundary probably represents the lowest level of the water table. Pebbles and fossils occur at some horizons. Calcite was noted in the lower levels of the holes and a 9 inch thick limestone band occurred at about 72 feet 6 inches.

Hole 3

This hole was commenced in basalt boulders and entered weathered and broken unweathered basalt to about 38 feet. Recovery was poor around this depth but some grey and brown clay was obtained to 42 feet 4 inches at which depth undoubted Permian sedimentary rocks were penetrated. Again mudstone and sandy mudstone with subordinate sandstone beds were encountered which contained pebbles and fossils at some horizons to a depth of about 115 feet 8 inches. Several limestone bands were noted and calcite was common on joints, bedding planes and in the matrix of the coarser grained beds. These rocks were limonite-stained to a depth of about 50 feet. At about 115 feet 8 inches pebbly sandstone was encountered and continued to the bottom of the hole (127 feet 10 inches). Abundant worm tracks characteristic of the Liffey Group occur in the bottom 6-7 feet of the core.

Hole 4

Dolerite boulders, occasional quartz pebbles and dark brown clay were encountered to a depth of 6 feet 6 inches. Undoubted Permian rocks occur below this level to about 74 feet 8 inches and consist of sandstone with subordinate sandy mudstone and mudstone. Pebbles were fairly common throughout and except for the bottom 8-10 feet the beds were fossiliferous. These rocks were stained with limonite to about 32 feet from the surface. Calcite and a little pyrite were noted in parts of this section. Some zones towards the bottom of this section were soft and broken. After 74 feet 8 inches a 3 feet thick band of clay with many glide planes was encountered above mudstone and sandy mudstone. A two inch pyrite nodule occurred towards the bottom of the hole.



- Drill hole
- Proposed drill hole

DEPARTMENT OF MINES—TASMANIA	
PROPOSED DRILL HOLES PATERSONIA DAMSITE	
DATE <i>DECEMBER 1969</i>	0 800 FT.
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REVISIONS	FILE N° 3299

Figure 1

Hole 5

Basalt boulders and weathered basalt were drilled to a depth of about 18 feet followed by a thin band of quartzite, gravelly clay, quartz gravel and dolerite boulders to about 31 feet 6 inches where Permian rocks were encountered. To 73 feet 8 inches the Permian sedimentary rocks consisted of unfossiliferous sandstone, sandy mudstone and mudstone beds. Pebbles and mica were fairly common throughout. Most of the limonite staining ends at 52 feet but some joints are stained to 62 feet. After 73 feet 8 inches richly fossiliferous beds of mudstone, sandy mudstone and limestone were drilled to the final depth of 129 feet. Slip surfaces were noted at several places in this interval as were occurrences of pyrite and lime-rich sections.

The Permian beds consist of interbedded mudstone, sandy mudstone and dirty sandstone, so it has not been possible to correlate individual beds on lithology alone. However there are some thin zones which are richly fossiliferous and it has been possible to make correlations between the three holes on the eastern side of the rivulet on this basis. Measurements of bedding plane dip on core samples indicate an average dip of about 12.5°. The dip direction cannot be determined from the core, but dips measured from outcrops surrounding the dam site area indicate that the regional dip is 12.5° SW and it seems likely that this is the dip direction of the Permian rocks along the axis of the dam. This is confirmed by the correlations made between the drill holes.

Sandstone of the Liffey Group crops out east of Hole 3 and the top of the Liffey Group was struck in this hole. Examination of levels suggests that the Liffey Group dips from these surface outcrops to the bottom of Hole 3 at the regional dip with little or no displacement by faulting. If correlations between holes 3 and 1 are correct, then there is little or no displacement between these holes.

Assuming a dip of 12.5° SW over the whole dam site area, the top Permian bed in Hole 1 would occur about 50 feet below the bottom of Hole 4, so that unless there is a fault between these holes, equivalents of the beds in Hole 1 would not occur in Hole 4. The cores show a little lithological similarity. Assuming again a dip of 12.5° SW and no faults, there should be a considerable overlap between the sequences in holes 4 and 5. Although there are comparable thicknesses of richly fossiliferous beds in the two holes, the lithologies of these beds are markedly different. There are abundant slip surfaces in the cores from these holes and faulting has probably eliminated overlap between the respective sequences.

WATER PRESSURE TESTING

The results of the water pressure testing for each hole are appended. Testing of the upper sections of each hole was not possible with the equipment available, because of the loose nature of the material.

Fairly high permeabilities were calculated for certain sections in several of the holes. In holes 1, 4 and 5, the pump used in the tests did not have the capacity for the recommended pressures to be reached in some sections. During the drilling of Hole 4 there was a section of the hole where there was no water return and in a section of Hole 5 only about 50% of the water returned to the surface. The larger water losses in holes 4 and 5 are probably due to the presence of sandstone, together with fracturing associated with faulting.

All holes finished in rocks which had comparatively low calculated permeabilities.

DISCUSSION OF DRILLING RESULTS

The diamond drilling, together with the auger drilling which was done previously, has shown that the geology of the area differs in some respects from that outlined in the original report. It was thought originally that the dolerite boulders in the area were the result of the weathering of a sill intruding the Permian sedimentary rocks. It has now been established fairly conclusively that these boulders (in the dam site area in particular) are pre-basalt talus deposits in the valley down which the basalt flowed.

In the first interpretation, it was considered that the dam would be built against Permian sedimentary rocks overlain by intruding dolerite, and the investigation of the site as to its suitability as a dam site would be fairly straightforward. The drilling shows that other materials form part of the abutments because the pre-basalt valley extends to lower levels at points on the dam axis than at first thought. To investigate the site completely will therefore require more drilling than was originally envisaged. This drilling should determine

the extent and directions of the lows of the pre-basalt valleys and would also determine the permeability of the material filling these valleys.

FUTURE INVESTIGATIONS

The following work would be required to complete a feasibility study of the dam site.

Drilling in the Permian

The section between holes 1 and 4 is incomplete and in order to determine whether faulting is present two holes, each 80 to 100 feet deep, are suggested; one vertical and one inclined at 45° SW along the axis of the dam.

Further investigation is required upstream and downstream of holes 4 and 5 because of the presence of faulting in this area. Two holes upstream and two holes downstream from the centre line, all inclined at 45° SW, are suggested. These should be deep enough (100–150 ft) so that definite correlations between boreholes can be made in this area.

Some fairly high water losses occurred in Hole 1 and a hole (say 80–100 feet deep), drilled east of Hole 1 and at 45° NE along the axis of the dam, is suggested in order to determine the extent of this leakage.

If no faulting is found between holes 1 and 4 these seven extra holes should be adequate for the investigation of this part of the dam foundations. Water pressure testing would need to be carried out in all holes.

Drilling to investigate pre-basalt valleys

About eight holes would be required to determine the extent and permeability of material filling the pre-basalt valley on the eastern abutment (e.g. four or five holes along the axis, two holes north of the axis and one or two holes south of the axis of the dam). These holes would all need to be drilled into the underlying Permian sedimentary rocks.

Leakage through material filling pre-basalt valleys is unlikely to be as great on the western side of the rivulet as on the east. However the lowest part of the old valley is upstream from the dam site and it appears to cross the axis of the dam southwest of Hole 5. If the valley continues in the direction suggested by the distribution of the basalt (i.e. southwesterly), leakage would probably not be very important because of the long leakage path. If however the valley meanders, or there is a side valley towards the area where landslips were mapped originally, leakage in this area could become important if the material overlying the Permian is very permeable. Four or six holes are suggested in this area and each should be extended into the Permian. It is possible that some *in situ* dolerite might be struck in this area.

There is a possibility that a valley was eroded into the Permian rocks around the fault east of the dam site (F2 on Figure 2). Although the leakage path would be comparatively long, two or three holes are suggested to test whether such a valley exists and whether significant leakage would occur.

Where significant leakages are found to occur from pressure testing, the possibility of grouting should be examined and trial grouting attempted where the country rock is suitable. It seems likely that some of the Permian rocks will require grouting.

Apart from the above drilling requirements, investigations into finding suitable material for the construction of the dam would be required. A suitable quarry site would have to be found and it is expected that at least three or four diamond-drill holes would be required to prove that sufficient material of the required quality is present. If the dam is to have a clay core, suitable material might be present in the dam site but shallow drilling and testing of the material would be necessary to prove this.

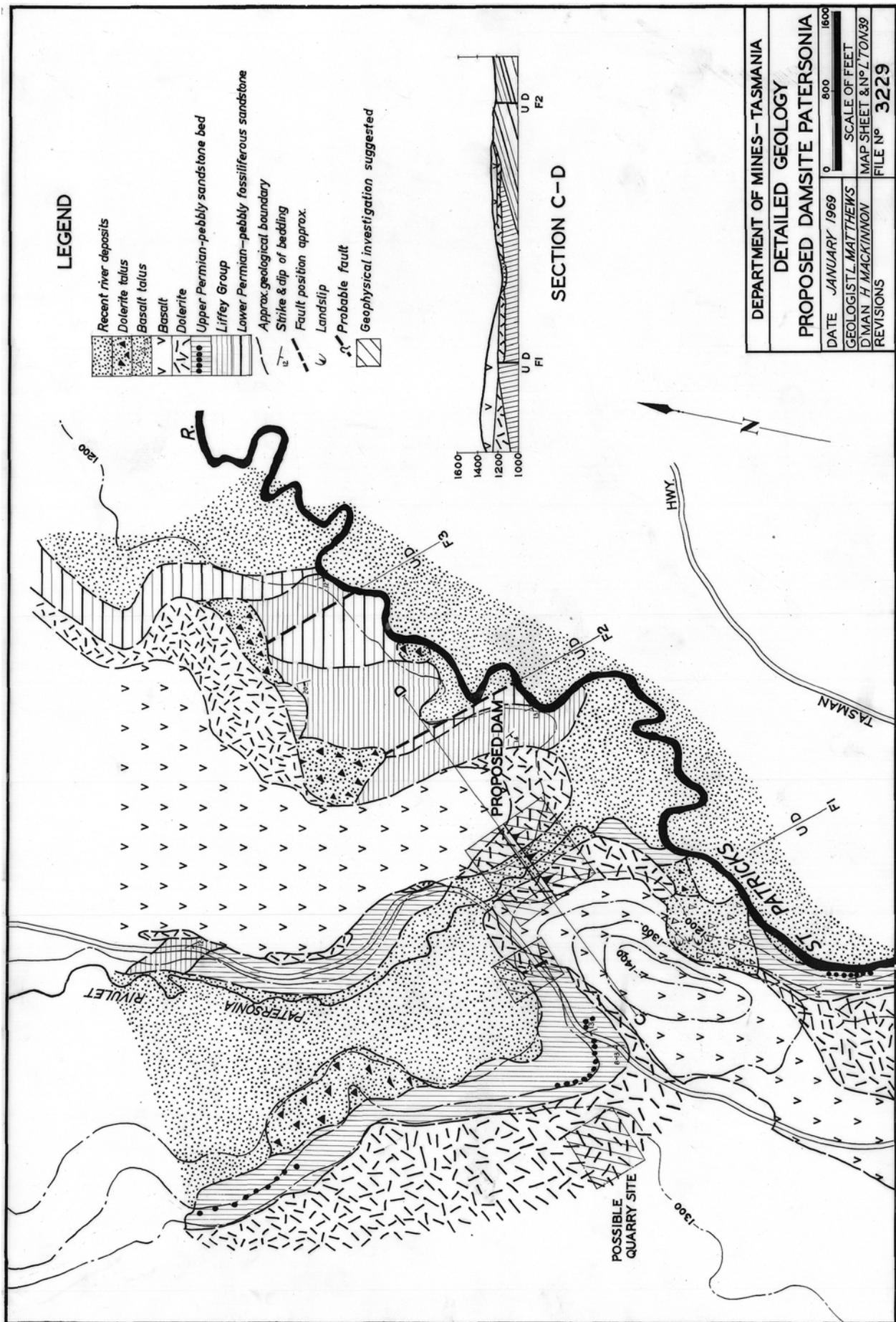


Figure 2

Some attention should be given to other possible problems such as clay seams in the Permian (e.g. the 3 foot seam in Hole 4 which might occupy a fault plane) and limestone in the Permian. Although most of the intersections of limestone are probably through nodules and lenticular deposits of limestone as in other areas, some of the limestone bands in Hole 5 were fossiliferous and could extend for some distance laterally. The possibility of solution of this limestone should be examined.

[24 December 1969]

RESULTS OF PUMP TESTING

Hole 1

Section of hole	Time (mins)	Applied Pressure (lb/in ²)	Water loss (gal)	Water loss (gal/min)	Standing water (feet)	Head (feet/year)	K
9'10" – 19'10"	5	10	1	0.2	2'10"	25.9	45.5
9'10" – 19'10"	5	20	6	1.2	2'10"	49.2	149.5
19'5" – 29'5"	5	15	25	5.0	2'10"	37.5	784.1
19'5" – 29'5"	5	30	48	9.6	2'10"	72.1	783.0
29'5" – 39'5"	5	20	2	0.4	2'10"	49.0	40.0
29'5" – 39'5"	5	40	7	1.4	2'10"	95.2	86.5
39'6" – 49'6"	5	25	33	6.6	4'2"	62.0	625.9
39'6" – 49'6"	5	50	50	10.0	4'2"	119.7	491.3
48'4" – 58'4"	10	25	80	0.0	4'2"	62.0	758.8
48'4" – 58'4"	5	45	57	11.4	4'2"	108.2	619.6
48'4" – 58'4"	5	30	34	6.8	4'2"	73.5	684.8
58'9" – 68'9"	5	35	1	0.2	4'2"	85.1	13.8
58'9" – 68'9"	5	70	1	0.2	4'2"	165.9	7.1
68'11" – 78'11"	5	40	2	0.4	4'2"	96.6	24.3
68'11" – 78'11"	5	80	2	0.4	4'2"	189.0	12.4

Hole 2

Section of hole	Time (mins)	Applied Pressure (lb/in ²)	Water loss (gal)	Water loss (gal/min)	Standing water (feet)	Head (feet/year)	K
22'2" – 32'2"	5	15	3	0.6	-	61.6	57.3
22'2" – 32'2"	5	30	6	1.2	-	96.5	73.1
32'4" – 42'4"	5	20	2	0.4	35'6"	81.7	28.8
32'4" – 42'4"	5	40	5	1.0	35'6"	127.9	46.0
42'4" – 52'4"	5	25	20	4	35'6"	93.4	251.9
42'4" – 52'4"	5	50	36	7.2	35'6"	151	280.3
52'4" – 62'4"	5	30	2	0.4	35'6"	104.8	22.5
52'4" – 62'4"	5	60	2	0.4	35'6"	174.1	13.5
61'3" – 71'3"	5	35	1	0.2	35'6"	116.4	10.1
61'3" – 71'3"	5	70	3	0.6	35'6"	197.2	17.9
70'0" – 80'0"	5	40	3	0.6	35'6"	127.9	27.6
70'0" – 80'0"	5	80	5	1.0	35'6"	220.3	26.8
80'8" – 90'8"	5	90	14	2.8	35'6"	253.4	65.0

Hole 3

Section of hole	Time (mins)	Applied Pressure (lb/in ²)	Water loss (gal)	Water loss (gal/min)	Standing water (feet)	Head (feet/year)	K
47'7" – 57'7"	5	30	1	0.2	22'6"	91.8	12.8
47'7" – 57'7"	5	60	3	0.6	22'6"	161.0	21.9
56'9" – 66'9"	5	35	2	0.4	22'6"	103.5	22.7
56'9" – 66'9"	5	70	3	0.6	22'6"	184.3	19.1
66'9" – 76'9"	5	40	27	5.4	38'6"	131.0	242.3
66'9" – 76'9"	5	80	31	6.2	38'6"	223.4	163.2
74'6" – 84'6"	5	45	6	1.2	38'6"	142.6	49.5
74'6" – 84'6"	5	85	9	1.8	38'6"	241.9	43.9
83'0" – 93'0"	5	45	1	0.2	48'0"	152.0	7.7
83'0" – 93'0"	5	90	2	0.4	48'0"	265.9	8.9
93'1" – 103'1"	5	50	1	0.2	48'0"	163.5	7.2
93'1" – 103'1"	5	100	1	0.2	48'0"	279	4.2
104'7" – 114'7"	5	50	1	0.2	48'0"	163.5	7.2
104'7" – 114'7"	5	100	2	0.4	48'0"	279	8.4
114'10" – 124'10"	5	50	2	0.4	48'0"	163.5	14.4
114'10" – 124'10"	5	100	3	0.6	48'0"	279	12.7

Hole 4

Section of hole	Time (mins)	Applied Pressure (lb/in ²)	Water loss (gal)	Water loss (gal/min)	Standing water (feet)	Head (feet/year)	K
13'0" – 23'0"	5	10	3	0.6	1'3"	24.4	144.6
13'0" – 23'0"	5	20	4	0.8	1'3"	47.5	99.0
23'4" – 33'4"	5	15	24	4.8	1'3"	35.9	786.1
23'4" – 33'4"	5	30	27	5.4	1'3"	70.6	449.8
33'2" – 43'2"	5	20	2	0.4	18'0"	64.2	36.6
33'2" – 43'2"	5	40	7	1.4	18'0"	110.4	74.6
43'6" – 53'6"	5	25	56	11.6	18'0"	75.8	899.9
43'6" – 53'6"	5	25	58	11.6	18'0"	75.8	899.9
52'0" – 62'0"	15	25	171	11.4	30'4"	88.1	760.8
62'3" – 72'3"	15	25	160	10.7	30'4"	88.1	714.1
71'4" – 81'4"	15	25	172	11.5	30'4"	88.1	767.5
80'2" – 90'2"	5	45	6	1.2	30'4"	134.4	52.5
80'2" – 90'2"	5	90	11	1.8	30'4"	238.3	44.4

Hole 5

Section of hole	Time (mins)	Applied Pressure (lb/in ²)	Water loss (gal)	Water loss (gal/min)	Standing water (feet)	Head (feet/year)	K
20'5" – 30'5"	5	5	7	1.4	–	60.2	136.8
20'5" – 30'5"	5	30	26	5.2	–	94.8	322.4
30'7" – 40'7"	5	20	21	4.2	38'9"	81.7	302.3
30'7" – 40'7"	5	40	35	7.0	38'9"	127.9	321.7
40'8" – 50'8"	5	25	17	3.4	38'9"	96.5	207.2
40'8" – 50'8"	5	50	50	10.0	38'9"	154.3	381.2
50'10" – 60'10"	5	30	9	1.8	43'0"	112.3	94.3
50'10" – 60'10"	5	60	13	2.6	43'0"	181.6	84.2
60'10" – 70'10"	5	35	43	8.6	42'0"	122.9	411.6
60'10" – 70'10"	5	70	60	12.0	42'0"	203.7	346.4
70'10" – 80'10"	5	10	60	12.0	51'0"	74.1	952.3
79'0" – 89'0"	5	40	7	1.4	51'6"	144.0	57.2
79'0" – 89'0"	5	80	15	3.0	51'6"	236.4	74.6
90'7" – 100'7"	5	50	34	6.8	51'6"	190.1	210.4
90'7" – 100'7"	5	65–85	44	8.8	51'6"	213.3– 253.9	242.5– 263.8
100'9" – 110'9"	5	50	14	2.8	51'0"	166.5	78.6
100'9" – 110'9"	4	100	20	5.0	51'0"	282.0	104.3
110'4" – 120'4"	5	50	6	1.2	51'0"	166.5	42.4
110'4" – 120'4"	5	100	18	3.6	51'0"	282.0	75.1
119'0" – 129'0"	5	50	2	0.4	51'0"	166.5	14.1
119'0" – 129'0"	5	100	3	0.6	51'0"	282.0	12.0