RB 52/20

DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY

EXPLORATION SECTION

INSTRUMENTS AND TECHNIQUE USED IN

RADIOACTIVE TRACER TESTS AT CHOWILLA DAMSITE

by

J. E. Webb

Senior Geophysicist

Rept. Bk. No. 52/20
G.S. No. 1917
D.M. 1286/60

1st February, 1961.

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Department of Mines
South Australia

Report on

INSTRUMENTS AND TECHNIQUE USED IN RADIOACTIVE TRACER TESTS AT CHOWILLA DAMSITE

SUMMARY

In a permeability test conducted between bores at the Chowilla Dam Site, radioactive iodine was used as one method of tracing the water flow, however the tracer did not follow the expected path. A description of the conduction of the experiment is given with recommendations for future tests.

INTRODUCTION

At the request of the Senior Geologist, Uranium & Fuel Section, the Geophysics Section participated in a radioactive tracer test of permeability at the Chowilla Damsite (see plan No. 61-39 for location). This Section was required to supply detection equipment with operators to work in conjunction with Mr. Roy Ellis of the Atomic Energy Commission who also supplied detection equipment.

The analysis of the test results is given in an appendix by G. Crawford to a report by Johnson, Hiern & Steel (41/136).

The purpose of this report is to place on record details of the equipment used, the difficulties experienced and to propose recommendations for future tests. The other test conducted in conjunction with the tracer tests didnot concern the Section and are not discussed.

EQUIPMENT USED

The test was conducted in a set of 4 boreholes approximately 50 ft. deep, twenty feet from the injection bore to the 1st test bore then 10 feet to the 2nd test bore and a further ten feet to the pumped bore. (See plan No. 61-39).

Three identical ratemeters equipped with scintillometer probes and supplied by the Atomic Energy Commission were used in the three test holes while a scintillometer with a 5" diameter crystal two inches thick was mounted over the discharge hose and connected to a recording milliampmeter. A La Roe hand scintillometer was used for general monitoring purposes. Health monitors were operated by R. Ellis of the Atomic Energy Commission and A. Wilson of the S.A. Department of Health as personnel safety checks while dosage badges were issued to all personnel in close contact with the test.

CONDUCTION OF TEST

Plan No. 61-39 shows the location of the test and the layout of the test holes. The radioactive iodine was injected into bore No. 1 by crushing the glass container in a steel vessel and pouring the liquid into the hole (using tongs for all operations). Tritium and 200 gallons of water containing fluorescein and Sodium Nitrate were poured into the hole at the same time to flush all the materials through the screen at the bottom of the hole.

Scintillometer probes were lowered to the bottom of bores Nos. 2, 3 & 4 and these were read at intervals of approximately one hour on a 24 hourly basis.

The pump installed on Bore No. 4 had established equilibrium prior to the injection and continued to pump continuously throughout the test except for very short periods for maintenance and one short test period mentioned later.

The recording scintillometer over the outlet hose was not to be used until the first indication was received at No. 2 bore.

RESULTS

Contrary to expectations, the first indication of activity was measured in No. 4 bore approximately 51 hours after injection (See plan No. 61-40), this increase persisted and was checked by traversing across the outlet hose with the hand scintillometer. Assimilar indications had not been

obtained in the other holes, the probes in Nos. 2 & 3 bores were raised to log the bore with readings at two feet intervals. High intensity zones were obtained at approx. depths of 3 feet and 13 feet in both bores indicating that the radioactive material was following a more shallow path than anticipated. (See Log for Nos. 2 & 3 holes on 7th October).

As a further check the pump was stopped and No. 4 bore logged. The reading rose to 1000 cpm and in the first 3 feet from the bottom and stayed at this reading to the surface. The probe was relowered to the bottom of No. 4 bore and the pump restarted. The reading of 70 at the bottom of the bore No. 4 increased on raising the probe two feet while pumping was in progress. These results suggested that the probe was in a backwater at the bottom of the bore, being bypassed by the radioactive effluent.

As it was obvious that the tracer material had not followed the required path the test was concluded at midnight on the 7th October. For the last six hours of the test the probes in bores Nos. 2 & 3 were raised to give a maximum reading and the probe in bore No. 4 was raised. to the inlet of the pump hose.

The bores were relogged on 13th & 14th October as a check on the condition of the ground one week after the test. The results were essentially the same as during the test for bore Nos. 2 & 3. While the comparison cannot be made for bore No. 4 because of detailed logs could not be taken during the test, the "dead" area in the bottom three feet of the hole is obvious.

RECOMMENDATIONS ON THE OPERATION OF FUTURE TESTS

1. The injection of the radioactive iodine should be made by breaking the container in the injection bore adjacent to the beds under test without any subsequent flushing. Precaution should be taken to ensure that leakage paths up the outside of the casing do not exist (by cementing etc.) This is mentioned in a letter from R. Ellis (D.M.1286/60 dated 21st November, 1960).

2. The intermediate test bores must be radioatively logged at intervals of one hour and should be deeper than both the injection and pumped bores to allow a check on the possibility of the radioactive material travelling under the "test" bed.

3. The probe in the pumped bore must be suspended above the perferations in the casing and below the pump inlet hose so that the effluent flows past it. The outlet bore should be probed once per day (say during maintenance stop) to ensure against flow of radioactive water from other beds. This probe should be connected to a recorder.

4. The scintillometer over the outlet hose should operate from the start of the test and be connected to a recorder, preferably a multipen recorder so that both this instrument and the probe in the pumped bore record on the same chart.

5. A hand scintillometer (e.g. La Roe) should be used to traverse across the outlet hose at 2 to 3 hour periods as a check on the recording meters by establishing the radioactive level in the hose in relation to the surrounding background activity.

CONCLUSION

Although the test at Chowilla did not test the permeability of the required beds, it did provide some valuable figures for calculations (See Crawford) but of greater value it showed the precautions which must be taken in future tests.

I consider that the Geophysics Section is equipped to conduct similar tests without equipment from the Atomic Energy Commission. However expert assistance on the handling of the radioactive material would be required.

J. E. WEBB
SENIOR GEOPHYSICIST
EXPLORATION

UEW:CERF
1/2/61

REFERENCE

JOHNSON, W, HIERN, M.N. & STEEL, R.D. : Chowilla DamSite - Geological Investigation, G.S.1875, Rept. Bk. 41/136 with appendices by Crawford, G.J. on Permeability Testing.

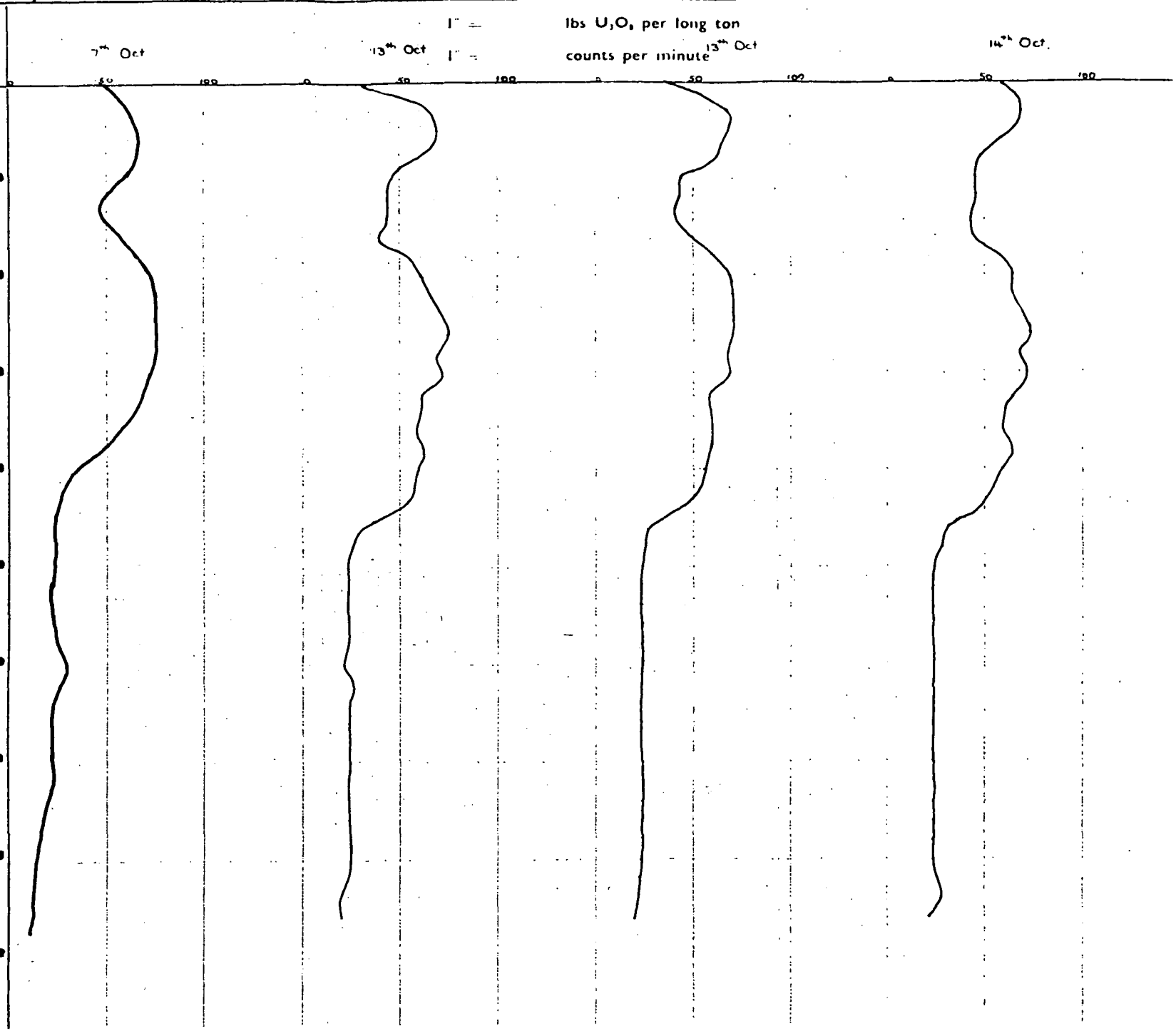
ELLIS, W.R. Private letter to W. Johnson, 21st November. (D.M.1286/60)

S.A. DEPARTMENT OF MINES

RADIOMETRIC BORE LOG

Location CHOWILLA DAMSITE (Renmark) Hole No. 2 Date 1960

Geological Log	Assays in lbs per long ton: Chem. core	Assays in lbs per long ton: Rad. core	Average radiometric counts/minute for intervals of 5 feet



S.A. DEPARTMENT OF MINES

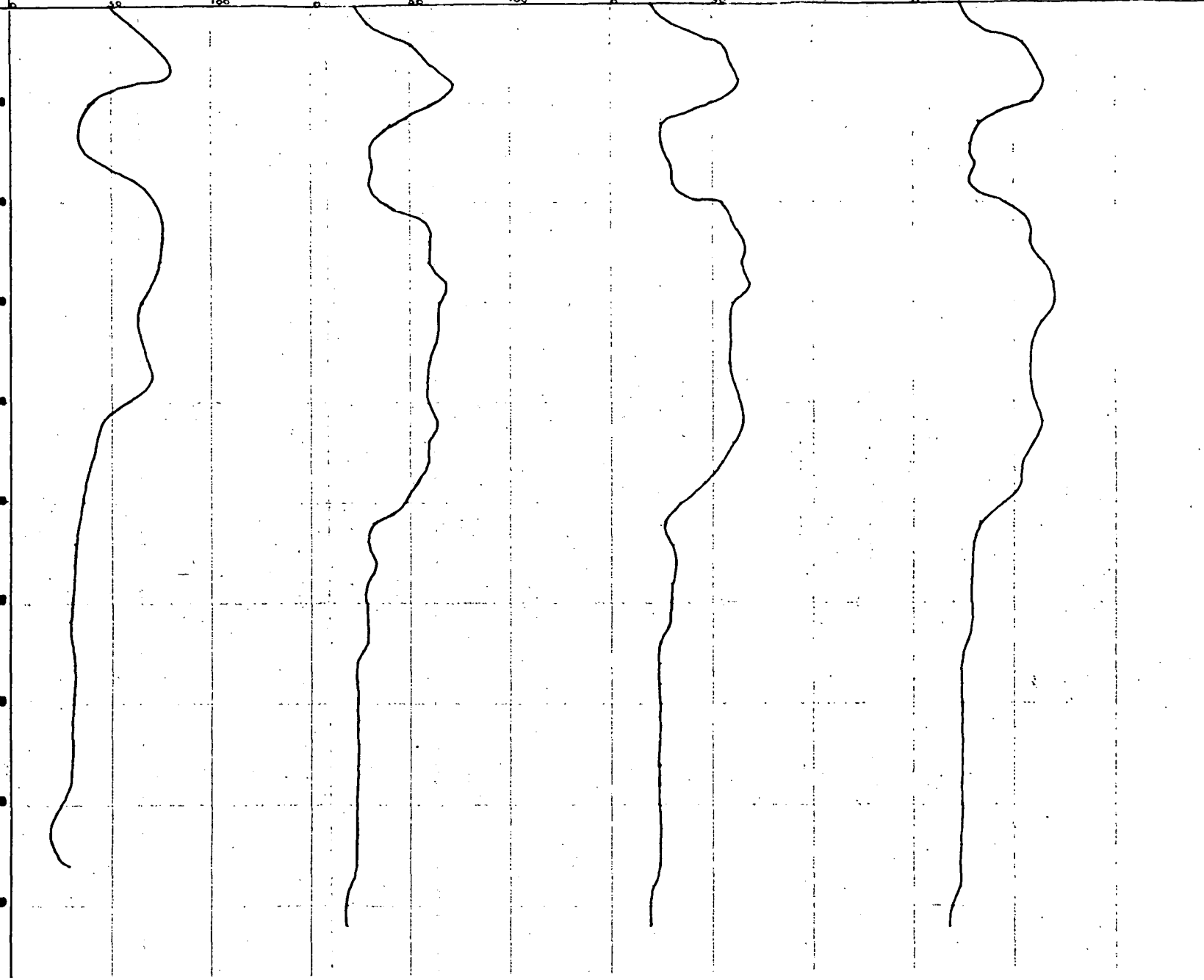
RADIOMETRIC BORE LOG

Location CHOWILLA DAMSITE (Renmark) Hole No. 3 Date 1960

Geological Log	Assays in lbs per long ton: Chem. core	Assays in lbs per long ton: Rad. core	Average radiometric counts/minute for intervals of 5 feet

1" — lbs U_3O_8 per long ton

1" — counts per minute



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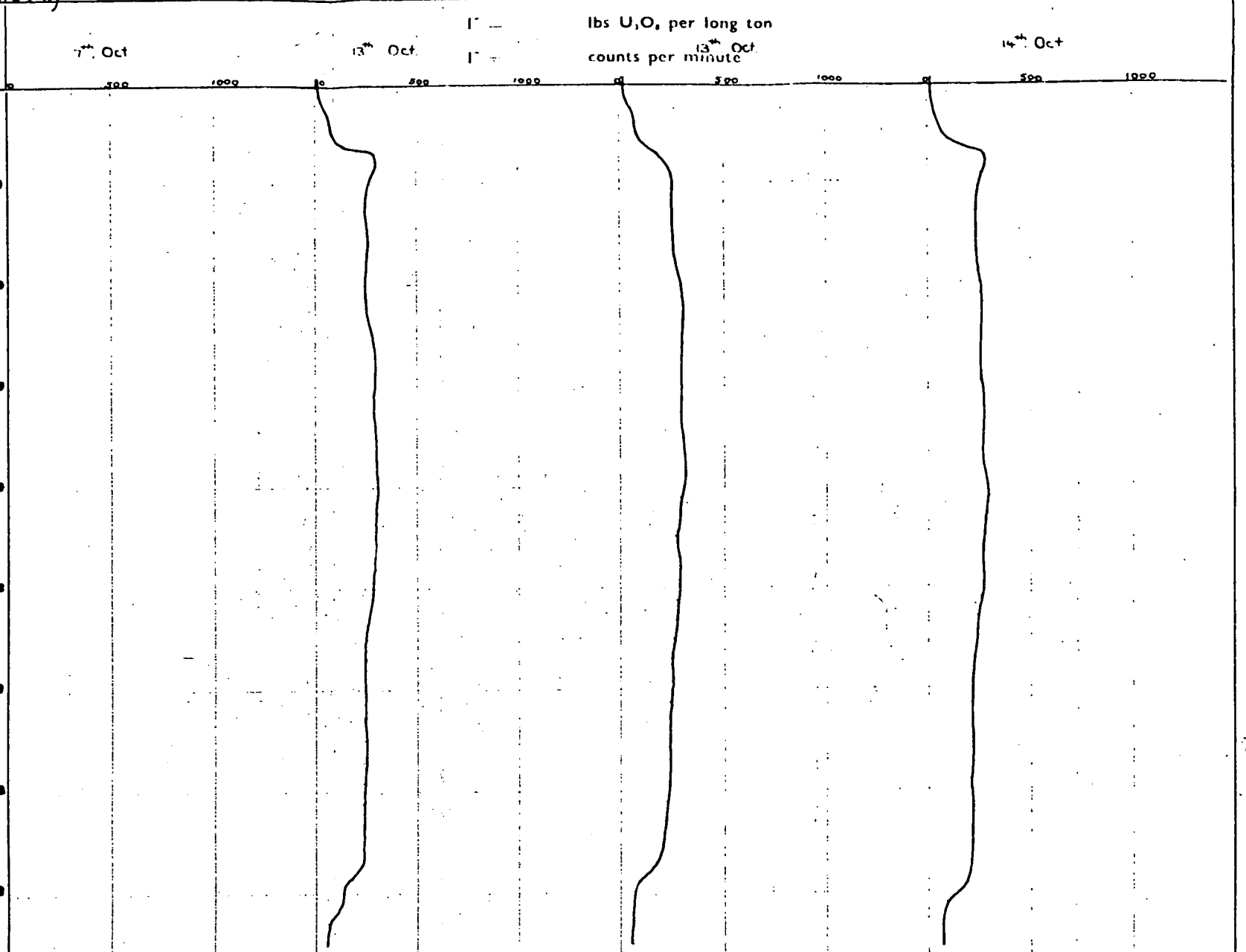
RADIOMETRIC BORE LOG

Location CHOWILLA DAMSITE (Renmark) Hole No. 4 Date 1960

Geological Log	Assays in lbs per long ton: Chem. core	Assays in lbs per long ton: Rad. core	Average radiometric counts/minute for intervals of 5 feet
			5
			10
			15
			20
			25
			30
			35
			40
			45



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RADIOMETRIC BORE LOG

Location CHOWILLA DAMSITE (Renmark) Hole No. 2 Date 1960

Geological Log	Assays in lbs per long ton		Average radiometric counts/ minute for intervals of 5 feet
	Chem. core	Rad. core	

1" = lbs U_3O_8 per long ton

1" = counts per minute

7th Oct. 13th Oct. 13th Oct. 14th Oct.

0 50 100 0 50 100 0 50 100 0 50 100

5 10 15 20 25 30 35 40 45 50

Approved	Passed	Scale	Remarks
		Date	

S.A. DEPARTMENT OF MINES

RADIOMETRIC BORE LOG

Location CHOWILLA DAMSITE (Renmark) Hole No. 3 Date 1960

Geological Log	Assays in lbs per long ton: Chem. core	Assays in lbs per long ton: Rad. core	Average radiometric counts/ minute for intervals of 5 feet

1" = lbs U_3O_8 per long ton

1" = counts per minute

7th Oct. | 13th Oct. | 13th Oct. | 14th Oct.

0 50 100 | 0 50 100 | 0 50 100 | 0 50 100

5 10 15 20 25 30 35 40 45 50

Approved	Passed	Scale	Remarks
Director		Date	

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RADIOMETRIC BORE LOG

Location CHOWILLA DAMSITE (Renmark) Hole No. 4 Date 1960

Geological Log	Assays in lbs per long ton: Chem. core	Assays in lbs per long ton: Rad. core	Average radiometric counts/ minute for intervals of 5 feet

1" = lbs U_3O_8 per long ton

1" = counts per minute

7th Oct. | 13th Oct | 13th Oct. | 14th Oct.

0 500 1000 | 0 500 1000 | 0 500 1000 | 0 500 1000

5 10 15 20 25 30 35 40 45 50

Approved	Passed	Scale	Remarks
Director		Date	

KEY

——— Hole 2

..... " 3

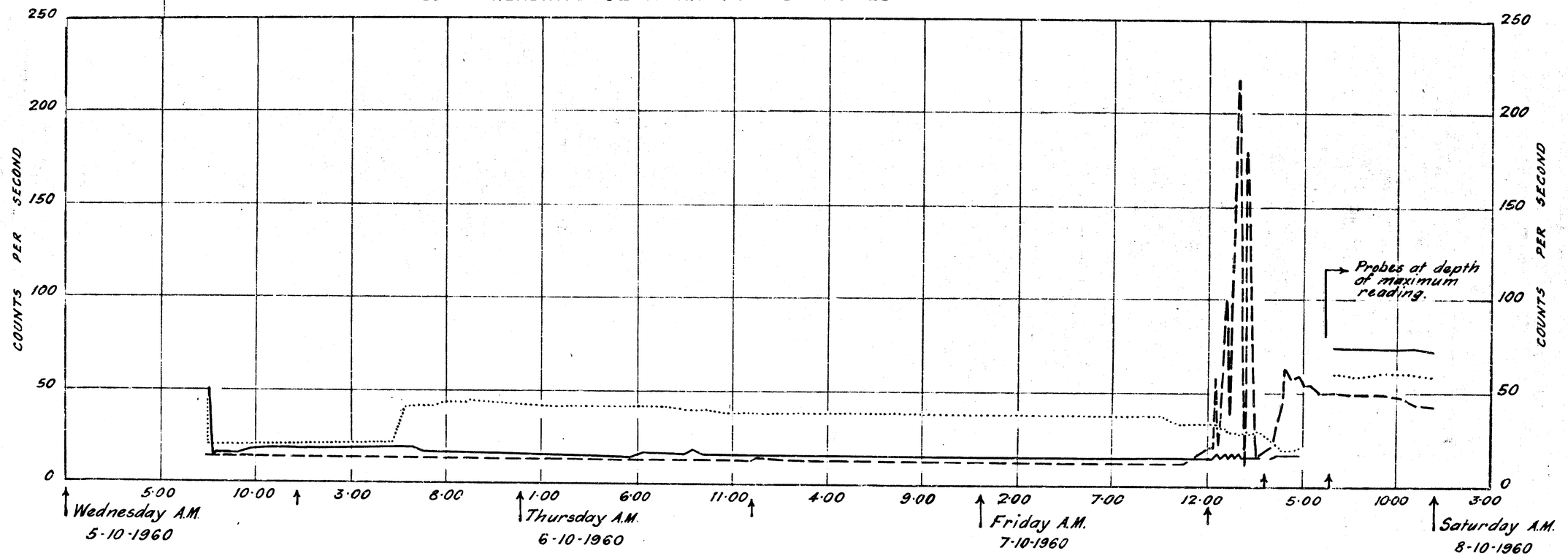
— — — " 4

CHOWILLA DAM SITE

RADIOACTIVE TRACER PERMEABILITY TEST

3 - 14 October 1960

PLOT OF READINGS OBTAINED IN TEST BORES



To accompany report by J. Webb.

S.A. DEPT OF MINES.

61-40
G+J

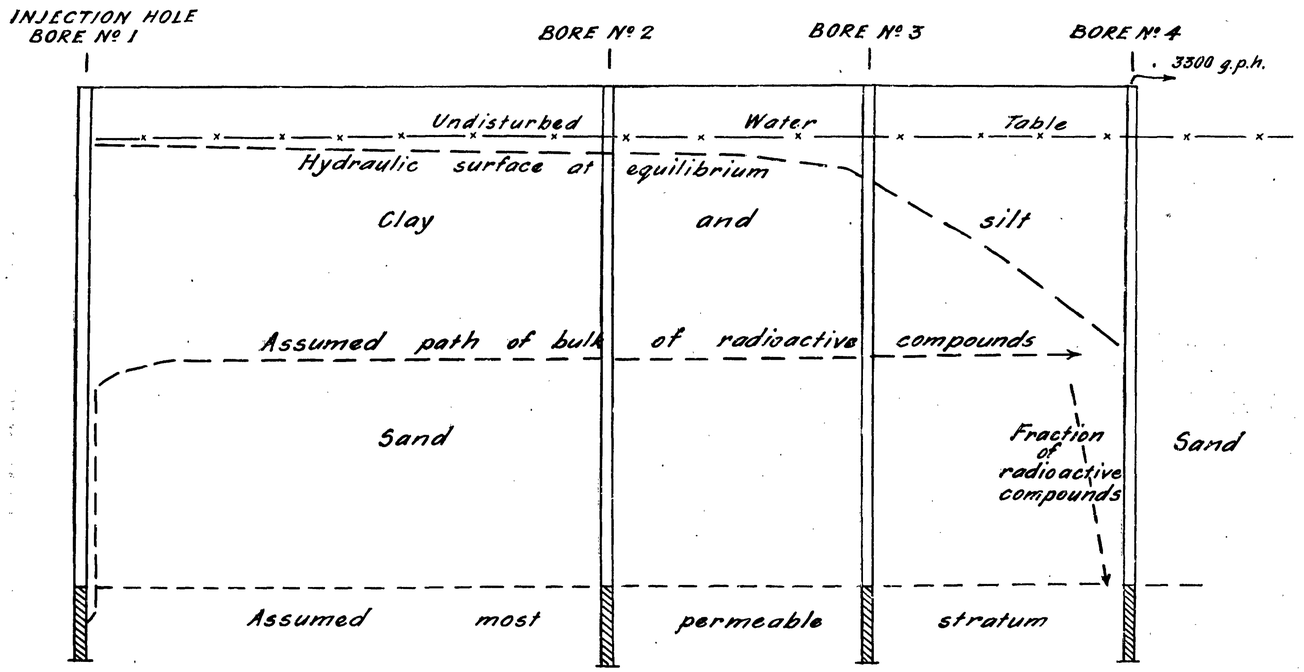
S.A. DEPARTMENT OF MINES

CHOWILLA DAM SITE
RADIOACTIVE TRACER
PERMEABILITY TEST
3 - 14 October 1960

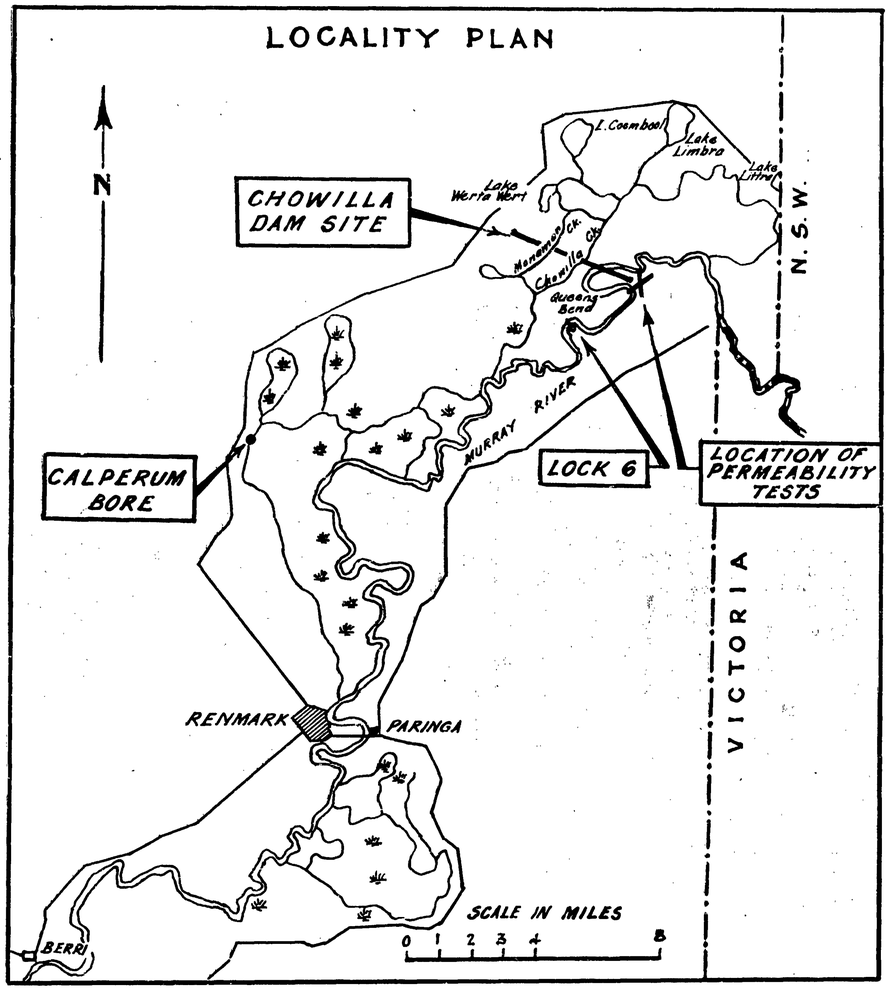
Approved | Passed | Drn. | Tcd. R.R. | Ckd. | Exd. | Scale: | 61-40 G+J | Date 24-1-61

Director

No. | Amendment | Exd. | Date



SCALES: Vert. 10 feet to 1 inch.
Hor. 5 feet to 1 inch.



CHOWILLA PERMEABILITY TESTS
TRACER PATTERN

To accompany report by J. Webb.

S.A. DEPT OF MINES

61-39
G+J

S.A. DEPARTMENT OF MINES
CHOWILLA PERMEABILITY TESTS
TRACER PATTERN

Scale: As shown.	61-39 G+J
Drn.	
Tcd. R.R.	
Ckd.	
Exd.	
Date 24-1-61	
Passed	
Approved	
Director	

No.	Amendment	Exd.	Date