DEPARTMENT OF MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1976/32

SUBSURFACE INVESTIGATION FOR PROPOSED RECLAMATION OF JERRABOMBERRA CREEK FLATS, A.C.T., 1973

P.D. Hohnen and J.P. Ceplecha

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by

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SUMMARY

At the request of the National Capital Development Commission, the Bureau of Mineral Resources investigated the engineering geology of the proposed area for land-fill reclamation at Jerrabomberra Creek flats. Core drilling and permeability testing of soils were carried out at 14 sites. Investigations indicate that refuse emplaced at the Kingston dump is probably in hydrologic continuity with Lake Burley Griffin. It is recommended that low-permeability fill be compacted on top of the more permeable sediments at the bottom of the excavation before the refuse is placed; this procedure will prevent the movement of leachate from the refuse into the underlying aquifers. Compaction during emplacement of refuse is required, to provide adequate foundations for light industrial buildings.

INTRODUCTION

In 1972, the National Capital Development Commission (NCDC) and the Department of the Interior (now Department of the Capital Territory) were considering using pulverised garbage as fill for the reclamation of four sites on Jerrabomberra Creek flats (Fig.1, Pl.1). It was proposed to extend the light industrial area at Fyshwick eventually into the reclaimed areas.

The BMR investigation followed a request for advice on the suitability of the area for the proposed reclamation technique. The investigation was concerned with groundwater levels, the movement of groundwater, the nature of the sediments on the flats and their permeabilities, and the likelihood of pollution of Lake Burley Griffin. The investigation comprised core drilling of soils at 14 sites (Pls. 1 & 3), soil permeability tests by bailing and recording recovery rates (van Bavel & Kirkham, 1948), and airphoto-interpretation of the flood-plain surface.

BMR produced a short technical report in April 1973 on the subsurface conditions and made recommendations for further work. The technical report forms the basis of this Record.

SOILS

Beneath the Jerrabomberra Creek flats the soils, including alluvium and wind-blown material, consist of irregular lenses of clay, sand, and gravel (Pls. 2 & 3). Low-permeability soils, 300-500 m west of the creek, consist of inorganic, organic, and fat clays, which allow ponding of water on their surface (Pls. 2 & 3). High-permeability sands and gravels with a few fines are interbedded with soils of lower permeability, such as clayey silts, sandy clays, and sand-clay mixtures.

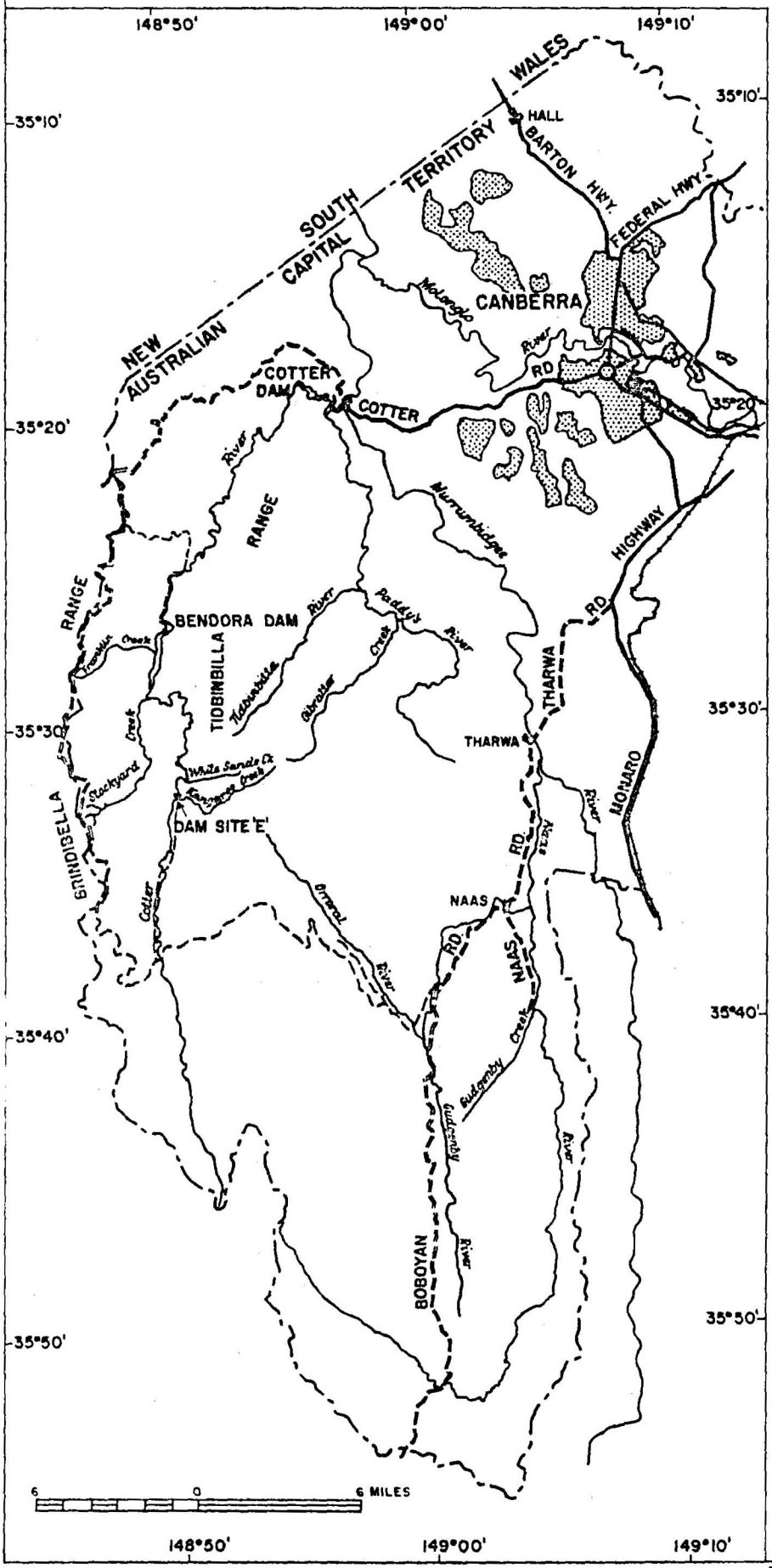
Aerial photographs flown in 1944, and topographic maps surveyed in 1941, 1956 and 1961, show a stream meandering across Site 2 (Plate 1). This stream has subsequently been filled with sediment, but its former location is indicated by a marsh. The greater thickness of alluvium intersected by holes F17, 21, 22, 23, and 24 is attributed to deposition of sediment along former courses of Jerrabomberra Creek and its tributaries (Pl.1) during Quaternary and Holocene times.

LOCATION MAP

Fig 1

Jerrabomberra Creek Flats, Reclamation Area

(see also Plate 1)



155/A16/1555

To accompany Record 1976/32

GROUNDWATER HYDROLOGY

Aquifers near Jerrabomberra Creek are mostly unconfined or water-table aquifers, but on both banks of the creek the aquifers are confined by clay deposits (Pls. 2 & 3).

The permeability of aquifers intersected by 7 of the holes ranged up to 1 cm/day. This means that average transmissivities of the multi-layered aquifers near Jerrabomberra Creek are of the order of 400 cm^2/day. These figures are much lower than expected, considering the grainsize and grading of the aquifers, and may be attributable to a smear of clay on the walls of auger holes. Since the aquifers were deposited by former courses of Jerrabomberra Creek and its tributaries, the aquifers will be long and narrow, i.e. of the 'shoe-string' type. It is unlikely that the auger holes would have intersected the most permeable portions of such an aquifer, and the permeability figures given above are likely to be average values for aquifers within the alluvium. Permeability coefficients for sand and gravel 'shoe-string' aquifers are likely to be in the range of 1 to 10 m/day, giving likely transmissivities of up to 40 m^2/day. The hydraulic gradient across the area, determined from standing water-levels in piezometers, is of the order of 10^{-3} to 3×10^{-3}. Throughflow of groundwater in aquifers beneath the flats is therefore equal to the cross-sectional area of the aquifers multiplied by the hydraulic gradient multiplied by the hydraulic conductivity of the aquifers. Substituting values of 1600 m^2, 10^{-3}, and 1 m respectively into the above equation, an estimate of the lowest likely throughflow of 1.6 m^3/day is obtained.

The December 1972 and January 1973 standing water-levels in piezometers ranged from 0.86 m below ground surface close to Jerrabomberra Creek, to 4.75 m below the surface 185 m east of the creek and 4.1 m below the surface 427 m west of the creek. These water-levels have been contoured and schematic flow lines drawn (Pl.1). The flow net indicates that groundwater does not flow beneath the present course of Jerrabomberra Creek, but flows towards Lake Burley Griffin in a northwesterly direction. Unless a buried stream channel exists in this direction, however, flow of groundwater in this direction must turn northerly beneath the Kingston refuse disposal area because permeabilities of clay deposits to the northwest of the area are too low to allow significant flow rates. The general lowering of the hydraulic gradient close to Lake Burley Griffin indicates that groundwater flow must move more slowly as it approaches the lake, and flow probably takes place through a broader cross-sectional area.

REFUSE DISPOSAL

As Lake Burley Griffin is close to the Jerrabomberra Creek flats, the suitability of the flats for refuse disposal is questionable. Because of the relatively free flow of groundwater through subsurface soils, the use of finely comminuted refuse as fill on the proposed reclamation sites, without the prior emplacement of a low-permeability clay blanket, would hasten chemical reactions producing leachate. The refuse should be compacted as it is placed, so as to ensure that the area will have foundation conditions appropriate for its subsequent development.

CONCLUSIONS AND RECOMMENDATIONS

1. There are sediments of moderate permeability which are likely to be in hydraulic continuity with Lake Burley Griffin and with refuse material in the Kingston Dump. These sediments are predominantly found near Jerrabomberra Creek and in the nearby buried stream channel (Pl.1).

2. Polluted groundwater is likely to discharge into the lake if leachate and gaseous decomposition products of refuse are allowed to migrate into the moderately permeable sediments near Jerrabomberra Creek.

3. A blanket of fill to a thickness of about 1 m should be placed over the area underlain by sandy and gravelly sediments. The fill should have a basis of lean clay, and could contain appreciable amounts of sand and gravel; it should be well compacted to prevent the downward movement of leachate. The refuse and cover material should also be compacted to a standard that will allow the safe construction of light industrial buildings as well as retarding the percolation of surface water into the proposed refuse dump.

4. If the area is contoured and drains are installed, surface drainage from the clay will not be a problem.

5. As the refuse is placed in the area, leachate should be trapped and collected for removal to a less permeable disposal site.

REFERENCE

VAN BAVEL, C.H.M., & KIRKHAM, D., 1948 - Field measurement of permeability using auger holes. Proc. Soil Sci. Soc. Am., 13, 90-6.

Reclamation of Jerrabomberra Creek flats; Generalized Flow Net

F11 — Auger hole

3 — No of proposed fill site

Former Jerrabomberra Creek (1944 airphotos)
" " (1965 topo map)

Ephemeral stream 1956 topographic survey (now buried)

Ephemeral stream 1941 topographic survey (now buried)

Marsh

Railway

A — - Section (P1.2) — B

A — B — C — Section (plate 3)

560.5m — - potentiometric-surface contour

1840'(560.8m) — topographic contour

▼560.6 - standing water-level in piezometer (metres)

- generalized groundwater flow line

Block 27, Canberra City district

Note: Hole 43 intersected only refuse emplaced as fill

PLATE 1

AMENDMENTS			
No.	Description	Author	Checked
A1			
A2			
A3			
A4			
A5			

SCALE 0 58 116 174 232 metres.

Base map/survey T.P. 243-65 (NCDC)

Hydrology by pdh
Geology By jpc

Compiled and checked pdh, Project geologist
Checked and approved, Senior geologist
Supervising geologist

COMMONWEALTH OF AUSTRALIA
BUREAU OF MINERAL RESOURCES
CANBERRA, A.C.T.

TITLE GENERALIZED FLOW NET

PROJECT RECLAMATION OF JERRABOMBERRA CREEK FLATS.

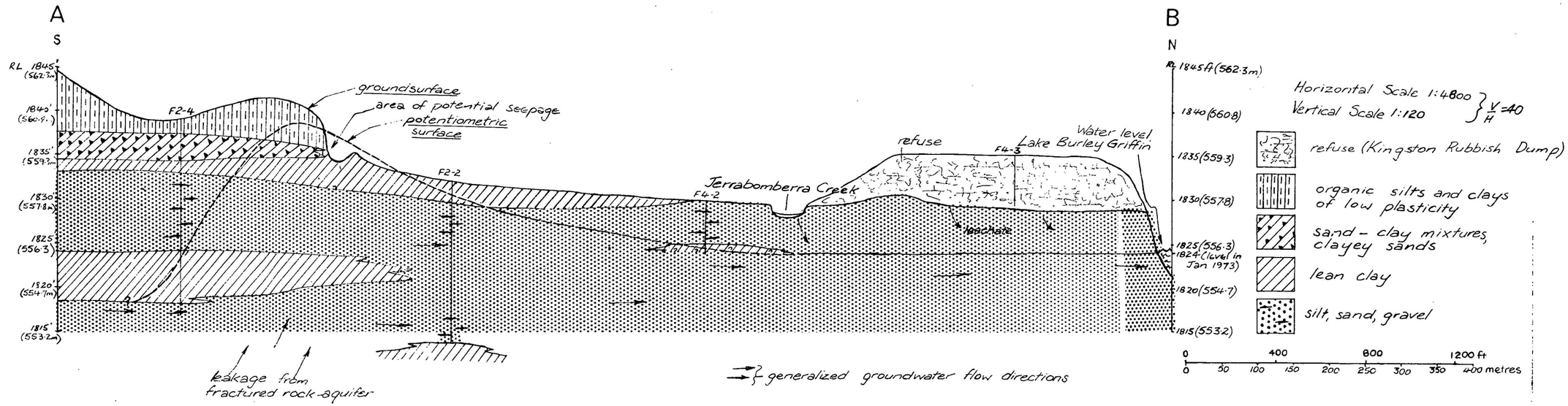
To accompany Record

Drawn by RBS

Drawing No. 155/A16/1553

Record 1976/32

SCHEMATIC GROUNDWATER MOVEMENTS



See Plate 1 for line of section

Note: The standing water level in piezometer F4-2 may be anomalously low - possibly due to smearing of clay on the walls of the auger hole. The hydraulic gradient may therefore be steeper than shown.

Plate 2

AMENDMENTS			
No.	Description	Author	Checked
A1			
A2			
A3			
A4			
A5			

H. SCALE 0 125 250m

Base map/survey TP243-65 (NCDC) 1:4800

Geology by JPC, pdh

Compiled and checked pdh, Project geologist

Checked and approved, Senior geologist

Supervising geologist

COMMONWEALTH OF AUSTRALIA
BUREAU OF MINERAL RESOURCES
CANBERRA, A.C.T.

TITLE: Schematic Groundwater Movements

PROJECT: Reclamation of Terrabomberra Creek Flats

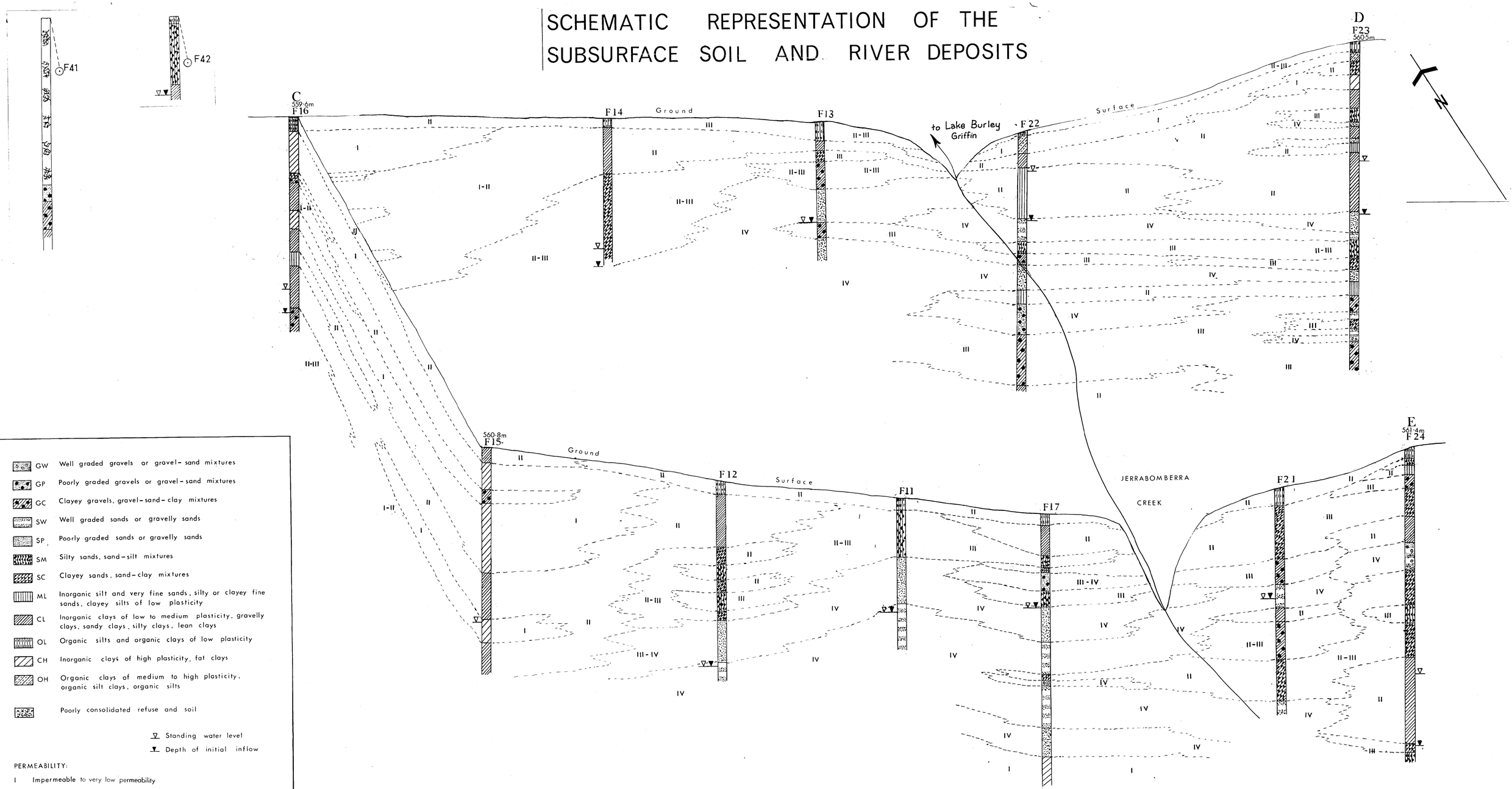
To accompany Record

Drawn by pdh

Drawing No. 155/A16/1554

Record 1976/32

SCHEMATIC REPRESENTATION OF THE SUBSURFACE SOIL AND RIVER DEPOSITS



GW	Well graded gravels or gravel–sand mixtures
GP	Poorly graded gravels or gravel–sand mixtures
GC	Clayey gravels, gravel–sand–clay mixtures
SW	Well graded sands or gravelly sands
SP	Poorly graded sands or gravelly sands
SM	Silty sands, sand–silt mixtures
SC	Clayey sands, sand–clay mixtures
ML	Inorganic silt and very fine sands, silty or clayey fine sands, clayey silts of low plasticity
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
OL	Organic silts and organic clays of low plasticity
CH	Inorganic clays of high plasticity, fat clays
OH	Organic clays of medium to high plasticity, organic silt clays, organic silts
	Poorly consolidated refuse and soil

▽ Standing water level

▼ Depth of initial inflow

PERMEABILITY:

I Impermeable to very low permeability

II Slightly to moderately permeable

III Moderately permeable

IV Very permeable

– – – – – Infered soil boundary

Horizontal Scale : 1 cm= 12 metres

Vertical Scale : 1 cm= 40 metres

$\frac{V}{H} = 33$

Record 1976/32

AMENDMENTS

No.	DESCRIPTION	AUTHOR	DATE	CHECKED	DATE
A1	Amended layout & reference	P.D.H.	24/9		
A2					
A3					
A4					
A5					
A6					

SCALE 0 15 30 45 60 METRES

BASE MAP/SURVEY

GEOLOGY BY J. P. CEPLECHA

COMPILED AND CHECKED PROJECT GEOLOGIST

CHECKED AND APPROVED SENIOR GEOLOGIST

SUPERVISING GEOLOGIST

PLATE 3

COMMONWEALTH OF AUSTRALIA

BUREAU OF MINERAL RESOURCES

CANBERRA, A.C.T.

TITLE SUBSURFACE SOIL AND RIVER DEPOSITS

PROJECT RECLAMATION OF JERRABOMBERRA CREEK FLATS

TO ACCOMPANY RECORD	DRAWN BY	DRAWING NUMBER
72/2945	J.P.C.	155/A16/1552