COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

~~RESTRICTED~~

Record No. 1970 / 61

North Molonglo Outfall Sewer, A.C.T. Geological Report on Detailed Investigation, 1969

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by

G.A.M. Henderson

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SUMMARY

A proposal to excavate a $4\frac{1}{2}$-mile-long tunnel for a sewer to service the northern suburbs of Canberra is being considered. The tunnel would begin near the Commonwealth Avenue-Parkes Way traffic interchange, and would run in a general westerly direction to a point near Coppins Crossing. Geological mapping and diamond drilling indicate that the tunnel would be in Ordovician and Lower Silurian sedimentary rocks between Commonwealth Avenue and Black Mountain Creek, and in Upper Silurian volcanic rocks between Black Mountain Creek and the outlet portal; the boundary between the sediments and the volcanics is formed by the Deakin Fault. The sediments consist of folded beds of sandstone, siltstone, shale, siliceous shale and chert; they are cut by several faults. Sandstone occurs under Black Mountain; the other sedimentary rock types are mainly east of Sullivans Creek. Some interbedded sandstone, siltstone, shale and chert occur immediately east of the Deakin Fault on the western slope of Black Mountain.

Diamond drilling and seismic refraction surveys indicate that in areas of shallow cover the tunnel would be in weathered rock which would require support ranging from rock bolts to steel sets. Under Black Mountain and the elevated area west of the Deakin Fault the tunnel would be in hard, strong, fresh rock in which little or no support would be required. Across Sullivans Creek, where tunnelling conditions are expected to be difficult, it is proposed to place the sewer in a trench. Almost the entire tunnel will be below the water table and slight to moderate water inflows can be expected. Overbreak in the tunnel will be minimal in fresh rock but some overbreak can be expected where the rock is weathered. Investigations to select the site of the outlet portal, near Coppins Creek, indicate that suitable rock occurs at tunnel level at about chainage 800 feet. A suitable location for the portal west of Sullivans Creek is indicated at about chainage 17700 feet. East of Sullivans Creek it is recommended that the trench be extended east to about chainage 19700 feet where suitable rock for the portal is indicated. The three shaft sites between Commonwealth Avenue and Sullivans Creek are considered satisfactory; all would be in weathered siltstone. It is recommended that the proposed shaft at Black Mountain Creek be located in the dacite tuff at the site of drill hole D.D. 2.

INTRODUCTION

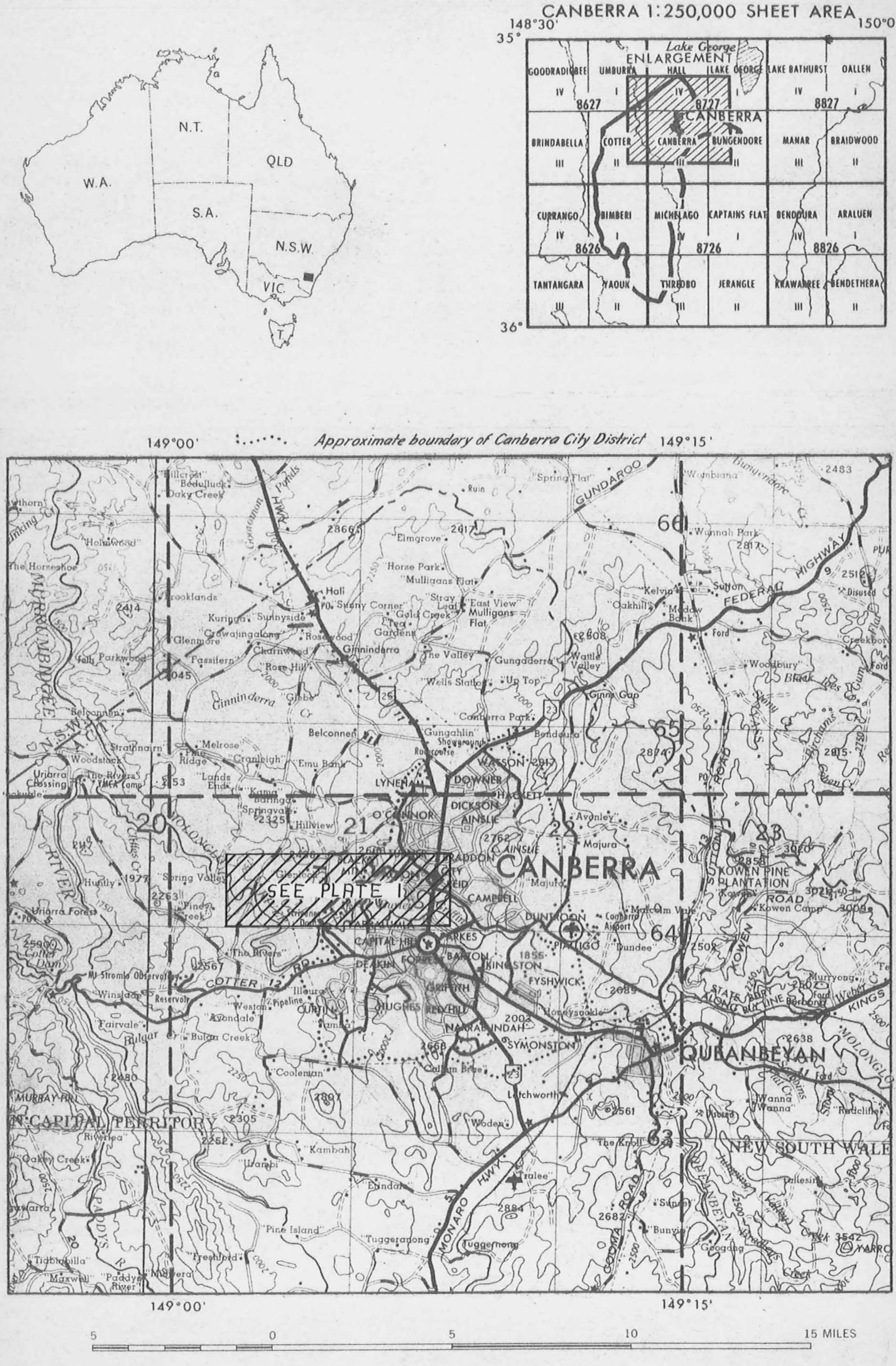
In October, 1966, a request was received from the Commonwealth Department of Works for geological information on a proposed $4\frac{1}{2}$-mile-long tunnel for an outfall sewer to service the northern suburbs of Canberra. The proposed route started near the junction of Commonwealth Avenue and London Circuit, and followed a line beneath the Australian National University and the southern part of Black Mountain to a point near Coppins Crossing (see Figure 1 and Plate 1). West of Black Mountain two alternative routes were considered, one running nearly west and the other south-west.

A geological investigation (Henderson, 1968) was carried out during April and May, 1967. It indicated that difficult tunnelling conditions could be expected in areas of low cover beneath Sullivans Creek, at Black Mountain Creek, and near the Hotel Acton. Each of the two proposed alternative routes west of Black Mountain appeared practicable. Augering, diamond drilling and seismic refraction work were recommended to provide more information on tunnelling conditions.

To reduce the difficulties indicated in the geological investigation, and to avoid cultural features such as roads, the tunnel route was amended to that shown on Plate 1 of this report. The tunnel would begin at a point immediately east of Commonwealth Avenue, near the Commonwealth Avenue - Parkes Way traffic interchange and would emerge at a point about $\frac{3}{4}$ of a mile east of Coppins Crossing. From the end of the tunnel the sewer would follow a surface route to a treatment works located downstream from Coppins Crossing.

Fig.1

NORTH MOLONGLO OUTFALL SEWER
LOCALITY MAP



Bureau of Mineral Resources, September 1969

I55/A16/645

To accompany Record 1970/61

INVESTIGATION METHODS

GEOLOGICAL MAPPING

The mapping that was done during the preliminary investigation (Henderson, 1968) was extended to provide further information along the amended route. In addition, a plane table survey was carried out in the outlet portal area, and a tape and compass survey on Black Mountain. Trenches on the east slope of Black Mountain and east of the Hotel Acton, and cuttings along the new hospital road were also mapped.

SEISMIC INVESTIGATIONS

Seismic refraction surveys were carried out along the tunnel line to determine the depth of weathering in areas of low cover. Initial surveys during 1968, by P.E. Mann of the Geophysical Branch of the Bureau, consisted of one traverse in the outlet portal area, four at Black Mountain Creek and one on the east slope of Black Mountain (traverses KK', FF', GG', HH', JJ' and LL', Plates 2 to 4). In April, 1969, F.J. Taylor, of the Geophysical Branch of the Bureau, made five traverses at the outlet portal to test possible alternative alignments of the tunnel in this area (traverses AA', BB', CC", DD' and EE', Plate 2). In July, 1969, a private organization, Soil Mechanics Ltd, of Huntingdale, Victoria, made several traverses between the east slope of Black Mountain and Commonwealth Avenue.

DIAMOND DRILLING

Diamond drilling was carried out from May to July, 1969, by a drilling team from the Snowy Mountains Hydro-Electric Authority. Two drilling rigs were used, with NMLC size triple tube core barrels and split inner tubes for maximum core recovery. Twelve holes were drilled, each to a depth of about five feet below the lowest practicable invert level of the proposed tunnel. Holes were drilled to test proposed portal and shaft locations and to give an indication of tunnelling conditions. Water pressure testing, to determine the permeability of bedrock, was carried out in all except one of the holes. The drill core was examined and described as drilling proceeded; drill logs are included in Appendix 2. The core was photographed in the split core barrel in the undisturbed state; it was also photographed later in the core boxes. The core is held at the Department of Works store at Kingston, A.C.T.

AUGERING

During June-July, 1969, twenty-two auger holes were drilled along the tunnel line, five in the outlet portal area, two at Black Mountain Creek, and fifteen between the east slope of Black Mountain and Commonwealth Avenue; a Gemco power auger was employed for the work. Each hole was drilled to refusal, and samples were taken at ten-foot intervals. The holes were logged by an officer of the Department of Works.

PHOTOGEOLOGICAL ANALYSIS

Simpson (1968) carried out a photogeological analysis of the area crossed by the tunnel route to identify the positions of any fracture zones and significant directions of weakness.

PHYSIOGRAPHY

The proposed tunnel will be driven through an area which can be divided into three topographically distinct units. West of Black Mountain the country is undulating, and slopes are gentle to moderate (Plate 1). On Black Mountain slopes are steep, and the elevation rises to about 500 feet above the general level of the surrounding countryside. East of Black Mountain the land surface is flat to gently undulating.

The Molonglo River (partly flooded by Lake Burley Griffin) drains the entire area shown on Plate 1. From a mature stage upstream from the Canberra City area the river becomes increasingly entrenched westward towards its confluence with the Murrumbidgee River about five miles downstream from Coppins Crossing. The main tributaries shown on the map are Coppins Creek, Black Mountain Creek and Sullivans Creek. The straight course of Black Mountain Creek is due to structural control by the Deakin Fault. Lake Burley Griffin is a man-made lake formed by the Scrivener Dam; it floods the former river valley to an R.L. of 1825 feet.

REGIONAL GEOLOGY

The regional geology, shown on Plate 1, is mainly as interpreted by Öpik (1958). The following paragraphs give a brief description of t the stratigraphy and structure of the rock units to be crossed by the proposed tunnel. Notes on weathering and groundwater are included.

STRATIGRAPHY

Lower Ordovician

The oldest rock unit in the area is thought to be the Black Mountain Sandstone. No direct fossil evidence for its age has been obtained; however, it appears to be older than the Pittman Formation whose age has been established by fossils as Middle Ordovician. The Black Mountain Sandstone is therefore assigned to the Lower Ordovician but may possibly be older.

The unit consists of beds of fine-grained, quartzose sandstone up to 5 feet thick, with occasional shale interbeds not more than 6 inches thick; it crops out extensively on Black Mountain and is exposed in cuttings along the Black Mountain road. On the south-east slope of Black Mountain a trench exposed two beds of laminated shale, each with a visible thickness of 50 feet, stratigraphically below the main sandstone body. This shale had previously been mapped as State Circle Shale of Lower Silurian age.

The proposed tunnel line passes through the Black Mountain Sandstone between the South Black Mountain Fault and the Black Mountain Fault. A diamond drill hole, D.D.10, on the east slope of Black Mountain, penetrated Black Mountain Sandstone (see Plate 4 for location of drill hole and Appendix 2 for geological log).

Middle Ordovician

Between the Black Mountain Fault and the Deakin Fault the proposed tunnel line passes through the Pittman Formation which is of Middle Ordovician age. The Pittman Formation consists of interbedded sandstone, siltstone, shale and chert; individual beds are up to 4 feet thick, but thicknesses of up to 200 feet of one rock type may occur as, for example, in the Belconnen area. Outcrops occur along the tunnel line immediately west of the Black Mountain Fault (see Plate 3). The Pittman Formation was penetrated by diamond drill hole D.D.3.

Upper Ordovician

The tunnel line passes through the Upper Ordovician Acton Shale between Sullivans Creek and the Acton Fault. The rock which crops out immediately east of Sullivans Creek is a laminated slaty siliceous shale; it was penetrated in diamond drill holes D.D.6 and D.D.12 (Plates 4 and 5). Interbedded siltstone and shale were found in diamond drill hole D.D.11 (Plate 4); they appear to overlie the siliceous shale, probably conformably.

Lower Silurian

East of the Acton Fault the tunnel line crosses the Lower Silurian Riverside Formation (Plate 5). Three diamond drill holes, (D.D.7; D.D.8, and D.D.9) penetrated clayey siltstone in beds up to one foot thick. This rock is exposed in cuttings along the new hospital road and was mapped in trenches east of the Hotel Acton. In one cutting along the new hospital road there is some limestone. West of the Acton Fault, Lower Silurian State Circle Shale was observed by Öpik in the foundations of University House. He interprets this occurrence as part of a small wedge that rests unconformably on Ordovician rocks; it is bounded on the east by the University Fault.

Upper Silurian

Outcrops of the Upper Silurian Mount Painter Porphyry occur between the outlet portal and the Deakin Fault. Öpik interpreted this unit as an intrusive sill but recent petrological work indicates that it is, at least in part, a welded crystal tuff of extrusive origin. The rock is massive, dark grey or green-grey, and coarse-grained; it is of dacitic composition and consists of crystal grains of quartz, feldspar and minor amounts of altered mafic minerals in a matrix of devitrified glass.

Quaternary

Colluvium, probably mainly of Pleistocene age; covers the lower slopes of Black Mountain. It consists of soft, poorly consolidated silty clay containing angular to sub-rounded fragments of sandstone. A diamond drill hole, D.D.5, on the east side of Black Mountain penetrated 63 feet of this material before reaching bedrock. Most sandstone fragments are a few inches or less in diameter, but one block encountered in D.D.5 was one foot nine inches across.

Alluvium occurs along the tunnel line at Black Mountain Creek and at Sullivans Creek. Along Black Mountain the alluvium consists of silty clay containing varying proportions of gravel; it appears to be up to about 30 or 40 feet thick. The alluvium at Sullivans Creek consists of silty clay possibly with some gravelly horizons at depth.

STRUCTURE

The rocks along the tunnel route are folded and faulted. An interpretation of the structure is shown in cross section on Plate 6. The following paragraphs describe the nature of the folding and faulting. Notes on jointing are included.

Folding

Bedding attitudes in the Black Mountain Sandstone show considerable local variations in strike; dips are generally less than 45 degrees. There appear to be no well defined fold axes which can be located on the map although a complex syncline is indicated. A stereographic plot of poles to bedding suggests a fold system with axes plunging east-north-east. A minor anticline was exposed in a trench close to diamond drill hole D.D.10.

Beds of the Pittman Formation immediately to the west of the Black Mountain Fault/strike north-south and dip about 45 degrees to the east (Plate 3). Towards the Deakin Fault bedrock is covered by soil and scree and the attitude of the bedding is not known. No structural information was found that would either confirm or disprove a supposed anticline which Öpik (1958) shows between the Deakin and Black Mountain Faults.

The Upper Ordovician between Sullivans Creek and the Acton Fault is exposed only near diamond drill hole D.D.6 (Plate 4), where it dips steeply south-east. The structure of this area is not evident on the surface. Öpik's map shows a syncline and an anticline, both complicated by drag folding; his information was presumably derived from excavations.

East of the Acton Fault, in the Riverside Formation, opposing dips in exposures along the new hospital road suggest an anticline plunging south; its axis would pass through the tunnel line close to diamond drill hole D.D.7 (Plate 5). Trenches east of the Hotel Acton revealed bedding of very variable attitude. The predominant strike is slightly west of north, and the dip to the east suggests that this area is on the eastern limb of Öpik's Acton Anticline. The diverging attitudes probably occur on minor folds, subsidiary to the main structures.

Faulting:

Several major faults cross the tunnel line and separate rocks of different geological ages (Plate 1). The Deakin Fault, east of Black Mountain, separates Upper Silurian Volcanics from Ordovician and Lower Silurian rocks. The western block has a downthrow of at least 4000 feet. The fault is concealed by soil and scree in the area of the tunnel line.

On the western slope of Black Mountain the Black Mountain Fault separates the Pittman Formation from the older Black Mountain Sandstone. Another fault, the South Black Mountain Fault, forming the south-eastern limit of the Black Mountain Sandstone, is thought to occur between Sullivans Creek and diamond drill hole D.D.5. The eastern side of the fault is downthrown.

Separating the Riverside Formation from the Acton Shale is the Acton Fault which forms the eastern boundary of the Black Mountain Horst; the downthrow to the east is about 3000 feet. The University Fault branches from the Acton Fault near University House. The downthrow is to the west and the displacement is probably about 500 feet.

Other minor faults probably cross the tunnel line; however, they are not expected to affect significantly the overall structural picture.

Jointing

All rocks along the tunnel line are jointed. In the Black Mountain Sandstone 282 joints were measured along the Black Mountain Road. A stereographic plot of the results (Henderson, 1968) shows that, apart from bedding plane joints, there are two principal joint directions, one averaging about 107°/70°S * and the other about 032°/75°E.

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* That is, strike 107° true, dip 70° south. All bearings in this report are true bearings.

Joint spacing, except in shear zones, is generally greater than six inches, and ranges up to more than three feet. Some joint orientations in the other formations were measured, but no predominant joint directions can be predicted because insufficient readings were taken to provide statistically significant results.

Joint spacing in the bedded sedimentary rocks is related to the thickness of bedding. Sandstone generally exhibits more widely spaced joints than finer grained, thinner bedded siltstone and shale. In the siliceous shale of the Acton Shale the bedding plane joints are at few places more than 1½ inches apart and generally give the appearance of a slaty cleavage.

Joint directions in the volcanics between the outlet and Black Mountain Creek are probably nearly random, taken overall, but principal directions would occur at any particular place. This supposition is based on joint measurements in volcanics in the Belconnen area. A near-vertical system, striking slightly west of north, is apparent in the vicinity of the proposed outlet portal. Measurements of joint spacing in outcrops along the tunnel line and in the drill core indicate that, except in shear zones, joints are probably spaced between six inches and two feet apart; however, in places they could be more widely spaced, as seen in outcrops near Coppins Crossing.

WEATHERING

Weathering occurs in all rocks along the tunnel line; the nature and depth of the weathering depend mainly on the particular type of rock. The degree of weathering of the bedrock, as determined by drilling, augering and seismic refraction, is shown in cross section on Plates 7, 8, and 9.

In the area underlain by volcanic rocks, soil and completely weathered bedrock extend to about 5 feet, and highly weathered rock to a maximum depth of about 40 feet. The completely weathered rock consists of grains of quartz in a matrix of brown clay; it has the mechanical properties of a soil. The highly weathered rock consists of quartz grains in a brown soft and weak matrix of decomposed feldspar and other minerals.

Below the highly weathered zone the rock is moderately weathered. Grains of quartz and white feldspar are visible and occur in a brown matrix; the rock is moderately hard and strong. Below a depth of about 90 feet the rock is no more than slightly weathered except near faults such as the Deakin Fault where the seismic results indicate weathering down to a maximum depth of 140 feet.

Within the weathered zone the degree of weathering may not be uniform. In places residual masses of less weathered and even fresh rock are surrounded and underlain by moderately to completely weathered rock. The residuals range in size from boulders to masses several feet across; some of them appear at the surface as outcrops and tors.

The observed depth of weathering in the sandstone and shale on Black Mountain ranges from 46 feet in diamond drill hole D.D.3 to more than 100 feet in D.D.10. The depth of weathering in interbedded sandstone and shale, as determined by seismic refraction methods, is not as predictable as it is in the more homogeneous volcanic rocks, and there is no close correlation between drilling and seismic results.

The siliceous shale is resistant to weathering and commonly appears to be only slightly weathered at the surface, such as near diamond drill hole D.D.6. However, open joints in this rock have allowed access of groundwater, and slight to moderate weathering is observed to the bottom of D.D.6 (60 feet 4 inches).

The depth of weathering in the siltstone of the Riverside Formation is not known, as the seismic refraction survey did not pick up a deep refractor in the area. The drilling indicates that moderately to highly weathered rock extends to at least 70 feet.

GROUNDWATER

Below a level, which varies in depth from place to place, all intergranular spaces and open joints are filled with groundwater. This level is known as the water table. The intergranular porosity of the fresh rocks is low to extremely low in all rocks, consequently the specific volume of groundwater stored is a function of fracturing and weathering.

The position of the water table along the tunnel line is indicated at several places from the water level measurements made in the diamond drill holes. Between Commonwealth Avenue and diamond drill hole D.D.10 the water table ranges from about 25 to 50 feet (R.L. 1825 to 1855 feet) above tunnel level (see Plate 9). The water table is high along most of this section of the tunnel route because joints are sealed with clay, preventing lateral percolation of water to lower levels. In the open-jointed sandstone west of the South Black Mountain Fault, and in the siliceous shale immediately west of the Acton Fault, the water table is at a greater depth below the surface. In the siliceous shale immediately east of Sullivans Creek the depth to the water table is small because it is controlled by the level of Lake Burley Griffin.

The water table under Black Mountain Creek is about 30 to 60 feet above tunnel level (R.L. 1825 to 1855 feet, see Plate 8). In the outlet portal area (Plate 7) the proposed tunnel is at or above the level of the water table for a short section in from the portal; however, the water table rises above tunnel level to the east.

Between the outlet and Black Mountain Creek and under Black Mountain there is no direct information on the position of the water table. However, general groundwater conditions in the area (Burton, 1967) suggest that the water table would be approximately as shown on Plate 6.

ENGINEERING GEOLOGY

TUNNELLING CONDITIONS

Rock Strength

The strength of the rock material depends on the rock type and the degree of weathering or other alteration. Definitions of terms used in reference to rock strength and rock weathering are given in Appendix 1. The depths of weathering in areas of shallow cover along the tunnel line are shown in Plates 7, 8, and 9. The strength of the rock mass as a whole depends on a combination of rock type, weathering and the presence of structural discontinuities such as joints, faults and shear zones.

The dacite crystal tuff which occurs west of the Deakin Fault is very hard and strong where fresh to slightly weathered. To excavate it close drilling and blasting would be required. Moderately weathered dacite tuff can be excavated by light drilling and blasting, and finishing done with pneumatic power tools. Highly weathered rock can generally be excavated by earth-moving equipment such as a back-hoe. The completely weathered rock has the properties of a soil.

The drilling indicates that most of the dacite tuff at tunnel level is fresh; weathered tuff occurs in areas of low cover near the outlet portal and the Deakin Fault. Joints are generally moderately to widely spaced. Any wide shear zones that may be present and which would seriously reduce the strength of the rock mass, are not exposed in outcrop. Some shearing and quartz veining, which may be associated with faulting, is evident in outcrops at about chainage 8000 feet; the exposed bedrock, though altered, remains hard. Seismic results indicate an increase in the depth of weathering near the Deakin Fault; there, the rock is probably strongly sheared, closely jointed and seamed with clay.

The massively bedded sandstone under Black Mountain is probably fresh and very hard; it would need to be broken from the tunnel face by close drilling and blasting. The thickness of the sandstone beds generally ranges from about one to five feet, with occasional thinner beds. Joints are moderately to widely spaced from, say one to five feet. Minor shears a few inches wide were observed at several localities. The strength of the rock mass would be reduced slightly by thin shale interbeds which are known to occur throughout.

Interbedded sedimentary rocks occur in two places along the tunnel line: siltstone, sandstone, shale and chert between the Deakin and the Black Mountain Fault on the western slope of Black Mountain, and siltstone and shale between Sullivans Creek and the Acton Fault. Their strength is reduced by the occurrence of weak beds, and of thin and closely jointed beds within the harder and thicker strata.

The rocks between the Deakin and the Black Mountain Faults are expected to be unweathered at tunnel level except for a short section near the Deakin Fault. Drilling and blasting will be required to break the rock. The shale beds are comparatively soft and many beds are thin and closely jointed; these two factors should result in a higher drilling rate, and smaller explosive charges than in the dacite tuff and Black Mountain Sandstone.

TABLE 1. Tunnelling conditions, based on tunnel invert at R.L. 1770 feet at outlet portal

(This table gives the conditions to be expected generally. In all sections structural defects may produce narrow zones of poor tunnelling conditions).

	ROCK TYPE AND DEGREE OF WEATHERING	ROCK STRENGTH	OVERBREAK	SUPPORT	INITIAL GROUNDWATER INFLOW
Ch. 00 - 800 feet (Trench)	DACITE CRYSTAL TUFF, moderately to highly weathered	Soft, weak			Bottom of trench at or above water table
Ch. 800 - 1000 feet	DACITE CRYSTAL TUFF, slightly to moderately weathered	Moderately hard and strong	Slight to moderate	Steel sets	Slight to moderate, up to about 4 gall/min. per 100-foot length of tunnel initial inflow. Rapid decline, with temporary increase after heavy rain
Ch. 1000 - 2100 feet	DACITE CRYSTAL TUFF, fresh to slightly weathered	Hard, strong	Mostly slight	Rock bolts, a few steel sets locally	Moderate up to about 30 gall/min. per 100-foot length of tunnel
Ch. 2100 - 9600 feet	DACITE CRYSTAL TUFF, possibly a small amount of rhyolite, fresh	Hard, strong	Mostly slight	No support except for a few rock bolts locally	Moderate, about 20-60 gall/min. per 100-foot length of tunnel
Ch. 9600 - 10400 feet	DACITE CRYSTAL TUFF, fresh to slightly weathered	Hard, strong	Mostly slight	Rock bolts, a few steel sets locally, particularly chainage 10,200 - 10,400	Moderate, about 18 gall/min. per 100-foot length of tunnel
Ch. 10400 - 10920 feet	DACITE CRYSTAL TUFF, moderately weathered Fault zone at about chainage 10920 feet	Moderately soft and weak to moderately hard and strong	Moderate	Steel sets	Moderate, about 18 gall/min. per 100-foot length of tunnel
Ch. 10920 - 11000 feet	INTERBEDDED SANDSTONE, SILTSTONE, SHALE AND CHERT, moderately weathered	Moderately hard and strong; soft, weak shale beds	Moderate	Steel sets	Moderate, about 8 gall/min. per 100-foot length of tunnel
Ch. 11,000-12580 feet	INTERBEDDED SANDSTONE, SILTSTONE, SHALE AND CHERT, fresh. Fault zone at about chainage 12580 feet	Moderately hard and strong to hard, strong	Slight to moderate	Rock bolts, possibly no support in places	Moderate, about 8-12 gall/min. per 100-foot length of tunnel
Ch. 12580 - 17400 feet	SANDSTONE with a few thin shale interbeds, fresh	Hard, strong	Mostly slight	No support except for a few rock bolts locally	Moderate, about 10-20 gall/min. per 100-foot length of tunnel
Ch. 17400 - 17800 feet	SANDSTONE AND SHALE, slightly to moderately weathered	Moderately hard and strong	Slight to moderate	Steel sets, possibly only rock bolts towards Ch. 17400	Moderate, about 10 gall/min. per 100-foot length of tunnel

TABLE 1 (cont.)

	ROCK TYPE AND DEGREE OF WEATHERING	ROCK STRENGTH	OVERBREAK	SUPPORT	INITIAL GROUNDWATER INFLOW
Ch. 17800 - 18330 feet (Trench, of tunnel).	SOIL AND SCREE	Soft, weak; scree is weakly cemented and stands in high vertical faces			Probably slight
Ch. 18330 - 18810 feet (Trench)	ALLUVIUM	Soft, weak		Full side-support of trench	Unknown
Ch. 18810 - 19220 feet (Tunnel or Trench)	SILICEOUS SHALE, slightly to moderately weathered (at tunnel level)	Moderately hard, weak	Moderate	Steel sets, mesh if tunnelled	Slight to moderate
Ch. 19220 - 19680 feet (Tunnel or Trench)	INTERBEDDED SILTSTONE AND SHALE, moderately weathered (at tunnel level)	Soft, weak	Moderate	Steel sets if tunnelled, 20'-30' of unconsolidated material would need to be battered	Slight, less than 1 gall/min. per 100-foot length of tunnel
Ch. 19680 - 19850 feet	INTERBEDDED SILTSTONE AND SHALE, fresh to slightly weathered	Moderately hard and strong	Moderate	Steel sets or rock bolts	Slight, less than 1 gall/min. per 100-foot length of tunnel
Ch. 19850 - 20770 feet	INTERBEDDED SILTSTONE AND SHALE, slightly to moderately weathered. Fault Zone at about chainage 20770 feet.	Moderately soft and weak	Moderate	Steel sets	Slight, less than 1 gall/min. per 100-foot length of tunnel
Ch. 20770 - 20970 feet	SILICEOUS SHALE, slightly to moderately weathered	Moderately hard, weak	Moderate	Steel sets, mesh	Moderate, about 12 gall/min. per 100-foot length of tunnel
Ch. 20970 - 21290 feet	SILICEOUS SHALE, fresh to slightly weathered Fault Zone at about chainage 21290 feet	Hard, weak	Moderate	Steel sets, mesh	Moderate, about 7 gall/min. per 100-foot length of tunnel
Ch. 21290 - 24218 feet	SILTSTONE, moderately to highly weathered	Soft, weak; soil-like in places east of DD 9	Moderate	Steel sets, possible need for forepoling and spiling east of DD 9	Slight, less than 1 gall/min. per 100-foot length of tunnel

The siltstone which occurs east of the Acton Fault is expected to be very weak throughout because of deep weathering, close jointing and numerous clay seams. Tunnelling could probably be done by means of pneumatic tools or mechanical equipment that can excavate soft rock. Light blasting may be needed in some places.

The siliceous shale east of Sullivans Creek is slightly to moderately weathered; it is moderately hard, broken by closely spaced joints and tends to split easily along the laminations to form slaty fragments. The siliceous shale west of the Acton Fault is mainly fresh to slightly weathered at tunnel level; it is hard but closely jointed.

The siliceous shale is expected to act as a fairly hard rock in drilling, and the drill may tend to be jammed frequently by broken fragments. Breaking out of the rock in blasting will be facilitated by the close jointing.

Overbreak

Overbreak depends on the strength of the rock and on the orientations of bedding planes, joints and other planar defects. It would be a minimum in fresh, tight-jointed or unjointed rock where the strikes of the planes of parting are nearly at right angles to the tunnel line. However, where intersecting joints and bedding run parallel or near parallel to the tunnel line, some overbreak could be expected, even in fresh rock.

A photogeological analysis of lineations in the dacite tuff (Simpson, 1968) suggests a prominent joint direction south of the tunnel line ranging in strike from70 to 100 degrees; north of the tunnel line no preferred joint direction is evident. The prominent joint directions south of the tunnel line would be nearly parallel to the tunnel, and, if encountered in the tunnel, may cause some overbreak. However, the moderate to wide spacing of joints indicates that overall there should be little overbreak in the dacite tuff.

In the Black Mountain Sandstone the photogeological analysis shows no preferred trend of lineations. However, measurement of joint directions in cuttings along the Black Mountain Road indicates preferred directions of about $107^{\circ}/70^{\circ}$S and $032^{\circ}/75^{\circ}$E. Bedding attitudes vary widely and in some places the strike is parallel to the tunnel line.

The direction of the tunnel line through most of the Black Mountain Sandstone is 090 degrees which is close to the joint direction striking at 107°degrees. Therefore in some places the directions of bedding, jointing and the tunnel may be similar, and some overbreak can be expected.

In the sedimentary rocks west of the Black Mountain Fault there is no indication of preferred joint directions. Bedding strikes almost at right angles to the tunnel line; dips are commonly less than 60°.

Overbreak in rocks weakened by weathering will be greater than in the fresh rock. This will particularly be the case in the weathered rock which occurs at tunnel level east of Sullivans Creek. Overbreak will be greater in rocks which part readily along bedding or joint planes. In the brittle siliceous shale, bedding and joint planes are closely spaced and tend to be open; overbreak is expected to occur in this rock.

Support

Support would be required for the tunnel where rock is liable to fall from the roof or walls. In general fresh rock would not require support unless the orientation and spacing of joints and bedding planes were such that unstable or poorly supported blocks were present in the tunnel roof; in this case rock bolts would be needed. Steel supports would probably be needed in closely sheared zones. In the fresh dacite tuff, and probably in the fresh Black Mountain Sandstone, little, if any, support will be needed in the tunnel, other than in fault and shear zones. In the closely jointed siliceous shale bolts and mesh will probably be needed to prevent small fragments falling from the roof.

Slightly weathered rock would be almost as hard and strong as the fresh rock. Where it is verging on moderately weathered its strength, though reduced, would be sufficient to ensure stable walls and roof in the absence of structural breaks. However, in most types of rock, weathering gives rise to clay minerals which tend to coat, or form the walls of joints, faults and shears. This decreases the frictional resistance and diminishes the support of blocks of rock in the walls and roof that are bounded by joints, faults or shears. Weathering also tends to reduce the cohesive strength across bedding planes. As a result increased support is needed by way of rock bolting, and locally of steel sets. Clay is likely to form or accumulate in joints in the weathered bedrock except where very siliceous types of rock, such as the Black Mountain Sandstone and the siliceous Acton Shale, occur.

Moderately to highly weathered rock would probably need steel supports throughout.

The length of tunnel which would require support has been estimated from the rock conditions indicated by the drilling and seismic work. About 25% of the tunnel would require full steel support and about 20% would need rock bolts and perhaps a few steel sets locally. The remainder would be in hard, strong rock which would require no support except possibly some local rock bolting. The sections of tunnel where support would be required are near the outlet portal, under Black Mountain Creek, near the portal on the west side of Sullivans Creek, the whole tunnel between Sullivans Creek and Commonwealth Avenue, and locally elsewhere where structural defects have produced narrow zones of rock or unstable ground at tunnel level. A summary of probable support requirements is given in Table 1.

Inflow of Groundwater

Except for a short section near the outlet portal the tunnel will be below the water table throughout, and wet conditions can be expected. Estimated inflows from place to place along the tunnel line are summarized in Table 1. The rate of water inflow will depend on the height of the water table above the tunnel and on the permeability of bedrock. The total inflow will depend on the amount of water stored in joints above tunnel level. The rate of inflow will tend to diminish as the reservoir is drained. Water pressure testing of drill holes was carried out to give an indication of bedrock permeabilities; the results are shown in Appendix 3 and on Plate 10. In the several types of bedrock along the tunnel line, the rock material is virtually impermeable; the observed permeability is due to fractures in the rock mass. Permeabilities in ten-foot intervals of drill hole range from zero to more than 500 feet per year (40 lugeons).

In the Canberra area, in a normal season, groundwater levels are highest in October-November and lowest in June-July. Consequently inflows into the tunnel would tend to be greatest about September-January and least in the early winter. As the level of the water table varies only a few feet in the course of the year the seasonal affect would be most marked where the water table is only a few feet above tunnel level. In these areas, also, the decline of inflow from the initial inflow will tend to be greatest; on the other hand inflow into those sections of tunnel with low cover will tend to be most sensitive to heavy rain.

In those drill holes where relatively large water losses occurred it appears that there are a few open joints, represented by broken zones in the drill core, along which most of the water loss took place. The rate of water inflow could be reduced, if necessary, by grouting the joints.

Estimates of volumes of water flowing into the tunnel are derived from water pressure test results by a method explained in Appendix 3. Table 2 shows the estimated inflows into a 100-foot length of tunnel near those drill holes where considerable water losses occurred.

Table 2. Estimates of flow of water into tunnel where water water loss was high in drill hole.

Drill Hole	Estimated flow of water into 100-foot length of tunnel in gallons per minute, for R.L. of tunnel as shown in plans.	Approximate height of water table above tunnel in feet, as measured immediately after drilling.
D.D.2	18	60
D.D.3	8	30
D.D.4	19	30
D.D.10	12	25
D.D.12	12	25

In other drill holes tested, but not shown on the table, the indicated water inflows are less than one gallon per minute for a 100-foot length of tunnel. The water table at D.D.1 is below tunnel level; if it were say 30 feet above tunnel level the inflow into a 100-foot length of tunnel would be 3 gallons per minute.

The greatest inflows are expected to occur where the water table rises to a maximum height above the tunnel. This occurs between the outlet portal and Black Mountain Creek where the water table is estimated to rise to 140 feet above the tunnel at the highest point. The bedrock along this section is dacite crystal tuff similar to that in diamond drill holes D.D.1, D.D.2, and D.D.4. From the water inflows calculated for these three drill holes, at the respective heights of the water table above tunnel level, it is estimated that the initial water inflow, where the water table is 140 feet above tunnel level, will be between 40 and 100 gallons per minute, for a 100-foot length of tunnel.

Under Black Mountain the water table is not expected to rise more than about 40 feet above tunnel level. From the water inflow estimate for the tunnel near drill hole D.D.10, which is in Black Mountain Sandstone, it is estimated that the maximum water inflow into a 100-foot length of tunnel under Black Mountain would be about 20 gallons per minute.

Water losses in drill holes D.D.6 and D.D.11 east of Sullivans Creek were negligible. However, only one 10-foot section in D.D.6 and two in D.D.11 were tested which is probably insufficient for a reasonably accurate indication of likely water flows in this section. Moderate water losses occurred in D.D.12 in the Acton Shale near Liversidge Street, and an estimated 12 gallons per minute would flow into the tunnel at this point.

East of the Acton Fault there is a possibility of encountering limestone which may be cavernous. In this case a large inflow of water could occur. However, water losses in the siltstone encountered in drill holes D.D.7, D.D.8, and D.D.9 were small, and, unless limestone is present, they should be indicative of water inflow to be expected in this section. Cavernous limestone was encountered inthe foundations for the Secretariat Building, near the National Library, and limestone occurs in the Canberra Hospital peninsula. (See Plate 1). The nearest exposure of limestone to the tunnel line occurs in a cutting along the new hospital road. This limestone does not show any signs of solution and its projection along the strike of bedding does not cross the tunnel line. There may, however, be other concealed limestone lenses along the tunnel line.

PORTALS

As well as an outlet portal for the tunnel near Coppins Creek a portal will be needed each side of Sullivans Creek, where it is proposed to place the sewer in a trench. The following paragraphs describe the bedrock conditions at the portal sites.

Outlet Portal

The proposals for the tunnel provide for an outlet portal at about the centre of the area shown on Plate 2. At the present (December, 1969) stage of planning, a tolerance of about 20 feet, between R.L. 1760 and R.L. 1780 feet, is permissible in the invert level. Investigations undertaken to select the site included two diamond drill holes, five auger holes and six seismic refraction traverses. The proposed tunnel line follows seismic traverse AA'; traverses BB', CC' and KK' were placed along possible alternative routes.

The site for the portal was selected so that, on the one hand there is sufficient cover of sound bedrock east of it in the tunnel,and on the other hand there is a minimum depth of cover west of it where the sewer would be placed in a trench. Bedrock in the portal area is dacite crystal tuff; Plate 7 shows in vertical section an interpretation of weathering zones along the proposed route. A suggested elevation of the tunnel is shown with a portal at about chainage 800 feet. The exact location of the portal would depend on conditions revealed by the excavation but, it is expected, should be somewhere between the positions of auger hole A.23 and diamond drill hole D.D.1.

Auger hole A.27 was put down to test the site of a possible alternative location for the portal. The tunnel line for this portal site would follow traverse CC' and join the original tunnel line at the intersection of traverses CC' and AA'. No advantage is seen in this alignment however; the auger hole penetrated to 47 feet in weathered bedrock, and the seismic traverse CC' indicates that fresh bedrock is no closer to the surface than along the originally proposed tunnel route.

Portal West of Sullivans Creek

Diamond drill hole D.D.5 was sited east of Clunies Ross Street, where it was hoped to be able to locate the portal so that no diversion of the roadway would be necessary. However, D.D.5 penetrated soil and scree to a depth of 63 feet, and soft highly altered mudstone for a further 3 feet; this indicated that a portal east of the road would be in unconsolidated material.

Another drill hole, D.D.10, was then drilled west of the road; it penetrated interbedded sandstone and shale beneath only a thin overburden of soil. The bedrock is soft down to about 35 feet; below this most of the core is moderately hard and strong, although there are several intervals of soft rock, generally shale. The change to harder rock at 35 feet agrees with the results of a seismic traverse along the tunnel line. The seismic results indicate that the depth to hard bedrock increases to the east and that the hard bedrock surface approaches tunnel level at about chainage 17700 feet. To have a portal in reasonably hard bedrock it would therefore be necessary to place it at, or west of, chainage 17700 feet.

Portal East of Sullivans Creek

Diamond drill hole D.D.6 was drilled at the intended location of the portal east of Sullivans Creek. However, drilling revealed very broken siliceous shale in which it would probably be difficult and costly to establish a portal.

An alternative scheme was suggested by the Department of Works engineers in which the trench would continue across the flat south of the Research School of Physical Sciences, and a portal would be established in the slope south of the Department of Geophysics and Geochemistry. The trench would follow a line slightly south of the originally proposed tunnel route.

Drill hole D.D.11 was put down to test the alternative portal site. It revealed siltstone and shale weathered to a depth of 53 feet. The drilling and the results of a seismic traverse indicate that a portal could probably established near D.D.11 or up to 50 feet west of it; a portal at this locality would be in stronger rock than one near D.D.6.

SHAFTS

It is proposed to put down several shafts along the tunnel line, to provide access, and later ventilation, along the sewer line. Present proposals envisage three shafts between Sullivans Creek and Commonwealth Avenue, one near Black Mountain Creek and possibly one about half way between Black Mountain Creek and the outlet portal.

Between Sullivans Creek and Commonwealth Avenue diamond drill holes D.D.7, D.D.8 and D.D.9 were put down at proposed shaft sites; all revealed moderately to highly weathered siltstone. Excavation at each site can probably be accomplished without blasting. D.D.7 and D.D.8 both encountered very soft rock; in D.D.9 the drill core is harder and there is less clay along joints. The walls of the shafts will need to be supported.

The tunnel line near drill hole D.D.7 is not the one that was originally chosen. The original site for a shaft and for D.D.7 was in the middle of a deposit of fill covered by dense shrubbery. The drill hole and shaft site, and the tunnel line were consequently moved to the north.

Diamond drill holes D.D.2 and D.D.3 were sited at two possible locations for a shaft near Black Mountain Creek. D.D.2, west of the creek, encountered dacite crystal tuff; and D.D.3, east of the creek, encountered interbedded sandstone and shale of the Pittman Formation. The dacite tuff in D.D.2 is weathered to a depth of 76 feet (for log see Appendix 2). The walls of a shaft would probably need support down to at least 45 feet. Close drilling and blasting would be needed in the fresh rock below 76 feet.

At D.D.3 bedrock is covered by soil and scree to a depth of 28 feet; below the overburden soft siltstone and shale occur down to 80 feet. A shaft here would require support down to at least 80 feet. Conditions for a shaft therefore appear better at the site of drillhole D.D.2. Further, the depth to tunnel level at this site is 20 feet less than at D.D.3. Possibly an access ramp will be constructed instead of a shaft. For this purpose rock conditions, topography and location of watercourses are more favourable at D.D.2.

A shaft half way between Black Mountain Creek and the outlet portal would be in dacite crystal tuff. On geological grounds the location of the shaft is not critical. Bedrock is probably not weathered below the depth of about 90 feet indicated by the seismic traverses at the outlet portal. Support would probably be needed down to about 45 feet as at D.D.2. The fresh rock below 90 feet would require close drilling and blasting.

TRENCH ACROSS SULLIVANS CREEK

Across Sullivans Creek (Plate 4), where tunnelling conditions are expected to be difficult, it is proposed to place the sewer in a trench. The length of trench depends on the location of the portals. On the western side of the creek the portal would be either in bedrock at about chainage 17700 feet or in soil and scree at some point to the east. On the eastern side the portal would be either near drill hole D.D.6 or farther to the east near drill hole D.D.11 (see "Portals").

The western part of the trench would be in soil and scree which consists of soft, poorly consolidated silty clay containing angular to sub-rounded fragments of sandstone. In drill hole D.D.5 the base of the soil and scree is 63 feet below the surface (R.L. 1885 feet). West of the drill hole the soil and scree becomes thinner, and the bottom of the trench for a short section near the portal would be in interbedded sandstone and shale (Plate 9).

Under the creek the trench will be in alluvium. The position of the boundary between the soil and scree, and the alluvium is not known accurately; the inferred position is shown on Plates 4 and 9. The alluvium consists of silty clay with possibly some gravelly horizons at depth, as indicated by auger holes put down some years ago further up the creek.

Where the trench crosses the creek a coffer dam will be needed each side of it. The banks should consist of impermeable material to keep water leakage into the trench to a minimum.

If the trench is extended east of the creek it will be in siliceous shale between about chainages 18800 and 19200 feet. Between chainage 19200 feet and a portal at about 19680 feet the bedrock is probably moderately to highly weathered siltstone and shale overlain by up to about 20 feet of soil which is at least partly alluvium and fill.

Exavation of the trench will be possible with earth moving equipment in the soil and scree, and in the alluvium. Some light blasting will probably be needed where bedrock occurs. The trench will be up to 70 feet deep and supports will be needed to prevent collapse, particularly in the soil and scree, and in the alluvium.

Water inflows will probably be slight in the soil and scree, and in the siltstone and shale. Moderate water inflows may occur in the siliceous shale and if gravel beds occur in the alluvium.

SEISMICITY

Seismic activity in the region is fairly common but is of low magnitude, not exceeding 3½ on the Richter scale and generally much lower. (Cleary, 1967). The ground accelerations associated with the recorded shocks would not be sufficient to affect the tunnel and its portals . None of the faults crossed by the tunnel line has been active in recent times, and any future movement is considered extremely unlikely.

USE OF EXCAVATED MATERIAL

Fresh dacite crystal tuff excavated from the tunnel would be a source of high grade concrete aggregate for lining the tunnel and shafts, provided that it could be suitably crushed and screened. The rock is extremely hard and strong, and is not known to contain any minerals deleterious to concrete. The sandstone from under Black Mountain could also be used for aggregate provided that it does not contain an undue proportion of shale.

CONCLUSIONS AND RECOMMENDATIONS

1. The investigations carried out indicate that, on geological grounds, proposed route for the tunnel is suitable. The route incorporates some minor alterations to the tunnel alignment made desirable by the results of drilling and surface investigations.

2. It is estimated from the drilling and seismic refraction results that about 55% of the tunnel would be in hard, strong, fresh rock where little or no support of the tunnel roof would be needed.

3. About 25% of the tunnel would be in rock softened and weakened by weathering in which the roof of the tunnel would need to be supported by steel sets. Another 20% of the tunnel would need rock bolts and possibly some steel sets for support.

4. Overbreak in the tunnel would be minimal in fresh rock where joints and bedding planes are at a high angle to the tunnel. Some overbreak can be expected in rock softened and weakened by weathering. In places intersecting planar defects such as bedding and faults joints striking parallel to the tunnel may give rise to some overbreak.

5. Close drilling and blasting would be needed to excavate fresh rock. Where the rock is highly weathered excavation without blasting will generally be possible; some forepoling may be needed in the worst ground. Moderately weathered rock will require light blasting.

6. Almost the entire length of the tunnel will be below the water table and consequently wet conditions can be expected. Water-pressure testing of drill holes indicates that water flows into 100-foot lengths of tunnel will range from almost zero to about 100 gallons per minute.

7. A suitable location for the outlet portal is indicated at about chainage 800 feet for a recommended tunnel invert level of 1770 feet.

8. For the portal west of Sullivans Creek suitable bedrock at tunnel level is indicated at about chainage 17700 feet.

9. East of Sullivans Creek it is recommended that the trench be extended east along the alternative alignment which passes through drill hole D.D.11. Suitable bedrock for the location of the portal is indicated at about chainage 19700 feet.

10. The three shaft sites at drill holes D.D.7, D.D.8 and D.D.9 are considered satisfactory from a geological viewpoint.

11. It is recommended that the shaft at Black Mountain Creek be located at the site of drill hole D.D.2 rather than at D.D.3.

ACKNOWLEDGEMENTS

The geological investigation was carried out in co-operation with officers of the Commonwealth Department of Works, Canberra. In particular, they were responsible for organizing the drilling, augering and the seismic work by Soil Mechanics Ltd., the results of which have been incorporated in this report.

REFERENCES

BEST, E.J., - Geological report on the site investigation and construction of Corin Dam, Cotter River, A.C.T. Bur. Miner. Resour. Aust. Rec 1969/111.

BURTON, G.M., 1967 - Recharge conditions and the siting of bores in fractured rock aquifers of the A.C.T. Bur. Miner. Resour. Aust. Rec. 1967/93 (in manuscript).

CLEARY, J.R., 1967 - The seismicity of the Gunning and surrounding areas, 1958-1961 Geol. Soc. Aust. V. 14(1).

HENDERSON, G.A.M., 1968 - Preliminary geological report on proposed North Molonglo Outfall Sewer, A.C.T., 1967. Bur. Miner Resour. Aust. Rec. 1968/110 (unpubl.).

ÖPIK, A.A., 1958 - The geology of the Canberra City district. Bur. Miner. Resour. Aust. Bull. No.32.

SIMPSON, C.J., 1968 - North Molonglo Outfall Sewer project photogeological analysis. Bur. Miner. Resour. Aust. Rec. 1968/122 (unpubl.).

S.M.H.E.A., 1958 (revised 1961) - Engineering geology manual, Part 1, Chapter 7. Snowy Mountains Hydro-Electric Authority (unpubl.).

SOIL MECHANICS LIMITED, 1969 - Report of Seismic Survey of Proposed Outfall Sewer Alignments, Canberra, A.C.T. Report No. 5401.

APPENDIX 1

DEFINITIONS OF SEMI-QUANTITATIVE DESCRIPTIVE TERMS

Grain Size

Coarse-grained	- 1 mm to 4 mm in diameter
Medium-grained	- $\frac{1}{4}$ mm to 1 mm in diameter
Fine-grained	- Less than $\frac{1}{4}$ mm in diameter

Bedding

Laminated	- Less than 10 mm thick
Thinly bedded	- 10 mm to 100 mm thick
Thickly bedded	- More than 100 mm thick

Hardness

Hard to very hard	- impossible to scratch with knife blade
Moderately hard	- Shallow scratches with knife blade
Soft	- deep scratches with knife blade

Percussive strength

Strong to very strong	- cannot be broken by repeated blows with a hammer
Moderately strong	- rock breaks after 3 or 4 heavy blows with hammer
Weak	- rock breaks after one blow with hammer (includes brittle, fissile, friable, plastic and flaky rocks)

Joint Spacing

Closely spaced	- joints spaced less than 6 inches apart
Moderately spaced	- joints spaced between 6 inches at 3 feet apart
Widely spaced	- joints spaced more than 3 feet apart

Weathering

Fresh	- rock shows no discolouration or loss of strength
Slightly weathered	- rock is slightly discoloured but not noticeably lower in strength than the fresh rock
Moderately weathered	- rock is discoloured and noticeably weakened but a 2-inch diameter drill core cannot usually be broken by hand across the rock fabric
Highly weathered	- rock is discoloured and weakened to such an extent that a 2-inch diameter core can be broken readily by hand across the rock fabric
Completely weathered	- rock is discoloured, decomposed and easily crumbles, but the fabric of the rock is mostly preserved. Rock has the engineering properties of a soil.

APPENDIX 2

GEOLOGICAL LOGS OF DIAMOND DRILL HOLES

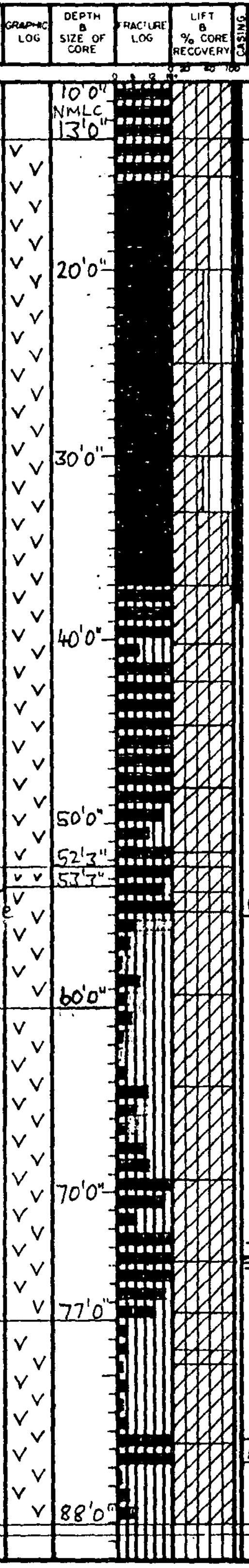
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION SOUTH OF COPPINS CREEK, 10 FEET WEST OF TRACK, ALONG PROPOSED LINE OF TUNNEL (SEE BELOW*)
ANGLE FROM HORIZONTAL 45°
DIRECTION 081° (True)
COORDINATES 12570E, 11690N (Stromlo Co-ords)
R.L. 1815'

HOLE NO. **D.D.1**
SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	DEPTH & SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES
	Brown silty clay	10'0" NMLC 13'0"	13'0"
DACITE CRYSTAL TUFF highly weathered	Pale brown, coarse grained weak, mod. soft rock. Max. core length 9", most core lengths 1"-4". Core lengths interspersed with broken material	20'0" 30'0" 40'0" 50'0" 52'3"	Rock broken almost throughout, core loss probably sandy decomposed tuff
TUFF	Dark blue grey, fine gr.	53'7"	
DACITE CRYSTAL TUFF Slightly to mod. weath.	Pale brown to grey, coarse grained, mod. hard and strong rock.	60'0"	55'0"
DACITE CRYSTAL TUFF Slightly weathered	Pale grey, coarse gr, mod. hard and strong rock. Max. core length 1'5", most core lengths 3"-6".	70'0" 77'0"	73'8" 73'10" Broken zone
DACITE CRYSTAL TUFF Fresh to slightly weathered	Pale grey, coarse gr, hard, strong rock. Max. core length 1'2", most core lengths 4"-8"	88'0"	83'4" 84'8" Broken zone
	END OF HOLE		88' 0"



WATER LEVEL 64' 5/6/69

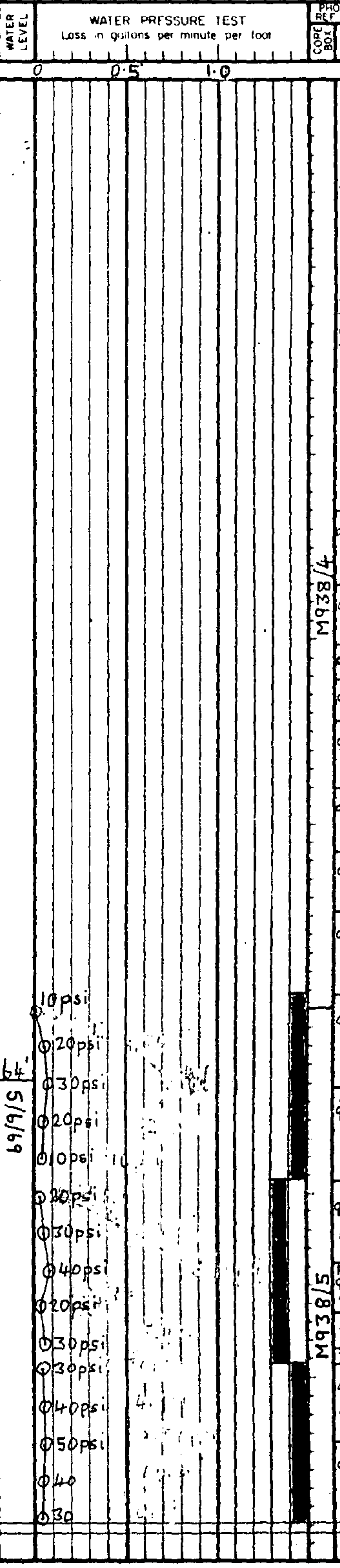


PHOTO REF NO: NO PHOTOS
CORE BOX: M938/4; M938/5
CORE BARREL: M 900 1; M 900 2; M 900 3; M 900 4; M 900 5; M 900 6; M 900 14; M 900 15; M 900 16; M 900 18; M 900 19; M 900 20; 21; 22; M 900 23; M 900 24

DRILL TYPE E1000 Mindrill
FEED hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M. Dziwulski
COMMENCED 22/5/69
COMPLETED 5/6/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10 feet : 1 inch

NOTES

FRACTURE LOG:– Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES:– Angles are measured relative to a plane normal to the core axis

*FOR Location SEE DRAWING, NO I55/A16/647

Rec. 1970/61

I55/A16/660

WATER PRESSURE TESTS
PACKER TYPE Mechanical
SUPPLY LINE N rod
VERTICAL SCALE 50 p.s.i. : 1 inch
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no. and frame no., e.g. M900/1
COLOUR

M(Pf)99

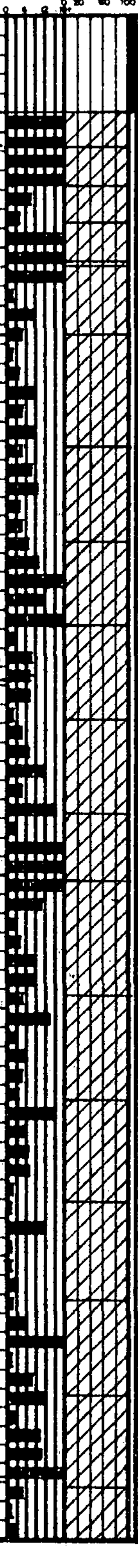
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

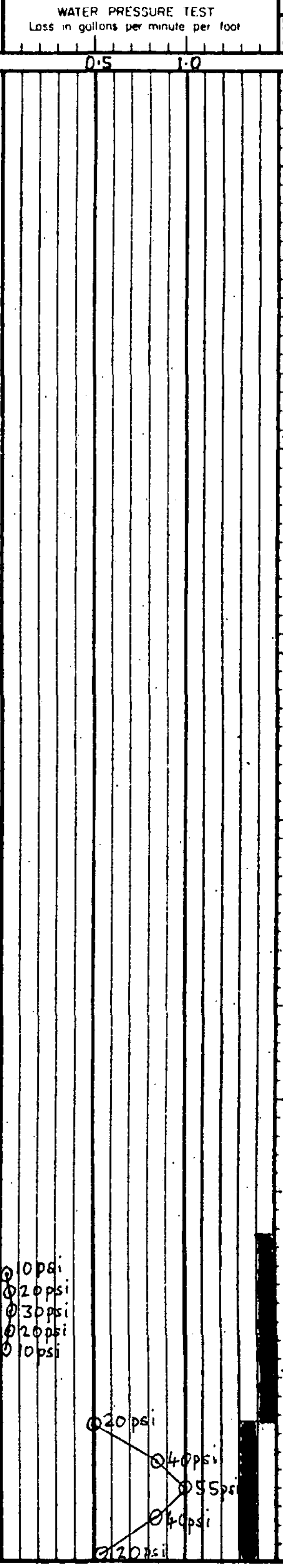
GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION 100 FEET WEST OF BLACK MOUNTAIN CREEK ON PROPOSED TUNNEL LINE (See below*)
ANGLE FROM HORIZONTAL 90° DIRECTION
COORDINATES 21875 E, 13100 N (Stromlo Co-ords.) R.L. 1883'

HOLE NO. D.D.2
SHEET 1 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	GRAPHIC LOG	DEPTH & SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	PHOTO REF NO CORE BOX	PHOTO REF NO CORE BARREL
	NO CORE		NX casing 5'0"				
DACITE CRYSTAL TUFF Moderately to highly weathered	Pale brown, coarse grained, weak, mod. soft rock. Max. core length 7", most core lengths 1"-4"	V V V V V V V V V V V V	NMLC 10'0" 16'6"	5'9" 6'6" 8'1" 8'3" 11'0" 11'2" Broken zones c̄ sandy material			M 899 3 M 899 4 M 899 5 M 899 6 M 899 7
DACITE CRYSTAL TUFF Moderately weathered	Pale brown, coarse grained, moderately hard and strong rock. Max. core length 1'4", most core lengths 3"-8".	V V V V V V V V V V V V V V V V V V	20'0" 30'0" 34'9"	28'9" 29'5" 30'3" ½" seams of grey clay 31'8" 31'10" Broken zone	27' 2/6/69	M938/6	M 899 8 M 899 9 M 899 10 M 899 11
DACITE CRYSTAL TUFF Moderately weathered	Pale brown, medium grained, mod. hard and strong rock. Max. core length 8", most core lengths 2"-6"	V V V V V V V V V V	40'0" 45'0"	43'9" 44'7" Brown & white clay 45'4" 45'10" Broken zone			M 899 12 M 899 13
DACITE CRYSTAL TUFF Slightly to moderately weathered	Pale brown grey, coarse grained, moderately hard and strong rock. Max. core length 1'3", most core lengths 3"-8"	V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V	50'0" 60'0" 70'0" 76'8"	69'8" 69'11" Broken zone 72'9" 72'11" Broken zone 76'0" 76'2" Broken zone		M938/7	NO PHOTO M 899 15 M 899 16 M 899 17 M 899 18 M 899 19
DACITE CRYSTAL TUFF	Blue grey, coarse grained hard, strong rock.	V V V					M 899 20





DRILL TYPE Boyles
FEED hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M. Parcell
COMMENCED 22/5/69
COMPLETED 2/6/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10feet: 1inch

NOTES

FRACTURE LOG:- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis

*FOR Location see DRAWING No I55/A16/648

Rec. 1970/61

I55/A16/661 (1 of 2)

WATER PRESSURE TESTS
PACKER TYPE Mechanical
SUPPLY LINE N rod
VERTICAL SCALE 100psi: 1inch
Figures given are gauge pressures
Test sections are indicated graphically by blocked in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no. and frame no., e.g. M899/3
COLOUR

M(Pf)99

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

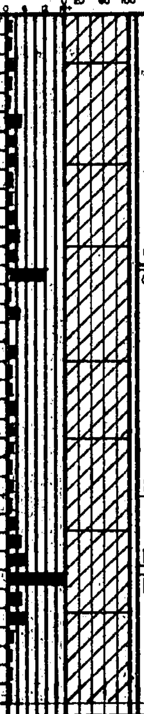
GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION 100 FEET WEST OF BLACK MOUNTAIN CREEK
FOR LOCATION SEE DRAWING No I55/A16/648
ANGLE FROM HORIZONTAL 90°
DIRECTION
COORDINATES 21875E, 13100N (Stromlo Co-ords)
R.L. 1883'

HOLE NO. D.D. 2
SHEET 2 OF 2

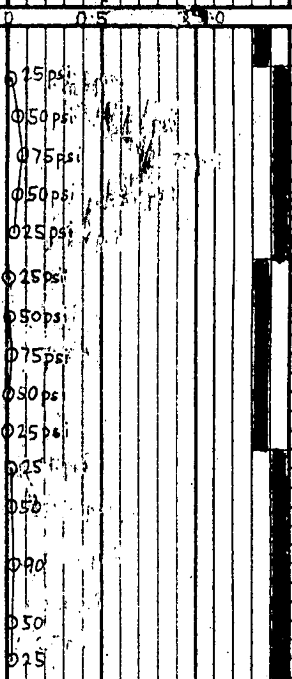
ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	PHOTO REF NO. CORE BOX	PHOTO REF NO. CORE BARREL
DACITE CRYSTAL TUFF Fresh to slightly weathered	Pale blue grey, coarse grained, hard, strong rock. Max. core length 1'6", most core lengths 3" - 1'0"	V V	80'0" NMLC			M 899 20
		V V			M938/7	M 899 21
		V V	90'0"	93'0" 93'2" Broken zone fresh fragments		M 899 22
	Occasional small cavities where soft feldspar washed out during drilling	V V				M 899 23
		V V	100'0"	105'0" ¼" vein of soft Kaolin		M 899 24
		V V	110'0"	108'10" 109'2" Broken zone fresh fragments	M938/8	M 899 25
		V V	116'0"			M 899 26
						M 899 28
	END OF HOLE			116' 0"		

FRACTURE LOG · LIFT & % CORE RECOVERY · CASING



WATER LEVEL

WATER PRESSURE TEST
Loss in gallons per minute per foot



DRILL TYPE Boyles
FEED hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M. Parcell
COMMENCED 22/5/69
COMPLETED 2/6/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10 feet: 1 inch

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blacked in.
BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

Rec. 1970/61

I55/A16/661 (2 of 2)

WATER PRESSURE TESTS
PACKER TYPE Mechanical
SUPPLY LINE N rod
VERTICAL SCALE 125 p.s.i. : 1 inch
Figures given are gauge pressures
Test sections are indicated graphically by blocked in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no. and frame no., e.g. M899/20
COLOUR

M(Pf)99

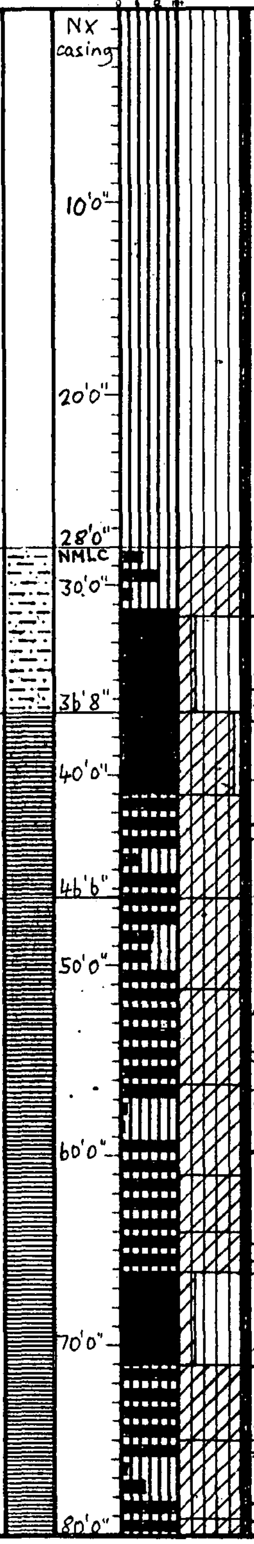
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION 1060 FEET EAST OF BLACK MOUNTAIN CREEK ON PROPOSED TUNNEL LINE (SEE BELOW*)
ANGLE FROM HORIZONTAL 90°
DIRECTION
COORDINATES 22930E, 13260N (Stromlo Co-ords) R.L. 1902'

HOLE NO. DD3
SHEET 1 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	DEPTH & SIZE OF CORE
	NO CORE in fanglomerate (rock fragments & soil, partly cemented)	NX casing; 0 – 28'0"
SILTSTONE moderately to highly weathered	Medium brown, soft weak rock. Max. core length 6", most core lengths 1"-4".	NMLC; 28'0" – 36'8"
SHALE highly weathered clayey	Fawn and pale grey very soft and weak rock. Max. core length 10".	36'8" – 46'6"
SHALE moderately to highly altered,** clayey in places	Pale to dark grey very soft and weak rock. Max. core length 12", most core lengths 1"-4"	46'6" – 80'0"



STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	
31'8" – 35'6"	Core loss probably clay
37'3" – 40'5"	Brown clay and small rock frags.
42'8" – 43'3"	Broken zone
52'6" – 54'7"	Broken zone
55'0" – 56'5"	Broken zone
59'10" – 64'6"	Broken zone many small frags.
65'6" – 66'3"	Broken zone
66'3" – 71'0"	Core loss probably clay
75'0" – 75'7"	Broken zone
78'4" – 79'4"	Broken zone

WATER LEVEL: 77' 20/6/69

WATER PRESSURE TEST Loss in gallons per minute per foot

PHOTO REF NO. (CORE BOX / CORE BARREL): M899 29; NO PHOTOS; M899 30; M899 31; M938/9; M899 32; M899 33; NO PHOTO; M899 35; M899 36; M899 37; M938/10; M905 2

DRILL TYPE Boyles
FEED Hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M Parcell
COMMENCED 3/6/69
COMPLETED 20/6/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10 feet: 1 inch

NOTES

FRACTURE LOG.— Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES.— Angles are measured relative to a plane normal to the core axis

** rock is decomposed but is not discoloured by weathering

* For Location See Drawing No I55/A16/648

Rec. 1970/61 I55/A16/662 (1 of 2)

WATER PRESSURE TESTS
PACKER TYPE
SUPPLY LINE
VERTICAL SCALE
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no. and frame no., e.g. M899/29
COLOUR

M(Pf)99

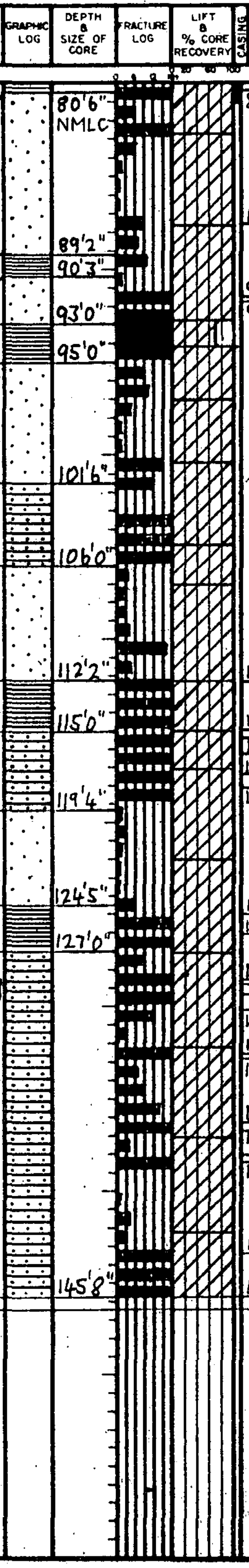
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION 1060 FEET EAST OF BLACK MOUNTAIN CREEK ON PROPOSED TUNNEL LINE (SEE BELOW*)
ANGLE FROM HORIZONTAL 90° DIRECTION
COORDINATES 22930 E, 13260 N (Stromlo Co-ords.) R.L. 1902'

HOLE NO. DD3
SHEET 2 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	DEPTH & SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES
SHALE	As above		80'4" Broken zone
SANDSTONE Slightly weathered to fresh	Pale grey, fine to med. grained, mod. hard and strong rock	80'6" NMLC	87'6" ½" shale bed bedding at 60°
	Soft shale	89'2" 90'3"	91'6" Broken zone 91'8"
	Soft shale	93'0" 95'0"	
	Interbedded sandstone & shale	101'6" 106'0"	
		112'2"	112'2"
SHALE	Pale grey, soft, weak rock	115'0"	Broken zones 115'0" 116'4"
1/6 SHALE & SANDSTONE	Pale grey, alternating hard and soft rock	119'4"	117'4" Broken zone 118'1"
SANDSTONE fresh	Pale grey, mod. hard and strong rock	124'5"	
SHALE	Pale grey, soft, weak rock	127'0"	125'0" Broken zone 126'0"
1/6 SHALE & SANDSTONE SS fresh, shale altered	Pale grey alternating hard and soft rock. Max. core length 1'2", most core lengths 2"–6"	145'8"	128'6" Broken zones 130'1" 132'7" Broken zone 132'9" 136'3" 136'8" Broken zones 138'4" 143'5" 145'8" Broken zone
	END OF HOLE		145' 8"



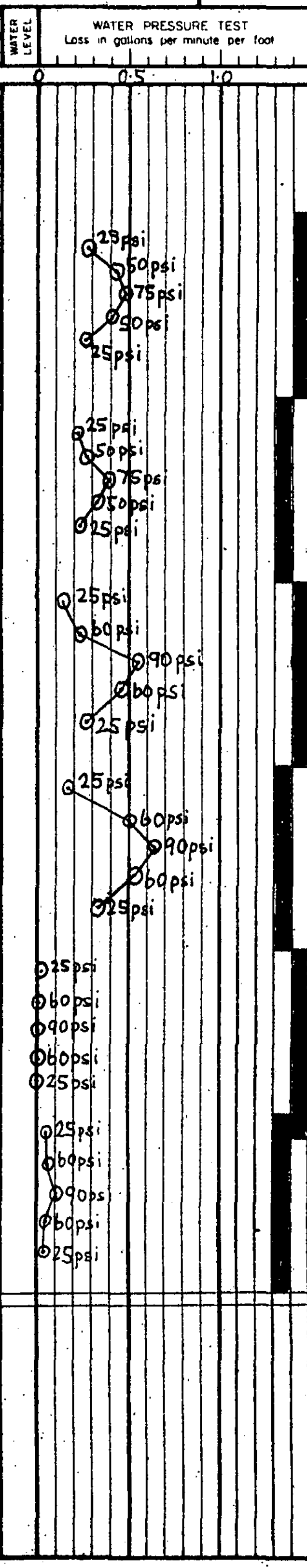


PHOTO REF NO. CORE BARREL
M 905 3
M 905 4
M 905 5
M 905 6
M 905 7
M 905 8
M 905 9
M 905 10
NO PHOTO
905 11
M 905 12
M 905 13
M 905 14
M 905 15
M 905 16
M 905 17

DRILL TYPE Boyles
FEED Hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M. Parcell
COMMENCED 3/6/69
COMPLETED 20/6/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10 feet: 1 inch

NOTES

FRACTURE LOG:- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis

*FOR LOCATION SEE DRAWING No I55/A16/648

WATER PRESSURE TESTS
PACKER TYPE Mechanical
SUPPLY LINE N rod
VERTICAL SCALE 200psi : 1 inch
Figures given are gauge pressures
Test sections are indicated graphically by blocked in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no. and frame no., e.g. M905/3
COLOUR

Rec. 1970/61 I55/A16/662 (2 of 2)

M(Pt)99

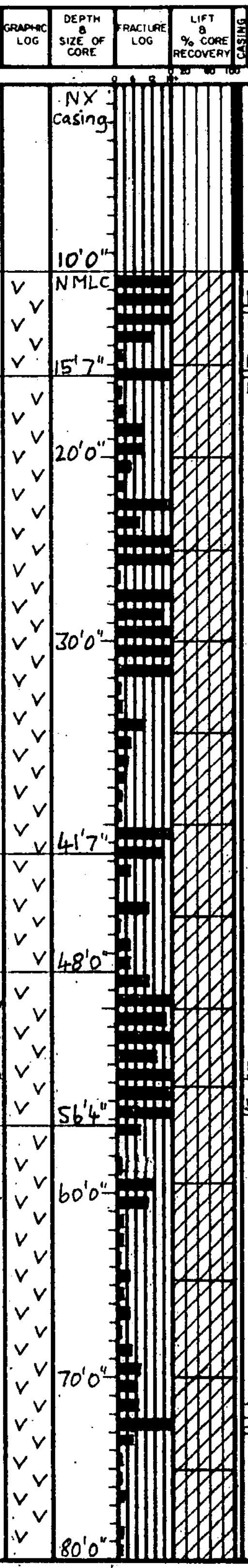
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION AT INTERSECTION OF SEISMIC TRAVERSES AA' AND DD' NEAR OUTLET PORTAL (SEE BELOW*)
ANGLE FROM HORIZONTAL 90° DIRECTION
COORDINATES 13360E, 11820N (Stromlo Co-ords) R.L. 1862'

HOLE NO. DD4
SHEET 1 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	DEPTH & SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES
	NO CORE soil and decomposed tuff	NX casing 10'0"	
DACITE CRYSTAL TUFF highly weath.	Brown, coarse grained, moderately soft and weak rock	NMLC 15'7"	11'11" 12'2" Broken zone with sandy material 15'4" 15'7" Broken zone
DACITE CRYSTAL TUFF moderately weathered	Brown to pale grey green, coarse grained, mod. hard and strong rock. Max. core length 1'2", most core lengths 2"-6"	20'0" 30'0" 41'7"	
DACITE CRYSTAL TUFF sl. weath.	Pale grey, coarse gr., hard strong rock. Max. core length 1'9", most core lengths 4"-10"	48'0"	
DACITE CRYSTAL TUFF moderately weathered	Brown to pale grey green, coarse gr., mod. hard, mod weak rock. Max. core length 8", most core lengths 1"-4"	56'4"	53'10" 55'9" Broken zone
DACITE CRYSTAL TUFF fresh to slightly weathered	Pale grey, coarse gr., hard, strong rock. Max. core length 1'8", most core lengths 4"-1'2"	60'0" 70'0" 80'0"	72'2" 72'7" Broken zone



WATER LEVEL 54' 13/6/69

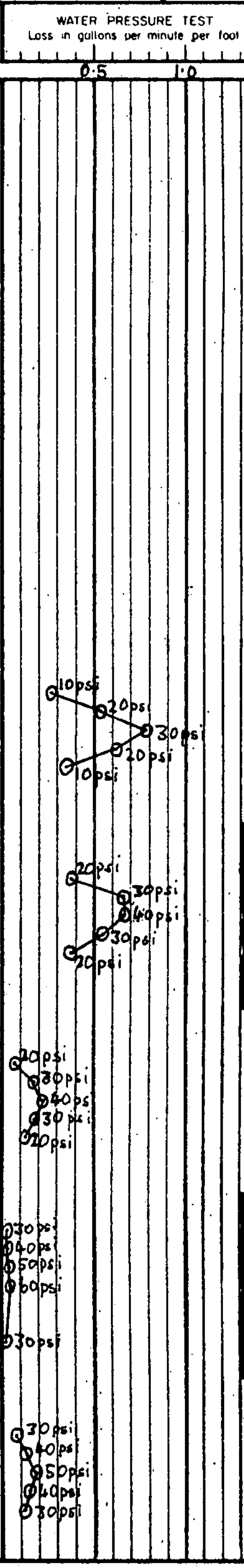


PHOTO REF NO

CORE BOX: M938/12, M938/13

CORE BARREL: M900 25, M900 26, M900 27, M900 28, M900 29, M900 30, M900 31, M900 32, M900 33, M900 34, M900 35, M900 36, M904 2, M904 3

DRILL TYPE E1000 Mindrill
FEED Hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M. Dziwulski
COMMENCED 6/6/69
COMPLETED 13/6/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10 feet: 1 inch

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

*FOR LOCATION SEE DRAWING No I55/A16/647

Rec. 1970/61 I55/A16/663 (1 of 2)

WATER PRESSURE TESTS
PACKER TYPE Mechanical
SUPPLY LINE N rod
VERTICAL SCALE 100psi : 1 inch
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no. and frame no., e.g. M900/25
COLOUR

M(Pf)99

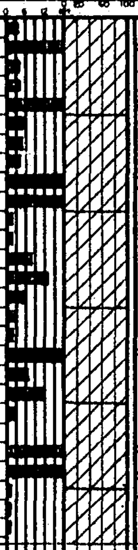
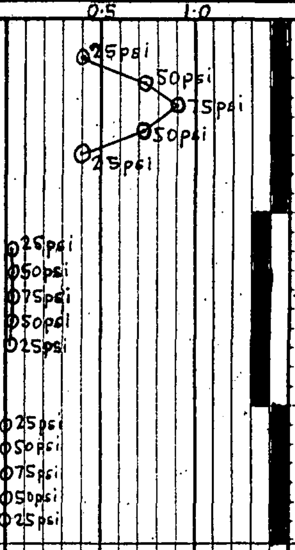
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION AT INTERSECTION OF SEISMIC TRAVERSES AA' AND DD' NEAR OUTLET PORTAL (SEE BELOW*)
ANGLE FROM HORIZONTAL 90°
DIRECTION
COORDINATES 13360E, 11820N (Stromlo Co-ords.) R.L. 1862'

HOLE NO. DD4

SHEET 2 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF NO CORE BOX	PHOTO REF NO CORE BARREL
DACITE CRYSTAL TUFF fresh to slightly weathered	Pale grey, coarse grained, hard strong rock. Max. core length 1'9", most core lengths 3"-10"	V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V V	80'0" NMLC				81'4" 81'6" Broken zone			M938/13	M 904 4
							84'3" 84'5" Broken zone				M 904 5
			90'0"				88'2" 88'10" Broken zone				M 904 6
			100'0"				97'2" 97'4" Broken zone				M 904 7
							102'2" 103'10" Broken zones				M 904 8
			107'4"								M 904 9
	END OF HOLE						107'4"				

DRILL TYPE E1000 Mindrill
FEED Hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M. Dziwulski
COMMENCED 6/6/69
COMPLETED 13/6/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10 feet: 1 inch

NOTES

FRACTURE LOG:- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis

*For Location See Drawing No I55/A16/647

Rec. 1970/61 I55/A16/663 (2 of 2)

WATER PRESSURE TESTS
PACKER TYPE Mechanical
SUPPLY LINE N rod
VERTICAL SCALE 200 psi : 1 inch
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources, film no. and frame no., e.g. M904/4
COLOUR

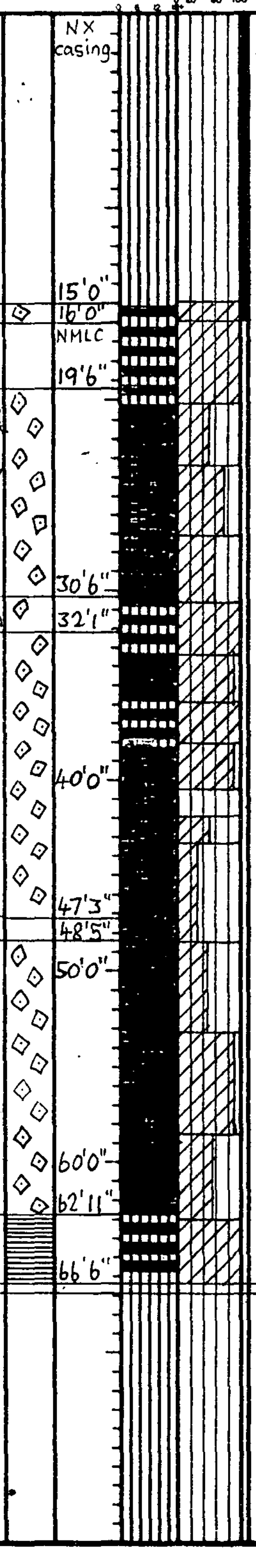
M(Pf)99

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION 50 FEET EAST OF CLUNIES ROSS STREET, ALONG PROPOSED TUNNEL LINE (SEE BELOW*)
ANGLE FROM HORIZONTAL 90°
DIRECTION
COORDINATES 29335E, 12310N (Stromlo Co-ords.)
R.L. 1848'

HOLE NO. D.D.5
SHEET 1 OF 1



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	DEPTH & SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	CORE BOX	PHOTO REF NO.
	No core	NX casing 15'0"					
Sandstone	Fragments	16'0"					
White sandy clay		NMLC 19'6"				M938/14	M 905 18
Interspersed sandstone fragments and sandy clay (soil & scree)	Sandstone med. gr., mod hard and strong to soft, weak pale grey and brown rock. Max. core length 5"	30'6"					M 905 19 M 905 20 M 905 21
	Sandstone, 1 9" core length	32'1"					M 905 22
		40'0" 47'3"					M 905 23 M 905 24 M 905 25 No PHOTO M 905 26
	Brown clay	48'5"				M938/15	
		50'0" 60'0" 62'11"					M 905 27 M 905 28 M 905 29
MUDSTONE highly altered	Dark grey, soft weak clayey rock.	66'6"					M 905 30
	END OF HOLE		66' 6"				

DRILL TYPE Boyles
FEED Hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M. Parcell
COMMENCED 24/6/69
COMPLETED 30/6/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10 feet : 1 inch

NOTES

FRACTURE LOG:- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis

*For Location See Drawing No I55/A16/649

Rec. 1970/61

I55/A16/664

WATER PRESSURE TESTS
PACKER TYPE
SUPPLY LINE
VERTICAL SCALE
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no. and frame no., e.g. M905/18
COLOUR

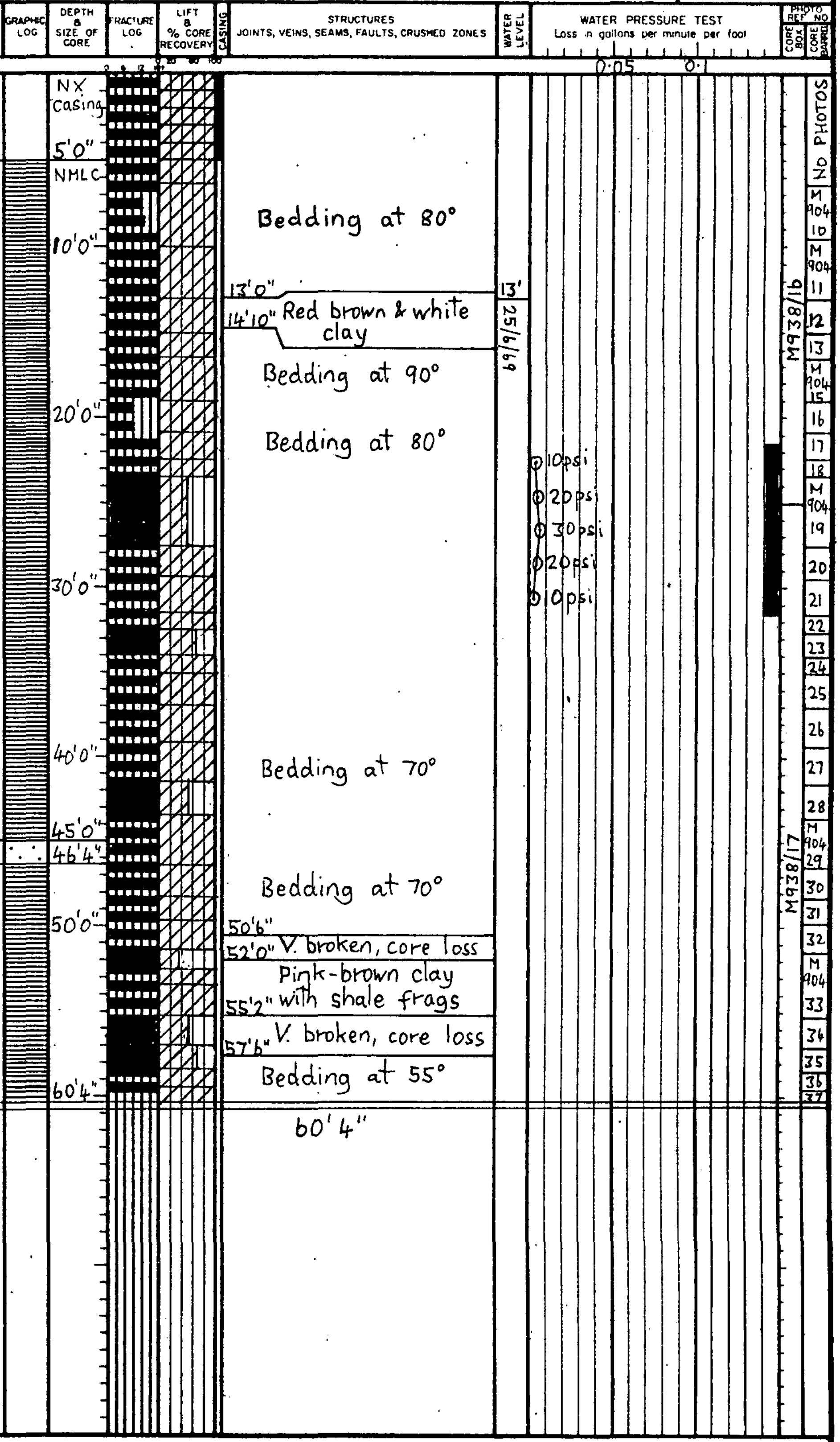
M(Pf)99

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION ON RIDGE IMMEDIATELY EAST OF SULLIVANS CREEK, ALONG PROPOSED TUNNEL LINE (See Below*)
ANGLE FROM HORIZONTAL 90° DIRECTION
COORDINATES 30080E, 11610N (Stromlo Co-ords.) R.L. 1845'

HOLE NO. **DD6**
SHEET 1 OF 1



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	DEPTH & SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST	PHOTO REF NO
	Soil and siliceous shale fragments	NX Casing 5'0"				No PHOTOS
SILICEOUS SHALE slightly to moderately weathered	Brown to pale grey moderately hard but weak rock. Max. core length 3". Mostly broken throughout as rock fractures easily along bedding and joint planes. Bedding planes up to ½" apart, joints 1"-2" apart	NMLC 10'0"	Bedding at 80°			M904 10 M904 11
			13'0"–14'10" Red brown & white clay	13' 25/6/69		M938/16 12 13
		20'0"	Bedding at 90° Bedding at 80°			M904 15 16 17 18
					10psi 20psi 30psi 20psi 10psi	M904 19 20 21
		30'0"				22 23 24 25 26
		40'0"	Bedding at 70°			27 28
		45'0"				M904 29
	Soft sandstone	46'4"	Bedding at 70°			M938/17 30 31
		50'0"	50'6"–52'0" V. broken, core loss			32
			Pink-brown clay with shale frags			M904 33
			55'2"–57'6" V. broken, core loss			34
		60'4"	Bedding at 55°			35 36 37
	END OF HOLE		60'4"			

DRILL TYPE E1000 Mindrill
FEED Hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M. Dziwulski
COMMENCED 18/6/69
COMPLETED 25/6/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10 feet: 1 inch

NOTES

FRACTURE LOG:- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis

*For Location See Drawing No I55/A16/649

Rec. 1970/61

I55/A16/665

WATER PRESSURE TESTS
PACKER TYPE Mechanical
SUPPLY LINE N rod
VERTICAL SCALE 50 psi: 1 inch
Figures given are gauge pressures.
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no. and frame no., e.g. M904/10
COLOUR

M(Pf)99

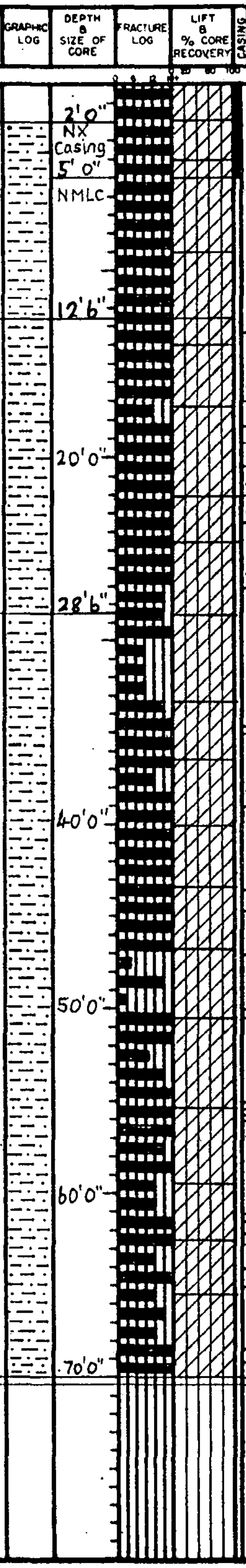
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

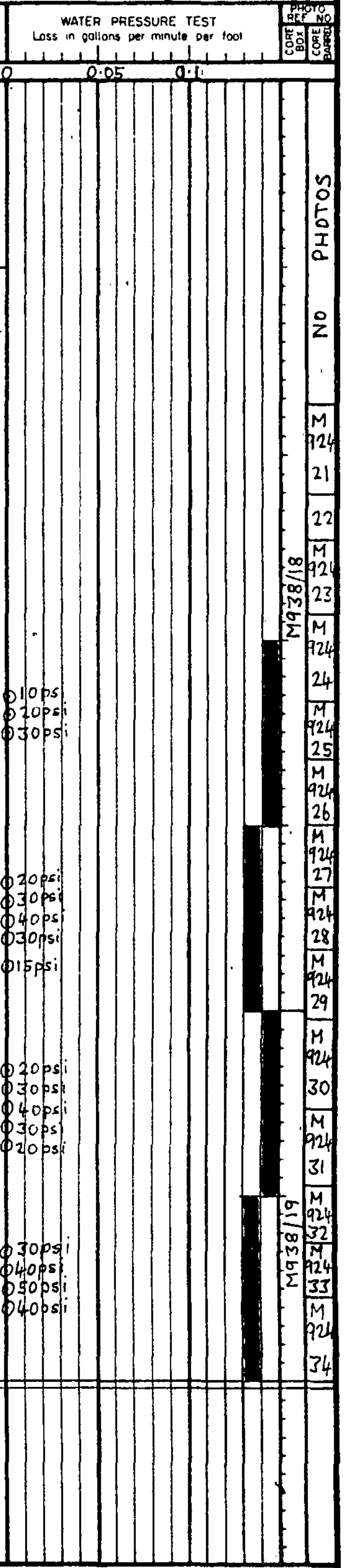
GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION 200 FEET NORTH OF NEW HOSPITAL ROAD, ALONG PROPOSED TUNNEL LINE (See below*)
ANGLE FROM HORIZONTAL 90°
DIRECTION
COORDINATES 32955E, 11470N (Stromlo Co-ords.)
R.L. 1858'

HOLE NO. D.D.7
SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC	DEPTH & SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL
	Red brown clay	2'0"		
Siltstone fragments and clay	Red brown and yellow brown decomposed material, broken throughout	NX Casing 5'0" NMLC 12'6"		10' 10/7/69
SILTSTONE moderately to highly weathered with clay	Red brown and yellow brown soft, weak rock. Extensively broken in many places	20'0" 28'6"	13'4" Broken zone 17'0" 18'3" 19'2" Broken zone 20'5" 22'0" Broken zone 23'6" Broken zone 27'0"	
SILTSTONE moderately to highly weathered	Red brown and yellow brown soft, weak rock. Max. core length 11", most core lengths 1"-4". Much broken rock. Bedding at 20°	40'0" 50'0" 60'0" 70'0"	34'9" 35'0" Broken zone 39'0" Broken zone 43'6" 44'10" Broken zone 47'0" 50'0" Broken zone 50'4" 55'0" Broken zones 56'0" 61'1" Broken zones 62'9" 64'0" Broken zone 65'0" 68'6" Broken zone 69'2"	
	END OF HOLE		70'0"	





DRILL TYPE E1000 Mindrill
FEED Hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M. Dziwulski
COMMENCED 5/7/69
COMPLETED 10/7/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10 feet: 1 inch

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

*For Location See Drawing No I55/A16/650

Rec. 1970/61 I55/A16/666

WATER PRESSURE TESTS
PACKER TYPE Mechanical
SUPPLY LINE N rod
VERTICAL SCALE 100 psi : 1 inch
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no and frame no., e.g. M924/21
COLOUR

M(Pf)99

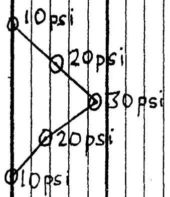
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION 150 FEET WEST OF COMMONWEALTH AVENUE ALONG PROPOSED TUNNEL LINE (See Below*)
ANGLE FROM HORIZONTAL 90° DIRECTION
COORDINATES 34830E, 10765N (Stromlo Co-ords.) R.L. 1843'

HOLE NO. D.D.8
SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG 0 6 12 18+	LIFT & % CORE RECOVERY 0 20 60 100	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot 0·05 0·1	PHOTO REF NO. CORE BOX	PHOTO REF NO. CORE BARREL
	Black soil and pale brown clay		NX casing 5'0"								
SILTSTONE highly weathered	Pale yellow brown soft, weak rock, much decomposed to clay. Max. core length 4"		NMLC 10'0" 20'0" 30'0" 40'0" 50'0"				Bedding at 35° Bedding at 40°	8' 1/7/69	10psi 20psi 30psi 20psi 10psi	M938/20	NO PHOTOS M 924 1 M 924 3 M 924 4 M 924 5 M 924 6 7 M 924 8 M 924 9 M 924 10 M 924 11 M 924 12
	END OF HOLE						50'0"				



DRILL TYPE E1000 Mindrill
FEED Hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M. Dziwulski
COMMENCED 27/6/69
COMPLETED 1/7/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10 feet : 1 inch

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

For Location See DRAWING No I55/A16/650

Rec. 1970/61

I55/A16/667

WATER PRESSURE TESTS
PACKER TYPE Mechanical
SUPPLY LINE N rod
VERTICAL SCALE 50psi : 1inch
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no. and frame no., e.g. M924/12
COLOUR

M(Pf) 99

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER

LOCATION 250 FEET SOUTH EAST OF HOTEL ACTON, ALONG PROPOSED TUNNEL LINE (SEE BELOW*)

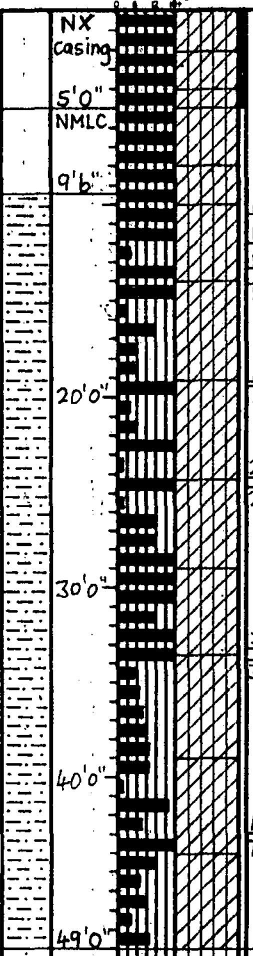
ANGLE FROM HORIZONTAL 90° DIRECTION

COORDINATES 34160E, 11230N R.L. 1833'

HOLE NO. D.D.9

SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	DEPTH & SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot (0·05, 0·1)	PHOTO REF NO.
	Dark brown clayey soil	NX casing 5'0"		5'		NO PHOTOS
	Yellow brown clay and siltstone fragments	NMLC 9'6"				
SILTSTONE moderately weathered	Yellow brown, soft, moderately weak rock. Max. core length 9", most core lengths 2"-6".		10'7"–12'0" Yellow brown clay			M924 13
			13'4"–14'2" Broken zone		10psi 20psi 30psi 20psi 10psi	M924 14
		20'0"	19'3"–19'5" Broken zone			M924 15
			24'2"–24'8" Broken zone			M924 16 M938/21
		30'0"	33'3"–33'10" Broken zone Bedding at 35°			M924 17 M924 18
		40'0"	43'0"–43'4" Broken zone		10psi 20psi 30psi 40psi	M924 19 M924 20
		49'0"				
	END OF HOLE		49 FEET			



DRILL TYPE E1000 Mindrill
FEED Hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M. Dziwulski
COMMENCED 2/7/69
COMPLETED 4/7/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10 feet: 1 inch

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blocked in.

BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

*For Location See Drawing No I55/A16/650

Rec. 1970/61 I55/A16/668

WATER PRESSURE TESTS
PACKER TYPE Mechanical
SUPPLY LINE N rod
VERTICAL SCALE 50psi : 1inch
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no. and frame no., e.g. M924/13
COLOUR

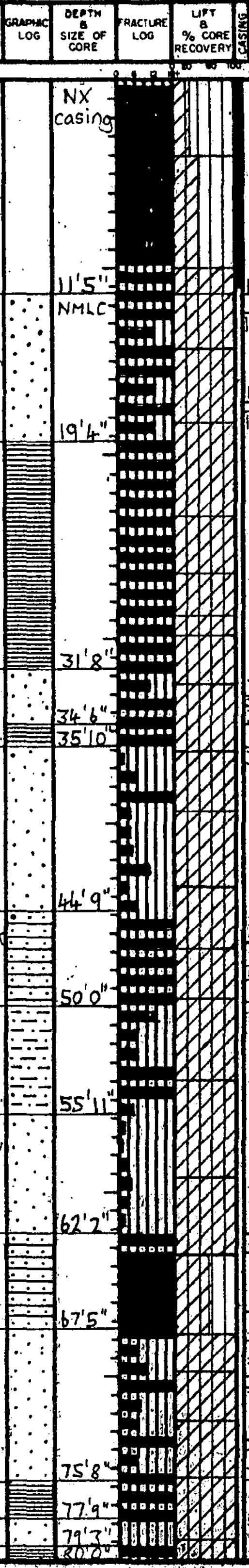
M(Pf)99

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION 300 FEET WEST OF CLUNIES ROSS STREET, ALONG PROPOSED TUNNEL LINE (SEE BELOW*)
ANGLE FROM HORIZONTAL 90° DIRECTION
COORDINATES 29080E, 12555N (Stromlo Co-ords.) R.L. 1892'

HOLE NO. D.D.10
SHEET 1 OF 2



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	DEPTH & SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot (0 – 0.5 – 1.0)	PHOTO REF. NO.
SANDSTONE fragments		NX casing 11'5"				NO PHOTOS
SANDSTONE moderately to highly weathered	Brown to pale grey, med. grained, mod. hard mod. weak rock. Max. core length 6".	NMLC 19'4"	11'5" – 12'5" Broken zone 17'2" – 17'9" Sandy material			M 905 31 M 905 32
SHALE highly weathered	Pale grey, soft, weak rock, broken almost throughout and much decomposed to clay	31'8"			5psi 10psi 15psi 10psi 5psi	M 905 33 M 905 34 M 905 35 M938/22
SANDSTONE mod. weath.	Brown to pale grey, mod. soft & weak rock.	34'6" 35'10"	33'0" – 33'7" Pale grey clay 34'6" – 35'10" Highly weath. shale			M 905 36 M 905 37
SANDSTONE moderately weathered	Brown and pale grey, fine grained, mod. hard and strong rock. Max. core length 8", most 3"-6"	44'9"				M 905 38 M 930 2
1/b SANDSTONE SILTSTONE & SHALE	Pale grey, soft, weak rock	50'0"	46'5" – 47'10" – 48'6" – 49'10" Broken zones			M 930 3 M 930 4
SILTSTONE moderately weathered	Pale grey, mod. soft and weak rock. Max. core length 7", most 1"-4"	55'11"			15psi 25psi 35psi 25psi 15psi	M 930 5 M 930 6
SANDSTONE moderately weathered	Pale purple, fine gr., hard, strong rock. Max. core length 1'4", most 3"-1'0"	62'2"				M 930 7
1/b SANDSTONE & SHALE	S.S. purple, shale pale grey, alternating hard & soft rock. Max. core length 6"	67'5"	62'2" – 63'3" Broken zone 66'6" – 68'0" Broken zone	67' 18/7/69	15psi 25psi 40psi 25psi 15psi	M 930 8 9 M938/23
SANDSTONE slightly to moderately weathered	Red brown and pale grey, fine gr., mod hard to hard rock. Max. core length 1'6". Soft grey shale Soft grey shale	75'8" 77'9" 79'3" 80'0"	70'0" – 70'7" 2 2" clay seams 73'7" – 75'0" Grey clay seam 75'0" – 75'8" Broken zone Bedding at 60°		20psi 40psi 60psi 40psi 20psi	M 930 10 M 930 11 M 930 12 13

DRILL TYPE Boyles
FEED Hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M Parcell
COMMENCED 2/7/69
COMPLETED 18/7/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10 feet: 1 inch

NOTES

FRACTURE LOG:- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis

*For Location See Drawing No I55/A16/649

Rec. 1970/61 I55/A16/669 (1 of 2)

WATER PRESSURE TESTS
PACKER TYPE Mechanical
SUPPLY LINE N rod
VERTICAL SCALE 100psi : 1 inch
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no. and frame no., e.g. M905/31
COLOUR

M(Pf)99

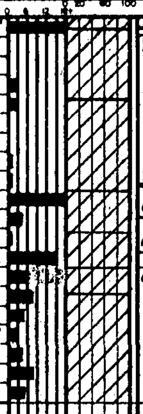
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

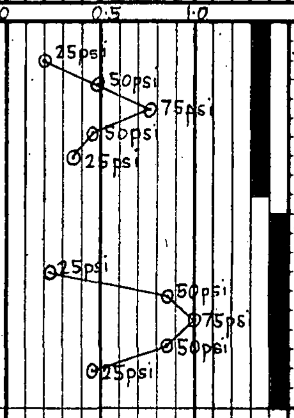
GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION 300 FEET WEST OF CLUNIES ROSS STREET, ALONG PROPOSED TUNNEL LINE (SEE BELOW*)
ANGLE FROM HORIZONTAL 90° DIRECTION
COORDINATES 29080 E, 12555 N (Stromlo Co-ords.) R.L. 1892'

HOLE NO. D.D10
SHEET 2 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	PHOTO REF NO.
SANDSTONE slightly to moderately weathered	Light to medium grey and pale red brown, medium grained hard strong rock. Max. core length 2'6", most core lengths 3"-10"		80'0" NMLC 90'0" 100'0"	[illegible]–80'10" Broken zone 88'10" 2" clay seam 90'5" 2" shale bed 92'2"–93'0" Broken zone Bedding at 60°	M930 14 M930 15 M938/23 16 17 18 M930 19
	END OF HOLE			100' 0"	





DRILL TYPE Boyles
FEED Hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M. Parcell
COMMENCED 2/7/69
COMPLETED 18/7/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10 feet : 1 inch

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blacked in.
BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

*For Location See Drawing No I55/A16/649

Rec. 1970/61

I55/A16/669 (2 of 2)

WATER PRESSURE TESTS
PACKER TYPE Mechanical
SUPPLY LINE N rod
VERTICAL SCALE 200psi : 1 inch
Figures given are gauge pressures
Test sections are indicated graphically by blocked in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no. and frame no., e.g. M930/14
COLOUR

M(Pf)99

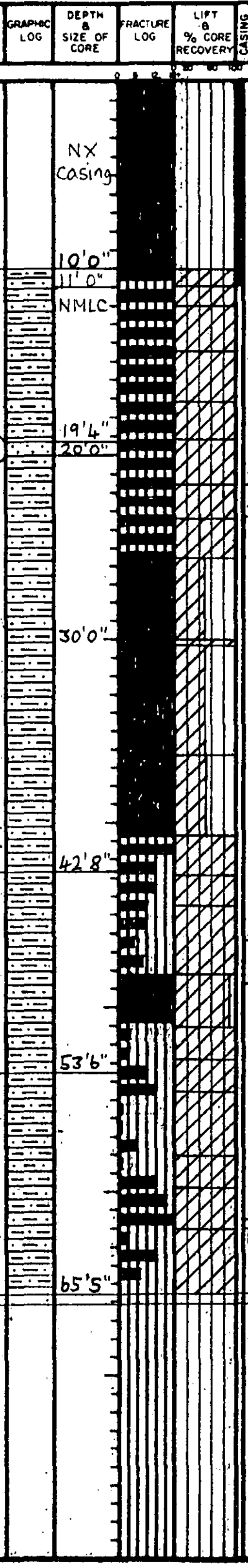
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION ABOUT 150 FEET SOUTH OF DEPT. OF GEOPHYSICS AND GEOCHEMISTRY ALONG PROPOSED TUNNEL LINE (See Below*)
ANGLE FROM HORIZONTAL 90°
DIRECTION
COORDINATES 30940 E, 11400 N (Stromlo Co-ords.)
R.L. 1855'

HOLE NO. **D.D.11**
SHEET 1 OF 1

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	DEPTH & SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot	PHOTO REF NO CORE BOX	PHOTO REF NO CORE BARREL
					0 0.05 0.1		
NO CORE		NX Casing 10'0"		8' 25/7/69			
Interbedded SILTSTONE & SHALE highly weathered	Pale brown soft, weak rock. Max. core length 3". Much broken and decomposed to clay Sandstone	11'0" NMLC 19'4" 20'0"	21'7" 23'5" Near vertical quartz vein Bedding at 45°			M938/24	20 M 930 21 M 930 22 23 24 25 26 M 930 27 M 930 28 M 930 29 30
		30'0" 42'8"					
Interbedded SILTSTONE & SHALE moderately weathered	Pale brown, mod. soft, weak rock. Max. core length 9", most core lengths 1"-5".	53'6"	46'4" 48'9" 1" vertical qtz. vein		15psi 25psi 45psi	M938/25	31 M 930 32 M 930 34 35 37
SHALE fresh	Dark grey, mod. soft, mod. strong rock. Max. core length 1'0", most core lengths 2"-8".	65'5"	Bedding at 65° 61'6" 62'0" Broken zone		15psi 25psi 50psi		M 930 38 1 M 938 2 M 938 3
	END OF HOLE		65' 5"				



DRILL TYPE Boyles
FEED Hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M. Parcell
COMMENCED 21/7/69
COMPLETED 25/7/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10 feet: 1 inch

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

*For Location See Drawing No I55/A16/649

Rec. 1970/61

I55/A16/670

WATER PRESSURE TESTS
PACKER TYPE Mechanical
SUPPLY LINE N rod
VERTICAL SCALE 100psi : 1 inch
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no. and frame no., e.g. M930/21
COLOUR

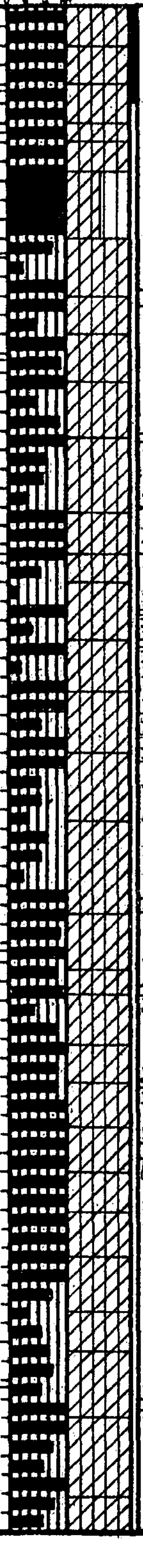
M(Pf)99

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION 80 FEET WEST OF LIVERSIDGE STREET, ALONG PROPOSED TUNNEL LINE (See Below*)
ANGLE FROM HORIZONTAL 45°
DIRECTION 088° (True)
COORDINATES 32320E, 12050N (Stromlo Co-ords.)
R.L. 1885'

HOLE NO. D.D 12
SHEET 1 OF 2



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	DEPTH & SIZE OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL	WATER PRESSURE TEST Loss in gallons per minute per foot (0 0·5 1·0)	PHOTO REF NO. CORE BOX	PHOTO REF NO. CORE BARREL
	Red brown clay with quartz pebbles.	NX casing 4'3" 5'0"					
	Clay and shale fragments	6'6"					
SILICEOUS SHALE mod. to highly weathered	Pale grey, broken, decomposed to clay in places	NMLC 10'0" 12'8"					NO PHOTOS
SILICEOUS SHALE moderately weathered	Pale to medium grey mod. hard, but weak rock	18'4"	14'10" Broken zone 15'6"				
SILICEOUS SHALE slightly to moderately weathered	Med grey to green grey mod. hard, but weak rock, laminated	20'0" 26'0"	22'2" Broken zone 22'6" 26'0"			M938/26	M 924 35
SHALE & CLAY	Grey and yellow c̄ quartz	28'6"	28'6" Shear zone c̄ 6" wide				36
SILICEOUS SHALE slightly to moderately weathered	Med. grey, mod. hard but weak, laminated rock. Rock splits easily along laminations spaced ¼" to 3" apart	30'0" 40'0" 49'4"	Bedding at 70° 31'6" 31'8" 32'0" Broken zones 33'3" 35'0" 37'0' Broken zone 38'0" 39'6" Broken zone 46'10" Quartz and clay 47'4"				M 924 37 M 939 1 M 939 2 M 939 3 M 939 4 M 939 5
SILICEOUS SHALE slightly weathered	Med. grey, mod. hard but weak, laminated rock. Rock splits easily along laminations spaced ¼" - 3" apart	50'0" 60'0" 70'0" 72'3"	51'4" Broken zone 51'9" 56'5" Soft shale and clay 56'7" 59'7" Broken zone c̄ clay 60'6"	70' 24/7/69	20psi 30psi 40psi 30psi 20psi 30psi 40psi 50psi 40psi 30psi 25psi	M938/27	6 M 939 7 8 9 M 939 10 11 12 M 939 13
SILICEOUS SHALE fresh to slightly weathered	Dark grey, mod. hard but weak, laminated rock. Rock splits easily along laminations	80'0"	73'0" Broken zone 73'7"		50psi 75psi 50psi 25psi		M 939 14 M 939 15 16

DRILL TYPE E1000 Mindrill
FEED Hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M Dziwulski
COMMENCED 11/7/69
COMPLETED 24/7/69
LOGGED BY R. Thieme
VERTICAL SCALE 10 feet : 1 inch

NOTES

FRACTURE LOG :- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES :- Angles are measured relative to a plane normal to the core axis

*For Location See Drawing No I55/A16/650

WATER PRESSURE TESTS
PACKER TYPE Mechanical
SUPPLY LINE N rod
VERTICAL SCALE 100psi : 1 inch
Figures given are gauge pressures
Test sections are indicated graphically by blocked in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no. and frame no., e.g. M924/35
COLOUR

Rec. 1970/61

I55/A16/671 (1 of 2)

M(Pf)99

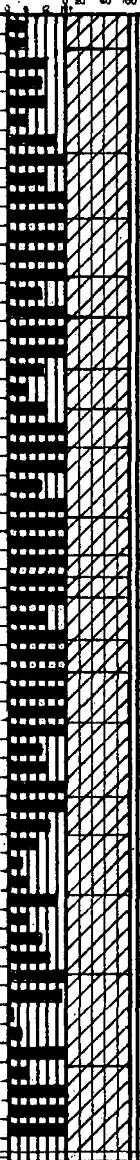
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT NORTH MOLONGLO OUTFALL SEWER
LOCATION 80 FEET WEST OF LIVERSIDGE STREET, ALONG PROPOSED TUNNEL LINE (SEE BELOW*)
ANGLE FROM HORIZONTAL 45° DIRECTION 088°(True)
COORDINATES 32320E, 12050N (Stromlo Co-ords) R.L. 1885'

HOLE NO. DD 12
SHEET 2 OF 2

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION LITHOLOGY, COLOUR, STRENGTH, HARDNESS, ETC.	GRAPHIC LOG	DEPTH & SIZE OF CORE	FRACTURE LOG	LIFT & % CORE RECOVERY	CASING	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	WATER LEVEL
SILICEOUS SHALE fresh to slightly weathered	Dark grey, mod. hard, but weak, laminated rock. Rock splits easily along laminations spaced ¼" to 3" apart Some iron stained joints.		NMLC					
							87'1" 87'7" Broken zone	
			90'0"				89'9" 91'8". Broken zone	
							95'3" 95'8" Broken zone	
			100'0"				Bedding at 75°	
							102'3" 103'3" Broken zone	
							106'1" 106'9" 107'8" 108'2" Broken zones	
			110'0"				108'10" 110'0" Broken zone	
							110'7" 111'9" Broken zone	
							112'1" 115'0" Broken zone	
	Bedding at 45°						[illegible] 115'11" Broken zone	
							117'3" Broken zone	
			120'0"				119'9" 1" Quartz veins	
							Pyrite mineralization	
			130'0"				130'9" 130'11" Broken zone	
	Bedding at 45°							
							136'7" 137'8" Broken zone	
			139'9"				138'6" 139'9" Broken zone	
	END OF HOLE						139'9"	



WATER PRESSURE TEST
Loss in gallons per minute per foot

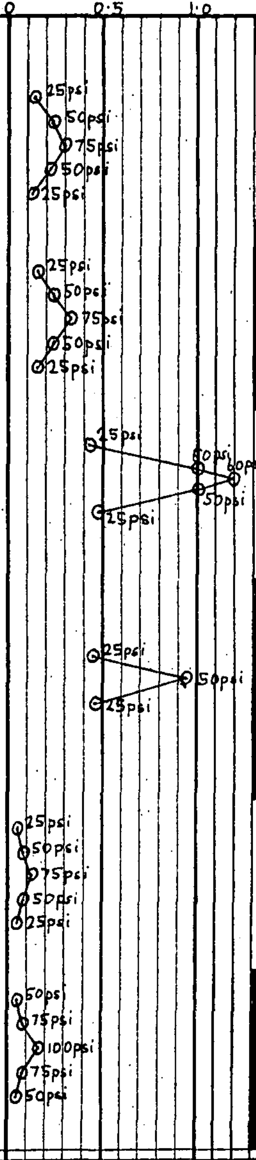


PHOTO REF NO.

CORE BOX: M938/27; M938/28

CORE BARREL: 16; M 939 17; M 939 18; M 939 19; 20; M 939 21; 22; 23; M 939 24; 26; 27; 28; M 939 29; 30; M 939 31; M 939 32; 33; M 939 34; M 939 35; M 939 36; M 939 37

DRILL TYPE E1000 Mindrill
FEED Hydraulic
CORE BARREL TYPE NMLC triple tube, split inner tube
DRILLER M. Dziwulski
COMMENCED 11/7/69
COMPLETED 24/7/69
LOGGED BY G.A.M. Henderson
VERTICAL SCALE 10feet : 1 inch

NOTES

FRACTURE LOG:- Number of fractures per foot of core. Zones of core loss are blocked in.
BEDDING AND JOINT PLANES:- Angles are measured relative to a plane normal to the core axis

*For Location See Drawing No I55/A16/650

Rec. 1970/61 I55/A16/671 (2 of 2)

WATER PRESSURE TESTS
PACKER, TYPE Mechanical
SUPPLY LINE N rod
VERTICAL SCALE 200psi : 1 inch
Figures given are gauge pressures
Test sections are indicated graphically by blocked-in strips

PHOTOGRAPH REFERENCE SYSTEM
BLACK AND WHITE Bureau of Mineral Resources film no. and frame no., e.g. M939/17
COLOUR

M(Pf)99

APPENDIX 3

WATER PRESSURE TESTING

Water pressure testing, whereby water is introduced under pressure into a section of drill hole and the water loss measured, was carried out in all drill holes except D.D.5. Testing was carried out at 10-foot intervals down from the highest level that the packer would seal in each hole. D.D.5 was not tested because the packer would not seal in that hole. In all drill holes, except D.D.7, D.D.11 and D.D.12, pressure in the test sections was maintained by a mindrill pump capable of delivering water at a maximum pressure of 150 pounds per square inch. In the drill holes where the pump was not used the supply line was connected to the nearest water main. All testing was done with a mechanical packer.

In the computation sheets the field results are reduced to give water losses in gallons per minute per foot of drill hole, and to give the effective pressures in the test sections. Rock permeabilities are also calculated.

The water loss(t,, in gallons per minute per foot of drill hole, is obtained by the formula:

$$t = \frac{kh}{i}$$

where k = a conversion factor, theoretically derived, which allows for leakage paths at the ends of test sections different from those at the centre of test sections.

h = the leakage rate in gallons per minute

i = the length of the test section in feet

The effective test pressure (s), in pounds per square inch, is obtained from the formula:

$$s = d + p - q - r$$

where d = the gauge pressure

p = the water column pressure

q = the loss of pressure in the supply line

r = the loss of pressure in the packer

The water column pressure (p) depends on the slope depth in feet to the water table (l) in relation to the slope depth to the test section (a).

If $l < a$ the formula used is

$$p = 0.44 \sin \theta \, (l+m)$$

where θ = the slope of the drill hole in degrees

m = the slope height from the collar of the drill hole to the pressure gauge

If $l > a$ the formula used is

$$p = 0.44 \sin \theta \, n$$

where n = the length of the supply line.

The pressure losses in the supply line and packer depend on the rate of water loss in the test section. To obtain these pressure losses graphs derived from calibration tests carried out at Corin Damsite (Best, 1969) were used.

The water losses at the respective effective pressures were used to calculate the joint permeability of the rock in each 10-foot section. The joint permeability (U), in feet per year, obtained from the formula derived by engineers of the Snowy Mountains Hydro-Electric Authority, is:

$$U = \frac{h}{s} \frac{16200}{i} \left(1 + 0.825 \log_{10} \frac{i}{R}\right)$$

where h = the flow out of the test section in gallons per minute

s = the effective pressure in the test section in pounds per square inch

i = the length of the test section in feet

R = the radius of the drill hole in inches

To use the test data from an NX size drill hole to compute the approximate leakage due to groundwater into a 10-foot diameter tunnel, located below the water table, the following procedure is adopted.

The leakage per foot of drill hole at the effective pressure in the test section is converted to the leakage that would occur at the groundwater pressure at the roof of the tunnel. It is then multiplied by a factor of 1.6 which in a 10-foot diameter tunnel, gives the leakage per foot of tunnel for a 100-foot long section of tunnel. In estimating the flow of water into the tunnel the average rate of water loss in the drill hole at a given pressure is taken.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS
REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER
FEATURE OUTLET PORTAL
HOLE NO. DD1
ANGLE FROM HORIZONTAL (θ) 45°
DIRECTION 081°(True)
R.L. OF COLLAR 1815'
SIZE OF HOLE NMLC
LOCATION 12570E, 11690N
PACKER TYPE Mechanical
DRILL LOG REF.
SHEET 1 OF 1

DATE	SECTION TESTED		TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS		WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (= 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT. GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES		EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
	FROM (ft.)	TO (ft.)			START (galls.)	FINISH (galls.)									SUPPLY LINE (p.s.i.)	PACKER (p.s.i.)			
	a	b	c	d	e	f	f − e = g	g/c = h	b − a = i	k*	ℓ	m	n	p+	q*	r*	d+p−q−r	k x h/i	
3·6·69	59'4"	69'4"	5	10	0·0	0·0	0·0	0·0	10·0	0·9	25?	0	60'	8·0	0·0	0·0	18·0	0·0	Good Seal
			5	10	0·0	0·0	0·0	0·0					N rod		0·0	0·0	18·0	0·0	
			5	20	0·0	3·125	3·125	0·625							0·0	0·0	28·0	0·056	
			5	20	3·125	6·25	3·125	0·625							0·0	0·0	28·0	0·056	Permeability
			5	30	0·0	4·5	4·5	0·9							0·0	0·0	38·0	0·081	50 ft/yr.
			5	30	4·5	8·875	4·375	0·875							0·0	0·0	38·0	0·079	4 lugeons
			5	20	0·0	3·25	3·25	0·65							0·0	0·0	28·0	0·059	
			5	20	3·25	6·5	3·25	0·65							0·0	0·0	28·0	0·059	
			5	10	0·0	2·125	2·125	0·425							0·0	0·0	18·0	0·038	
			5	10	2·125	4·25	2·125	0·425							0·0	0·0	18·0	0·038	
	69'4"	79'4"	5	20	0·0	1·0	1·0	0·2	10·0	0·9	0?	0	70'	0·0	0·0	0·0	20·0	0·018	Good Seal
			5	20	1·0	2·0	1·0	0·2					N rod		0·0	0·0	20·0	0·018	
			5	30	0·0	3·125	3·125	0·625							0·0	0·0	30·0	0·056	Permeability
			5	30	3·125	6·375	3·25	0·65							0·0	0·0	30·0	0·056	50 ft/yr.
			5	40	0·0	4·75	4·75	0·95							0·0	0·0	40·0	0·086	4 lugeons
			5	40	4·75	9·5	4·75	0·95							0·0	0·0	40·0	0·086	
			5	20	0·0	1·5	1·5	0·3							0·0	0·0	20·0	0·027	
			5	20	1·5	3·0	1·5	0·3							0·0	0·0	20·0	0·027	
			5	30	0·0	3·25	3·25	0·65							0·0	0·0	30·0	0·059	
			5	30	3·25	6·5	3·25	0·65							0·0	0·0	30·0	0·059	
	79'4"	88'0"	5	30	0·0	2·125	2·125	0·425	8·7	0·85	49?	0	80'	15·0	0·0	0·0	45·0	0·043	Good Seal
			5	30	2·125	4·25	2·125	0·425					N rod		0·0	0·0	45·0	0·043	
			5	40	0·0	2·5	2·5	0·5							0·0	0·0	55·0	0·05	
			5	40	2·5	5·0	2·5	0·5							0·0	0·0	55·0	0·05	Permeability
			5	50	0·0	3·125	3·125	0·625							0·0	0·0	65·0	0·063	25 ft./yr.
			5	50	3·125	6·375	3·25	0·65							0·0	0·0	65·0	0·065	2 lugeons
			5	40	0·0	2·625	2·625	0·525							0·0	0·0	55·0	0·053	
			5	40	2·625	5·25	2·625	0·525							0·0	0·0	55·0	0·053	
			5	30	0·0	2·125	2·125	0·425							0·0	0·0	45·0	0·043	
			5	30	2·125	4·25	2·125	0·425							0·0	0·0	45·0	0·043	

* Values are read from appropriate correction graphs. **Rec. 1970/61**

\+ If $\ell \leqslant a$, $p = 0{\cdot}44 . \sin\theta . (\ell + m)$; if $\ell > a$, $p = 0{\cdot}44 . \sin\theta . n$.

FILE No. 155/A16/672

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER FEATURE PROPOSED SHAFT

ANGLE FROM HORIZONTAL (θ) 90° DIRECTION

R.L. OF COLLAR 1883' SIZE OF HOLE N

LOCATION 21875 E, 13100 N PACKER TYPE Mechanical DRILL LOG REF.

HOLE NO. DD 2

SHEET 1 OF 2

DATE	SECTION TESTED		TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS		WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≥ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES		EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY TYPE & CAPACITY OF PUMP, ETC.
	FROM (ft.)	TO (ft.)			START (galls.)	FINISH (galls.)									SUPPLY LINE (p.s.i.)	PACKER (p.s.i.)			
	a	b	c	d	e	f	f - e = g	g/c = h	b - a = i	k*	ℓ	m	n	p⁺	q*	r*	d+p-q-r	k x h/i	
28·5·69	62'5"	72'5"	5	10	0·0	1·0	1·0	0·2	10·0	0·9	9?	0	70'	4·0	0·0	0·0	14·0	0·018	Good Seal
			5	10	1·0	2·0	1·0	0·2					N rod		0·0	0·0	14·0	0·018	
			5	20	0·0	2·625	2·625	0·525							0·0	0·0	24·0	0·047	
			5	20	2·625	5·25	2·625	0·525							0·0	0·0	24·0	0·047	Permeability
			5	30	0·0	3·625	3·625	0·725							0·0	0·0	34·0	0·065	50 ft/yr.
			5	30	3·625	7·125	3·5	0·7							0·0	0·0	34·0	0·063	4 lugeons
			5	20	0·0	2·75	2·75	0·55							0·0	0·0	24·0	0·050	
			5	20	2·75	5·5	2·75	0·55							0·0	0·0	24·0	0·050	
			5	10	0·0	1·5	1·5	0·3							0·0	0·0	14·0	0·027	
			5	10	1·5	3·0	1·5	0·3							0·0	0·0	14·0	0·027	
28-5-69	72'5"	82'5"	5	20	0·0	29·0	29·0	5·8	10·0	0·9	27?	0	80'	12·0	0·5	0·5	31·0	0·522	
			5	20	29·0	56·5	27·5	5·5					N rod		0·5	0·5	31·0	0·495	
			5	40	0·0	47·25	47·25	9·45							1·0	1·5	49·5	0·851	
			5	40	47·25	94·75	47·5	9·5							1·0	1·5	49·5	0·856	Permeability
			5	55	0·0	57·5	57·5	11·5							1·5	2·5	63·0	1·035	445 ft/yr
			5	55	57·5	105·125?	47·625	9·525							1·0	1·5	64·5	0·857	36 lugeons
			5	40	0·0	47·25	47·25	9·45							1·0	1·5	49·5	0·851	
			5	40	47·25	94·5	47·25	9·45							1·0	1·5	49·5	0·851	
			5	20	0·0	30·0	30·0	6·0							0·5	0·5	31·0	0·54	
			5	20	30·0	60·0	30·0	6·0							0·5	0·5	31·0	0·54	
29·5·69	82'0"	92'0"	5	25	0·0	1·375	1·375	0·275	10·0	0·9	27?	0	90'	12·0	0·0	0·0	37·0	0·025	Good Seal
			5	25	1·375	2·75	1·375	0·275					N rod		0·0	0·0	37·0	0·025	
			5	50	0·0	3·125	3·125	0·625							0·0	0·0	62·0	0·056	
			5	50	3·125	6·25	3·125	0·625							0·0	0·0	62·0	0·056	Permeability
			5	75	0·0	4·375	4·375	0·875							0·0	0·0	87·0	0·079	25 ft/yr
			5	75	4·375	8·75	4·375	0·875							0·0	0·0	87·0	0·079	2 lugeons
			5	50	0·0	3·125	3·125	0·625							0·0	0·0	62·0	0·056	
			5	25	0·0	1·5	1·5	0·3							0·0	0·0	37·0	0·027	
29-5-69	92'0"	102'0"	5	25	0·0	0·0	0·0	0·0	10·0	0·9	27?	0	100'	12·0	0·0	0·0	37·0	0·0	Good Seal
			5	25	0·0	0·0	0·0	0·0					N rod		0·0	0·0	37·0	0·0	
			5	50	0·0	0·625	0·625	0·125							0·0	0·0	62·0	0·011	
			5	50	0·625	0·875	0·25	0·05							0·0	0·0	62·0	0·005	Permeability
			5	75	0·0	0·625	0·625	0·175							0·0	0·0	87·0	0·011	< 1 lugeon
			5	75	0·625	1·350	0·725	0·145							0·0	0·0	87·0	0·013	
			5	50	0·0	0·0	0·0	0·0							0·0	0·0	62·0	0·0	
			5	25	0·0	0·0	0·0	0·0							0·0	0·0	37·0	0·0	

* Values are read from appropriate correction graphs. **Rec. 1970/61** + If $\ell \leqslant a$, $p = 0.44 . \sin \theta . (\ell + m)$; if $\ell > a$, $p = 0.44 . \sin \theta . n$.

FILE No. I55/A16/673 (1 of 2)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER FEATURE PROPOSED SHAFT

ANGLE FROM HORIZONTAL (θ) 90° DIRECTION R.L. OF COLLAR 1883' SIZE OF HOLE N

LOCATION 21840E, 13100N PACKER TYPE Mechanical DRILL LOG REF.

HOLE NO. DD2

SHEET 2 OF 2

DATE	SECTION TESTED		TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS		WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT. GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES		EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
	FROM (ft.)	TO (ft.)			START (galls.)	FINISH (galls.)									SUPPLY LINE (p.s.i.)	PACKER (p.s.i.)			
	a	b	c	d	e	f	f − e = g	g/c = h	b − a = i	k*	ℓ	m	n	p+	q*	r*	d+p−q−r	k x h/i	
2·6·69	102'0"	116'0"	5	25	0·0	0·5	0·5	0·1	14	0·95	27?	0	110'	12·0	0·0	0·0	37·0	0·007	Good Seal
			5	25	0·5	1·0	0·5	0·1					N rod		0·0	0·0	37·0	0·007	
			5	50	0·0	1·0	1·0	0·2							0·0	0·0	62·0	0·014	Permeability
			5	50	1·0	2·0	1·0	0·2							0·0	0·0	62·0	0·014	< 1 lugeon
			5	90	0·0	1·25	1·25	0·25							0·0	0·0	102·0	0·017	
			5	90	1·25	2·5	1·25	0·25							0·0	0·0	102·0	0·017	
			5	50	0·0	1·0	1·0	0·2							0·0	0·0	62·0	0·014	
			5	25	0·0	0·5	0·5	0·1							0·0	0·0	37·0	0·007	

* Values are read from appropriate correction graphs. **Rec. 1970/61** + If $\ell \leqslant a$, $p = 0·44 . \sin\theta . (\ell + m)$; if $\ell > a$, $p = 0·44 . \sin\theta . n$.

FILE No. I55/A16/673 (2 of 2)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER FEATURE PROPOSED SHAFT

ANGLE FROM HORIZONTAL (θ) 90° DIRECTION R.L. OF COLLAR 1902' SIZE OF HOLE N

LOCATION 22930E, 13260 N PACKER TYPE MECHANICAL DRILL LOG REF.

HOLE NO. DD3

SHEET 1 OF 2

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≅ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
	a	b	c	d	e	f	f - e = g	g/c = h	b - a = i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
10-6-69	87'0"	97'0"	5	25	0.0	16.0	16.0	3.2	10.0	0.9	56?	0	90'	25.0	0.0	0.0	50.0	0.288	Fair Seal
			5	25	16.0	31.75	15.75	3.15					N rod		0.0	0.0	50.0	0.284	
			5	50	0.0	23.125	23.125	4.625							0.5	0.5	74.0	0.416	
			5	50	23.125	46.75	23.625	4.725							0.5	0.5	74.0	0.425	Permeability
			5	75	0.0	27.0	27.0	5.4							0.5	0.5	99.0	0.486	150 ft/yr.
			5	75	27.0	54.0	27.0	5.4							0.5	0.5	99.0	0.486	12 lugeons
			5	50	0.0	22.5	22.5	4.5							0.5	0.5	74.0	0.406	
			5	25	0.0	15.0	15.0	3.0							0.0	0.0	50.0	0.27	
11-6-69	97'0"	107'0"	5	25	0.0	11.5	11.5	2.3	10.0	0.9	77?	0	100'	34.0	0.0	0.0	59.0	0.207	Good Seal
			5	25	11.5	23.0	11.5	2.3					N rod		0.0	0.0	59.0	0.207	
			5	50	0.0	15.375	15.375	3.075							0.0	0.0	84.0	0.277	
			5	50	15.375	31.125	15.75	3.15							0.0	0.0	84.0	0.284	Permeability
			5	75	0.0	22.5	22.5	4.5							0.5	0.5	108.0	0.405	100 ft./yr.
			5	75	22.5	44.75	22.25	4.45							0.5	0.5	108.0	0.401	8 lugeons
			5	50	0.0	17.5	17.5	3.5							0.0	0.0	84.0	0.315	
			5	25	0.0	12.5	12.5	2.5							0.0	0.0	59.0	0.225	
12-6-69	107'0"	117'0"	5	25	0.0	8.125	8.125	1.625	10.0	0.9	77?	0	110'	34.0	0.0	0.0	59.0	0.146	Good Seal
			5	25	8.125	16.0	7.875	1.575					N rod		0.0	0.0	59.0	0.137	
			5	60	0.0	12.25	12.25	2.45							0.0	0.0	94.0	0.221	
			5	60	12.25	24.25	12.0	2.4							0.0	0.0	94.0	0.216	Permeability
			5	90	0.0	31.25	31.25	6.25							0.5	1.0	122.5	0.561	125 ft/yr
			5	90	31.25	62.50	31.25	6.25							0.5	1.0	122.5	0.561	10 lugeons
			5	60	0.0	25.625	25.625	5.125							0.5	0.5	93.0	0.461	
			5	25	0.0	15.0	15.0	3.0							0.0	0.0	59.0	0.27	
18-6-69	117'0"	127'0"	5	25	0.0	10.125	10.125	2.025	10.0	0.9	77?	0	120'	34.0	0.0	0.0	59.0	0.182	
			5	25	10.125	19.25	9.125	1.825					N rod		0.0	0.0	59.0	0.164	
			5	60	0.0	27.125	27.125	5.425							0.5	0.5	93.0	0.488	Permeability
			5	60	27.125	55.375	28.25	5.65							0.5	0.5	93.0	0.509	150 ft/yr.
			5	90	0.0	34.75	34.75	6.95							1.0	1.0	122.0	0.626	12 lugeons
			5	90	34.75	69.5	34.75	6.95							1.0	1.0	122.0	0.626	
			5	60	0.0	29.375	29.375	5.875							0.5	0.5	93.0	0.529	
			5	25	0.0	18.75	18.75	3.75							0.0	0.5	58.5	0.338	

* Values are read from appropriate correction graphs. **Rec. 1970/61** + If $\ell \leq a$, $p = 0.44 \sin\theta (\ell + m)$; if $\ell > a$, $p = 0.44 \sin\theta \, n$.

FILE No. I55/A1b/674 (1 of 2)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS
REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER FEATURE PROPOSED SHAFT

ANGLE FROM HORIZONTAL (θ) 90° DIRECTION R.L. OF COLLAR 1902' SIZE OF HOLE N

LOCATION 22930 E, 13260 N PACKER TYPE MECHANICAL DRILL LOG REF.

HOLE NO. DD3

SHEET 2 OF 2

DATE	SECTION TESTED		TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS		WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES		EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
	FROM (ft.)	TO (ft.)			START (galls.)	FINISH (galls.)									SUPPLY LINE (p.s.i.)	PACKER (p.s.i.)			
	a	b	c	d	e	f	f − e = g	g/c = h	b − a = i	k*	ℓ	m	n	p+	q*	r*	d + p − q − r	k x h/i	
18-6-69	127'0"	137'0"	5	25	0·0	0·875	0·875	0·175	10·0	0·9	77?	0	130'	34·0	0·0	0·0	59·0	0·016	Hole closed up
			5	25	0·875	1·5	0·625	0·125					N rod		0·0	0·0	59·0	0·011	at 60psi
			5	60	0·0	0·0	0·0	0·0							0·0	0·0	94·0	0·0	
			5	60	0·0	0·0	0·0	0·0							0·0	0·0	94·0	0·0	Permeability
			5	90	0·0	0·0	0·0	0·0							0·0	0·0	124·0	0·0	< 1 lugeon
			5	90	0·0	0·0	0·0	0·0							0·0	0·0	124·0	0·0	
			5	60	0·0	0·0	0·0	0·0							0·0	0·0	94·0	0·0	
			5	25	0·0	0·0	0·0	0·0							0·0	0·0	59·0	0·0	
20-6-69	135'8"	145'8"	5	25	0·0	3·125	3·125	0·625	10·0	0·9	77?	0	140'	34·0	0·0	0·0	59·0	0·056	
			5	25	3·125	6·25	3·125	0·625					N rod		0·0	0·0	59·0	0·056	Permeability
			5	60	0·0	4·125	4·125	0·825							0·0	0·0	94·0	0·074	25 ft/yr
			5	60	4·125	8·25	4·125	0·825							0·0	0·0	94·0	0·074	2 lugeons
			5	90	0·0	5·75	5·75	1·15							0·0	0·0	124·0	0·104	
			5	90	5·75	11·5	5·75	1·15							0·0	0·0	124·0	0·104	
			5	60	0·0	3·75	3·75	0·75							0·0	0·0	94·0	0·068	
			5	25	0·0	2·5	2·5	0·5							0·0	0·0	59·0	0·045	

* Values are read from appropriate correction graphs. Rec. 1970/61 + If $\ell \leq a$, $p = 0{\cdot}44 . \sin\theta . (\ell + m)$; if $\ell > a$, $p = 0{\cdot}44 . \sin\theta . n$.

FILE No. I55/A16/674 (2 of 2)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS
REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER
FEATURE AREA of LOW COVER
ANGLE FROM HORIZONTAL (θ) 90°
DIRECTION
R.L. OF COLLAR 1862'
SIZE OF HOLE N
LOCATION 13360E, 11820N
PACKER TYPE Mechanical
DRILL LOG REF.
HOLE NO. DDA
SHEET 1 OF 3

DATE	SECTION TESTED		TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS		WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES		EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY TYPE & CAPACITY OF PUMP, ETC.
	FROM (ft.)	TO (ft.)			START (galls.)	FINISH (galls.)									SUPPLY LINE (p.s.i.)	PACKER (p.s.i.)			
	a	b	c	d	e	f	f - e = g	g/c = h	b - a = i	k*	ℓ	m	n	p+	q*	r*	d + p - q - r	k x h/i	
9-6-69	30'0"	40'0"	5	10	0·0	15·625	15·625	3·125	10·0	0·9	5.?	0	40'	2·0	0·0	0·0	12·0	0·281	Good Seal
				10	15·625	31·25	15·625	3·125					N rod		0·0	0·0	12·0	0·281	
				20	0·0	29·5	29·5	5·9							0·0	0·5	21·5	0·531	
				20	29·5	59·0	29·5	5·9							0·0	0·5	21·5	0·531	Permeability
				30	0·0	44·0	44·0	8·8							0·5	1·5	30·0	0·792	715 ft/yr.
				30	44·0	88·0	44·0	8·8							0·5	1·5	30·0	0·792	58 lugeons
				20	0·0	34·25	34·25	6·85							0·5	1·0	20·5	0·617	
				20	34·25	68·375	34·125	6·825							0·5	1·0	20·5	0·614	
				10	0·0	19·25	19·25	3·85							0·0	0·5	11·5	0·347	
				10	19·25	38·5	19·25	3·85							0·0	0·5	11·5	0·347	
10·6·69	40'0"	50'0"	5	20	0·0	21·5	21·5	4·3	10·0	0·9	14?	0	50'	6·0	0·0	0·5	25·5	0·387	Good Seal
				20	21·5	43·0	21·5	4·3					N rod		0·0	0·5	25·5	0·387	
				30	0·0	37·0	37·0	7·4							0·5	1·0	34·5	0·666	
				30	37·0	74·125	37·125	7·425							0·5	1·0	34·5	0·668	
				40	0·0	37·125	37·125	7·425							0·5	1·0	44·5	0·668	Permeability
				40	37·125	75·25	38·125	7·625							0·5	1·0	44·5	0·686	405 ft/yr.
				40	75·25	108·25	33·0	6·6							0·5	1·0	44·5	0·594	33 lugeons
				30	0·0	31·0	31·0	6·2							0·5	0·5	35·0	0·558	
				30	31·0	61·75	30·75	6·15							0·5	0·5	35·0	0·554	
				30	61·75	91·5	29·75	5·95							0·5	0·5	35·0	0·536	
				20	0·0	21·0	21·0	4·2							0·0	0·5	25·5	0·378	
				20	21·0	42·0	21·0	4·2							0·0	0·5	25·5	0·378	
10·6·69	50'0"	60'0"	5	20	0·0	4·75	4·75	0·85	10·0	0·9	14?	0	60'	6·0	0·0	0·0	26·0	0·086	Good Seal
				20	4·75	9·5	4·75	0·85					Nrod		0·0	0·0	26·0	0·086	
				30	0·0	10·25	10·25	2·05							0·0	0·0	36·0	0·185	
				30	10·25	20·5	10·25	2·05							0·0	0·0	36·0	0·185	
				40	0·0	11·5	11·5	2·3							0·0	0·0	46·0	0·207	Permeability
				40	11·5	23·0	11·5	2·3							0·0	0·0	46·0	0·207	125 ft/yr.
				30	0·0	9·0	9·0	1·8							0·0	0·0	36·0	0·162	10 lugeons
				30	9·0	18·0	9·0	1·8							0·0	0·0	36·0	0·162	
				20	0·0	6·5	6·5	1·3							0·0	0·0	26·0	0·117	
				20	6·5	13·0	6·5	1·3							0·0	0·0	26·0	0·117	

* Values are read from appropriate correction graphs. **Rec. 1970/61** + If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No. I55/A16/675 (1 of 3)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER FEATURE AREA of LOW COVER

ANGLE FROM HORIZONTAL (θ) 90° DIRECTION R.L. OF COLLAR 1862' SIZE OF HOLE N

LOCATION 13360E, 11820N PACKER TYPE MECHANICAL DRILL LOG REF.

HOLE NO. DD4

SHEET 2 OF 3

DATE	SECTION TESTED		TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS		WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft)	CONVERSION FACTOR (≡20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft)	SLOPE HT. GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES		EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
	FROM (ft.)	TO (ft.)			START (galls.)	FINISH (galls.)									SUPPLY LINE (p.s.i.)	PACKER (p.s.i.)			
	a	b	c	d	e	f	f - e = g	g/c = h	b - a = i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
11-6-69	60'0"	70'0"	5	30	0.0	1.0	1.0	0.2	10.0	0.9	0?	0	70'	0.0	0.0	0.0	30.0	0.018	Good Seal
			5	30	1.0	2.0	1.0	0.2					N rod		0.0	0.0	30.0	0.018	
			5	40	0.0	1.5	1.5	0.3							0.0	0.0	40.0	0.027	
			5	40	1.5	3.0	1.5	0.3							0.0	0.0	40.0	0.027	
			5	50	0.0	2.0	2.0	0.4							0.0	0.0	50.0	0.036	Permeability
			5	50	2.0	4.0	2.0	0.4							0.0	0.0	50.0	0.036	25 ft/yr.
			5	60	0.0	2.875	2.875	0.575							0.0	0.0	60.0	0.052	2 lugeons
			5	60	2.875	5.75	2.875	0.575							0.0	0.0	60.0	0.052	
			5	60	5.75	8.625	2.875	0.575							0.0	0.0	60.0	0.052	
			5	30	0.0	1.0	1.0	0.2							0.0	0.0	30.0	0.018	
			5	30	1.0	2.0	1.0	0.2							0.0	0.0	30.0	0.018	
12-6-69	70'0"	80'0"	5	30	0.0	5.0	5.0	1.0	10.0	0.9	0?	0	80'	0.0	0.0	0.0	30.0	0.09	Good Seal
			5	30	5.0	10.0	5.0	1.0					N rod		0.0	0.0	30.0	0.09	
			5	40	0.0	6.625	6.625	1.325							0.0	0.0	40.0	0.119	
			5	40	6.625	13.25	6.625	1.325							0.0	0.0	40.0	0.119	
			5	50	0.0	10.625	10.625	2.125							0.0	0.0	50.0	0.191	Permeability
			5	50	10.625	21.25	10.625	2.125							0.0	0.0	50.0	0.191	100 ft/yr.
			5	40	0.0	8.375	8.375	1.675							0.0	0.0	40.0	0.151	8 lugeons
			5	40	8.375	16.75	8.375	1.675							0.0	0.0	40.0	0.151	
			5	30	0.0	6.25	6.25	1.25							0.0	0.0	30.0	0.113	
			5	30	6.25	12.5	6.25	1.25							0.0	0.0	30.0	0.113	
12-6-69	80'0"	90'0"	5	25	0.0	28.0	28.0	5.6	10.0	0.9	14?	0	90'	6.0	0.5	0.5	30.0	0.544	Good Seal
			5	25	28.0	50.0	22.0	4.4					N rod		0.5	0.5	30.0	0.396	
			5	25	22.0	44.0	22.0	4.4							0.5	0.5	30.0	0.396	
			5	50	0.0	40.625	40.625	8.125							1.0	1.0	54.0	0.729	Permeability
			5	50	40.625	81.25	40.625	8.125							1.0	1.0	54.0	0.733	345 ft/yr.
			5	75	0.0	50.0	50.0	10.0							1.5	2.0	87.5	0.9	28 lugeons
			5	75	50.0	100.0	50.0	10.0							1.5	2.0	87.5	0.9	
			5	50	0.0	40.0	40.0	8.0							1.0	1.0	54.0	0.72	
			5	50	40.0	80.0	40.0	8.0							1.0	1.0	54.0	0.72	
			5	25	0.0	22.0	22.0	4.4							0.5	0.5	30.0	0.396	
			5	25	22.0	44.0	22.0	4.4							0.5	0.5	30.0	0.396	

* Values are read from appropriate correction graphs. **Rec. 1970/61** + If ℓ ≤ a, p = 0.44. sin θ. (ℓ + m); if ℓ > a, p = 0.44. sin θ. n.

FILE No. 155/A16/675 (2 of 3)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER

FEATURE AREA of LOW COVER

HOLE NO. DD4

ANGLE FROM HORIZONTAL (θ) 90°

DIRECTION

R.L. OF COLLAR 1862'

SIZE OF HOLE N

LOCATION 13360E, 11820N

PACKER TYPE MECHANICAL

DRILL LOG REF.

SHEET 3 OF 3

DATE	SECTION TESTED		TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS		WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (= 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft)	SLOPE HT. GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES		EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
	FROM (ft.)	TO (ft.)			START (galls.)	FINISH (galls.)									SUPPLY LINE (p.s.i.)	PACKER (p.s.i.)			
	a	b	c	d	e	f	f - e = g	g/c = h	b - a = i	k*	ℓ	m	n	p+	q*	r*	d + p - q - r	k x h/i	
13-6-69	90'0"	100'0"	5	25	0·0	1·375	1·375	0·275	10·0	0·9	54?	0	90'	23·8	0·0	0·0	48·8	0·026	Good Seal
			5	25	1·375	2·75	1·375	0·275					N rod		0·0	0·0	48·8	0·025	
			5	50	0·0	1·5	1·5	0·3							0·0	0·0	73·8	0·027	
			5	50	1·5	3·0	1·5	0·3							0·0	0·0	73·8	0·027	Permeability
			5	75	0·0	1·75	1·75	0·35							0·0	0·0	98·8	0·032	10 ft/yr.
			5	75	1·75	3·5	1·75	0·35							0·0	0·0	98·8	0·032	1 lugeon
			5	50	0·0	1·5	1·5	0·3							0·0	0·0	73·8	0·027	
			5	50	1·5	3·0	1·5	0·3							0·0	0·0	73·8	0·027	
			5	25	0·0	1·25	1·25	0·25							0·0	0·0	48·8	0·022	
			5	25	1·25	2·5	1·25	0·25							0·0	0·0	48·8	0·022	
17·6·69	100'0"	107'4"	5	25	0·0	0·0	0·0	0·0	7·3		54?	0	100'	~~23·8~~	0·0	0·0	48·8	0·0	Good Seal
			5	25	0·0	0·0	0·0	0·0					N rod		0·0	0·0	48·8	0·0	
			5	50	0·0	0·0	0·0	0·0							0·0	0·0	73·8	0·0	
			5	50	0·0	0·0	0·0	0·0							0·0	0·0	73·8	0·0	Permeability
			5	75	0·0	0·0	0·0	0·0							0·0	0·0	98·8	0·0	zero
			5	75	0·0	0·0	0·0	0·0							0·0	0·0	98·8	0·0	
			5	50	0·0	0·0	0·0	0·0							0·0	0·0	73·8	0·0	
			5	50	0·0	0·0	0·0	0·0							0·0	0·0	73·8	0·0	
			5	25	0·0	0·0	0·0	0·0							0·0	0·0	48·8	0·0	
			5	25	0·0	0·0	0·0	0·0							0·0	0·0	48·8	0·0	

* Values are read from appropriate correction graphs. **Rec. 1970/61** + If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No. 155/A16/675 (3 of 3)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS
REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER FEATURE PORTAL

ANGLE FROM HORIZONTAL (θ) 90° DIRECTION ______ R.L. OF COLLAR 1845' SIZE OF HOLE N

LOCATION 30080E, 11610N PACKER TYPE MECHANICAL DRILL LOG REF. ______

HOLE NO. 006

SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (= 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT. GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
	a	b	c	d	e	f	$f-e=g$	$g/c=h$	$b-a=i$	k^*	ℓ	m	n	p^+	q^*	r^*	$d+p-q-r$	$k \times h/i$	
21-6-69	21'6"	31'6"	5	10	0.0	0.25	0.25	0.05	10.0	0.9	6?	0	30'	2.5	0.0	0.0	12.5	0.005	Good Seal
			5	10	0.25	0.5	0.25	0.05					Nrod		0.0	0.0	12.5	0.005	
			5	20	0.0	0.375	0.375	0.075							0.0	0.0	22.5	0.007	
			5	20	0.375	0.75	0.375	0.075							0.0	0.0	22.5	0.007	Permeability
			5	30	0.0	0.5	0.5	0.1							0.0	0.0	32.5	0.009	< 1 lugeon
			5	30	0.5	1.0	0.5	0.1							0.0	0.0	32.5	0.009	
			5	20	0.0	0.25	0.25	0.05							0.0	0.0	22.5	0.005	
			5	20	0.25	0.5	0.25	0.05							0.0	0.0	22.5	0.005	
			5	10	0.0	0.125	0.125	0.025							0.0	0.0	12.5	0.002	
			5	10	0.125	0.25	0.125	0.025							0.0	0.0	12.5	0.002	

* Values are read from appropriate correction graphs. **Rec. 1970/61** + If $\ell \leqslant a$, $p = 0.44. \sin\theta. (\ell + m)$; if $\ell > a$, $p = 0.44. \sin\theta. n$.

FILE No. I55/A16/676

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS
WATER PRESSURE TESTS
REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER FEATURE PROPOSED SHAFT
ANGLE FROM HORIZONTAL (θ) 90° DIRECTION R.L. OF COLLAR 1858' SIZE OF HOLE N
LOCATION 32955 E, 11470 N PACKER TYPE MECHANICAL DRILL LOG REF.

HOLE NO. DD 7
SHEET 1 OF 1

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (= 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY TYPE & CAPACITY OF PUMP, ETC.
	a	b	c	d	e	f	f - e = g	g/c = h	b - a = i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
8·7·69	30' 0"	40' 0"	5	10	0·0	0·0	0·0	0·0	10·0	0·9	10·0	0·0	40'	4·4	0·0	0·0	14·4	0·0	Good Seal
			5	10	0·0	0·0	0·0	0·0					N rod		0·0	0·0	14·4	0·0	
			5	20	0·0	0·0	0·0	0·0							0·0	0·0	24·4	0·0	Permeability
			5	20	0·0	0·0	0·0	0·0							0·0	0·0	24·4	0·0	zero
			5	30	0·0	0·0	0·0	0·0							0·0	0·0	34·4	0·0	
9·7·69	40' 0"	50' 0"	5	20	0·0	0·0	0·0	0·0	10·0	0·9	10·0	0·0	50'	4·4	0·0	0·0	24·4	0·0	Good Seal
			5	20	0·0	0·0	0·0	0·0					N rod		0·0	0·0	24·4	0·0	
			5	30	0·0	0·0	0·0	0·0							0·0	0·0	34·4	0·0	
			5	30	0·0	0·0	0·0	0·0							0·0	0·0	34·4	0·0	Permeability
			5	40	0·0	0·0	0·0	0·0							0·0	0·0	44·4	0·0	zero
			5	40	0·0	0·0	0·0	0·0							0·0	0·0	44·4	0·0	
			5	30	0·0	0·0	0·0	0·0							0·0	0·0	34·4	0·0	
			5	15	0·0	0·0	0·0	0·0							0·0	0·0	19·4	0·0	
			5	15	0·0	0·0	0·0	0·0							0·0	0·0	19·4	0·0	
9·7·69	50' 0"	60' 0"	5	20	0·0	0·0	0·0	0·0	10·0	0·9	10·0	0·0	60'	4·4	0·0	0·0	24·4	0·0	Good Seal
			5	20	0·0	0·0	0·0	0·0					N rod		0·0	0·0	24·4	0·0	
			5	30	0·0	0·0	0·0	0·0							0·0	0·0	34·4	0·0	
			5	30	0·0	0·0	0·0	0·0							0·0	0·0	34·4	0·0	Permeability
			5	40	0·0	0·25	0·25	0·05							0·0	0·0	44·4	0·005	< 1 lugeon
			5	40	0·25	0·5	0·25	0·05							0·0	0·0	44·4	0·005	
			6	30	0·0	0·125	0·125	0·025							0·0	0·0	34·4	0·002	
			5	30	0·125	0·25	0·125	0·025							0·0	0·0	34·4	0·002	
			5	20	0·0	0·0	0·0	0·0							0·0	0·0	24·4	0·0	
10·7·69	60' 0"	70' 0"	5	30	0·0	0·0	0·0	0·0	10·0	0·9	10·0	0·0	70'	4·4	0·0	0·0	34·4	0·0	Good Seal
			5	30	0·0	0·0	0·0	0·0					N rod		0·0	0·0	34·4	0·0	
			5	40	0·0	0·0	0·0	0·0							0·0	0·0	44·4	0·0	
			5	40	0·0	0·0	0·0	0·0							0·0	0·0	44·4	0·0	Permeability
			5	50	0·0	0·125	0·125	0·025							0·0	0·0	54·4	0·002	< 1 lugeon
			5	50	0·125	0·25	0·125	0·025							0·0	0·0	54·4	0·002	
			5	40	0·0	0·0	0·0	0·0							0·0	0·0	44·4	0·0	
			5	40	0·0	0·0	0·0	0·0							0·0	0·0	44·4	0·0	

* Values are read from appropriate correction graphs. **Rec. 1970/61** + If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No. I55/A16/677

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER FEATURE SHAFT

ANGLE FROM HORIZONTAL (θ) 90° DIRECTION

R.L. OF COLLAR 1843' SIZE OF HOLE N

LOCATION 34830 E , 10765 N PACKER TYPE MECHANICAL DRILL LOG REF.

HOLE NO. DD8

SHEET 1 OF 1

DATE	SECTION TESTED		TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS		WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES		EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
	FROM (ft.)	TO (ft.)			START (galls.)	FINISH (galls.)									SUPPLY LINE (p.s.i.)	PACKER (p.s.i.)			
	a	b	c	d	e	f	f − e = g	g/c = h	b − a = i	k*	ℓ	m	n	p+	q*	r*	d+p−q−r	k x h/i	
30·6·69	21'0"	31'0"	5	10	0·0	0·0	0·0	0·0	10·0	0·9	8·0	0	30'	3·5	0·0	0·0	13·5	0·0	Good Seal
			5	10	0·0	0·0	0·0	0·0					N rod		0·0	0·0	13·5	0·0	
			5	20	0·0	1·25	1·25	0·25							0·0	0·0	23·5	0·023	
			5	20	1·25	2·5	1·25	0·25							0·0	0·0	23·5	0·023	Permeability
			5	30	0·0	2·5	2·5	0·5							0·0	0·0	33·5	0·046	35 ft/yr.
			5	30	2·5	5·0	2·5	0·5							0·0	0·0	33·5	0·045	3 lugeons
			5	20	0·0	1·0	1·0	0·2							0·0	0·0	23·5	0·018	
			5	20	1·0	2·0	1·0	0·2							0·0	0·0	23·5	0·018	
			5	10	0·0	0·0	0·0	0·0							0·0	0·0	13·5	0·0	
			5	10	0·0	0·0	0·0	0·0							0·0	0·0	13·5	0·0	
1·7·69	31'0"	40'0"	5	10	0·0	0·0	0·0	0·0	9·0	0·9	8·0	0	40'	3·5	0·0	0·0	13·5	0·0	
			5	10	0·0	0·0	0·0	0·0					N rod		0·0	0·0	13·5	0·0	Permeability
			5	20	0·0	0·0	0·0	0·0							0·0	0·0	23·5	0·0	zero
			5	20	0·0	0·0	0·0	0·0							0·0	0·0	23·5	0·0	
1·7·69	40'0"	50'0"	5	10	0·0	0·0	0·0	0·0	10·0	0·9	9·0	0	50'	4·0	0·0	0·0	14·0	0·0	
			5	10	0·0	0·0	0·0	0·0					N rod		0·0	0·0	14·0	0·0	Permeability
			5	20	0·0	0·0	0·0	0·0							0·0	0·0	24·0	0·0	zero

* Values are read from appropriate correction graphs. Rec. 1970/61

+ If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No. I55/A16/678

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER FEATURE SHAFT

ANGLE FROM HORIZONTAL (θ) 90° DIRECTION R.L. OF COLLAR 1833' SIZE OF HOLE N

LOCATION 34160E, 11230N PACKER TYPE MECHANICAL DRILL LOG REF.

HOLE NO. DD9

SHEET 1 OF 1

DATE	SECTION TESTED		TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS		WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≥ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES		EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
	FROM (ft.)	TO (ft.)			START (galls.)	FINISH (galls.)									SUPPLY LINE (p.s.i.)	PACKER (p.s.i.)			
	a	b	c	d	e	f	f − e = g	g/c = h	b − a = i	k*	ℓ	m	n	p+	q*	r*	d + p − q − r	k x h/i	
3-7-69	14'4"	24'4"	5	10	0·0	0·0	0·0	0·0	10	0·9	5	0	20'	2·5	0·0	0·0	12·5	0·0	Good Seal
			5	10	0·0	0·0	0·0	0·0					N rod		0·0	0·0	12·5	0·0	
			5	20	0·0	0·125	0·125	0·025							0·0	0·0	22·5	0·002	Permeability
			5	20	0·125	0·25	0·125	0·025							0·0	0·0	22·5	0·002	< 1 lugeon
			5	30	0·0	0·25	0·25	0·05							0·0	0·0	32·5	0·005	
			5	30	0·25	0·5	0·25	0·05							0·0	0·0	32·5	0·005	
			5	20	0·0	0·25	0·25	0·05							0·0	0·0	22·5	0·005	
			5	20	0·25	0·5	0·25	0·05							0·0	0·0	22·5	0·005	
			5	10	0·0	0·125	0·125	0·025							0·0	0·0	12·5	0·002	
			5	10	0·125	0·25	0·125	0·025							0·0	0·0	12·5	0·002	
3-7-69	24'0"	34'0"	5	10	0·0	0·0	0·0	0·0	10	0·9	7	0	30'	3·5	0·0	0·0	13·5	0·0	
			5	10	0·0	0·0	0·0	0·0					N rod		0·0	0·0	13·5	0·0	Permeability
			5	20	0·0	0·0	0·0	0·0							0·0	0·0	23·5	0·0	zero
			5	20	0·0	0·0	0·0	0·0							0·0	0·0	23·5	0·0	
4-7-69	34'0"	49'0"	5	10	0·0	0·0	0·0	0·0	15	0·9	2·5	0	40'	1·5	0·0	0·0	11·5	0·0	
			5	10	0·0	0·0	0·0	0·0					N rod		0·0	0·0	11·5	0·0	
			5	20	0·0	0·0	0·0	0·0							0·0	0·0	21·5	0·0	Permeability
			5	20	0·0	0·0	0·0	0·0							0·0	0·0	21·5	0·0	zero
			5	30	0·0	0·0	0·0	0·0							0·0	0·0	31·5	0·0	
			5	30	0·0	0·0	0·0	0·0							0·0	0·0	31·5	0·0	
			5	40	0·0	0·0	0·0	0·0							0·0	0·0	41·5	0·0	
			5	40	0·0	0·0	0·0	0·0							0·0	0·0	41·5	0·0	

* Values are read from appropriate correction graphs. + If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No. 155/A1b/679

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER FEATURE PROPOSED PORTAL

ANGLE FROM HORIZONTAL (θ) 90° DIRECTION R.L.OF COLLAR 1892' SIZE OF HOLE N

LOCATION 28080E, 12555N PACKER TYPE MECHANICAL DRILL LOG REF.

HOLE NO. DD 10

SHEET 1 OF 2

DATE	SECTION TESTED		TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS		WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft)	SLOPE HT. GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES		EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
	FROM (ft.)	TO (ft.)			START (galls.)	FINISH (galls.)									SUPPLY LINE (p.s.i.)	PACKER (p.s.i.)			
	a	b	c	d	e	f	f − e = g	g/c = h	b − a = i	k*	ℓ	m	n	p+	q*	r*	d+p−q−r	k x h/i	
3·7·69	16' 8"	26' 8"	5	5	0·0	0·0	0·0	0·0	10·0	0·9	8?	0	20'	3·5	0·0	0·0	8·5	0·0	Good Seal
			5	5	0·0	0·0	0·0	0·0					N rod		0·0	0·0	8·5	0·0	
			5	10	0·0	0·0	0·0	0·0							0·0	0·0	13·5	0·0	
			5	10	0·0	0·0	0·0	0·0							0·0	0·0	13·5	0·0	Permeability
			5	15	0·0	0·0	0·0	0·0							0·0	0·0	18·5	0·0	zero
			5	15	0·0	0·0	0·0	0·0							0·0	0·0	18·5	0·0	
			5	10	0·0	0·0	0·0	0·0							0·0	0·0	13·5	0·0	
			5	5	0·0	0·0	0·0	0·0							0·0	0·0	8·5	0·0	
8-7-69	47'5"	59'5"	5	15	0·0	0·0	0·0	0·0	12·0	0·9	6?	0	50'	2·5	0·0	0·0	17·5	0·0	Good Seal
			5	15	0·0	0·0	0·0	0·0					Nrod		0·0	0·0	17·5	0·0	
			5	25	0·0	0·0	0·0	0·0							0·0	0·0	27·5	0·0	
			5	25	0·0	0·0	0·0	0·0							0·0	0·0	27·5	0·0	Permeability
			5	35	0·0	0·0	0·0	0·0							0·0	0·0	37·5	0·0	zero
			5	35	0·0	0·0	0·0	0·0							0·0	0·0	37·5	0·0	
			5	25	0·0	0·0	0·0	0·0							0·0	0·0	27·5	0·0	
			5	25	0·0	0·0	0·0	0·0							0·0	0·0	27·5	0·0	
			5	15	0·0	0·0	0·0	0·0							0·0	0·0	17·5	0·0	
8-7-69	59'5"	69'11"	5	15	0·0	11·5	11·5	2·3	10·5	0·9	67?	0	60'	26·5	0·0	0·0	41·5	0·197	
			5	15	11·5	23·5	12·0	2·4					Nrod		0·0	0·0	41·5	0·206	
			5	15	23·5	35·5	12·0	2·4							0·0	0·0	41·5	0·206	
			5	25	0·0	16·0	16·0	3·2							0·0	0·0	51·5	0·274	Permeability
			5	25	16·0	32·0	16·0	3·2							0·0	0·0	51·5	0·274	150 ft/yr.
			5	40	0·0	20·5	20·5	4·1							0·0	0·5	66·0	0·351	12 lugeons
			5	40	20·5	41·0	20·5	4·1							0·0	0·5	66·0	0·351	
			5	25	0·0	16·0	16·0	3·2							0·0	0·0	51·5	0·274	
			5	25	16·0	32·0	16·0	3·2							0·0	0·0	51·5	0·274	
			5	15	0·0	11·5	11·5	2·3							0·0	0·0	41·5	0·197	
			5	15	11·5	23·0	11·5	2·3							0·0	0·0	91·5	0·197	
17·7-69	68'11"	78'11"	5	20	0·0	5·625	5·625	1·125	10·0	0·9	67?	0	70'	30·0	0·0	0·0	50·0	0·101	Good Seal
			5	20	5·625	11·0	5·375	1·075					N rod		0·0	0·0	50·0	0·097	
			5	40	0·0	12·5	12·5	2·5							0·0	0·0	70·0	0·225	Permeability
			5	40	12·5	24·375	11·875	2·375							0·0	0·0	70·0	0·214	160 ft/yr.
			5	60	0·0	20·5	20·5	4·1							0·0	0·5	89·5	0·369	13 lugeons
			5	60	20·5	41·5	21·0	4·2							0·0	0·5	89·5	0·378	
			5	40	0·0	22·75	22·75	4·55							0·0	0·5	70·0	0·41	
			5	20	0·0	16·25	16·25	3·25							0·0	0·0	50·0	0·293	

* Values are read from appropriate correction graphs. **Rec. 1970/61** + If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No. I55/A16/680 (1 of 2)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS
REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER FEATURE PROPOSED PORTAL

ANGLE FROM HORIZONTAL (θ) 90° DIRECTION R.L. OF COLLAR 1892' SIZE OF HOLE N

LOCATION 29080E, 12555 N PACKER TYPE MECHANICAL DRILL LOG REF.

HOLE NO. DD 10

SHEET 2 OF 2

DATE	SECTION TESTED FROM (ft.)	SECTION TESTED TO (ft.)	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS START (galls.)	WATER METER READINGS FINISH (galls.)	WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (= 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES SUPPLY LINE (p.s.i.)	FRICTION LOSSES PACKER (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
	a	b	c	d	e	f	f − e = g	g/c = h	b − a = i	k*	ℓ	m	n	p⁺	q*	r*	d + p − q − r	k x h/i	
18·7-69	79'2"	89'2"	5	25	0·0	10·75	10·75	2·15	10·0	0·9	67?	0·8	80'	30·0	0·0	0·0	55·0	0·194	Good Seal
			5	25	10·75	22·75	12·0	2·4					Nrod		0·0	0·0	55·0	0·216	
			5	60	0·0	26·25	26·25	5·25							0·5	0·5	79·0	0·473	Permeability
			5	50	26·25	54·5	28·25	5·65							0·5	0·5	79·0	0·509	170 ft/yr.
			5	75	0·0	42·5	42·5	8·5							1-0	1·5	102·5	0·765	14 lugeons
			5	75	42·5	85·0	42·5	8·5							1·0	1·5	102·5	0·765	
			5	50	0·0	26·25	26·25	5·25							0·5	0·5	79·0	0·473	
			5	25	0·0	20·0	20·0	4·0							0·5	0·5	54·0	0·36	
19-7-69	90'0"	100'0"	5	25	0·0	12·375	12·375	2·475	10·0	0·9	67?	0	90'	30·0	0·0	0·0	55·0	0·223	
			5	25	12·375	25·75	13·375	2·675					Nrod		0·0	0·0	55·0	0·241	
			5	50	0-0	48·5	48·5	9·7							1·0	1·5	77·5	0·873	Permeability
			5	50	48·5	95·625	47·125	9·425							1·0	1·5	77·5	0·848	270 ft/yr.
			5	75	0·0	56·25	56·25	11·25							1·5	2·5	101·0	1·01	22 lugeons
			5	75	56·25	112·5	56·25	11·25							1·5	2·5	101·0	1·01	
			5	50	0·0	48·0	48·0	9·6							1·0	1·5	77·5	0·864	
			5	25	0·0	26·0	26·0	5·2							0·5	0·5	54·0	0·468	

* Values are read from appropriate correction graphs. **Rec. 1970/61** + If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No. I55/A16/680 (2 of 2)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS
REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER
FEATURE PROPOSED PORTAL
ANGLE FROM HORIZONTAL (θ) 90°
DIRECTION
R.L. OF COLLAR 1855 '
SIZE OF HOLE N
LOCATION 30940 E , 11400 N
PACKER TYPE MECHANICAL
DRILL LOG REF.
HOLE NO. DD 11
SHEET 1 OF 1

DATE	SECTION TESTED		TIME OF TEST	GAUGE PRESSURE	WATER METER READINGS		WATER LOSS	LEAKAGE RATE	LENGTH OF TEST SECTION	CONVERSION FACTOR	SLOPE DEPTH TO STANDING WATER	SLOPE HT. GAUGE TO COLLAR	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE	FRICTION LOSSES		EFFECTIVE TEST PRESSURE	WATER LOSS	REMARKS
	FROM (ft.)	TO (ft.)	(min.)	(p.s.i.)	START (galls.)	FINISH (galls.)	(galls.)	(g.p.m.)	(ft.)	(≡ 20' of NX hole)	(ft)	(ft.)		(p.s.i.)	SUPPLY LINE (p.s.i.)	PACKER (p.s.i.)	(p.s.i.)	(g.p.m. per ft)	SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
	a	b	c	d	e	f	f - e = g	g/c = h	b - a = i	k*	ℓ	m	n	p+	q*	r*	d+p-q-r	k x h/i	
24·7·69	48'0"	58'0"	5	15	0·0	0·0	0·0	0·0	10·0	0·9	8·0	2·0	50'	4·4	0·0	0·0	19·4	0·0	Good Seal
			5	15	0·0	0·0	0·0	0·0					Nrod		0·0	0·0	19·4	0·0	
			5	25	0·0	0·0	0·0	0·0							0·0	0·0	29·4	0·0	Permeability
			5	25	0·0	0·0	0·0	0·0							0·0	0·0	29·4	0·0	zero
			5	45	0·0	0·0	0·0	0·0							0·0	0·0	49·4	0·0	
			5	45	0·0	0·0	0·6	0·0							0·0	0·0	49·4	0·0	
25·7·69	55'5"	65'5"	5	15	0·0	0·0	0·0	0·0	10·0	0·9	8·0	4·5	60'	5·5	0·0	0·0	20·5	0·0	
			5	15	0·0	0·0	0·0	0·0					Nrod		0·0	0·0	20·5	0·0	
			5	25	0·0	0·0	0·0	0·0							0·0	0·0	30·5	0·0	Permeability
			5	25	0·0	0·0	0·0	0·0							0·0	0·0	30·5	0·0	zero
			5	50	0·0	0·0	0·0	0·0							0·0	0·0	55·5	0·0	
			5	50	0·0	0·0	0·0	0·0							0·0	0·0	55·5	0·0	

* Values are read from appropriate correction graphs. **Rec. 1970/61** + If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No. **I55/A16/681**

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS

REDUCTION OF FIELD RESULTS

PROJECT North Molonglo Outfall Sewer FEATURE

ANGLE FROM HORIZONTAL (θ) 45° DIRECTION 088° (True) R.L. OF COLLAR 1885' SIZE OF HOLE

LOCATION PACKER TYPE DRILL LOG REF.

HOLE NO. DD12

SHEET 1 OF 3

DATE	SECTION TESTED		TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS		WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≡ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT. GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES		EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
	FROM (ft.)	TO (ft.)			START (galls.)	FINISH (galls.)									SUPPLY LINE (p.s.i.)	PACKER (p.s.i.)			
	a	b	c	d	e	f	f − e = g	g/c = h	b − a = i	k*	ℓ	m	n	p+	q*	r*	d + p − q − r	k x h/i	
17-7-69	51' 0"	61' 0"	5	20	0·0	0·0	0·0	0·0	10·0	0·9	0?	0	60'	0·0	0·0	0·0	20·0	0·0	
			5	20	0·0	0·0	0·0	0·0					N rod		0·0	0·0	20·0	0·0	
			5	30	0·0	1·25	1·25	0·25							0·0	0·0	30·0	0·023	
			5	30	1·25	2·5	1·25	0·25							0·0	0·0	30·0	0·023	Permeability
			5	40	0·0	9·625	9·625	1·925							0·0	0·0	40·0	0·173	110 ft/yr.
			5	40	9·625	19·0	9·375	1·875							0·0	0·0	40·0	0·169	9 lugeons
			5	30	0·0	4·0	4·0	0·8							0·0	0·0	30·0	0·072	
			5	30	4·0	8·0	4·0	0·8							0·0	0·0	30·0	0·072	
			5	20	0·0	1·875	1·875	0·375							0·0	0·0	20·0	0·034	
			5	20	1·875	3·75	1·875	0·375							0·0	0·0	20·0	0·034	
18-7-69	61' 0"	70' 6"	5	30	0·0	2·0	2·0	0·4	9·5	0·9	0?	0	70'	0·0	0·0	0·0	30·0	0·038	
			5	30	2·0	4·0	2·0	0·4					N rod		0·0	0·0	30·0	0·038	
			5	40	0·0	3·5	3·5	0·7							0·0	0·0	40·0	0·066	
			5	40	3·5	7·0	3·5	0·7							0·0	0·0	40·0	0·066	Permeability
			5	50	0·0	5·0	5·0	1·0							0·0	0·0	50·0	0·095	50 ft./yr.
			5	50	5·0	10·0	5·0	1·0							0·0	0·0	50·0	0·095	4 lugeons
			5	40	0·0	3·75	3·75	0·75							0·0	0·0	40·0	0·071	
			5	40	3·75	7·5	3·75	0·75							0·0	0·0	40·0	0·071	
			5	30	0·0	2·25	2·25	0·45							0·0	0·0	30·0	0·043	
			5	30	2·25	4·5	2·25	0·45							0·0	0·0	30·0	0·043	
18-7-69	70' 6"	81' 10"	5	25	0·0	1·0	1·0	0·2	11·3	0·9	0?	0	80'	0·0	0·0	0·0	25·0	0·016	
			5	25	1·0	2·0	1·0	0·2					N rod		0·0	0·0	25·0	0·016	
			5	50	0·0	2·25	2·25	0·45							0·0	0·0	50·0	0·036	
			5	50	2·26	4·5	2·25	0·45							0·0	0·0	50·0	0·036	Permeability
			5	75	0·0	3·5	3·5	0·7							0·0	0·0	75·0	0·056	25 ft./yr.
			5	75	3·5	7·0	3·5	0·7							0·0	0·0	75·0	0·056	2 lugeons
			5	50	0·0	2·375	2·375	0·475							0·0	0·0	50·0	0·038	
			5	50	2·375	4·75	2·375	0·475							0·0	0·0	50·0	0·038	
			5	25	0·0	1·125	1·125	0·225							0·0	0·0	25·0	0·018	
			5	25	1·125	2·375	1·25	0·25							0·0	0·0	25·0	0·02	
			5	25	2·375	3·625	1·25	0·25							0·0	0·0	25·0	0·02	

* Values are read from appropriate correction graphs. **Rec. 1970/61** + If $\ell \leqslant a$, $p = 0{\cdot}44 . \sin\theta . (\ell + m)$; if $\ell > a$, $p = 0{\cdot}44 . \sin\theta . n$.

FILE No. I55/A16/682 (1 of 3)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS
REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER FEATURE

ANGLE FROM HORIZONTAL (θ) 45° DIRECTION 088°(True) R.L.OF COLLAR 1885' SIZE OF HOLE N

LOCATION 32320E, 12050N PACKER TYPE MECHANICAL DRILL LOG REF.

HOLE NO. DD 12

SHEET 2 OF 3

DATE	SECTION TESTED		TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS		WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≥20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft.)	SLOPE HT. GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES		EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
	FROM (ft.)	TO (ft.)			START (galls.)	FINISH (galls.)									SUPPLY LINE (p.s.i.)	PACKER (p.s.i.)			
	a	b	c	d	e	f	f − e = g	g/c = h	b − a = i	k*	ℓ	m	n	p⁺	q*	r*	d + p − q − r	k x h/i	
19-7-69	81'10"	90'8"	5	25	0·0	7·0	7·0	1·4	8·8	0·8	35?	0	90'	11·0	0·0	0·0	36·0	0·127	Good Seal
			5	25	0·0	7·5	7·5	1·5					N rod		0·0	0·0	36·0	0·136	
			5	25	7·5	15·0	7·5	1·5							0·0	0·0	36·0	0·136	
			5	50	0·0	12·5	12·5	2·5							0·0	0·0	61·0	0·227	
			5	50	12·5	25·0	12·5	2·5							0·0	0·0	61·0	0·227	Permeability
			5	75	0·0	16·625	16·625	3·325							0·0	0·0	86·0	0·302	100 ft/yr.
			5	75	16·625	33·25	16·625	3·325							0·0	0·0	86·0	0·302	8 lugeons
			5	50	0·0	11·5	11·5	2·3							0·0	0·0	61·0	0·209	
			5	50	11·5	23·0	11·5	2·3							0·0	0·0	61·0	0·209	
			5	25	0·0	6·75	6·75	1·35							0·0	0·0	36·0	0·123	
			5	25	6·75	13·5	6·76	1·35							0·0	0·0	36·0	0·123	
21-7-69	90'8"	100'6"	5	25	0·0	8·5	8·5	1·7	9·8	0·9	67?	0	100'	22·0	0·0	0·0	47·0	0·156	Good Seal
			5	25	8·5	17·0	8·5	1·7					N rod		0·0	0·0	47·0	0·156	
			5	50	0·0	13·0	13·0	2·6							0·0	0·0	72·0	0·239	
			5	50	13·0	26·0	13·0	2·6							0·0	0·0	72·0	0·239	Permeability
			5	75	0·0	17·5	17·5	3·5							0·0	0·0	97·0	0·321	85 ft/yr.
			5	75	17·5	35·0	17·5	3·5							0·0	0·0	97·0	0·321	7 lugeons
			5	50	0·0	13·125	13·125	2·625							0·0	0·0	72·0	0·241	
			5	50	13·125	26·25	13·125	2·625							0·0	0·0	72·0	0·241	
			5	25	0·0	8·625	8·625	1·725							0·0	0·0	47·0	0·158	
			5	25	8·625	17·25	8·625	1·725							0·0	0·0	47·0	0·158	
22·7-69	100'0"	109'5"	5	25	0·0	22·0	22·0	4·4	9·5	0·9	0?	0	110'	0·0	0·5	0·5	24·0	0·417	
			5	25	22·0	44·0	22·0	4·4					N rod		0·5	0·5	24·0	0·417	
			5	50	0·0	55·0	55·0	11·0							2·0	2·5	45·5	1·04	Permeability
			5	50	55·0	110·0	55·0	11·0							2·0	2·5	45·5	1·04	580 ft/yr.
			5	60	0·0	65·0	65·0	13·0							2·5	3·0	54·5	1·23	47 lugeons
			5	60	65·0	130·0	65·0	13·0							2·5	3·0	54·5	1·23	
			5	50	0·0	55·0	55·0	11·0							2·0	2·5	45·5	1·04	
			5	50	55·0	110·0	55·0	11·0							2·0	2·5	45·5	1·04	
			5	25	0·0	25·0	25·0	5·0							0·5	0·5	24·0	0·474	
			5	25	25·0	50·0	25·0	5·0							0·5	0·5	24·0	0·474	

* Values are read from appropriate correction graphs. **Rec. 1970/61** + If ℓ ≤ a, p = 0·44. sin θ. (ℓ + m); if ℓ > a, p = 0·44. sin θ. n.

FILE No. I55/A16/682 (2 of 3)

M(Pf) 107

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

WATER PRESSURE TESTS
REDUCTION OF FIELD RESULTS

PROJECT NORTH MOLONGLO OUTFALL SEWER FEATURE

ANGLE FROM HORIZONTAL (θ) 45° DIRECTION 088° (True) R.L. OF COLLAR 1885' SIZE OF HOLE N

LOCATION 32320E, 12050N PACKER TYPE MECHANICAL DRILL LOG REF.

HOLE NO. DD 12
SHEET 3 OF 3

DATE	SECTION TESTED		TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i.)	WATER METER READINGS		WATER LOSS (galls.)	LEAKAGE RATE (g.p.m.)	LENGTH OF TEST SECTION (ft.)	CONVERSION FACTOR (≥ 20' of NX hole)	SLOPE DEPTH TO STANDING WATER (ft)	SLOPE HT. GAUGE TO COLLAR (ft.)	LENGTH & SIZE OF SUPPLY LINE	WATER COLUMN PRESSURE (p.s.i.)	FRICTION LOSSES		EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft)	REMARKS, SEALING PROPERTIES, WATER SUPPLY, TYPE & CAPACITY OF PUMP, ETC.
	FROM (ft.)	TO (ft.)			START (galls.)	FINISH (galls.)									SUPPLY LINE (p.s.i.)	PACKER (p.s.i.)			
	a	b	c	d	e	f	f − e = g	g/c = h	b − a = i	k*	ℓ	m	n	p+	q*	r*	d + p − q − r	k x h/i	
23-7-69	109'5"	121'0"	5	25	0.0	30.0	30.0	6.0	11.5	0.9	0?		110'	0.0	0.5	0.5	24.0	0.47	
			5	25	30.0	60.0	30.0	6.0					N rod		0.5	0.5	24.0	0.47	Permeability
			5	50	0.0	60.0	60.0	12.0							2.0	3.0	45.0	0.939	555 ft/yr.
			5	50	60.0	120.0	60.0	12.0							2.0	3.0	45.0	0.939	45 lugeons
			5	25	0.0	30.625	30.625	6.125							0.5	0.5	24.0	0.479	
			5	25	30.625	61.25	30.625	6.125							0.5	0.5	24.0	0.479	
24-7-69	121'0"	130'0"	5	25	0.0	3.0	3.0	0.6	9.0	0.9	70?		130'	23.0	0.0	0.0	48.0	0.06	
			5	25	3.0	6.0	3.0	0.6					N rod		0.0	0.0	48.0	0.06	
			5	50	0.0	4.5	4.5	0.9							0.0	0.0	73.0	0.09	
			5	50	4.5	9.0	4.5	0.9							0.0	0.0	73.0	0.09	Permeability
			5	75	12.125	18.25	6.125	1.225							0.0	0.0	88.0	0.123	35 ft/yr.
			5	75	18.25	24.375	6.125	1.226							0.0	0.0	88.0	0.123	3 lugeons
			5	50	0.0	4.5	4.5	0.9							0.0	0.0	73.0	0.09	
			5	50	4.5	9.0	4.5	0.9							0.0	0.0	73.0	0.09	
			5	25	0.0	3.0	3.0	0.6							0.0	0.0	48.0	0.06	
			5	25	3.0	6.0	3.0	0.6							0.0	0.0	48.0	0.06	
25-7-65	130'0"	140'0"	5	50	0.0	2.5	2.5	0.5	10.0	0.9	0?	0.0	140'	0.0	0.0	0.0	50.0	0.045	
			5	50	2.5	5.0	2.5	0.5					N rod		0.0	0.0	50.0	0.045	
			5	75	0.0	5.0	5.0	1.0							0.0	0.0	75.0	0.09	Permeability
			5	75	5.0	10.0	5.0	1.0							0.0	0.0	75.0	0.09	50 ft/yr.
			5	100	0.0	9.5	9.5	1.9							0.0	0.0	100.0	0.171	4 lugeons
			5	100	9.5	19.0	9.5	1.9							0.0	0.0	100.0	0.171	
			5	75	0.0	5.0	5.0	1.0							0.0	0.0	75.0	0.09	
			5	75	5.0	10.0	5.0	1.0							0.0	0.0	75.0	0.09	
			5	50	0.0	2.625	2.625	0.525							0.0	0.0	50.0	0.045	
			5	50	2.625	5.25	2.625	0.525							0.0	0.0	50.0	0.045	

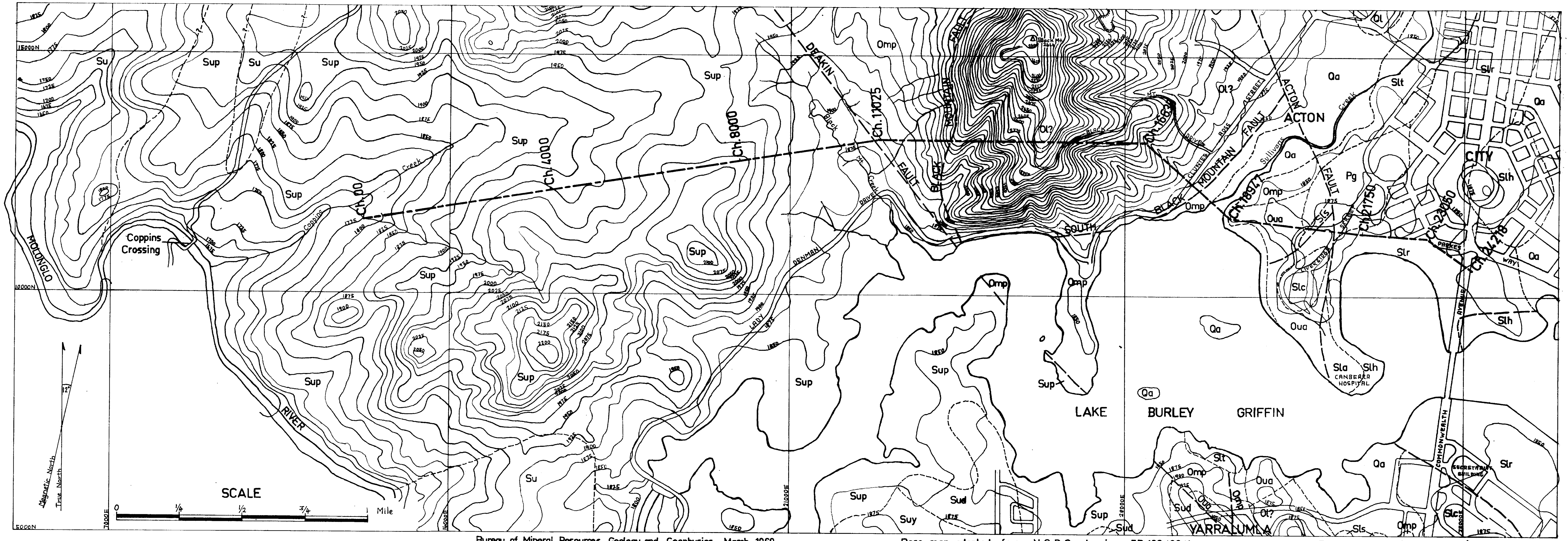
* Values are read from appropriate correction graphs. **Rec. 1970/61** + If $\ell \leq a$, $p = 0.44. \sin\theta. (\ell + m)$; if $\ell > a$, $p = 0.44. \sin\theta. n$.

FILE No. I55/A16/682 (3 of 3)

M(Pf) 107

PLATE 1

NORTH MOLONGLO OUTFALL SEWER
SURFACE GEOLOGY ALONG TUNNEL LINE



REFERENCE

RECENT TO PLEISTOCENE	Qa	Undifferentiated
	Ql	Lyneham Lake deposits
PERMIAN	Pg	Fyshwick Gravel
UPPER SILURIAN	Sup	Mt. Painter Porphyry
	Su	Volcanics
	Suy	Yarralumla Formation
	Sud	Deakin Volcanics
LOWER SILURIAN	Sla	Acton Limestone Member
	Slh	City Hill Shale
	Slr	Riverside Formation
	Slt	Turner Shale
	Sls	State Circle Shale
	Slc	Camp Hill Sandstone
UPPER ORDOVICIAN	Oua	Acton Shale
MIDDLE ORDOVICIAN	Omp	Pittman Formation
LOWER ORDOVICIAN	Ol?	Black Mt. Sandstone

- - - - Geological boundary, position approximate

— — Fault, position approximate

═ Road or street

Quarry

Contours show height above mean sea level

Grid based on Mt. Stromlo datum

—— Tunnel line

Bureau of Mineral Resources, Geology and Geophysics, March 1969

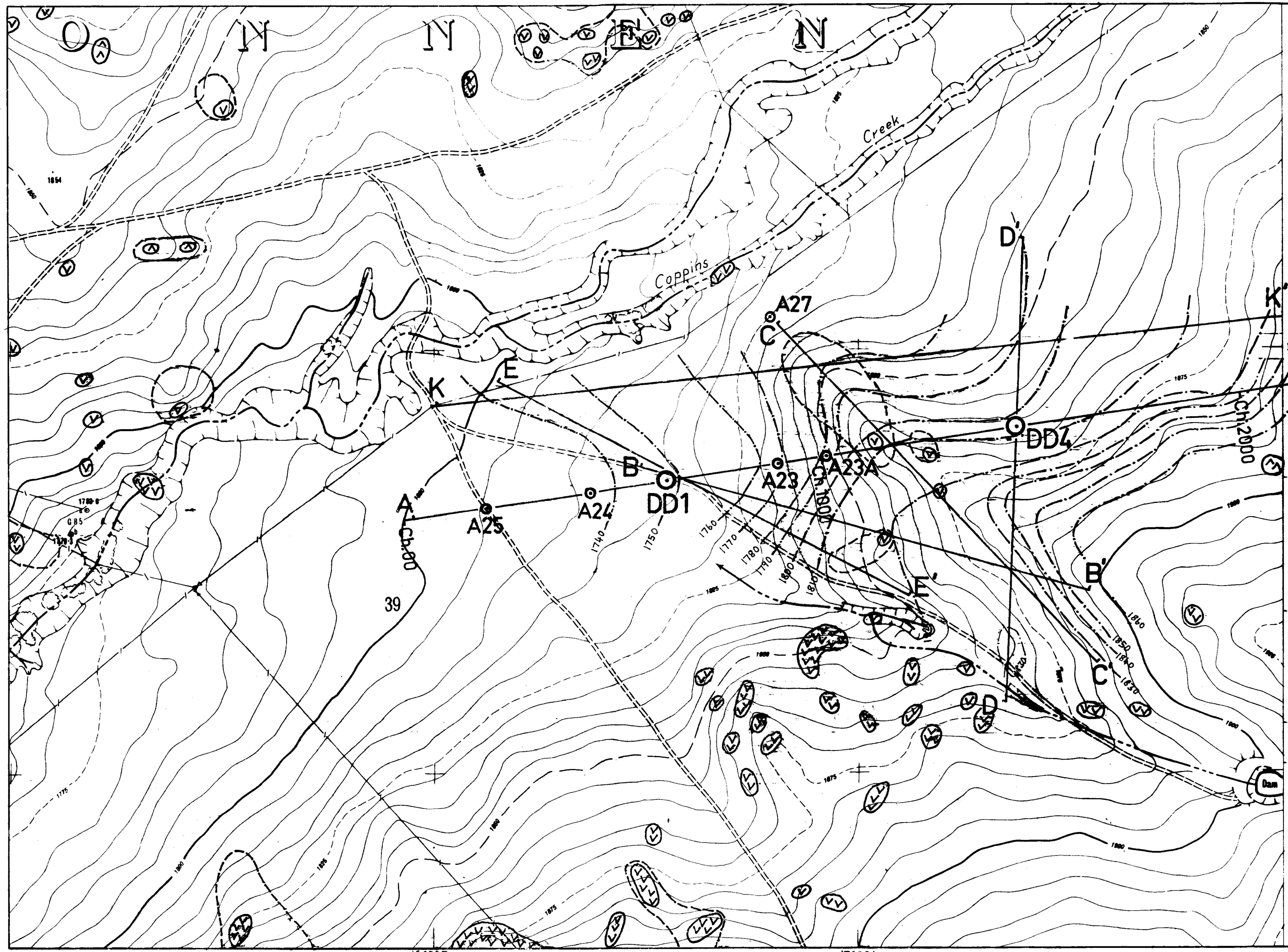
Base map adapted from N.C.D.C. drawing TP 199/66/1

To accompany Record 1970/61

I55/A16/646

PLATE 2

NORTH MOLONGLO OUTFALL SEWER
OUTLET PORTAL AREA

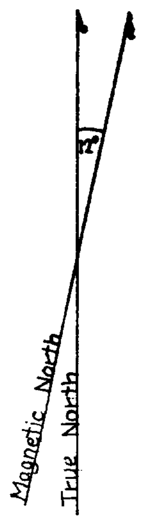


SCALE

Feet 200 0 200 400 600 Feet

REFERENCE

vvv	Dacite crystal tuff
^^^	Rhyolite
⊙DD1	Diamond drill hole
⊙A23	Auger hole
A___A'	Seismic traverse
1810 -·-·-	Structure contour on top of fresh bedrock
	Erosion gully
—/—	Fence
=====	Track



Proposed tunnel line follows seismic traverse AA'

Contours show height in feet above mean sea level

Co-ordinates are in feet with origin at Stromlo Trig. Station

Base map part of A.C.T. Detail Series Sheet G6D

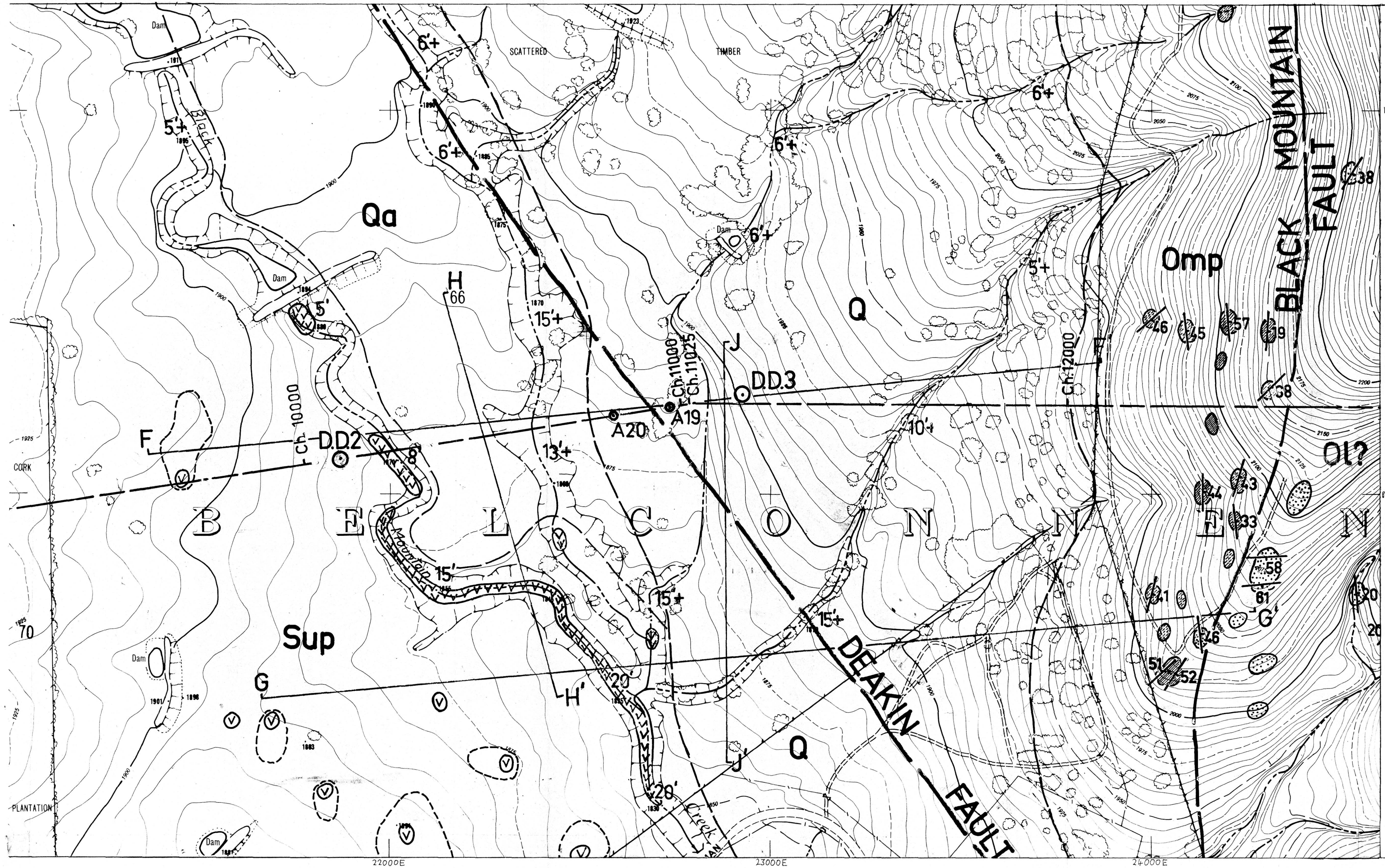
Bureau of Mineral Resources, Geology and Geophysics, August 1969

155/A16/647

To accompany Record 1970/61

PLATE 3

NORTH MOLONGLO OUTFALL SEWER
BLACK MOUNTAIN CREEK AREA

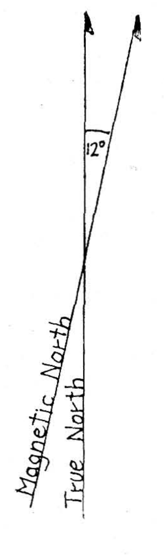


SCALE

Feet 200 0 200 400 600 Feet

REFERENCE

Qa	☐	Alluvium
Q	☐	Soil and scree
Sup	v v v	Dacite crystal tuff
Omp	▨	Chert
	▒	Siltstone
	⁚	Sandstone
Ol?	⁚	Sandstone
	╱ 38	Dip and strike of bedding
	— —	Geological boundary, position approximate
	▬ ▬	Fault, position approximate
	15'	Depth to bedrock in gully
	15'+	Depth of gully, no bedrock exposed
	⊙D.D.2	Diamond drill hole
	⊙A19	Auger hole
	F F'	Seismic traverse
	— - —	Tunnel line



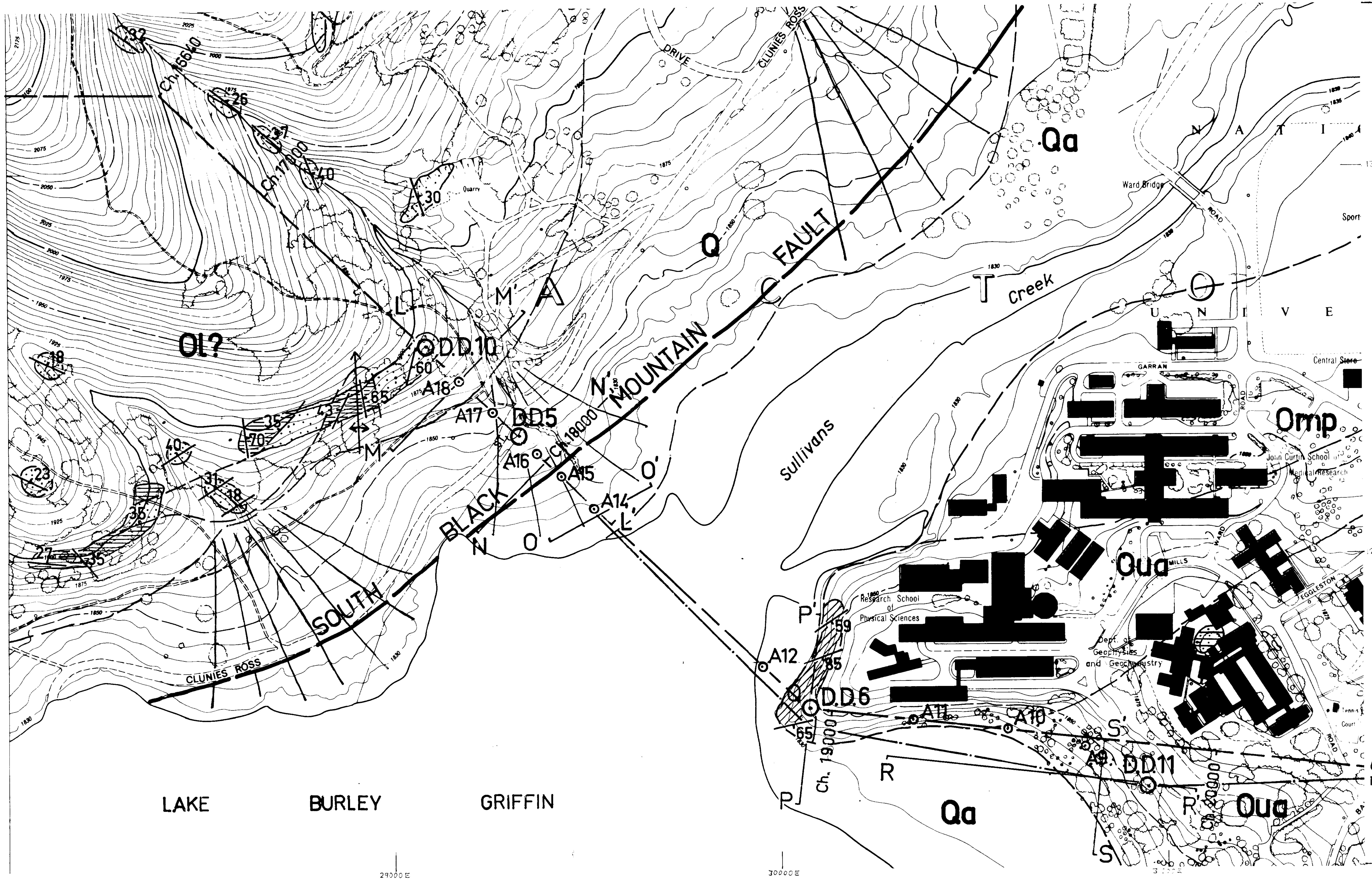
Base map part of A.C.T. Detail Series Sheet HbD

Bureau of Mineral Resources, Geology and Geophysics, August 1969

I55/A16/648

To accompany Record 1970/61

NORTH MOLONGLO OUTFALL SEWER
SULLIVANS CREEK AREA



SCALE

Feet 200 0 200 400 600 Feet

REFERENCE

Qa ☐	Alluvium
Q ☐	Soil and scree
Oua ▨	Interbedded sandstone, siltstone and shale Siliceous shale
Omp ☐	Interbedded sandstone, siltstone and shale
Ol? ▨	Sandstone Laminated shale
\37	Dip and strike of bedding
— —	Geological boundary, position approximate
━ ━	Fault, position approximate
→↕→	Anticline showing plunge
///	Alluvial fan
⊙D.D.5	Diamond drill hole
⊙A12	Auger hole
L⎵L'	Seismic traverse
———	Tunnel line
——·—·	Alternative tunnel line

12°
Magnetic North
True North

Base map part of A.C.T. Detail Series Sheet J6C

Bureau of Mineral Resources, Geology and Geophysics August 1969

I55/A16/649

To accompany Record 1970/61

PLATE 5

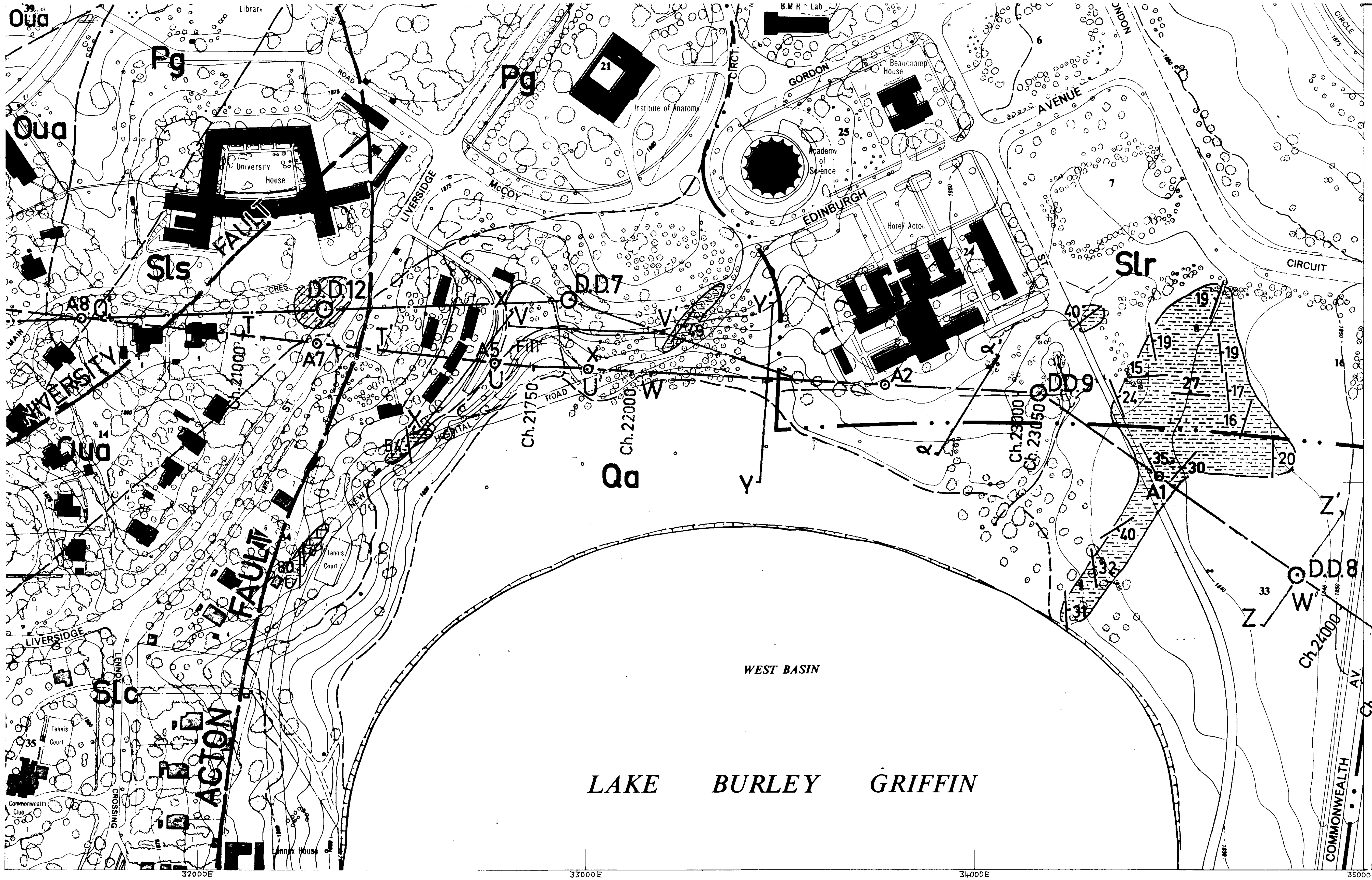
NORTH MCLONGLO OUTFALL SEWER
HOTEL ACTON AREA

SCALE

Feet 200 0 200 400 600 Feet

REFERENCE

Qa	☐	Alluvium
Pg	☐	Gravel
Slr	▦	Siltstone Limestone
Sls	☐	Shale
Slc	☐	Sandstone
Oua	▨	Siliceous shale
	↗19	Dip and strike of bedding
	— — —	Geological boundary position approximate
	▬▬	Fault, position approximate
	○DD7	Diamond drill hole
	⊙A5	Auger hole
	— - —	Tunnel line
	——·	Alternative tunnel line
	T ⌐ T'	Seismic traverse



Base map part of A.C.T. Detail Series Sheet J6C

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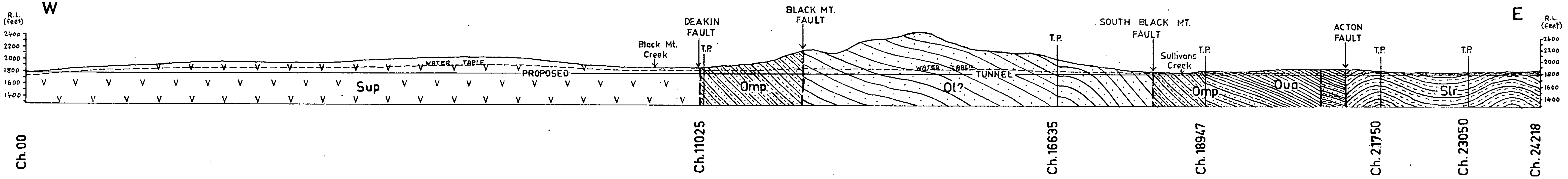
To accompany Record 1970/61

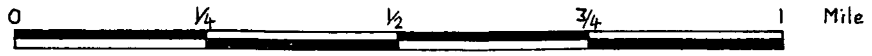
PLATE 6

NORTH MOLONGLO OUTFALL SEWER

GEOLOGICAL SECTION ALONG TUNNEL LINE



HORIZONTAL AND VERTICAL SCALE



REFERENCE

Sup	v	Mt. Painter Porphyry
Slr	▨	Riverside Formation
Oua	▨	Acton Shale
Omp	▨	Pittman Formation
Ol?	▨	Black Mt. Sandstone
	——	Fault, position approximate
	T.P.	Turning point

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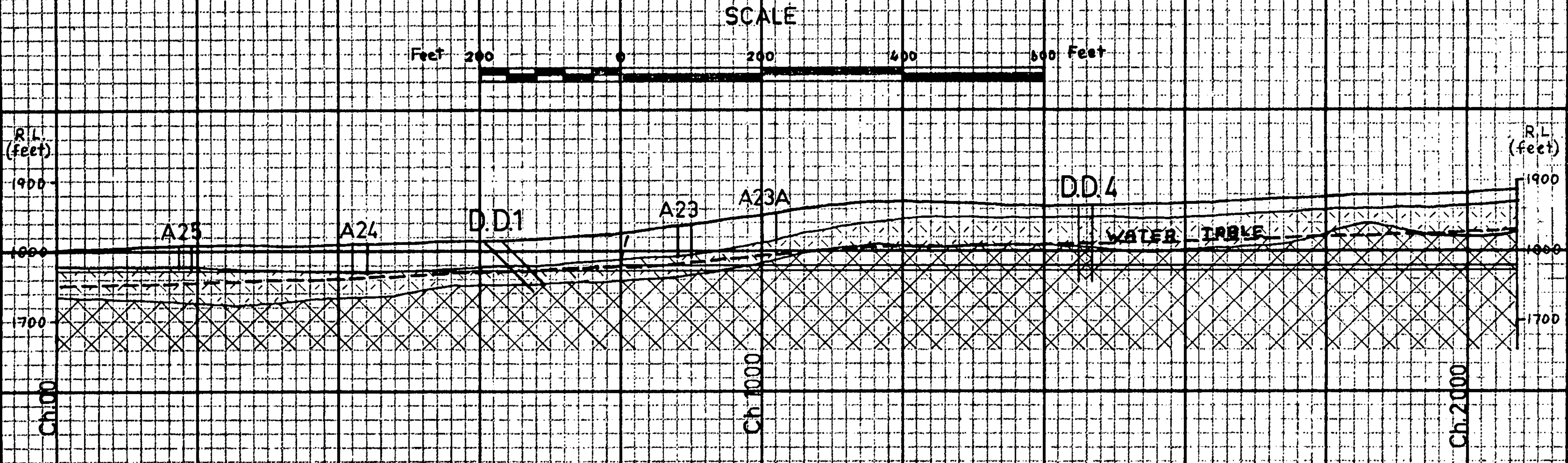
NORTH MOLONGLO OUTFALL SEWER

GEOLOGICAL SECTION OF OUTLET PORTAL AREA

(Section based on drilling, augering and seismic refraction survey results)



▭ Highly weathered dacite crystal tuff

▨ Slightly to moderately weathered dacite crysta tuff

⊠ Fresh to slightly weathered dacite crystal tuff

D.D.1 Diamond drill hole

A23 Auger hole

PLATE 7

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To accompany Record 1970/61

NORTH MOLONGLO OUTFALL SEWER

GEOLOGICAL SECTION OF BLACK MOUNTAIN CREEK AREA

(Section based on drilling, augering and seismic refraction survey results)

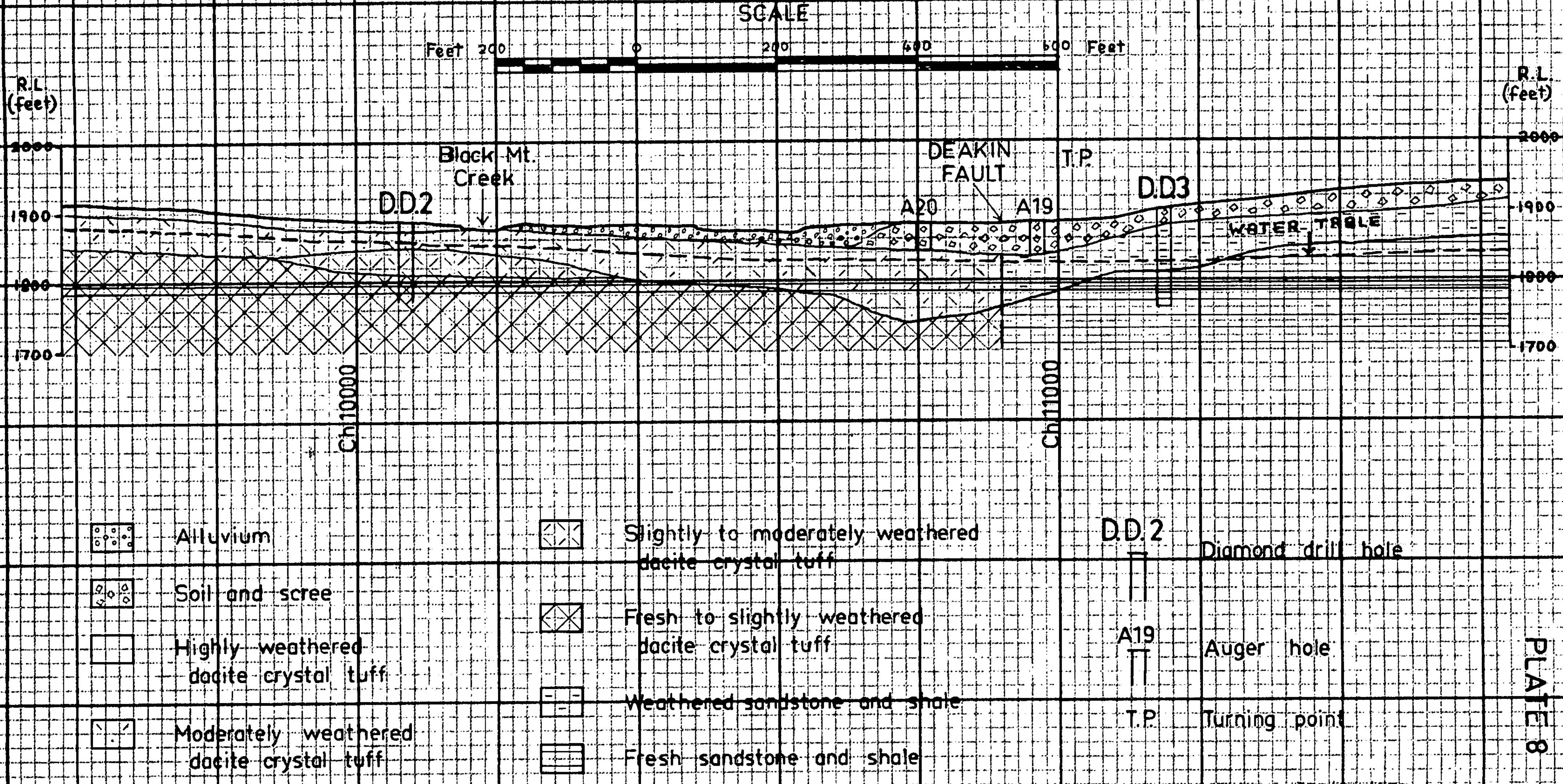

PLATE 8

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I55/A16/653

To accompany Record 1970/61

PLATE 9

NORTH MOLONGLO OUTFALL SEWER

GEOLOGICAL SECTION FROM WEST OF SULLIVANS CREEK TO COMMONWEALTH AVENUE

(FOLLOWING ALTERNATIVE TUNNEL LINE)

(Section based on drilling, augering and seismic refraction survey results)

DD6 Diamond drill hole

A12 Auger hole

T.P. Turning point

- ⁘ Alluvium
- ⁘ Soil and scree
- ▭ Moderately to highly weathered siltstone
- ▨ Moderately weathered siltstone and shale
- ▭ Highly weathered siltstone and shale
- ▨ Slightly to moderately weathered siltstone and shale
- ▧ Fresh to slightly weathered siltstone and shale
- ▨ Moderately to highly weathered siliceous shale
- ▨ Slightly to moderately weathered siliceous shale
- ▧ Fresh to slightly weathered siliceous shale
- ▭ Moderately to highly weathered sandstone and shale
- ▭ Slightly to moderately weathered sandstone and shale
- ▤ Fresh to slightly weathered sandstone and shale

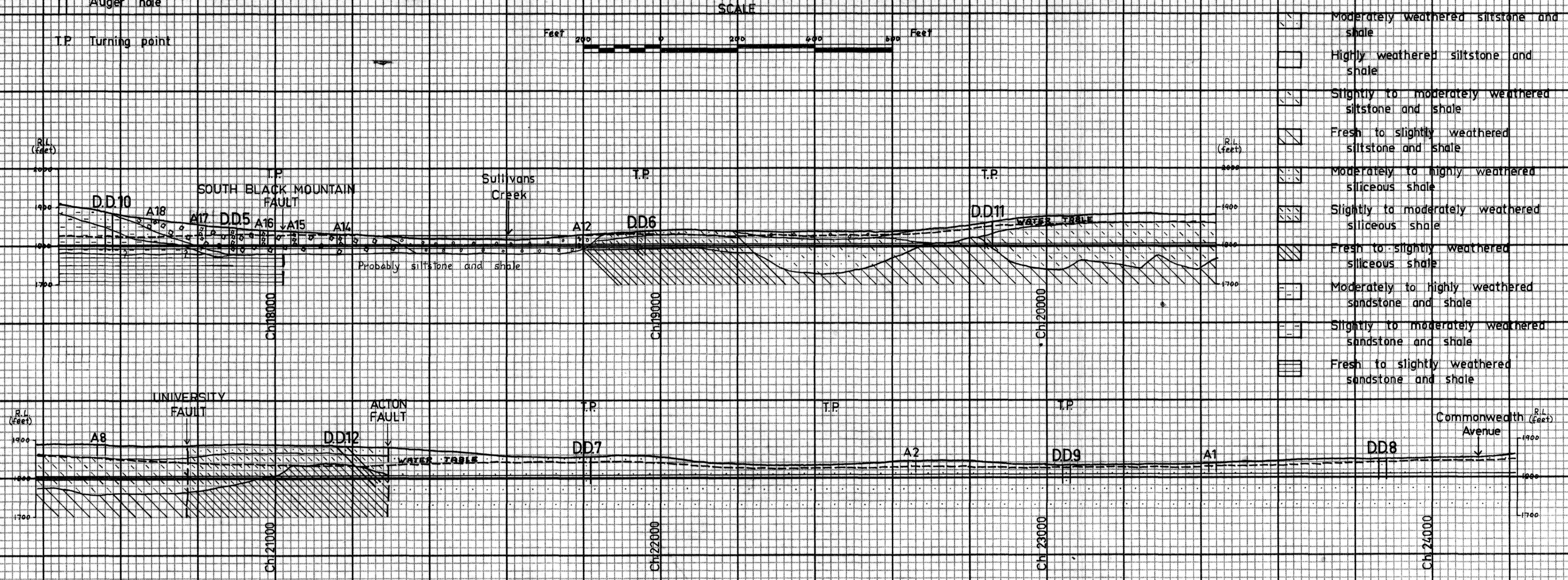

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PLATE 10

NORTH MOLONGLO OUTFALL SEWER
PERMEABILITIES IN DIAMOND DRILL HOLES

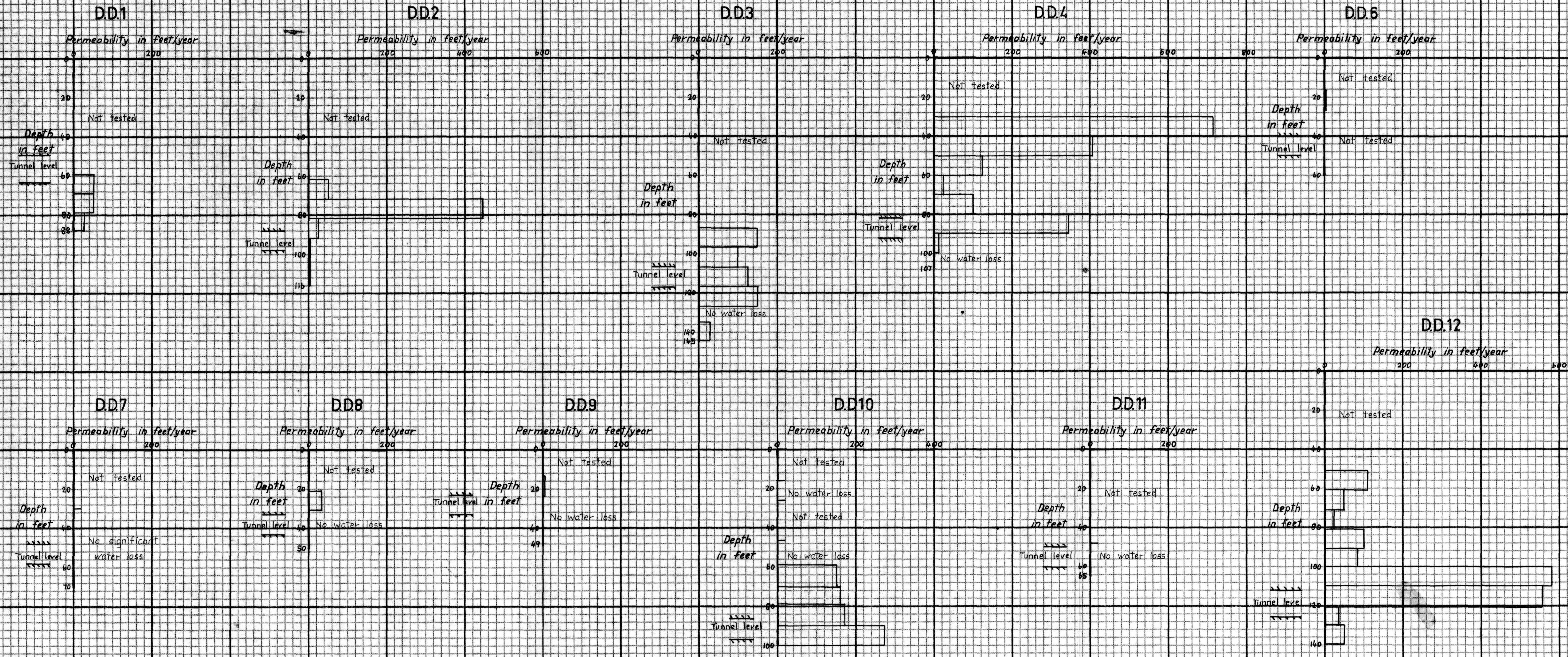

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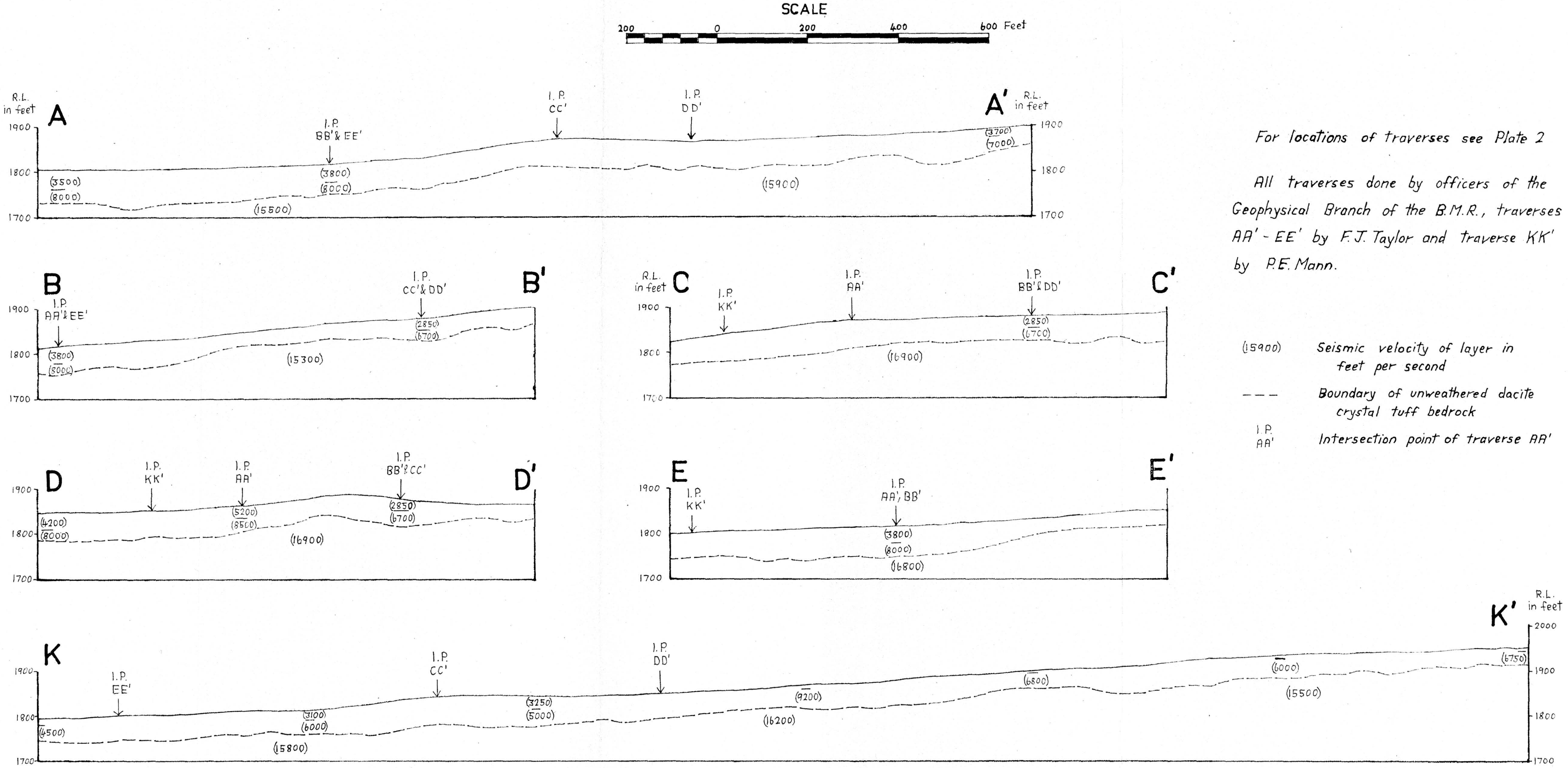
PLATE 11

NORTH MOLONGLO OUTFALL SEWER

SEISMIC CROSS SECTIONS IN OUTLET PORTAL AREA



For locations of traverses see Plate 2

All traverses done by officers of the Geophysical Branch of the B.M.R., traverses AA' - EE' by F.J. Taylor and traverse KK' by P.E. Mann.

(15900)	*Seismic velocity of layer in feet per second*
– – –	*Boundary of unweathered dacite crystal tuff bedrock*
I.P. AA'	*Intersection point of traverse AA'*

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To accompany Record **1970/61**

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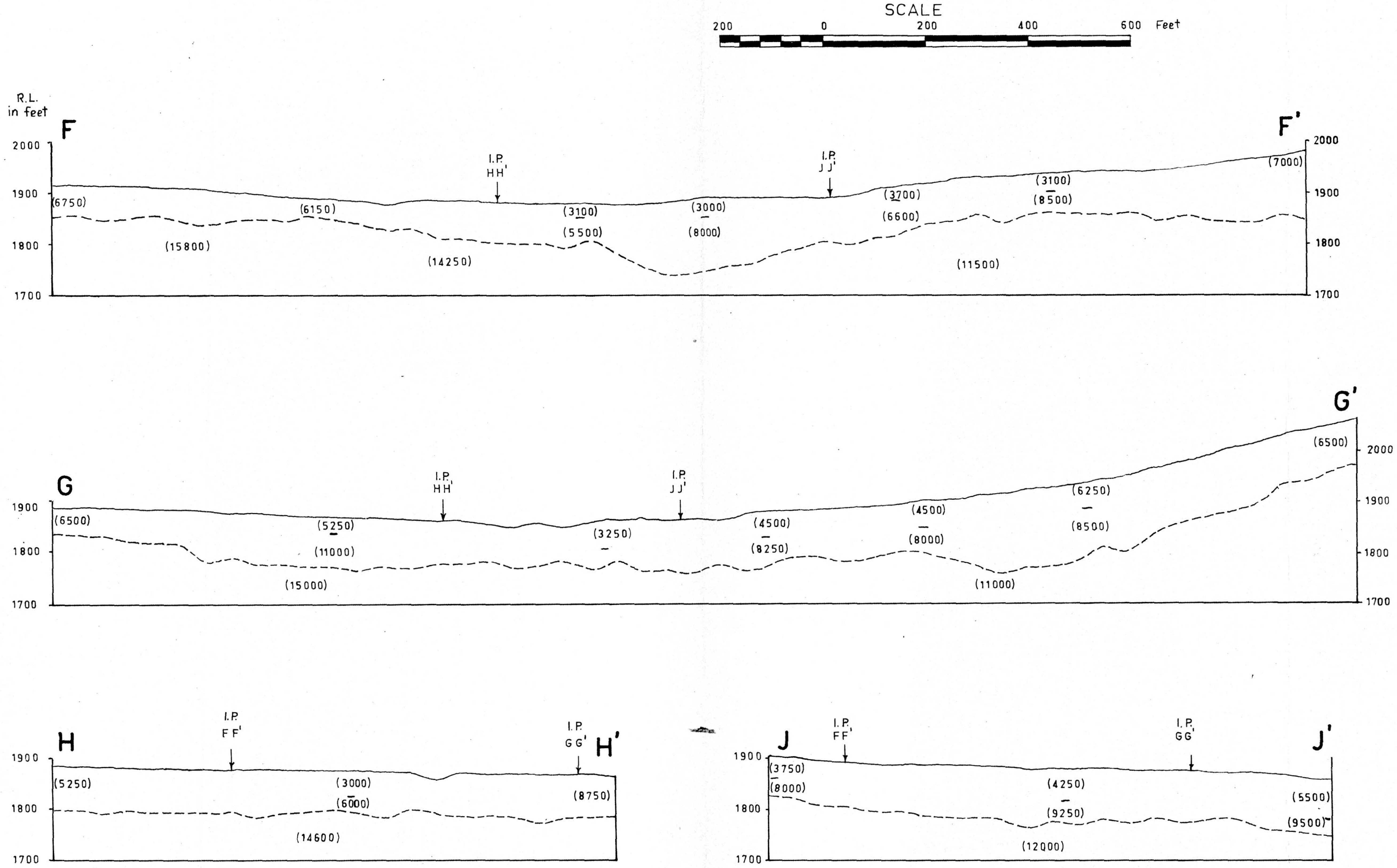
PLATE 12

NORTH MOLONGLO OUTFALL SEWER

SEISMIC CROSS SECTIONS - BLACK MOUNTAIN CREEK AREA



For location of traverses see plate 3

All traverses done by P.E.Mann of the Geophysical Branch of the B.M.R.

(6600) Seismic velocity of layer in feet per second

--- Boundary of high velocity layer

I.P. GG' Intersection point of traverse GG'

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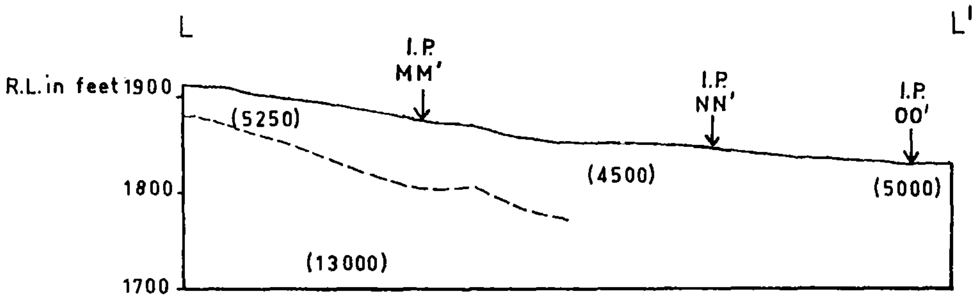
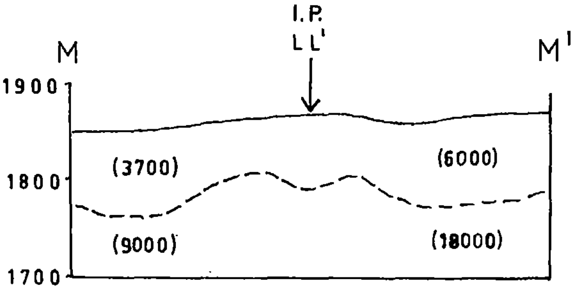
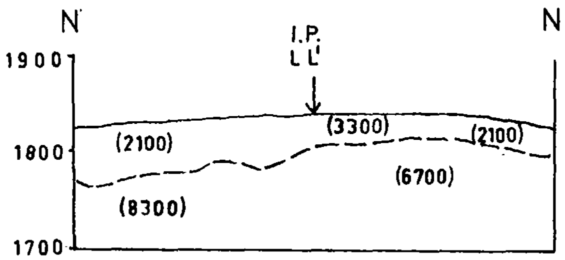
PLATE 13

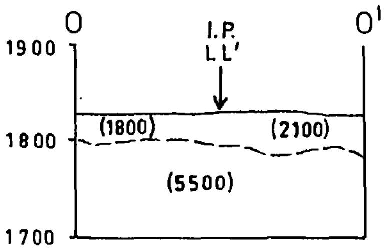
NORTH MOLONGLO OUTFALL SEWER

SEISMIC CROSS SECTIONS - PORTAL AREA WEST OF SULLIVANS CREEK









(8300) Seismic velocity of layer in feet per second.

--- Boundary of high velocity layer.

I.P. LL' Intersection point of traverse LL'

For location of traverses see Plate 4

Traverse LL' done by P. E. Mann of the Geophysical Branch of the B.M.R. Other traverses done by Soil Mechanics Ltd.

Bureau of Mineral Resources, Geology & Geophysics, November 1969

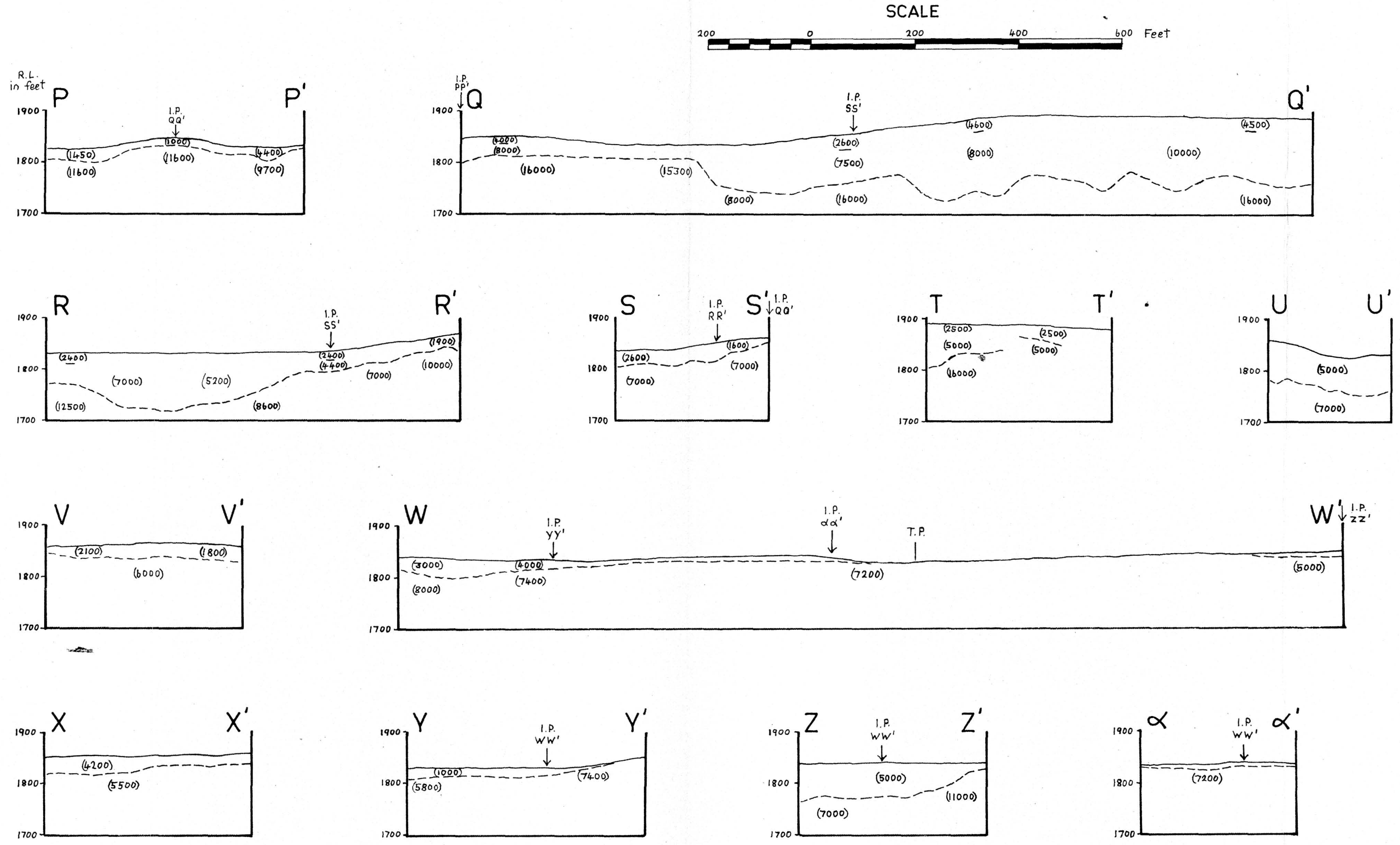
I55/A16/658

To accompany Record 1970/61

PLATE 14

NORTH MOLONGLO OUTFALL SEWER

SEISMIC CROSS SECTIONS BETWEEN SULLIVANS CREEK AND COMMONWEALTH AVENUE



For locations of traverses see Plates 4 & 5

All traverses done by Soil Mechanics Ltd.

(7200)	*Seismic velocity of layer in feet per second*
– – –	*Boundary of high velocity layer*
I.P. YY'	*Intersection point of traverse YY'*
T.P.	*Turning point*

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