DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept.Bk.No. 72/112
G.S. No. 4881
D.M. No. 874/71

ADELAIDE - PORT PIRIE RAILWAY STANDARDISATION
BALLAST SUPPLIES
SITE INVESTIGATIONS AT NANTAWARRA AND BUMBUNGA

Client - S.A. Railways

by

DOUGLAS NICHOL
GEOLOGIST
NON-METALLICS SECTION

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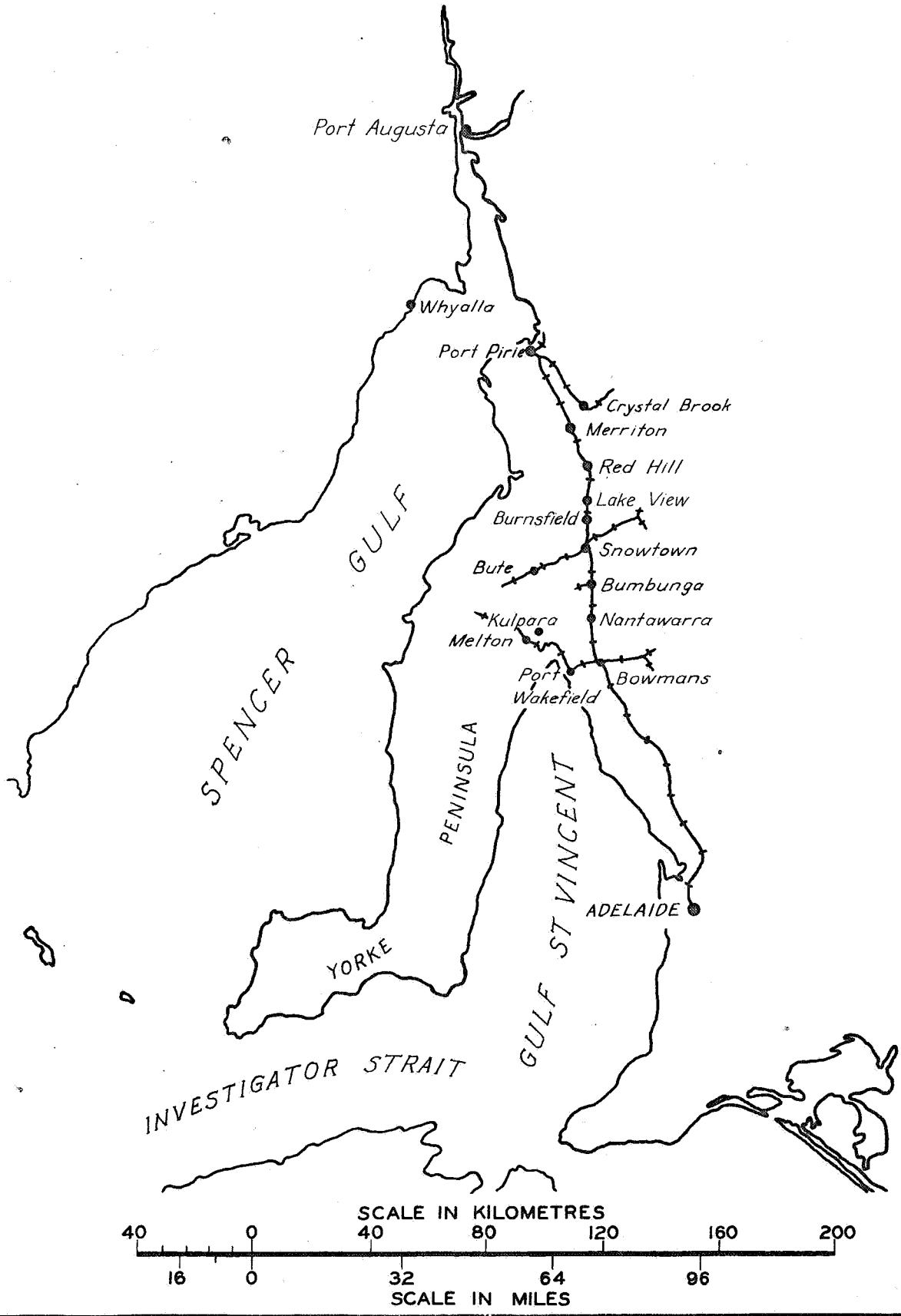
19th June, 1972.



NON-METALLIC MINERALS SECTION	**DEPARTMENT OF MINES – SOUTH AUSTRALIA**	Scale: 1:2,000,000
Compiled: D. Nichol	ADELAIDE – PT. PIRIE RAILWAY STANDARDISATION	Date: 9th March 1972
Drn. M.A.S. | Ckd.	BALLAST SUPPLIES	Drg. No.
	LOCALITY PLAN	S9700 Gcdtj

1M–2.70 A1810

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept.Bk.No. 72/112
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ADELAIDE - PORT PIRIE RAILWAY STANDARDISATION BALLAST SUPPLIES SITE INVESTIGATIONS AT NANTAWARRA AND BUMBUNGA

Client - S.A. Railways

ABSTRACT

A source of railway ballast was sought in the Barunga Sandstone of Upper Proterozoic age which underlies the Hummock Range, Barunga Range and other low lying hills in the midnorth of South Australia. Green clay occurring as interbeds and as joint fillings has caused difficulties in working earlier quarries in the area and initial exploration was designed to locate a site free of this material.

Trenching and drilling of one diamond drill hole in Section 165, Hundred of Goyder, 3.7 km (2.3 miles) south east of Nantawarra, has shown 3 metres (90.66 feet) of Barunga Sandstone unit. The latter consists of 86% quartzitic sandstone suited for ballast and 14% clay material which would be deleterious in crushed rock.

One diamond drill hole in Section 347, Hundred of Everard, 3.2 km (2.0 miles) east of Bumbunga, intersected 16.50 metres (54.12 feet) of Barunga Sandstone unit. This consisted of 72% quartzitic sandstone suited for ballast and 28% clay material which would be deleterious in crushed rock. However, to a depth of 8.00 metres (26.24 feet) only 3% clay material is present.

Both sites have been abandoned after consultation with South Australian Railways engineering personnel.

INTRODUCTION

Approximately 300 000 cubic metres (400 000 cubic yards) of ballast are required for standardisation of the Adelaide - Port Pirie railway.

Present proposals are to construct a new track adjacent to the present alignment at least as far as Merriton.

The South Australian Railways requested the Department of Mines to locate a source of railway ballast in the vicinity of Nantawarra, approximately at the centre point of the route.

Hiern (1971) carried out a reconnaissance of the area and selected a site in Sections 165, 166, 396, 397 and 398, Hundred of Goyder (3.7 km (2.3 miles) south east of Nantawarra) for preliminary investigation.

Bulldozing and diamond drilling showed the material to be unsuitable and a second site was selected by the writer in Section 347, Hundred of Everard (3.2 km (2.0 miles) east of Bumbunga).

Investigations were carried out during the period 3.12.71 to 24.2.72 as follows. All work was supervised by the writer.

Bulldozing, Sec. 165, 166, Hd. Goyder	3.12.71
Stadia survey by S. Wills, Sec. 165, 166, Hd. of Goyder.	6.12.71 - 10.12.71
Diamond drilling, Sec. 165, 166, Hd. of Goyder	24.1.72 - 28.1.72
Further reconnaissance	14.2.72 - 16.2.72
Diamond drilling, Sec. 347, Hd. of Everard	20.2.72 - 24.2.72

Petrographic description of material from diamond drill hole DN 1 was carried out by the Australian Mineral Development Laboratories. The results are referred to briefly in the text of this report and the full AMDEL report M.P.3754/72 is included in Appendix B.

GEOLOGICAL SETTING

Quartzitic sandstone with interbedded siltstone and mudstone underlie the Hummock and Barunga Ranges and low lying hills to the east (plan 72-99). These rocks, are referred to by Mirams (1964) as Barunga Sandstone and considered by Thomson (1969) to be equivalent to the Tent Hill Formation.

Although not accepted as a formal stratigraphic name the rocks are referred to as Barunga Sandstone in this report.

The Barunga Sandstone is composed of grey thick to thin bedded, medium grained feldspathic sandstones with minor ortho-quartzites and thin bedded pale green and brown mudstones. Clay pellets, heavy mineral lamination and current bedding are common features developed in the sandstone beds and clay commonly fills joint openings in the near surface rocks. The clay pellets and interbeds seriously affected workability and quality in some previous quarries although a site free of clay has been successfully worked near Lochiel.

In the area under consideration the Barunga Sandstone unit occupies a shallow north-south trending syncline, the strata dipping at low angles towards the valley centre. Horwitz (1961) postulates north south faults west of Nantawarra and east of Mt. Templeton with downthrow towards the east in each case.

Younger surficial deposits consist of gravel, sandy clay, clay, calcrete and soil.

BALLAST SITES

General

Sites were selected on the basis of promimity to existing sidings. The first stage of the investigation was to determine over burden thickness and then to drill a diamond core hole to see if cl interbeds were present in the Barunga Sandstone sequence.

If these preliminary conditions were satisfied it was proposed to follow up with more detailed site evaluation. This stage was not reached and both sites were abandoned after consultation with South Australian Railways engineering personnel.

Nantawarra

The area investigated extends over Sections 165, 166, 396, 397 and 398, Hundred of Goyder. Section 165 is freehold land with mineral rights, excepting stone ordinarily used for building or road purposes, reserved to the Crown. Sections 166, 396, 397 and 398 are private land with mineral rights alienated from the Crown. Under the Mining Act 1971, to be proclaimed shortly, the ownership of all minerals on all land will be vested to the Crown.

Entry was negotiated with the landowners by the South Australian Railways.

The site plan (plan No. 72-78) shows topography and the sites of bulldozer trenches and the diamond drill hole.

The site is situated on a north south trending ridge falling abruptly to the west with gentle slopes to the east.

Outcrop in the area is sparse though float of quartzitic sandstone is abundant.

Two bulldozer trenches, TN1 and TN2 (see plates 9582 and 9584) were sited to investigate the overburden thickness and to permit inspection of the bedrock material. TN1 and TN2 were cleared to a depth of 2.70 and 3.30 metres (9.86 and 10.82 feet) respectively Both trenches exposed thick overburden consisting of clay, sandy clay calcrete gravel and soil. Bedrock Barunga Sandstone in the floor of

the trenches has an attitude of strike 040° (true) and dip 10° S.E. indicating that the site probably lies on the western limb of a syncline.

Consideration of the site showed that a ballast source could be developed down slope from the overburden and concealed from the main road and railway to the west. Diamond drill hole DN1 was sited accordingly. The hole was drilled vertically to a depth of 30.44 metres (99.84 feet). The drill log is included in Appendix A. The material intersected comprised of 2.80 metres (9.18 feet) of overburden and 27.64 metres (90.66 feet) of Barunga Sandstone unit. The latter is composed of mainly very hard sandstone suited for ballast but includes 14% clay material in thin mudstone bands throughout the section. The amount of clay material present is too high and the site was abandoned.

Bumbunga

This site was selected after reconnaissance of the area with both overburden thickness and proximity to an existing siding in mind.

The site is located in Section 347, Hundred of Everard. Section 347 is leasehold land with mineral rights reserved to the Crown. Under the Mining Act 1971, to be proclaimed shortly, the ownership of all minerals in all land will be vested in the Crown.

Entry was negotiated by the South Australian Railways.

The site is situated on the eastern flank of a north south trending ridge.

A small cutting shows the overburden thickness on the ridge to be less than one metre (3.3 feet). The bedding attitude is strike 016° (true), dip 17°W.

No topographic survey was carried out at the site.

One vertical diamond drill hole, DB1, was sited on the floor of the cutting and was drilled to a depth of 16.50 metres (54.12 feet). The drill log is included in Appendix A. A summary of the sequence encountered is as follows:-

0 - 8 m (0 - 26.2 ft.) sandstone with thin mudstone bands

8 - 9 m (26.2 - 29.5 ft.) mudstone

9 - 12.5 m (29.5 - 41.0 ft.) sandstone with thin mudstone bands

12.5 - 16.5 m (41.0 - 54.1 ft.) mudstone

It is considered that the upper 8 m (26.24 ft.) is suitable for ballast but a quarry would cover an area of approximately 4 hectares (10 acres).

This site was also abandoned after consultation with South Australian Railways personnel.

The next site investigated is at Redhill and is the subject of a separate report.

SUMMARY AND CONCLUSIONS

The Barunga Sandstone is the only potential source of ballast material in the area. However, in several quarries which have been worked, the unit contains clay pellets and mudstone interbeds which are deleterious.

Overburden in the area is much thicker than surface exposures suggest.

Investigations of a site in Section 165, Hundred of Goyder, 3.7 km (2.3 miles) south east of Nantawarra showed about 3 metres (10 feet) of overburden on the hill crest. Diamond drilling downslope in an area of lesser overburden showed a high proportion of clay to be present in the sequence.

At a second site in Section 347, Hundred of Everard, 3.2 km (2.0 miles) east of Bumbunga, overburden is minimal. Diamond drilling showed 8.00 metres (26.24 feet) of quartzitic sandstone with only minor clay. While this material would be suitable for ballast, it would require a large area to produce the quantities required.

Both sites were abandoned after consultation with the South Australian Railways.

Douglas Nichol

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GEOLOGIST
NON-METALLICS SECTION

19th June, 1972.
DN:CMH

REFERENCES

Hiern, M.N., 1971. Reconnaissance for Railway Ballast. Redhill - Bowmans Area (S.A. Railways). Dept. Mines unpublished report R.B.71/131.

Horwitz, R.C., 1961. The Geology of the Wakefield Military sheet. Rept. Invest. geol. Surv. S. Aust., 18: 14 pp.

Mirams, R.C., 1964. BURRA map sheet, Geological Atlas of South Australia, 1:250 000 series, geol. Surv. S. Aust.

Thomson, B.P., 1969. ADELAIDE map sheet, Geological Atlas of South Australian 1:250 000 series. geol. Surv. S. Aust.

Trench TN1 (looking east). Section 165, Hundred of Goyder.
Adelaide-Pt. Pirie Railway Standardisation, Ballast Supplies.

Trench TN2 (looking east). Section 165, Hundred of Goyder.
Adelaide-Pt. Pirie Railway Standardisation, Ballast Supplies.

APPENDIX A

EXPLANATORY NOTES AND LOGS OF DIAMOND DRILL HOLES

APPENDIX A

EXPLANATORY NOTES AND LOGS OF DIAMOND DRILL HOLES

EXPLANATORY NOTES ON DRILLING PROCEDURES

Equipment

The type of diamond drilling machine used was the Mindrill F.20.

All core was drilled at NMLC core size, the nominal diameter of core being two inches. The cores were obtained with "M" type stationary inner tube core barrels fitted with bottom discharge bits. The inner tubes were of the split type, ensuring minimum disturbance of the core during removal from the barrel.

Storing and marking of core

Cores were stored in wooden boxes, each compartment of which has been designed to contain one metre (3.28 feet) of core. The internal length for each compartment was actually 1.03 metres (3.38 feet), to allow for 100 per cent core recovery. Roughness of the ends of the core, and small inaccuracies in measurement when breaking it to fit the box, make it difficult to fit one metre (3.28 feet) of core in a compartment of exactly that length. The boxes were marked with consecutive compartment numbers at one end, and the drilled depths from the surface in metres at the other.

The core was boxed in this manner at the drill site, the core being placed in its appropriate place in the box as soon as it was extracted from the core barrel. An aluminium depth marker was placed at the end of each core run and the depth recorded on the upper surface of the marker in felt pen, immediately it was placed in the box. The measured depth of the hole in metres from the surface was painted on the side of the core box and on the core. Timber blocks cut to the correct length indicate core not recovered

(red blocks) and core removed for testing (yellow blocks).

The core has been stored at the Department of Mines, Drilling and Mechanical Branch, Dalgleish Street, Thebarton, South Australia and is available for inspection.

NOTES ON DIAMOND DRILL LOG SHEETS

The logs have been plotted on a vertical scale of one centimetre = 1 metre (1:100).

The description given on the log sheet refers only to materials recovered as core. Core may be lost by the material being ground or washed away during the drilling process; it may usually be inferred that such material was relatively weak. However, this cannot always be assumed, since even solid rock core may be ground away and lost during drilling operations under some conditions.

To the left of the graphic log is a geological description of the materials sampled. This includes:-

Geological age } Printed vertically
Rock unit name }
Colour of material
Type of material

Classification of the rock substance in terms of its porosity, its condition and its hardness has been shown graphically in the appropriate columns. Such classification has been based on a qualitative estimate only.

Sample numbers (eg. P1071/72) shown in the column headed 'structures' on the log of diamond drill hole DN1, refer to petrographic descriptions presented in Appendix B.

DEPARTMENT OF MINES · SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

PROJECT ADELAIDE - PT. PIRIE RAILWAY STANDARDISATION BALLAST SUPPLIES

FEATURE BARUNGA SANDSTONE

LOCATION SECT. 165, HD. GOYDER

HOLE Nº DN1

SERIAL Nº 632/72

PLAN REFERENCE 72-78

COORDINATES —

ANGLE FROM HORIZ. 90° DIRECTION —

		DESCRIPTION OF CORE	DEPTH (m.)	STRUCTURES	DEPTH (FT.)
QUATERNARY		Brown soil over calcrete gravel over sandy clay and green plastic clay. The clay contains angular boulders of the underlying sandstone.	1, 2		
PROTEROZOIC (ADELAIDEAN)	BARUNGA SANDSTONE	GREY SANDSTONE	3		10
		BROWN SANDSTONE			
		PALE GREY SANDSTONE with thin beds (up to 4cm thick) of pale green MUDSTONE beds constituting about 20% of the interval.	4, 5, 6, 7	Heavy mineral laminations current bedding.	20
		BROWN, PINK AND GREY SANDSTONE with occasional pale green MUDSTONE partings.	8, 9	heavy mineral lamination current bedding.	30
		NO CORE RECOVERED			
		GREY SANDSTONE			
		PALE GREEN MUDSTONE			
		GREY SANDSTONE	10	heavy mineral laminations limonite stained joints.	
		PALE GREEN MUDSTONE			
		GREY SANDSTONE	11		
		GREY SANDSTONE with thin beds of pale green MUDSTONE beds constituting about 12% of the interval.	12		40
		PALE GREEN MUDSTONE		← P1073/72	
		NO CORE RECOVERED	13		
		GREY SANDSTONE with thin beds of pale green MUDSTONE beds constituting about 25% of the interval.	14		
		GREY SANDSTONE	15		50
		NO CORE RECOVERED			
		PALE GREEN MUDSTONE	16		
		PINK AND OFF-WHITE SANDSTONE with occasional thin beds of pale green MUDSTONE.	17	heavy mineral laminations current bedding.	
		PALE BROWN MUDSTONE	18		60
		PALE GREY SANDSTONE with thin beds of chocolate brown MUDSTONE constituting about 12% of the interval.	19		
		PALE GREY SANDSTONE & thin beds of pale green MUDSTONE		Current bedding.	
		PALE GREEN MUDSTONE	20		

POROSITY TERM
- HP Highly Porous
- P Porous
- MP Moderately Porous
- SP Slightly Porous
- NP Non Porous

CONDITION TERM
- Fresh
- Decomposed
- Weathered
- Altered
- Not applicable

HARDNESS TERM
- VS Very soft
- S Soft
- MH Moderately Hard
- H Hard
- VH Very Hard

MINERAL RESOURCES DIVISION

DRILL Nº D.M.7
TYPE MINDRILL F20
DRILLER H. ASCHMONEIT
START 25.1.72
FINISH 29.1.72

LOGGED D. NICHOL
DATE 28.1.72
TRACED R.W.W.
CHECKED

SHEET 1 OF 2 DOC. Nº S9888

P.F. Nº S9411 MB

DEPARTMENT OF MINES · SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE Nº DN1
SERIAL Nº 632/72

PROJECT ADELAIDE-PT.PIRIE RAILWAY STANDARDISATION BALLAST SUPPLIES
FEATURE BARUNGA SANDSTONE
LOCATION SECT. 185 HD. GOYDER
PLAN REFERENCE 72-78
COORDINATES —
ANGLE FROM HORIZ. 90° DIRECTION

DESCRIPTION OF CORE	LOG	DEPTH (m.)	POROSITY AND CONDITION	HARDNESS	STRUCTURES	CORE LOSS	CASING	DEPTH (FT.)
PROTEROZOIC (ADELAIDEAN) — BARUNGA SANDSTONE								
PALE GREEN MUDSTONE								
Pale pink sandstone with thin beds of chocolate brown mudstone constituting about 4% of the interval.		21			heavy mineral laminations current bedding.			70
Brown and pale green mudstone		22						
Pale brown sandstone with thin beds and laminae of brown mudstone constituting about 5% of the interval.		23			P1071/72 heavy mineral lamination current bedding. P1072/72			80
Brown and pale green mudstone		24			P1074/72			
Pale grey sandstone.		25			heavy mineral lamination current bedding			90
Pale grey sandstone & thin beds of brown mudstone		26						
Pale grey sandstone with occasional laminae of brown mudstone		27			heavy mineral lamination current bedding			
Brown mudstone		28						
Off-white sandstone.		29			heavy mineral lamination			100
Brown mudstone.		30						
End of hole 30·44 m								

POROSITY TERM

HP Highly Porous
P Porous
MP Moderately Porous
SP Slightly Porous
NP Non Porous

CONDITION TERM

Fresh
Decomposed
Weathered
Altered
Not applicable

HARDNESS TERM

VS Very soft
S Soft
MH Moderately Hard
H Hard
VH Very Hard

MINERAL RESOURCES DIVISION

DRILL Nº DM7
TYPE MINDRILL F20
DRILLER H. ASCHMONEIT
START 25·1·72
FINISH 29·1·72
LOGGED D. NICHOL
DATE 29·1·72
TRACED D.N.W.
CHECKED

SHEET 2 OF 2
DRG Nº S9686a Gd13

P.F.Nº S9411 MB

DEPARTMENT OF MINES · SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE Nº DB1
SERIAL Nº 637/72

PROJECT ADELAIDE – PT. PIRIE RAILWAY STANDARDISATION BALLAST SUPPLIES
FEATURE BARUNGA SANDSTONE
LOCATION SECT. 347 HD. EVERARD

PLAN REFERENCE —
COORDINATES —
ANGLE FROM HORIZ. 90° DIRECTION —

DESCRIPTION OF CORE	LOG	DEPTH (m.)	POROSITY AND CONDITION (HP P MP SP NP)	HARDNESS (VS S MH H VH)	STRUCTURES	CORE LOSS	CASING	DEPTH (FT.)
PROTEROZOIC (ADELAIDEAN) BARUNGA SANDSTONE								
GREY SANDSTONE with occassional very thin bed of pale green MUDSTONE		1						
PALE GREY SANDSTONE		2			current bedding steeply dipping joints			5
PALE GREY SANDSTONE with laminae of pale green MUDSTONE laminae constituting about 10% of the interval		3						10
PALE GREY SANDSTONE with very thin beds (up to 3cm. thick) of pale green MUDSTONE constituting about 7% of interval		4						
PALE GREY SANDSTONE		5 6 7			current bedding thin bands of friable sandstone			15 20
PALE GREY SANDSTONE with thin beds of pale green MUDSTONE constituting 8% of interval		8						25
PALE GREEN MUDSTONE		9						
PALE GREY SANDSTONE with thin beds of pale green MUDSTONE CONSTITUTING about 7% of the interval		10						30 35
PALE GREY SANDSTONE with occassional thin laminae of pale green MUDSTONE		11 12			thin bands of friable sandstone			40
PALE GREEN MUDSTONE & thin bands (less than 10 cm. thick) of very hard grey sandstone. The sandstone bands constitute about 7% of the interval		13 14 15 16						45 50
GREY SANDSTONE with thin beds pale green and brown MUDSTONE constituting 25% of interval								
END OF HOLE 16·50 metres								

POROSITY TERM
HP Highly Porous
P Porous
MP Moderately Porous
SP Slightly Porous
NP Non Porous

CONDITION TERM
Fresh
Decomposed
Weathered
Altered
Not applicable

HARDNESS TERM
VS Very soft
S Soft
MH Moderately Hard
H Hard
VH Very Hard

MINERAL RESOURCES DIVISION

DRILL Nº DM 7
TYPE MINDRILL F20
DRILLER J. JENSEN
START 22-2-72
FINISH 23-2-72

LOGGED D. NICHOL
DATE 23-2-72
TRACED DJM
CHECKED LVW

SHEET 1 OF 1
DRG Nº S9708 6d9

F.I.N. 3341 MB

APPENDIX B

PETROGRAPHIC DESCRIPTION OF SAMPLES

APPENDIX B

PETROGRAPHIC DESCRIPTION OF SAMPLES

AMDEL REPORT MP.3754/72 by F. Radke

Sample: P1071/72 : TS 28553

Location:

23.45 m (76.92 feet) down drill hole DN1, Nantawarra.

Rock Name:

Quartzose sandstone

Hand Specimen:

A pinkish grey, finely laminated rock with a well indurated, siliceous appearance. The laminae are oriented perpendicular to the core axis. The fracture surfaces have a deep red ocherous iron-oxide stain.

Thin Section:

An optical estimate of the constituents gives the following:

	%
Quartz	85
Feldspar	8
Clay	5
Sericite	Trace
Zircon	Trace
(?)Tourmaline	Trace
Opaques	1

Most of this rock consists of rounded quartz and minor feldspar grains between 0.05 and 0.6 mm wide which have undergone some recrystallisation during diagenesis to produce a tightly interlocking granular matrix. Some of the quartz grains exhibit overgrowths which are separated from the original grain by a cloudy, thin band of very fine inclusions.

The most common feldspar is an untwinned alkalic variety possibly albite because of its biaxial positive character and low refractive indices which has a brown cloudy nature due to encipient alteration. However, the assay values indicate it is most probably K-feldspar. Some fresh grains of gridiron twinned microcline and albite twinned plagioclase are also present in this rock.

The clay occurs as rounded patches up to 0.5 mm wide between the quartz grains and the small amounts of sericite occur as fine birefringent flakes up to 0.15 mm long, which are commonly located between quartz grains but also occur in some altered feldspar grains.

Traces of small (less than 0.03 mm wide) zircon grains and a single pleochroic green (?) tourmaline grain were observed in this rock. Opaque grains up to 0.1 mm wide are disseminated through this specimen.

Sample: P1072/72 : TS 28554

Location:

24.30 m (79.70 ft.) down drillhole DN1, Goyder.

Rock Name:

Quartzose sandstone

Hand Specimen:

Basically this rock is similar to P1071/72 but it has a region rich in a deep red brown clay which occurs as discontinuous bands up to 2 mm thick. A clay rich band truncates the fine bedding lamella in an area where it appears to be at the base of a scour and fill type structure.

Thin Section:

An optical estimate of the constituents gives the following:

	%
Quartz	85
Plagioclase	2
Microcline	1
Clay	10
Muscovite	Trace
Biotite	Trace
Tourmaline	Trace
Zircon	Trace
(?)Hematite	1
Opaques	1

This rock is very similar to sample P1071/72 (TS 28853) but has a slightly lower apparent abundance of feldspar. There are also irregular patches of very fine material with a deep reddish brown tint which probably represents iron stained clay.

The quartz forms rounded grains between 0.05 and 0.8 mm wide which commonly show overgrowths. Deformation of this rock is evidenced by fracturing and well developed strain extinction in some quartz grains. The same types of feldspar present in sample P1071/72 occur in this rock but in smaller amounts.

Most of the clay in this rock occurs as large brownish red patches and veins with many fine birefringent flakes (probably illite) and small quartz grains. These red patches are similar to those of sample P1074/72 in both hand specimen and thin section and probably have a similar mineralogical composition. Some clay occurs as clear to pale green round patches up to 0.4 mm wide and fine coatings between quartz grains.

One vein about 0.4 mm wide with scalloped sides consists of alternating bands of a red pleochroic mineral believed to be finely divided hematite and cryptocrystalline silica.

Small zircon grains less than 0.1 mm wide and pleochroic green tourmaline grains less than 0.2 mm wide occur in this rock as do disseminated opaque grains up to 0.1 mm wide.

Traces of muscovite and biotite flakes up to 0.2 mm long occur in or between quartz grains. The biotite is pleochroic from a pale yellow to a medium olive green.

Sample: P1073/72 : TS 28555

Location:

12.70 m (41.66 ft.) down drillhole DN1, Goyder.

Rock Name:

Argillaceous siltstone

Hand Specimen:

A massive, white rock with a clayey appearance.

X-Ray Diffraction Results:

An estimate of the mineralogy from intensity of X-ray diffraction peaks gives the following:

	%
Quartz	40-60
Kaolinite	30-40
Illite	10-20
Montmorillonite	Trace
Halite	Trace

Kaolinite : Montmorillonite : illite ratio = 2: Trace: 1.

Thin Section:

This rock consists largely of small quartz grains less than 0.5 mm wide set in a pale brown clay matrix which exhibits a well developed preferred orientation under crossed nicols. Some large clear areas up to 0.1 mm wide of a fibrous clay with a radial structure (probably kaolin) are distributed through the rock. The

amount of quartz visible in thin section is much lower than that estimated by X-ray diffraction.

Sample: P1074/72 : TS 28556

Location:

26.12 m (85.67 ft.) down drillhole DN1, Goyder.

Rock Name:

Mudstone with silt lenses

Hand Specimen:

A brownish red, finely laminated shale with a bedding oriented perpendicular to the core axis. Flakes of shiny white mica (illite) are visible on the bedding planes.

X-Ray Diffraction Results:

An estimate of the mineralogy from intensity of X-ray diffraction peaks gives the following:

	%
Illite	50-70
Montmorillonite	10-20
Kaolinite	5-15
Quartz	1- 2

Kaolinite : Montmorillonite : Illite ratio = 1:2:10

Thin Section:

Most of this sample consists of a deep red matrix with fine subparallel birefringent flakes (probably illite) up to 0.2 mm long. The rock has some bands and lenses up to 4 mm wide which consist of subangular quartz grains with a grain size of about 0.1 mm and are oriented parallel to the bedding defined by the birefringent illite flakes. Grains of quartz of similar size are also present within the main clay rich layers.

TABLE : RESULTS OF DIRECT READING EMISSION SPECTROGRAPHY (WT %)

	Lower Detection Limit	P1071/72	P1072/72	P1073/72	P1074/72
SiO_2	0.3	95 (1)	89.5(1)	59.8	57.5
TiO_2	0.01	0.15	0.40	1.50	1.40
Al_2O_3	.05	2.4	4.5	24.0	20.0
Fe_2O_3 (2)	0.5	0.8	1.9	2.0	7.2
MgO	0.03	0.05	0.40	1.35	1.90
MnO	0.02	nd (3)	nd	nd	0.02
CaO	0.1	nd	nd	nd	nd
Na_2O	0.03	nd	nd	nd	nd
K_2O	0.25	0.8	1.8	3.0	5.0
P_2O_5	0.02	nd	0.05	0.10	0.15
Cr_2O_3	0.1	nd	nd	nd	nd
V_2O_5	0.05	nd	nd	nd	nd
LOI (4)	-	0.25	1.15	7.8	6.55
TOTAL		99.45	99.70	99.55	99.72

(1) These values are too high for direct reader analysis and are intended as a guide only.

(2) Total Fe as Fe_2O_3.

(3) nd = below lower detection limit.

(4) LOI = loss on ignition.

138°00'

N

Redhill

Collinsfield

Lake View

Burnsfield

Brinkworth

BARUNGA RANGE

Snowtown

GLEASON HILL

Barunga Gap

Blyth

Bute

BUMBUNGA SITE
Sec. 347, Hd. Everard

LAKE BUMBUNGA

RANGE

Bumbunga

Brochiel

KANGAROO HILL

HUMMOCK

34°00'

BURRA 1:250000
ADELAIDE 1:250000

Nantawarra

MT TEMPLETON

NANTAWARRA SITE
Sects. 165, 166, 396-398, Hd. Goyder

Kulpara

Goyder

South Hummocks

Balaklava

Bowmans

Port Wakefield

ST. VINCENT GULF

SCALE IN KILOMETRES

5 0 5 10 15 20 25 30

4 0 4 8 12 16 20

SCALE IN MILES

LEGEND

TERTIARY		Gravel.
CAMBRIAN		KULPARA LIMESTONE PARARA LIMESTONE
ADELAIDEAN		BARUNGA SANDSTONE or TENT HILL FORMATION

GEOLOGY FROM ADELAIDE AND BURRA 1:250,000 GEOLOGICAL MAP SHEETS.

NON - METALLICS MINERALS SECT.

DEPARTMENT OF MINES - SOUTH AUSTRALIA

Compiled: N HIERN

Drn. A.G.R. Chkd R.H.

ADELAIDE-PT. PIRIE RAILWAY STANDARDISATION

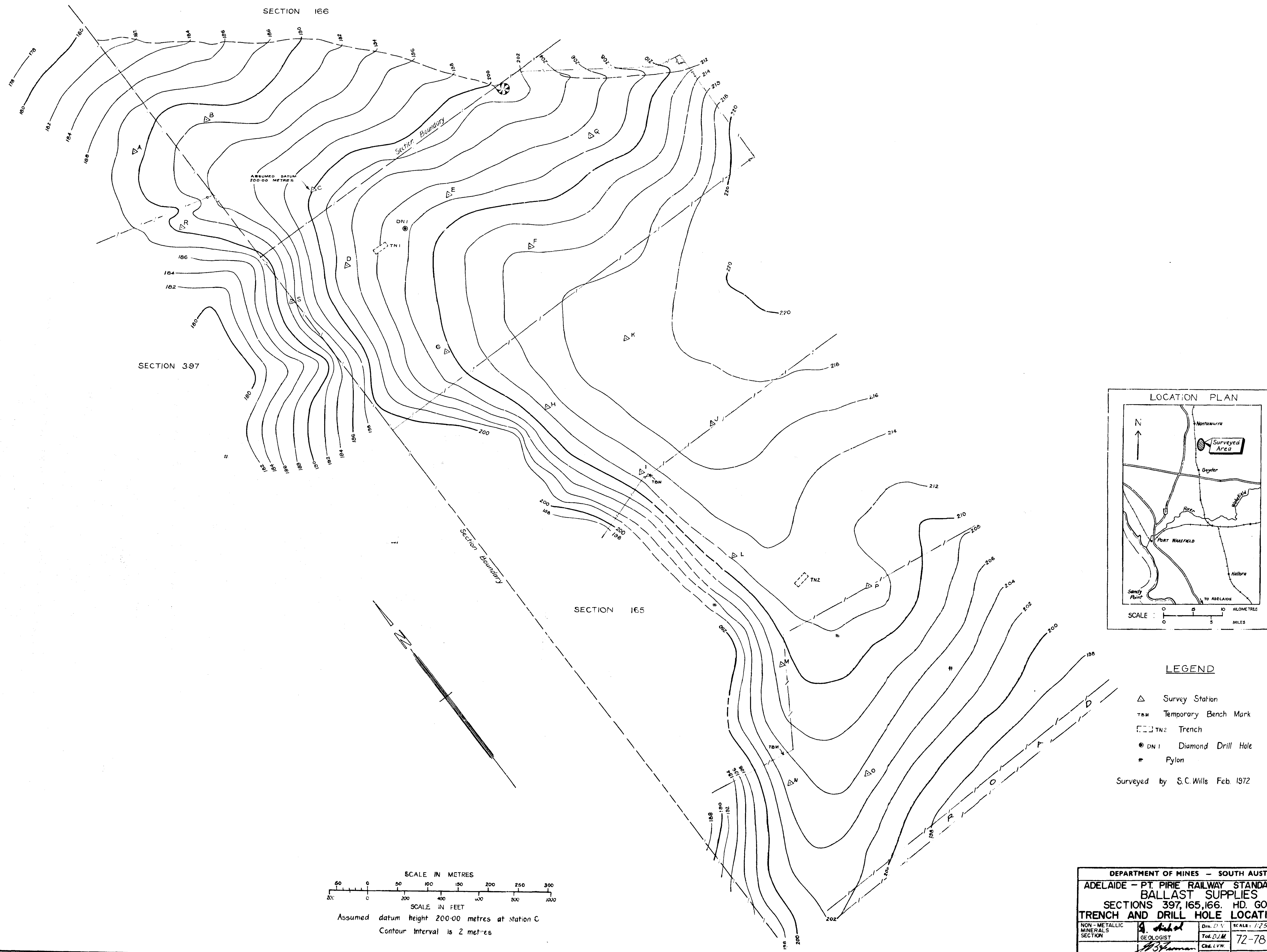
BALLAST SUPPLIES

GEOLOGICAL PLAN

Scale:

Date: 9th Mar 1972

Drg. No. 72-99 Sht 1



LEGEND

- △ Survey Station
- TBM Temporary Bench Mark
- TN2 Trench
- ◉ DN 1 Diamond Drill Hole
- ⌗ Pylon

Surveyed by S.C. Wills Feb. 1972

DEPARTMENT OF MINES – SOUTH AUSTRALIA

ADELAIDE – PT. PIRIE RAILWAY STANDARDISATION
BALLAST SUPPLIES
SECTIONS 397, 165, 166. HD. GOYDER
TRENCH AND DRILL HOLE LOCATION PLAN

NON-METALLIC MINERALS SECTION	[signature] GEOLOGIST	Drn. D.N.	SCALE: 1:2500 (orig.)
		Tcd. D.J.M.	72-78
Director of Mines	[signature] SEN. GEOLOGIST	Ckd. L.V.W.	Gd 13
		Exd.	DATE: 23 Feb. 1972