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RECORDS OF THE
GEOLOGICAL SURVEY
OF WESTERN AUSTRALIA

No. 1962/19

TITLE: REPORT ON BUSSELTON SHIRE COUNCIL WATER BORE, MILNE STREET, BUSSELTON, W.A.

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DATE: 10.12.62.

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REPORT ON BUSSELTON SHIRE COUNCIL WATER BORE, MILNE ST., BUSSELTON, W. A.

by

J. R. Passmore

Record No.1962/19.

C O N T E N T S

10th December, 1962.

ABSTRACT

A water bore for the Busselton Shire Council, drilled in Milne Street, Busselton, to a depth of 1,000 feet, intersected a large supply of good quality artesian water from aquifers within Cretaceous sediments of the Perth Basin. The sediments are non-marine sandstones and clays correlated with the Capel River Group.

Several zones produced artesian water, all of good quality. Flows of approximately 6,000 gallons per hour and 14,000 gallons per hour were obtained from the intervals 317 feet to 321 feet and 553 feet to 619 feet respectively, but these flows were not utilised. The bore produces from aquifers between 750 feet and 1,000 feet which yielded a flow of 23,000 gallons per hour and was pump tested at 35,000 gallons per hour. The water contains 272 parts per million (19 grains per gallon) total dissolved solids and 68 parts per million (4.8 grains per gallon) sodium chloride.

INTRODUCTION

The bore was drilled to obtain a water supply of 20,000 to 30,000 gallons per hour to irrigate a recreation ground to be established by the Busselton Shire Council on Reserve 8485 (Locality Plan, Plate 1).

Good supplies of artesian water have been encountered in previous bores in the town, such as those of the Water Board which have been the source of the town water supply for many years. At the Water Board No. 1 Pumping Station, 20 chains south of the present bore, two bores of depths 480 feet and 495 feet flowed at 6,300 g.p.h. and 15,000 g.p.h. respectively. The deepest bore in the town at the Water Board No. 2 Pumping Station, West Busselton, is 549 feet deep and has been pumped at 17,000 g.p.h.

The Mines Department financed drilling of the present bore from 550 feet to 1,000 feet to obtain geological and hydrological information on the deeper sediments. Deeper aquifers were sought as a source of water independent of those now producing. Also the Busselton Water Board required information on any deeper aquifers before deepening one of its producing bores.

The bore was drilled under contract by Westphal Bros. & Co. and the Geological Survey supervised collection of samples, development, and testing of aquifers. It was intended to test each aquifer below 550 feet as penetrated, but this was not possible below the depth of 630 feet. Due to collapsing of loose sandstones the section from 670 feet to 1,000 feet was drilled using bentonite mud, thus obscuring individual

aquifers, and this interval was developed and tested as a whole.

BORE HISTORY

1. General Data

Name: Busselton Shire Council Water Bore, Milne Street, Busselton.

Location: South-West Division.
Lat. 33° 39' S., Long. 115° 21' E. (approx.)
15 yards east of Milne St. about half-way between Marine Terrace and the road along the sea front.

Ground Elevation: about 10' above S.L.

Commenced: 22nd February 1962.

Drilling Completed: 7th June, 1962.

Testing Completed: 18th August 1962.

Total Depth: 1,000'.

Status: producing.

2. Drilling Data

Drilling Contractor: Westphal Bros. & Co.,
83-87 Abernethy Road, Belmont.

Rig: Ruston-Bucyrus 22 R.W., Percussion.

Hole Size: 10½"/0-40'; 8½"/40'-538'; 6½"/538'-1000'.

Casing: 10" O.D. / 0-40'; 8" O.D./0-538'; 6" O.D./490'-751'; 5" O.D./734'-1000'.
10" casing cemented.

Perforation: 5" casing perforated (3/16" diam. holes) and slotted (1/8" x 4" slots) from 754'-1000'.
9 lengths perforated, 4 lengths slotted.

GEOLOGY

General

Busselton is in the southern part of the Perth Basin, about half-way between the Darling and Dunsborough Faults which form the eastern and western margins of the basin in this region. From gravity survey results (Thyer and Everingham,1956) the total thickness of sediments here is thought to be 10,000-20,000 feet.

Mesozoic sediments of the Capel River Group (Fairbridge,1953) occur subsurface in the area; the greatest thickness encountered is 1,700 feet of sandstones, siltstones and mudstones in Abba River Bore No.1, located about 9 miles south-east of Busselton. These sediments are of Upper Jurassic to Lower Cretaceous age.

Quaternary dune sands, limestone and estuarine and alluvial deposits, cover the Mesozoic sediments in the Busselton area. At the bore location the surface deposits are dune sands.

Lithology

The lithological log of the section penetrated by the bore is given in Table 1.

Table 1.

SAMPLE LOG OF BUSSELTON SHIRE COUNCIL

WATER BORE, MILNE STREET.

From (feet)	To (feet)	Thickness (feet)	Lithology
0	9	9	Sand: quartz, unconsolidated, medium to coarse grained, with fine shell fragments.
9	21	12	Sandstone: calcareous, partly cemented to hard rock, medium to coarse grained, with shells.
21	34	13	Sandstone: quartz, clayey, light brown, calcareous, with shells.
34	45	11	Clay: dark grey, micaceous, with coal and pyrite.
45	50	5	Clay: sandy, light grey, sticky, with pyrite.
50	158	108	Sandstone: quartz, clayey, light grey, with rare coal and pyrite.
158	170	12	Clay: sandy, dark brown, sticky, with pyrite.
170	209	39	Siltstone: clayey, light grey, micaceous, with coal and rare pyrite.
209	317	108	Clay: silty, dark grey, sticky, micaceous, with coal and pyrite. Minor thin beds of hard fine grained sandstone and siltstone.
317	321	4	Sandstone: quartz, poorly consolidated, coarse grained, with pyrite. Minor thin beds of mudstone.
321	390	69	Clay: sandy, black, carbonaceous, with green felspar and minor pyrite.
390	398	8	Clay: silty, brown, with green felspar.
398	400	2	Sandstone: quartz, clayey, light grey.
400	402	2	Clay: grey, sticky.
402	509	107	Sandstone: quartz, clayey, light grey, coarse grained, felspathic, with coal, pyrite, and ilmenite. Minor beds of brown mudston
509	513	4	Clay: silty, dark brown, sticky, micaceous, with rare coal.
513	529	16	Clay: sandy, grey, with rare coal.
529	553	24	Clay: sandy, dark grey, sticky, micaceous, with rare coal and pyrite.
553	603	50	Sandstone: quartz, unconsolidated, coarse grained with some very coarse grained and fine grained, with felspar and ilmenite, thin beds of light grey clay.

SAMPLE LOG (Continued)

From (feet)	To (feet)	Thickness (feet)	Lithology
603	610	7	Clay: sandy, khaki coloured, micaceous, with rare ilmenite.
610	618	8	Clay: grey, sticky.
618	619	1	Sandstone: quartz, clean, unconsolidated, very coarse to granular, felspathic, with ilmenite. Some pebbles.
619	630	11	Clay: sandy, khaki coloured, sticky.
630	640	10	Clay: dark grey, dense.
640	656	16	Sandstone: quartz, clayey, very coarse grained, pebbly, with blue clay matrix. Thin beds of green silty clay and brown micaceous clay.
656	657	1	Boulder: quartzite, grey, hard.
657	670	13	Clay: sandy, dark grey with rare pyrite, very rare mica and ilmenite.
670	680	10	Sandstone: quartz, clayey, grey, coarse grained
680	700	20	Clay: sandy, grey.
700	750	50	Sandstone: quartz, clayey, grey.
750	770	20	Clay: sandy, light green colour.
770	830	60	Sandstone: quartz, clayey in part, grey, coarse grained, felspathic.
830	837	7	Clay: sandy, khaki coloured.
837	880	43	Sandstone: quartz, clayey in part, medium to coarse grained.
880	885	5	Clay: sandy, light green colour.
885	944	59	Sandstone: quartz, clayey in part, coarse grained.
944	947	3	Clay: blue and dark grey colour.
947	968	21	Sandstone: quartz, coarse grained.
968	980	12	Clay: sandy, green.
980	1000	20	Sandstone: quartz, coarse grained, some fine grained, slightly felspathic.

Stratigraphy

Recent sands and sandstones containing shells and calcareous fragments extend from the surface to 34 feet. They are dune sands and beach deposits, and overlie clays of probable Mesozoic age. (no age determination above 140 feet).

The sediments below 140 feet are of Mesozoic age and form part of the Capel River Group, which consists of continental deposits correlated with the Yarragadee Formation of the northern part of the basin and the South Perth Formation and Claremont Sandstone of the Perth area. No correlation between the section penetrated and the formations of the Capel River Group is attempted here, although McWhae and others (1958) suggest that the no.5 bore at Busselton (Saint-Smith,1912) intersected the Blackwood Shale.

Palynological examinations indicate Lower Cretaceous age for the sequence in this bore. The spores of stratigraphic importance in a sample from 140 feet are reported by Balme (1962) to occur also "in the Birdrong Formation, in beds immediately underlying the Osborne Formation in the Gingin area, in the upper part of the South Perth Formation, and in sediments from the upper 500 feet or so of the Laporte Bores, Australind". Examination of samples from 140, 150, and 970 feet by Edgell (see Appendices 1 and 2) showed that the sequence below 140 feet is wholly of Lower Cretaceous age, although the sample from 970 feet contained only a sparse microflora.

No Jurassic sediments were found in this bore although they occur below those of Lower Cretaceous age in the Abba River and Laporte (Australind) bores.

HYDROLOGY

The water table in February,1962, stood at 4 feet below ground level at the drill site. In the winter it rises almost to the surface.

Pressure water was struck in the bore at the following depths:

170 feet to 200 feet

Sub-artesian water with static water level 12 feet below ground level. Salinity 9,640 p.p.m. (675 gr/gall.) sodium chloride.

317 feet to 321 feet

A flow of approximately 6,000 gallons per hour from a thin bed of coarse grained loose sandstone. Salinity approximately 290 p.p.m. (20 gr/gall.) sodium chloride.

553 feet to 619 feet

A flow of approximately 14,000 g.p.h. from coarse grained sandstones with interbedded clays. Pump tested for 48 hours at 24,000 g.p.h. with a drawdown of 43 feet below the static water level of 27 feet above ground level. This water contains 190 p.p.m. (13 gr/gall.) total dissolved solids; the complete chemical analysis is given in Appendix 3.

750 feet to 1,000 feet

A flow of approximately 20,000 g.p.h. from sandstones with interbedded clays. More accurate location of aquifers was not possible because the hole was filled with drilling mud while this interval was drilled (the whole interval is cased with 5 inch casing, 9 lengths perforated, 4 lengths slotted). It was pump tested for 48 hours at 35,000 g.p.h. with a drawdown of 47 feet below the static water level of 28 feet above ground level. Calculations have shown that after 6 months' continuous pumping at 35,000 g.p.h. the drawdown would be 48 feet. As the maximum possible drawdown with a centrifugal pump is 25 feet below ground level (53 feet below static water

level in this bore) the maximum permissible output from this bore with a centrifugal pump is 38,500 g.p.h. These results, however, assume that the aquifer is laterally extensive, but it is possible that the 48 hour pump test was not long enough to indicate whether this is so. If the aquifer is actually of limited extent, the drawdown would increase at a greater rate over a long period of time.

The complete chemical analysis of the water from this interval is given in Appendix 3. The water contains 272 p.p.m. (19 gr/gall.) total dissolved solids, a little more than that from the 553 feet to 619 feet aquifer. However, the increased total dissolved solids content is due to higher bicarbonate content, while the chloride content is almost exactly the same. The deeper water is of excellent quality, and its salinity will probably not be affected by continued pumping.

Only water from the interval 750 feet to 1,000 feet is being used in the completed bore.

CONCLUSIONS

The results show that large supplies of excellent quality water are available from aquifers deeper than those at present utilised for the Busselton water supply. It is likely that deep bores in other parts of the town would be successful.

REFERENCES

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APPENDIX 1.

RECORD OF PALAEONTOLOGICAL EXAMINATION NO.4a/1962

by H. S. Edgell

Several shallow samples from the Busselton Milne St. Bore have been examined at the request of the Hydrology Division for palaeontological evidence of age.

These cable-tool samples consisted of light grey, slightly calcareous, silty sandstone and were from depths of 140' and 150' respectively. They were observed to contain Foraminifera, particularly Marginopora by the well-site geologist R. Passmore. The presence of this genus would indicate a Late Tertiary or Quaternary age. A palaeontological check on the samples was made, therefore, to determine whether such an unusual thickness of post-Cretaceous sediments exists in this well.

METHOD OF SAMPLE PREPARATION

For examination by standard micropalaeontological methods the samples were washed through a 200 mesh sieve to remove argillaceous material. The washed residue was then dried and microfossils separated from the sample by flotation with carbon tetrachloride and subsequent filtration. By this method microfaunas with frequent Foraminifera were recovered from both samples.

In view of the significant amount of carbonaceous material in the samples, which is rare in fully marine foraminiferal environments, an independent check on their age was made by palynological methods. This consisted essentially of boiling the sample successively in hydrochloric and hydrofluoric acids and macerating the residue with Schulze's solution. After final staining and mounting good spore assemblages were obtained.

MICROFAUNAL DETERMINATIONS

The following identifications were made from microfaunal assemblages recovered from the Busselton Shire Council Milne St. Bore:

A. 140 ft. depth.

Foraminifera

Amphistegina lessonii d' Orbigny (v r)
Cibicides cf. lobatulus (Walker & Jacob) (f)
Cibicides refulgens Montfort (f)
Discorbis dimidiatus (Parker and Jones) (f)
Elphidium macellum (Fichtel and Moll) (f)
Globigerina sp. (v r)
Marginopora vertebralis Blainville (r)
Quinqueloculina cf. granulicostata Germeraad (v r)
Quinqueloculina cf. seminulum (Linnaeus) (r)
Rosalina vilardeboana d'Orbigny (r)
Sphaeroidinella rutschi Cushman and Renz (v r)
Spiroloculina communis Cushman and Todd (v r)
Textularia cf. sagittula Defrance (v r)
Triloculina trigonula Lamarck (r)

Bryozoa

Tervia sp. (v r)
? Selenaria sp. (v r)

Gastropoda

Nassa sp. (r)

B. 150 ft. depth

Foraminifera

Angulogerina sp. aff. angulosa (Williamson) (v r)
Bolivina sp. (v r)
Cibicides refulgens Montfort (f)
Cibicides lobatulus (Walker and Jacob) (f)
Discorbir dimidiatus (Parker and Jones) (f)

Dyocibicides primitiva Vella (v r)

?Elphidiella sp. (v r)

Elphidium macellum (Fichtel and Moll) (f)

Globigerina eggeri Rhumbler (v r)

Globorotalia cf. punctulata (d'Orbigny) (v r)

Pileolina australensis Heron-Allen and Earland (r)

Quinqueloculina bradyana Cushman (f)

Quinqueloculina seminulum (Linnaeus) (f)

Quinqueloculina venusta Karrer (r)

Rectobolivina bifrons (Brady) (v r)

Reussella simplex (Cushman) (v r)

Rosalina paupereques Vella (v r)

Sphaeroidinella rutschi Cushman and Renz (v r)

Textularia cf. sagittula Defrance (r)

Triloculina terquemiana Brady (r to f)

Triloculina trigonula Lamarck (r)

Vertebralina striata d'Orbigny (r)

Porifera

triact sponge spicule (v r)

Gastropoda

juvenile gastropoda indet. (r)

Ostracoda

Cytheropteron sp. (v r)

The Foraminifera identified from these samples are clearly of Quaternary to Recent age. There is a predominance of forms known in present-day assemblages and the ranges of many of these do not extend back into the Tertiary.

MICROFLORAL DETERMINATIONS

Through the courtesy of the Department of Geology, University of Western Australia, laboratory facilities were made available for the maceration of these samples for palynological study.

One sample from a depth of 150 ft. in the Busselton Shire Council Milne St. Bore was treated and examined.

The microfloral assemblage from this sample contained the following spores:-

150 ft. depth

Acanthotriletes levidensis Balme	(v r)
Araucariacites australis Cookson	(r)
Cyathidites crassiangulatus Balme	(f)
Lycopodium austroclavatidites Cookson	(r)
Pityosporites cf. grandis Cookson	(v r)
Zonalisporites acusus Balme	(v r)
bisaccate spores indet.	(f)
dinoflagellate gen. and sp. indet.	(v r)

The spores identified from the above sample constitute a definite Cretaceous assemblage and, in view of the absence of pollen grains, suggest assignment to the Lower Cretaceous in the higher Neocomian or Aptian.

CONCLUSION

Although the samples from 140 ft. and 150 ft. in the Busselton Milne St. Bore contain good foraminiferal assemblages of Quaternary age, it appears that these are due to contamination from higher levels. Both samples have a high content of carbonaceous fragments uncommon in marine sediments and palynological examination shows that they are paralic sediments of Lower Cretaceous age and hence within the Capel River Group.

APPENDIX 2.

RECORD OF PALAEONTOLOGICAL EXAMINATION NO.4b/1962.

by H. S. Edgell.

Material: Cable-tool sample from Busselton, Milne Street Bore at a depth of 970 feet. Lithology predominantly silty sandstone.

Locality: Busselton, Milne Street Bore; Perth Basin.

Submitted by: R. Passmore.

Date submitted: 23rd July, 1962.

Information required: Geological age of sample and microfloral assemblage.

Date information supplied: 31st July, 1962.

PALAEONTOLOGICAL IDENTIFICATIONS

Maceration of this sandy sample revealed a sparse assemblage of spores and pollen grains. These are listed below with an indication of their frequency:

Busselton, Milne Street Bore.

Depth 970 feet.

Pollen:

Araucariacites australis Cookson (v r)

Entylissa nitidus Balme (v r)

Microcachrydites antarcticus Cookson (v r)

Pityosporites grandis Cookson (r)

Myrtaceidites eucalyptoides Cookson & Pike (r)

Spores:

Cyathidites crassiangulatus Balme (r)

Gleichenia cf. *cercinidites* Cookson (v r)

Ischyosporites crateris Balme (v r)

Osmundacidites comaumensis (Cookson) (v r)

Microplankton:

Pareodina aphelia Cookson and Eisenack

CONCLUSIONS

This is the lowest sample from the Busselton Milne Street Bore. It contains a sparse microflora of general Lower Cretaceous aspect corresponding with Microflora II b of Balme (1957). The species of this assemblage are long ranging forms and it is mostly on the absence of Zonalapollenites dampieri that a Jurassic age is excluded.

Due to sample contamination or caving from Quaternary deposits, a number of modern myrtaceous pollen are present particularly Myrtaceidites eucalyptoides.

APPENDIX 3.

WATER ANALYSES by Government Chemical Laboratories.

Water Cut	550' - 620'	750' - 1,000'
Date Collected	24/4/62	18/8/62
Conditions	After 48 hour pump test	After 48 hour pump test
Reaction	Neutral	Neutral
pH	6.6	7.6
Specific Conductivity (Micromhos at 20°C.)	N.D.	416
Mineral Matter (p.p.m.)		
Calcium, Ca	9	44
Magnesium, Mg.	7	7
Sodium, Na	39	37
Potassium, K.	15	14
Bicarbonate, HCO_3	82	181
Carbonate, CO_3	nil	nil
Sulphate, SO_4	11	12
Chloride, Cl	55	54
Nitrate, NO_3	Less than 1	0.2
Silica, SiO_2	N.D.	12
Iron, Fe	0.1	0.1
Total (by summation)	218	361
Total (by evaporation)	190	272
Assumed Combination on Evaporation at N.T.P.		
Calcium carbonate, $CaCO_3$	N.D.	110
Magnesium carbonate, $MgCO_3$	"	24
Sodium carbonate, Na_2CO_3	"	10
Calcium sulphate, $CaSO_4$	"	nil
Magnesium sulphate, $MgSO_4$	"	nil
Sodium sulphate, Na_2SO_4	"	18

Assumed Combination on Evaporation at N.T.P. (Continued)

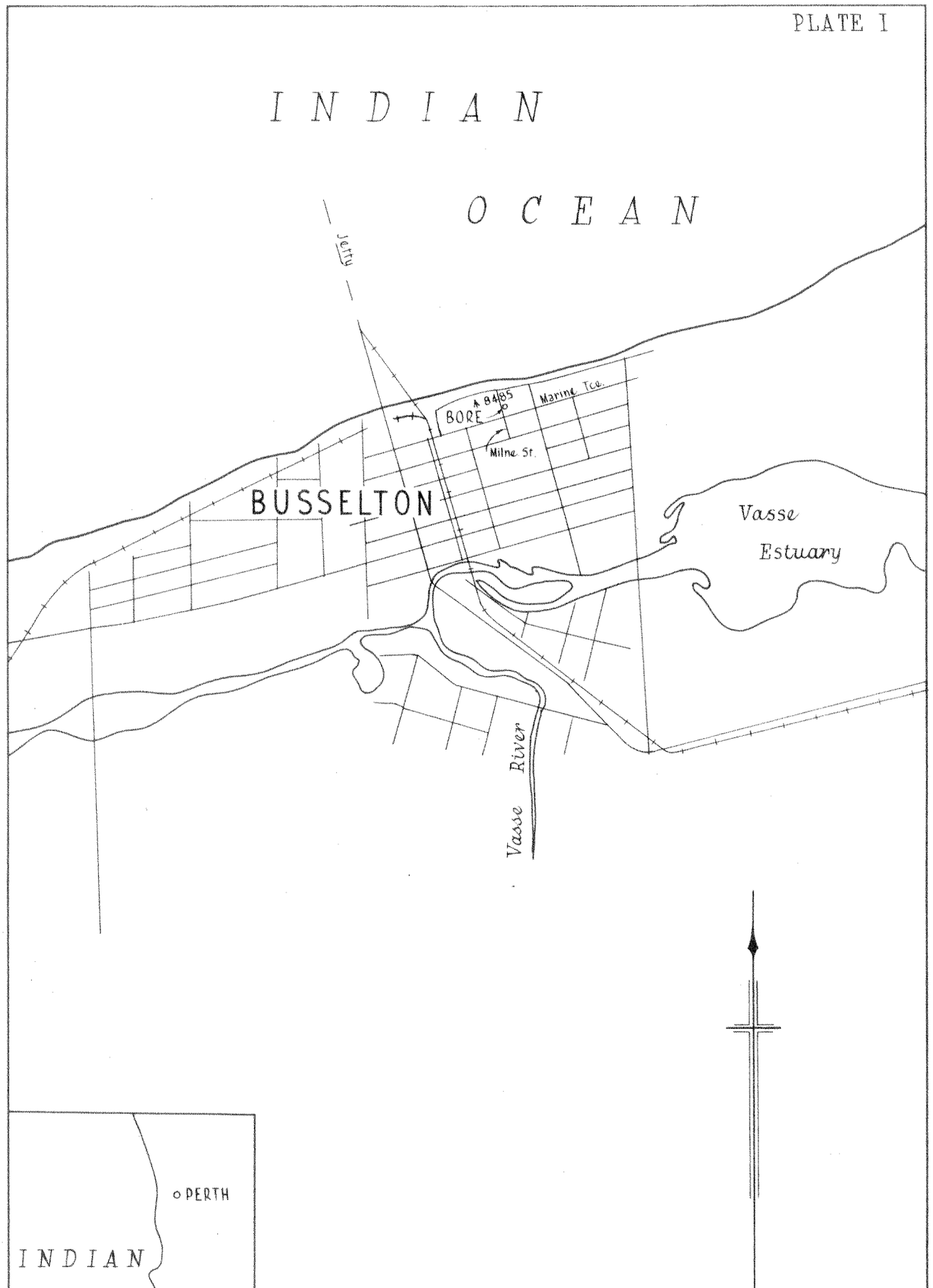
Magnesium chloride, $MgCl_2$	N.D.	nil.
Potassium chloride, KCl	"	27
Sodium chloride, NaCl	"	68
Sodium nitrate, $NaNO_3$	"	nil

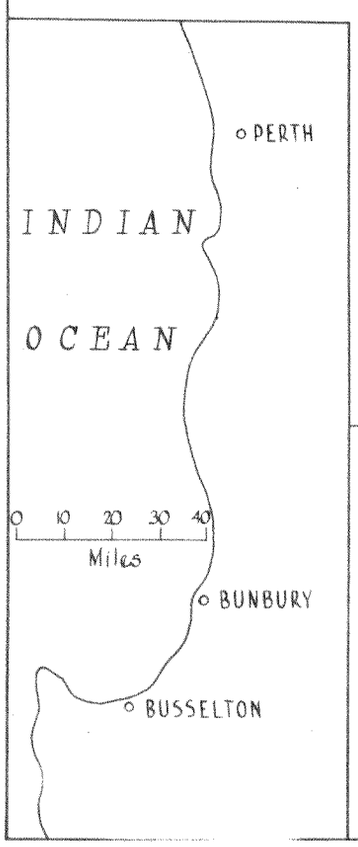
Hardness Calculated as Calcium Carbonate

Total hardness	51	139
Bicarbonate (temporary) hardness	51	139
Non-carbonate (permanent) "	nil	nil
Calcium hardness	22	110
Magnesium hardness	29	29

N.D. denotes not determined.

PLATE I





GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

LOCALITY PLAN

BUSSELTON SHIRE COUNCIL WATER BORE

MILNE ST BUSSELTON

Scale: ½ mile to 1 inch

Chains 0 10 20 30 40 Chains