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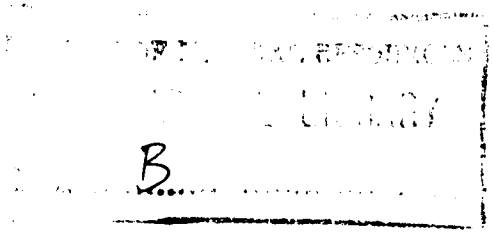
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DEPARTMENT OF NATIONAL DEVELOPMENT
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REVIEW OF AVAILABLE GROUNDWATER DATA ON THE GREAT ARTESIAN BASIN

by

G.W. Hahn and N.H. Fisher.

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REVIEW OF AVAILABLE GROUNDWATER DATA
OF THE GREAT ARTESIAN BASIN

by

G. W. Hahn & N. H. Fisher

SUMMARY

The purposes of this paper are to assess the availability, completeness, and usefulness of groundwater data from the Great Artesian Basin and to suggest means of overcoming any deficiencies in these data. The data are of two kinds: Basic, comprising primary facts, and interpretive, comprising inductions and conclusions from these facts.

Basic data include information from geological surveys, water bores, wells, oil bores, and geophysical investigations.

Water-bore data are deficient from the stand-points of areal distribution, for few bores occur in the northern and western parts of the basin; and of completeness, for elevations, chemical analyses, and detailed logs are not everywhere available. These deficiencies may be remedied by installing bores for scientific purposes and by revisiting selected, existing bores to take measurements and samples or to perform electric or gamma-ray logging. Bore data are also deficient in records of periodic measurements of water levels and artesian pressures; although pressures are measured in some bores, areal coverage should be improved to about one measuring point for every 500 square miles and the frequency of measurement should be increased to semiannual.

Oil-bore and geophysical data, especially that which meets the requirements of the Petroleum Search Subsidy Acts in completeness, are generally very useful in defining basin stratigraphy and also include significant hydrologic information.

The greater part of these basic data is available at three agencies: the Australian Bureau of Mineral Resources, the Queensland Irrigation and Water Supply Commission, and the New South Wales Water Conservation and Irrigation Commission. Complete data are not available at any single place, however, and, because filing systems are both diverse and complex, data are not readily accessible. It is suggested, therefore, that punched-card systems for filing basic data be adopted and that water level and pressure data, because of their current importance and broad usefulness, be published periodically.

Interpretive data are generally recorded in reports of four types: generalized reports, which briefly introduce the hydrology and geology of the basin; stratigraphic reports, which correlate water-bearing strata across the basin; reconnaissance reports, which relate the occurrence, quality, and yield of groundwater to stratigraphy and rock type; and comprehensive reports, which, in addition to these analyses, attempt a quantitative assessment of groundwater resources in parts of the basin.

There is a need for a series of new interpretive reports, based on studies of the accumulated basic data of the last decade and of the more modern methods of groundwater assessment.

One such study should revise the present interpretations of basin stratigraphy and point out areas where data are too sparse or inaccurate to permit effective interpretation. Another should attempt to assess unconfined groundwater resources in the basin and to determine recharge and discharge relationships among unconfined, perched, locally confined, and regionally confined groundwaters. A third report, or series of reports, should attempt to define the hydrologic properties of the water-bearing materials of the basin in terms of coefficients of transmissibility and permeability and of specific yield. A fourth report should make a basin-wide assessment of quality of water data and relate quality to aquifers and regions. Finally, a comprehensive hydrological report should co-ordinate the results of these investigations with climatological and surface-water data to define recharge, movement, discharge or withdrawal, water quality, and future development for the various confined and unconfined aquifers of the basin.

INTRODUCTION

In this paper a brief survey is made of the groundwater data that are available on the Great Artesian Basin and some suggestions are made for further work to overcome deficiencies in our knowledge of the Basin.

The paper deals only with groundwater data and associated geological data. "Groundwater" is used here as the equivalent of underground water and therefore comprises both unconfined and pressure waters. Meteorological and surface-water data, however important they may be in the appraisal of groundwater resources, are not described.

This assessment of the data is based generally on that held at the Bureau of Mineral Resources, and that described in reviews prepared by State water agencies and presented at the second annual meeting (May, 1962) of the Underground Water Conference of Australia, or received in reply to a questionnaire on underground water assessment, prepared and issued by a committee of the same conference in August, 1962.

Data are of two kinds: basic and interpretive. Basic data are primary facts, as measured or collected in the field or as transcribed from earlier records. These data may be collated or otherwise rendered more understandable, and still remain "basic". Interpretive data, on the other hand, consist of the conclusions or inductions derived from these primary facts. Some geological reports, which as a whole are indisputably interpretive, are here described as basic data, because their groundwater portions include only basic data or because interpretations of groundwater data are only rudimentary.

Because groundwater is a subsurface resource, its basic data are largely derived from bores, wells, or other subsurface explorations. Sources of basic groundwater data in the Great Artesian Basin include information gained from water bores and wells, from oil bores (here defined as comprising both oil wells and scout bores), and from geophysical investigations, as well as from surface geological mapping. The parts of the Great Artesian Basin that have been systematically mapped to modern standards with the use of air photographs and properly prepared base maps at scales of 1:250,000 or larger and of which printed maps for distribution are available at the Bureau of Mineral Resources or State Geological Surveys are shown on Plate 1.

BASIC DATA

Water Bore and Well Data

There are about 18,000 recorded water bores in the Great Artesian Basin; in the Queensland part alone there are about 12,000 recorded bores and in the New South Wales part, about 3,000 bores. About one fifth of these bores are artesian and slightly more than half of these are still flowing. Bores, and therefore data, are unevenly distributed over the area of the basin. Almost half of the basin, including the northern tip and the western part, has less than one bore per hundred square miles (Plate 2). Accordingly, data are relative deficient in these areas, and in many of them it seems that additional data must be gained from bores installed primarily for scientific purposes.

Basic data available for these water bores generally include locations, depths, flows or yields, and a brief log of materials encountered.

The logs vary over a wide range of detail and reliability. In a part of the Basin mapped by the Bureau of Mineral Resources in North-western Queensland it is estimated that locations were recorded correctly for about 50 per cent of the bores, elevations available for 45 per cent, the capacity of artesian bores and the original water level in non-artesian bores was known for about 80 per cent, but in less than 20 per cent had later water level measurements been recorded. Analyses were available for about half the bores, logs for about 40 per cent, temperatures for about 30 per cent, electric logs were entirely lacking, likewise records of gas content or conductivity. Locality data are better for older bores, logs and analyses commoner for more recent bores.

Over the whole of the Queensland part of the basin, elevations are available for only about one fifth of the bores, generally for the older artesian bores (about three fourths of the artesian bores have been levelled). Elevations are available for only about one tenth of the bores in the New South Wales part of the basin. Chemical analyses of water samples have been made for almost two fifths of the bores in the Queensland part (for about three fourths of the artesian bores) and for about half of the bores in the New South Wales part. Pressures have been measured, some periodically, in many artesian bores. Where required, these data may be completed at a relatively low cost of money and time by measurements and samples collections at existing bores.

However, there is a serious lack of detailed bore logs, and knowledge of the continuity of aquifers and their water-bearing characteristics is limited as a result. A partial solution to this problem would be a programme of electric logging for uncased bores and gamma-ray logging for cased bores. Since 1960, a programme of gamma-ray logging in existing bores, co-ordinated with temperature logging, has been carried out in Queensland by the Bureau of Mineral Resources in co-operation with the Queensland Irrigation and Water Supply Commission. Positive correlation of formations by means of their radioactivity has already been established and demonstrates the value of expanding this programme to cover the entire Basin.

Partly because of a scarcity of coarse-grained, water-bearing surficial deposits and partly because of a concentration of development and study upon artesian aquifers, few data are

available on the occurrence of unconfined groundwater in the Great Artesian Basin. Data on depths to water, well yields, water quality and the nature of the water-bearing materials, should be collected and collated if only to support negative conclusions as to these resources. Some of these data are available, but more-or-less hidden, in the records of bores.

Another serious deficiency in groundwater data is of records of relatively frequent and comparable measurements of water levels and artesian pressures. Such measurements, taken in a series of representative observation bores tapping confined aquifers, would define the response of parts of the artesian system to short-term and long-term changes in recharge and discharge. At present, the Queensland Irrigation and Water Supply Commission measures pressures in a series of bores at annual or longer intervals and the New South Wales Water Conservation and Irrigation Commission gauges about 600 observation bores annually or biennially, depending upon their respective magnitudes of flow. However, for the most useful regional picture, measurements should be at least semiannual (summer and winter).

Measurements of the semiannual frequency would be impracticable under the present methods of gauging, which require a full day to measure the pressure at a single bore. Measurements of water levels in representative sub-artesian bores would provide data of the same significance and would require only minutes to perform. Measurements in key artesian bores could be continued by measuring water levels in casings extended above the level of artesian head. If these bores were to remain in use, a 'tee' and valve on the side of the extended casing would permit the bore to flow between measurements. Valves for a series of bores could be closed on a particular day, and the water levels measured (and the valves reopened) on the succeeding day. Flow could be checked rapidly by a manometer and orifice (permanently installed and suitably protected) prior to the water-level measuring sequence.

Similar measurements in representative bores or wells tapping unconfined groundwater would supply knowledge or recharge to unconfined aquifers and, in intake areas, to the artesian aquifers as well.

A minimum network of observation bores in the Great Artesian Basin would comprise a relatively even areal distribution of about 1,400 bores, or approximately one measuring point for every 500 square miles. Probably the majority of these should tap confined aquifers. Selection of the members of such a network should be based on the latest stratigraphic knowledge, in order to provide representation in depth as well as in area. Also, a programme of semiannual measurements in 1,400 widely-spaced bores could well make use of co-operative bore owners, who would measure levels or pressures in their own bores and transmit the data by post to the proper agency.

Oil-Bore and Geophysical Data

An extremely valuable contribution to the knowledge of Great Artesian Basin stratigraphy has been made by companies engaged in petroleum exploration. The data from these sources, some of it confidential as yet, include the results of more than 100 seismic (Plate 3), gravity (Plate 4), and aeromagnetic surveys (Plate 5) and the records of about 270 oil bores (as of the end of April 1963). The oil bores, however, are not uniformly distributed and tend naturally to be concentrated in the areas of most interest for oil search, namely in South-

eastern Queensland. About three fifths of the oil bores and essentially all of the geophysical investigations have been completed in the last decade. The records, particularly those meeting the requirements of the Petroleum Search Subsidy Acts, are generally excellent.

Oil bore data include locations, depths, elevations, lithologic logs, electric logs, radiometric logs, water yields and pressures, water analyses, porosities, and permeabilities. The detailed logs, in addition to defining lithology at the bore sites, are keys to the interpretation of less-complete, water-bore logs and thus form a framework for the stratigraphic correlation of aquifers. Although not numerous, the values for porosity and permeability can serve as a nucleus of comparable data from which a quantitative investigation of aquifer characteristics may proceed.

Geophysical data comprise contour maps of important stratigraphic surfaces, and cross sections correlating geophysically distinctive units in some cases over considerable areas. Both forms of data are useful in tracing the continuity of aquifers in the basin.

Accessibility of data

A comprehensive listing of the basic data described above, together with their repositories or references, is given in Table 1. An examination of this table shows that the greatest mass of basic data is in the form of files at three agencies: the Australian Bureau of Mineral Resources (also the repository for a number of unpublished reports containing basic data), the Queensland Irrigation and Water Supply Commission, and the New South Wales Water Conservation and Irrigation Commission. The South Australian Department of Mines and the Water Resources Branch of the Northern Territory Administration file much smaller amounts of basic data on the Great Artesian Basin, the Queensland and New South Wales Departments of Mines file petroleum exploration data and water bore data. Published basic data are few, but some have recently become available in the Petroleum Search Subsidy Acts publications of the Bureau of Mineral Resources. Some basic data are published in interpretive reports.

In general, these data are not readily accessible, because they occur in widely separated places and under diverse filing systems. Increased accessibility may be gained through publication, but because of the large quantities of data and the difficulties of their preparation for publication, this is an expensive and time-consuming method. A better method is to increase the efficiency of the files by the adoption of relatively uniform punched-cards systems, including an inexpensive means of reproducing cards for transmittal between interested parties. This solution has been recognised by the various agencies and is being implemented in the Bureau of Mineral Resources.

However, data relating to changes in water levels and artesian pressures; because they have both current and lasting importance and may be applied widely to problems in agriculture, engineering, forestry, sanitation, and water supply; should be published at relatively short intervals. A scheme for the collection of such data was outlined briefly in a preceding section of this paper (p. 6). Publication of these data could follow the pattern of the U.S. Geological Survey Water Supply Paper series entitled: "Water Levels and Artesian Pressures in Observation Wells in the United States". The periodicity of publication should not exceed five years and might better be two years.

INTERPRETIVE DATA

A comprehensive list of interpretive data available on the Great Artesian Basin is given in Table 1. Study areas smaller than the entire basin or than State portions of it are shown in plate 6. Most of these data are in the form of published or unpublished reports.

Existing Reports

Interpretive reports on the Great Artesian Basin, with few exceptions, fall into four classes: generalised reports, stratigraphic reports, reconnaissance reports, and comprehensive reports.

The generalised reports are useful introductions to the hydrology and geology of the basin, but are too brief and undetailed to be of service from the standpoint of groundwater development. The best of these are by Ward (1946) and David (1950), (Table 1).

Stratigraphic reports are concerned primarily with the correlation of geologic strata across the basin, but some reports also attempt to relate the occurrence and quality of groundwater to specific strata. However, many of the stratigraphic interpretations need to be revised in the light of the results of petroleum exploration. The recent, unpublished reports by Tissot (1961 and 1962, Table 1), although limited in scope, provide examples of a more modern approach to correlation.

The reports of reconnaissance investigations by Jack (1925) and Kenny (1934) go further in relating the occurrence and quality of groundwater to stratigraphy and rock type. They also make some attempt toward defining the quantities of water available from their study areas. These are excellent primary hydrologic reports, handicapped only by the lack of basic data.

Comprehensive reports generally include a fairly detailed description of the geology of the basin and a quantitative examination of its hydrology. Going beyond generalised statements as to where and at what depths groundwater occurs, these reports attempt to define how much water is available, from what source it is derived, how and at what rate it moves, what happens as it is used, and how it can best be developed. Old, but still informative, comprehensive reports are those of the Interstate Conference on Artesian Water and the unpublished interim reports of the New South Wales Water Conservation and Irrigation Commission (1912 to 1928 and 1939 to 1940, respectively, Table 1). Most recent and of most significance, however, is the report on the Queensland portion of the basin by Whitehouse, Ogilvie, et al. (1954).

Suggested Reports

The foremost, and most obvious, limitation of all of these existing reports is their age. Large quantities of basic data have been collected, although possibly not analysed, since their publication. Newer methods of analysis have been introduced and older methods have been refined since even the most recent of the comprehensive reports. There is a need, therefore, for a series of new interpretive reports, which will take advantage of the more abundant and more accurate basic data and of the more modern approaches of groundwater assessment.

A basin-wide progress report on stratigraphy is required. The report should take advantage of oil-bore data, palaeontological, particularly palynological correlations, gamma-ray logging,

and information gained from seismic and gravity surveys. Its objectives should be (1) revision of the interpretation of basin stratigraphy, and (2) indication of areas where bore logs are too sparse or inaccurate to permit effective interpretation. Such a report might be done by subdividing the basin, and compiling for each part maps showing, by means of colours and hachures, the surface and subsurface extents of various aquifers. Marginal cross sections, with diagrammatic logs of representative data, would clarify stratigraphic relationships at depth; the text could be very abbreviated.

A second report should be based on studies of the unconfined groundwater of the Great Artesian Basin. It must be granted that, due to fine-grained source rocks and low gradients, most alluvium in the basin is fine grained, poorly sorted, and hence a poor water-bearing material; furthermore, that deep water tables often make unconfined groundwater an uneconomic resource. Nevertheless, areas in the vicinity of coarser-grained outcrops or steeper gradients should be investigated more thoroughly than has been done in the past. These investigations, particularly in intake areas, should quantitatively assess recharge and discharge relationships among unconfined, perched, locally confined, and regionally confined groundwaters.

Thirdly, studies should be made of the hydrological properties of the water-bearing materials of the basin, and the results of these studies should be made available in a series of progress reports. It is common knowledge that ordinary geological descriptions of materials, however detailed, are inadequate for estimating hydrological properties. Quantitative descriptions of materials, based on laboratory determinations (particle-size analysis, porosity, permeability, etc.), are better, but are liable to serious errors arising from sample collection and preparation. Most reliable estimations of transmissibility, permeability, and specific yield are gained through controlled pumping tests on properly constructed and screened bores. Estimates of the coefficient of transmissibility have been based on pressure data from existing bores, but their accuracy must be questioned. Generally, these values seem much too low, which may be expected from the inefficiency of slotted casings and the imperfect development of the bores. In other words, the transmissibility of a particular bore-aquifer combination is being estimated, not the transmissibility of the aquifer. Furthermore, there is little or no knowledge as to the relative transmissibilities of individual strata. However, with some data from pumping tests serving as controls, estimations from pressure tests could be more useful.

Fourthly, quality of water data should be analysed in a basin-wide report which relates, as much as possible, quality to aquifer and region.

Finally, a comprehensive hydrological report on the Great Artesian Basin should be prepared. This report should co-ordinate the results of the above-mentioned investigations with data on water levels and pressures, precipitation, and streamflow (particularly net flow across intake areas) to provide an appraisal of: (1) how much water is recharged to various confined and unconfined aquifers; (2) in what directions and at what rates these waters move; (3) where, from what aquifers, and at what rates groundwater may be withdrawn or discharged as flow; (4) the range in water quality for each aquifer and area; and (5) what future groundwater development should be permitted and what the consequences of such development will be.

TABLE I - GROUNDWATER DATA ON THE GREAT ARTESIAN BASIN

(Numbers refer to areas or localities on Plate 6)

State or Territory	Kind of Data		Status	Repository or Reference
Entire Basin	Basic	Petroleum exploration: discussion, map of bore locations, bore depths.	Published	Australian Bureau of Mineral Resources, 1960 - Summary of oil-search activities in Australia and New Guinea to June, 1959. <u>Aust.Bur.Min.Res.</u> , Rep. 41a, Canberra.
"	"	Oil-bore progress reports: locations, depths, electric and radiometric logs, core samples.	Files	Australian Bureau of Mineral Resources, Canberra.
"	"	Oil-bore reports: discussions, locations, depths, elevations, lithologic logs, electric logs, radiometric logs, water yields and pressures, porosities, permeabilities, water analyses, geophysical data.	Unpub. reports	Subsidized petroleum exploration companies' well completion reports. <u>Aust.Bur.Min.Res.</u> , Canberra.
"	Inter-pretive	Generalized: discussion, maps, cross sections, brief table of water analyses.	Published	David, T.W.E., 1950 - Geology of the Commonwealth of Australia, vol. 2, p. 518-539. Edward Arnold and Co., London.
"	"	Generalized: discussion, map.	"	Ward, L.K., 1950 - Underground water in Australia, Australian artesian basins - the Great Artesian Basin. Chem. Engr. and Mining Review, vol. 43, no. 3, p. 97-107.
"	"	Stratigraphic: discussion, maps, cross sections, tables of oil-bore data, composite logs.	Unpub. report	Tissot, B., 1961 - The Great Artesian Basin. Institut Francais du Petrole, Mission in Australia, Sedimentary Basins Study Group, First progress report, AUS/25, Canberra.
"	"	Comprehensive: discussions, maps, cross sections, tables of bore data and water analyses, bore logs, diagrams.	Published	Interstate Conference on Artesian Water - Reports of the Interstate Conference on Artesian Water. No. 1, Sydney, 1912; No. 2, Brisbane, 1914; No. 3, Adelaide, 1921; No. 4, Perth, 1924; No. 5, Sydney, 1928.
Queensland	Basic	Bore locations, depths, elevations, logs, yields, pressures, water analyses and temperatures.	Files	Queensland Irrigation and Water Supply Commission, Brisbane.
"	"	Discussion, map of oil-bore locations, cross sections, tables of bore data and water analyses, oil-bore logs.	Published	Geological Survey of Queensland, 1960 - Occurrence of petroleum and natural gas in Queensland. Qd. Dept. of Mines, Geol. Surv. Pub. no. 299, Brisbane.
"	"	Oil-bore reports: locations, depths, elevations, lithologic logs, electric logs, radiometric logs, water yields and pressures, porosities, permeabilities, water analyses, core samples.	Files	Queensland Department of Mines, Brisbane.
"	"	Bore locations, depths, elevations; some driller's logs and gamma-ray logs.	"	Australian Bureau of Mineral Resources, Canberra.
Queensland (No. 1)	"	Geology, bore locations, depths, logs, yields.	Unpub. Records	Reynolds, M.A., 1960 - Mesozoic and younger sediments of the Gilberton and Georgetown 4-mile sheet, and White, D.A., 1960 - Explanatory notes to the Georgetown 4-mile sheet. <u>Aust.Bur.Min.Res.</u> , Records 1960/68 and 1960/84, respectively, Canberra.
Queensland (No. 2)	"	" "	Unpub. Records	Carter, E.K., 1959 - Explanatory notes on the Dobbyn 4-mile geological sheet. <u>Aust.Bur.Min.Res.</u> , Records 1959/96, Canberra.
Queensland (No. 3)	"	" "	Unpub. Records	Reynolds, M.A., 1960 - Mesozoic and younger sediments of the Gilberton and Georgetown 4-mile sheet, and White, D.A., 1960 - Explanatory notes to the Gilberton 4-mile sheet. <u>Aust.Bur.Min.Res.</u> , Records 1960/68 and 1960/83, respectively, Canberra.
Queensland (No. 4)	"	Geology, bore locations, depths, logs, yields, seismic information.	Unpub. Records	Carter, E.K., 1959 - Explanatory notes on the Cloncurry 4-mile geological map, F54/2, and Mann, P.E., and Wiebenga, W.A., 1960 - Cloncurry geophysical survey for underground water, Qd., <u>Aust.Bur.Min.Res.</u> , Records 1959/95 and 1962/77, respectively, Canberra.

TABLE I - GROUNDWATER DATA ON THE GREAT ARTESIAN BASIN (CONTINUED)

State or Territory	Kind of Data		Status	Repository or References
Queensland (No. 5)	Basic	Geology, bore locations, depths, logs, yields.	Unpub. Records	Vine, R.R., and Jauncey, W., 1962 - Explanatory notes, Julia Creek sheet, Qd.; <u>Aust.Bur.Min.Res.</u> , Records 1962/81, Canberra.
Queensland (No. 6)	"	" "	"	Vine, R.R., and Jauncey, W., 1962 - Explanatory notes, McKinlay sheet, Qd.; <u>Aust.Bur.Min.Res.</u> , Records 1962/80, Canberra.
Queensland (No. 7)	"	" "	"	Cassey, J.N., and others, 1960 - The geology of the Boulia area, western Qd.; <u>Aust.Bur.Min.Res.</u> , Records 1960/12, Canberra.
Queensland (No. 8)	"	" "	"	Vine, R.R., 1962 - Explanatory notes, Mackunda sheet, Qd.; <u>Aust.Bur.Min.Res.</u> , Records 1962/70, Canberra.
Queensland (No. 9)	"	" "	"	Reynolds, M.A., 1960 - Geology of the Springvale 4-mile sheet area, Qd.; <u>Aust.Bur.Min.Res.</u> , Records 1960/92, Canberra.
Queensland (No. 10)	"	" "	"	Jauncey, W., 1962 - Explanatory notes, Brighton Downs sheet, Qd.; <u>Aust.Bur.Min.Res.</u> , Records 1962/79, Canberra.
Queensland (No. 11)	"	" "	"	Reynolds, M.A., Olgers, F., and Jauncey, W., 1961 - Geology of the Bedourie-Machattie-Birdsville-Betoota 4-mile sheet areas in western Qd.; <u>Aust. Bur. Min. Res.</u> , Records 1961/54, Canberra.
Queensland (No. 12)	"	" "	"	Olgers, F., 1961 - The geology of the Machattie 4-mile sheet area, Qd.; <u>Aust.Bur.Min.Res.</u> , Records 1961/61, Canberra.
Queensland (No. 13)	"	" "	"	Olgers, F., 1961 - The geology of the Birdsville 4-mile sheet area, Qd.; <u>Aust.Bur.Min.Res.</u> , Records 1961/62, Canberra.
Queensland (No. 14)	"	" "	"	Jauncey, W., 1961 - The geology of the Betoota 4-mile sheet area, western Qd.; <u>Aust.Bur.Min.Res.</u> , Records 1961/67, Canberra.
Queensland (No. 15)	"	Bore location, log, electric log.	"	Jesson, E.E., and Radeski, L., 1960 - Winton No. 2 bore logging, Qd.; <u>Aust.Bur.Min.Res.</u> , Records 1961/14, Canberra.
Queensland (No. 16)	"	Bore location, log, gamma-ray and temperature logs.	"	Jewell, F., and Jesson, E.E., 1960 - Mitchell no. 2 bore logging, Qd.; <u>Aust.Bur.Min.Res.</u> , Records 1961/15, Canberra.
Queensland (No. 17)	"	Discussion, map, detailed	Published	Associated Australian Oilfields N.L., 1960 - Karumba A.A.O. No. 8 bore, northern Queensland. <u>Aust.Bur.Min.Res.</u> , Petroleum Search Subsidy Acts, Pub. no. 2, Canberra.
Queensland (No. 18)	"	Discussion, contour maps.	"	Papuan Apinaipi Petroleum Company Limited, 1962 - Boulia Area gravity survey, Queensland, 1959. <u>Aust.Bur.Min.Res.</u> , Petroleum Search Subsidy Acts, Pub. no. 37, Canberra.
Queensland (No. 19)	"	" "	"	Magellan Petroleum Corporation, 1961 - North Winton gravity survey, Queensland, 1959. <u>Aust.Bur.Min.Res.</u> , Petroleum Search Subsidy Acts, Pub. no. 30, Canberra.
Queensland (No. 20)	"	Discussion, map, contour maps, cross sections, seismic data.	"	Artesian Basin Oil Company Proprietary Limited, 1962 - Muttaborra seismic survey, Queensland, 1959. <u>Aust.Bur.Min.Res.</u> , Petroleum Search Subsidy Acts, Pub. no. 32, Canberra.
Queensland (No. 21)	"	Discussion, maps, detailed composite log, water yield and pressure, porosities, water analyses.	"	Delhi-Frome-Santos, 1961 - D.F.S. No. 1 Betoota, Queensland. <u>Aust.Bur.Min.Res.</u> , Petroleum Search Subsidy Acts, Pub. no. 10, Canberra.
Queensland (No. 22)	"	Discussion, map, contour maps, cross sections, seismic data.	"	L.H. Smart Oil Exploration Company Limited, 1962 - Grey Range seismic survey, Queensland, 1959. <u>Aust.Bur.Min.Res.</u> , Petroleum Search Subsidy Acts, Pub. no. 29, Canberra.

TABLE I - GROUNDWATER DATA ON THE GREAT ARTESIAN BASIN (CONTINUED)

State or Territory	Kind of Data		Status	Repository or Reference
Queensland (No. 23)	Basic	Discussion, map, contour maps, cross sections, seismic data.	Published	Phillips Petroleum Company and Sunray Mid-Continent Oil Company, 1961 - Quilpie-Thargomindah-Charleville seismic survey, Queensland, 1959-1960. <u>Aust.Bur.Min.Res.</u> , Petroleum Search Subsidy Acts, Pub. no. 19, Canberra.
Queensland (No. 24)	"	"	"	Associated Australian Oilfields N.L., 1962 - South Roma seismic survey, Queensland, 1959. <u>Aust.Bur.Min.Res.</u> , Petroleum Search Subsidy Acts, Pub. no. 34, Canberra.
* Queensland (No. 47)	"	Discussion, maps, detailed composite log, water yield and pressure, porosities, water analyses.	"	Associated Australian Oilfields N.L.; Pickanjinie No. 1 Bore. <u>Aust.Bur.Min.Res.</u> , Petroleum Search Subsidy Acts, Pub. No. 22, Canberra.
Queensland (No. 24)	"	Discussion, map, contour maps, cross sections, seismic data.	"	Associated Australian Oilfields N.L.; East Roma Seismic Survey, Queensland, 1959-60. <u>Aust.Bur.Min.Res.</u> , Petroleum Search Subsidy Acts, Pub. no. 35, Canberra.
* Queensland (No. 39)	"	Discussion, maps, detailed composite log, water yield and pressure, porosities, water analyses.	"	Conorada Petroleum Corporation; Ooroonoo No. 1. <u>Aust.Bur.Min.Res.</u> Petroleum Search Subsidy Acts Pub. No. 23, Canberra.
Queensland (No. 40)	"	"	"	Magellan Petroleum Corporation; Corfield No. 1, Queensland. <u>Aust.Bur.Min.Res.</u> Petroleum Search Subsidy Acts. Pub. No. 26, Canberra.
* Queensland (No. 43)	"	"	"	Phillips Petroleum Co. and Sunray Mid-Continent Oil Co. 1963; Phillips-Sunray Buckabie No. 1, Queensland. <u>Aust.Bur.Min.Res.</u> Petroleum Search Subsidy Acts, Pub. No. 41, Canberra.
* Queensland (No. 44)	"	"	"	Union Oil Development Corporation, Kern County Land Company and Australian Oil and Gas Corporation Ltd; Union-Kern-A.O.G. 1963. Moonie No. 1. <u>Aust.Bur.Min.Res.</u> Petroleum Search Subsidy Acts. Pub. No. 45, Canberra.
* Queensland (No. 45)	"	"	"	Union Oil Development Corporation, Kern County Land Company and Australian Oil and Gas Corporation Ltd; Union-Kern-A.O.G. 1963. Cabawin No. 1 Queensland. <u>Aust.Bur.Min.Res.</u> Petroleum Search Subsidy Acts. Pub. No. 43, Canberra.
* Queensland (No. 45)	"	"	"	Union Oil Development Corporation, Kern County Land Company and Australian Oil and Gas Corporation Ltd; Union-Kern-A.O.G. 1963. Cabawin East No. 1. <u>Aust.Bur.Min.Res.</u> Petroleum Search Subsidy Acts. Pub. No. 44, Canberra.
Queensland (No. 49)	"	Discussion, maps, cross sections, seismic data.	"	Cree Oil of Canada Ltd.; Longreach - Silsac Seismic Survey, Queensland. <u>Aust.Bur.Min.Res.</u> Petroleum Search Subsidy Acts. Pub. No. 39, Canberra.
* Queensland (No. 41)	"	Discussion, contour maps, gravity data.	"	Magellan Petroleum Corporation, Tambo-Augathella Aeromagnetic and Gravity Surveys, Queensland 1959-60. <u>Aust.Bur.Min.Res.</u> Petroleum Search Subsidy Acts. Pub. No. 31, Canberra.
* Queensland (No. 46)	Inter-pretive	Geology, discussion, stratigraphic correlations.	"	Mack, J.E. Jr., (Union Oil Development Corporation) 1963; Reconnaissance Geology of the Surat Basin, Queensland and New South Wales. <u>Aust.Bur.Min.Res.</u> Petroleum Search Subsidy Acts. Pub. No. 40, Canberra.
Queensland (No. 25)	Basic	Discussion, map, contour maps, cross sections, seismic data.	"	Associated Australian Oilfields N.L., 1961 - Eumamurrin (North Roma) seismic survey, Queensland, 1959-1960. <u>Aust.Bur.Min.Res.</u> , Petroleum Search Subsidy Acts, Pub. No. 27, Canberra.

* In press,
1963

TABLE I - GROUNDWATER DATA ON THE GREAT ARTESIAN BASIN (CONTINUED)

State or Territory	Kind of Data		Status	Repository or Reference
Queensland (No. 26)	Inter-pretive	Stratigraphic: discussion, cross section, correlation table.	Unpub. report	Tissot, B., 1962a - The Permo-Triassic of the Bowen-Surat Basin. Institut Francais du Petrole, Mission in Australia, Sedimentary Basins Study Group, Progress report No. 2, AUS/35, Canberra.
Queensland (No. 26)	"	" "	"	Tissot, B., 1962b - Correlation of recent bores in the Roma area. <i>ibid.</i> Progress report No. 3, AUS/42, Canberra.
Queensland (No. 26)	"	" "	"	Tissot, B., 1963 - Correlations of the Jurassic and Middle-Upper Triassic in the Bowen-Surat Basin. <i>ibid.</i> Progress report No. 5, AUS/66, Canberra.
Queensland (No. 26)	"	Discussion, maps, cross sections, seismic data.	"	Schwing, E., 1963 - Bowen-Surat Basin Geophysical Compilation; Seismic reinterpretation; <i>ibid.</i> Progress report No. 6, AUS/67, Canberra.
Queensland (No. 48)	"	Stratigraphic subdivision and correlation.	Unpub. Records	Evans, P.R., 1962 - A revised Palynological report on S.P.L. No. 1 (Birkhead) Well, Great Artesian Basin, Queensland. <u>Aust.Bur.Min.Res.</u> , Records 1962/139, Canberra.
Queensland (No. 50)	"	" "	"	Evans, P.R., and Terpstra, G.R.J., 1962 - Palaeontological examination of samples from Delhi-Santos Mornington Island No. 1 Well, Carpentaria Basin, Queensland. <u>Aust.Bur.Min.Res.</u> , Records 1962/174.
Queensland	Inter-pretive	Comprehensive, brief: discussion, maps, cross sections, diagrams.	Published	Whitehouse, F.W., Ogilvie, C., et al., 1945 - First interim report on artesian water supplies in Queensland. Qd. Parl. Rep., Brisbane.
Queensland	"	Comprehensive: discussion, maps, cross sections, tables of data, diagrams.	"	Whitehouse, F.W., Ogilvie, C., et al., 1954 - Artesian water supplies in Queensland. Qd. Parl. Rep., Brisbane.
New South Wales	Basic	Bore locations, depths, elevations, logs, yields, pressures, water analyses, water temperatures, flowline maps, maps of the basin basement.	Files	New South Wales Water Conservation and Irrigation Commission, Sydney.
New South Wales (No. 34)	"	Discussion.	Published	Kenny, E.J., 1925 - Progress report of survey of underground water resources, Dubbo-Coonabarabran area. N.S.W. Dept. of Mines, Ann. Rep. 1925, p.137-138, Sydney.
New South Wales (No. 33)	"	"	"	Kenny, E.J., 1927 - Geological survey of the Dunedoo-Binaway District, with special reference to the occurrence of sub-surface water. N.S.W. Dept. of Mines, Ann. Rep. 1927, p.119-120, Sydney.
New South Wales (No. 32)	"	"	"	Kenny, E.J., 1927-28 - Geological survey of the Coonabarabran-Gunnedah District with special reference to the occurrence of underground water. N.S.W. Dept. of Mines, Ann. Rep. 1927, p. 130-131, and 1928, p. 117-118, Sydney.
New South Wales (No. 35)	"	Discussion, one water analysis.	"	Lloyd, A.C., 1934 - Geological survey of the Dubbo District, with special reference to the occurrence of underground water. N.S.W. Dept. of Mines, Ann. Rep. 1934, p. 84-86, Sydney.
New South Wales	Inter-pretive	Generalized: discussion, map, water analyses.	Unpub. report	Griffin, R.J., 1962 - The underground water resources of New South Wales. N.S.W. Dept. of Mines, Unpub. report, Sydney.
New South Wales	"	Generalized: discussion, map, table of water analyses, diagram.	"	Williamson, W.H., and Hind, M.C., 1962 - A review of groundwater resources of New South Wales. N.S.W. Water Cons. and Irr. Comm., Unpub. report, p. 21-25, Sydney.

TABLE I - GROUNDWATER DATA ON THE GREAT ARTESIAN BASIN (CONTINUED)

State or Territory	Kind of Data		Status	Repository or Reference
New South Wales (No. 29)	Inter-pretive	Stratigraphic: discussion, maps, cross section, table of water analyses.	Published	Rade, J., 1953 - Geology and subsurface waters of the Moree District, New South Wales. Jour.Roy.Soc. of N.S.W., vol. 87, p.152-162.
New South Wales (No. 28)	"	Stratigraphic: discussion, maps, table of water analyses.	"	Rade, J., 1954 - Geology and sub-surface waters of the area north of the Darling River between longitudes 145° and 149° E., N.S.W. Jour. Roy. Soc. of N.S.W., vol. 88, p.24-32.
New South Wales (No. 30)	"	Stratigraphic: discussion and map.	"	Rade, J., 1954 - Warialda artesian intake beds. Jour.Roy.Soc. of N.S.W., vol. 88, p.40-49.
New South Wales (No. 31)	"	" "	"	Rade, J., 1954 - Geology and sub-surface waters of the Coonamble Basin, N.S.W., Jour.Roy.Soc. of N.S.W., vol. 88, p.77-88.
New South Wales (No. 27)	"	Reconnaissance: discussion, maps, cross sections, tables of bore data and water analyses, diagrams.	"	Kenny, E.J., 1934 - West Darling District, a geological reconnaissance with special reference to the resources of subsurface water. N.S.W. Dept. of Mines, Mineral Resources No. 36, Sydney.
New South Wales	"	Comprehensive: discussion, maps, cross sections, tables of bore data, diagrams.	Unpub. report	New South Wales Water Conservation and Irrigation Commission, 1939 - Artesian investigation. First interim report, Sydney.
New South Wales	"	" "	"	New South Wales Water Conservation and Irrigation Commission, 1940 - Artesian investigation. Second interim report, Sydney.
New South Wales (No. 31)	Inter-pretive	Comprehensive, brief: discussion, maps, cross sections.	Published	Mulholland, C. St. J., 1944 - Review of southern intake beds, New South Wales, and their bearing on artesian problems. N.S.W. Dept. of Mines, Geol. Reports, 1939-45, p. 125-127, Sydney.
South Australia	Basic	Bore locations, depths, elevations, logs, yields, pressures, water analyses, water temperatures.	Files	South Australia Department of Mines, Adelaide.
South Australia (No. 38)	"	Discussion, maps, detailed composite log, water yield and pressure, porosities, water analyses.	Published	Dolhi-Frome-Santos, 1961 - Innamincka No. 1 well, South Australia. <u>Aust.Bur.Min.Res.</u> , Petroleum Search Subsidy Acts, Pub. No. 9, Canberra.
South Australia	Inter-pretive	Generalized: discussion, maps, cross sections, tables of water analyses.	"	Ward, L.K., 1946 - The occurrence, composition, utilization and testing of underground water in South Australia, and the search for further supplies. S.Aust.Geol.Surv., Bull. 23, p. 43-67, Adelaide.
South Australia	"	Generalized: brief discussion.	"	Glaessner, M.F., Parkin, L.W., et al., 1957 - The geology of South Australia. Jour. Geol. Soc. Aust., vol. 5, pt. 2, p.100. Reprinted 1958, Melbourne University Press, Victoria.
South Australia	"	" "	"	South Australia, 1959 - Groundwater handbook. S. Aust. Dept. of Mines, p. 25-26, Adelaide.
South Australia	"	Stratigraphic: discussion, map, cross sections.	"	Jack, R.L., 1930 - Geological structure and other factors in relation to underground water supply in portions of South Australia. S. Aust. Geol. Surv., Bull. 14, p. 9-22, Adelaide.
South Australia (No. 36)	"	Stratigraphic: discussion, maps, cross sections, tables of bore data and water analyses, bore logs.	"	Chugg, R.I., 1957 - The hydrology of portion of the Great Artesian Basin, near the Peake and Denison Ranges. S.Aust.Geol.Surv., Rep. of Investigations No. 10, Adelaide.
South Australia	"	Water quality and movement: discussion, maps, table of water analyses.	"	Jack, R.L., 1923 - Composition of waters of the Great Artesian Basin in South Australia. Trans.Roy.Soc. S. Aust., No. 47, p. 316-321.
South Australia	"	Reconnaissance study of unconfined groundwater: discussion, maps, cross sections, bore logs.	"	Jack, R.L., 1925 - Some developments in shallow water areas in the north-east of South Australia. S. Aust. Geol. Surv., Bull. 11, Adelaide.
Northern Territory	Basic	Bore locations, depths, elevations, logs, yields, pressures, water analyses, water temperatures.	Files	Water Resources Branch, Northern Territory Administration, Darwin.

GEOLOGICAL MAPPING IN THE GREAT ARTESIAN BASIN

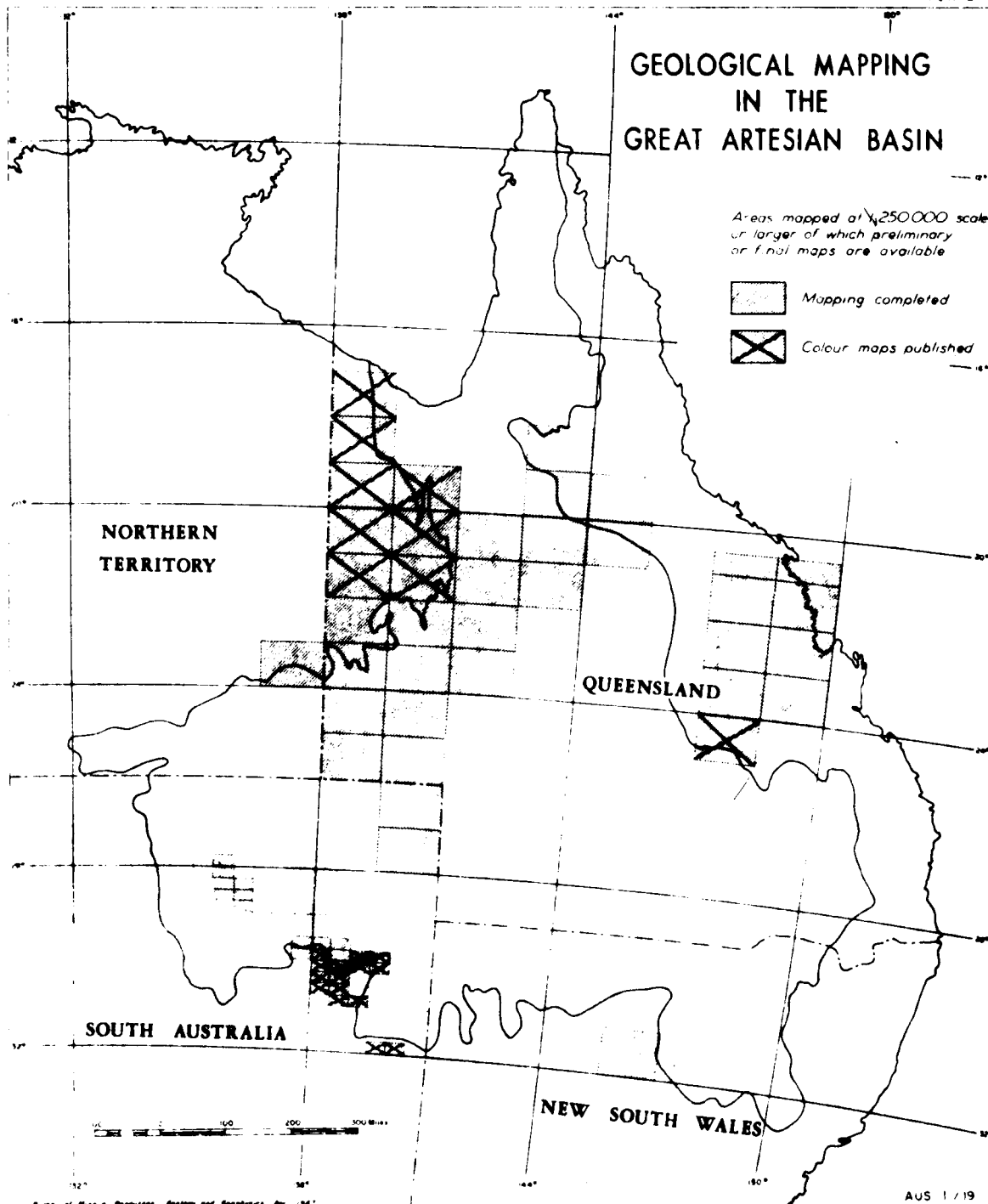
Areas mapped at $\frac{1}{4}$ 250 000 scale
or larger of which preliminary
or final maps are available

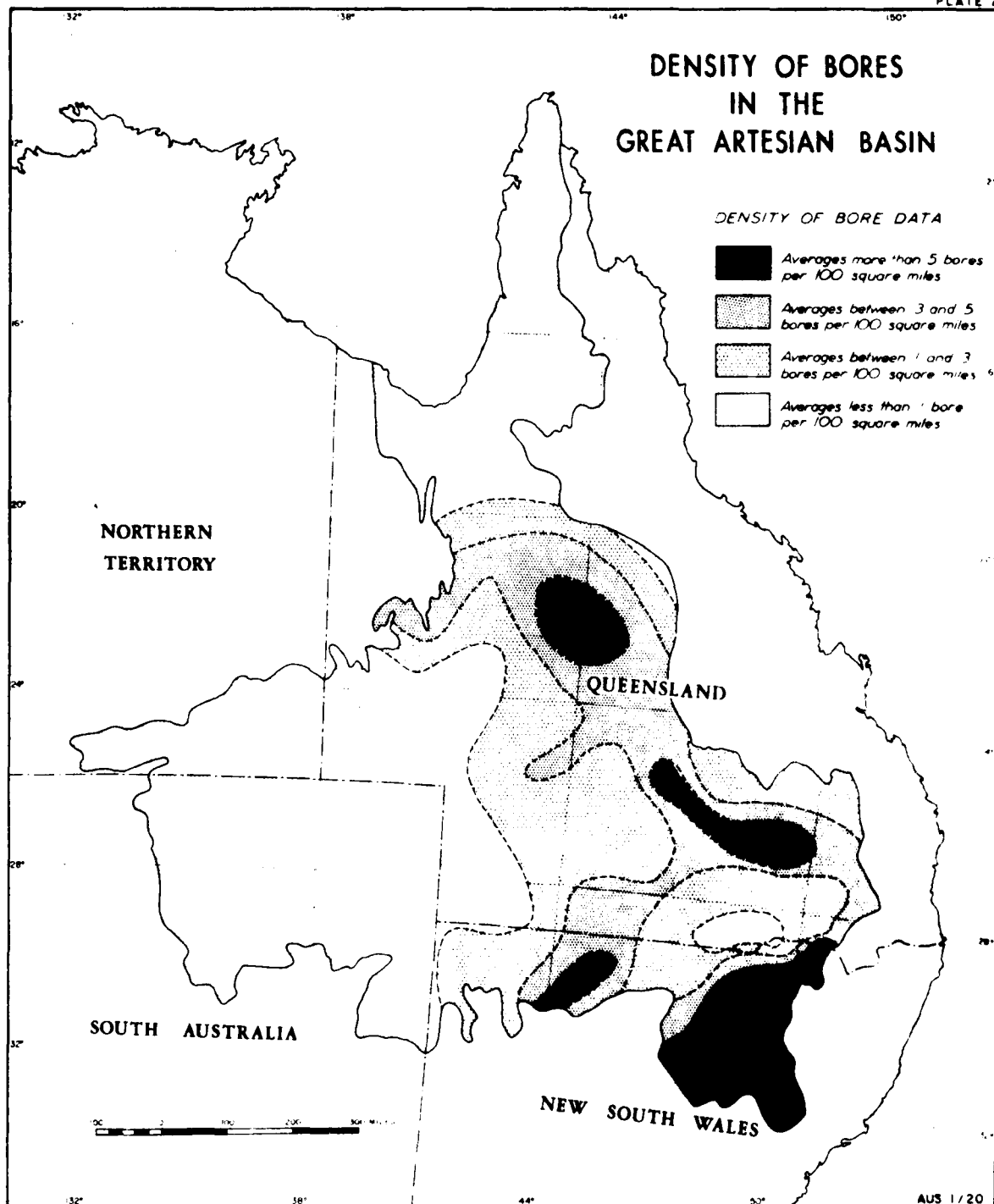


Mapping completed

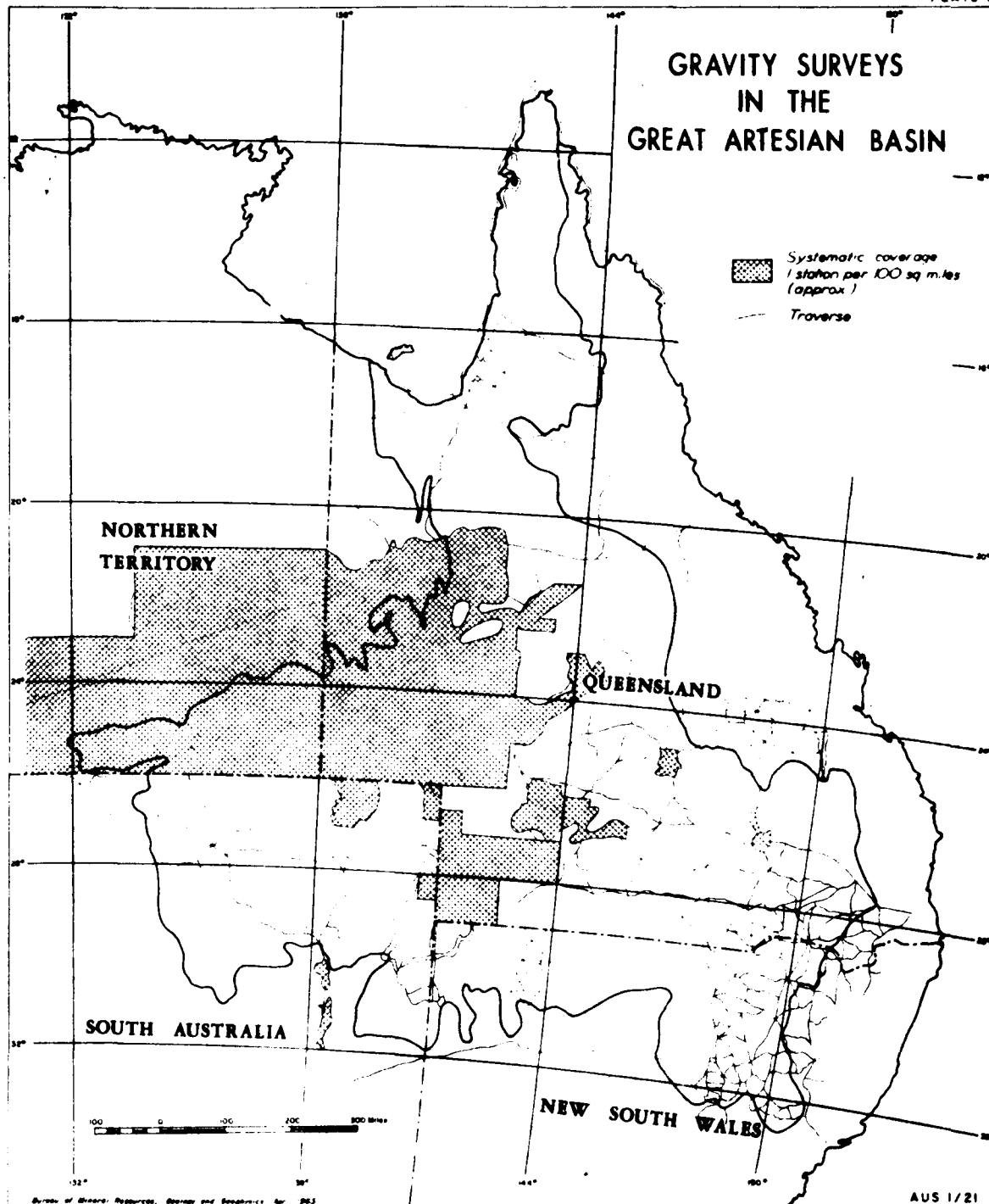


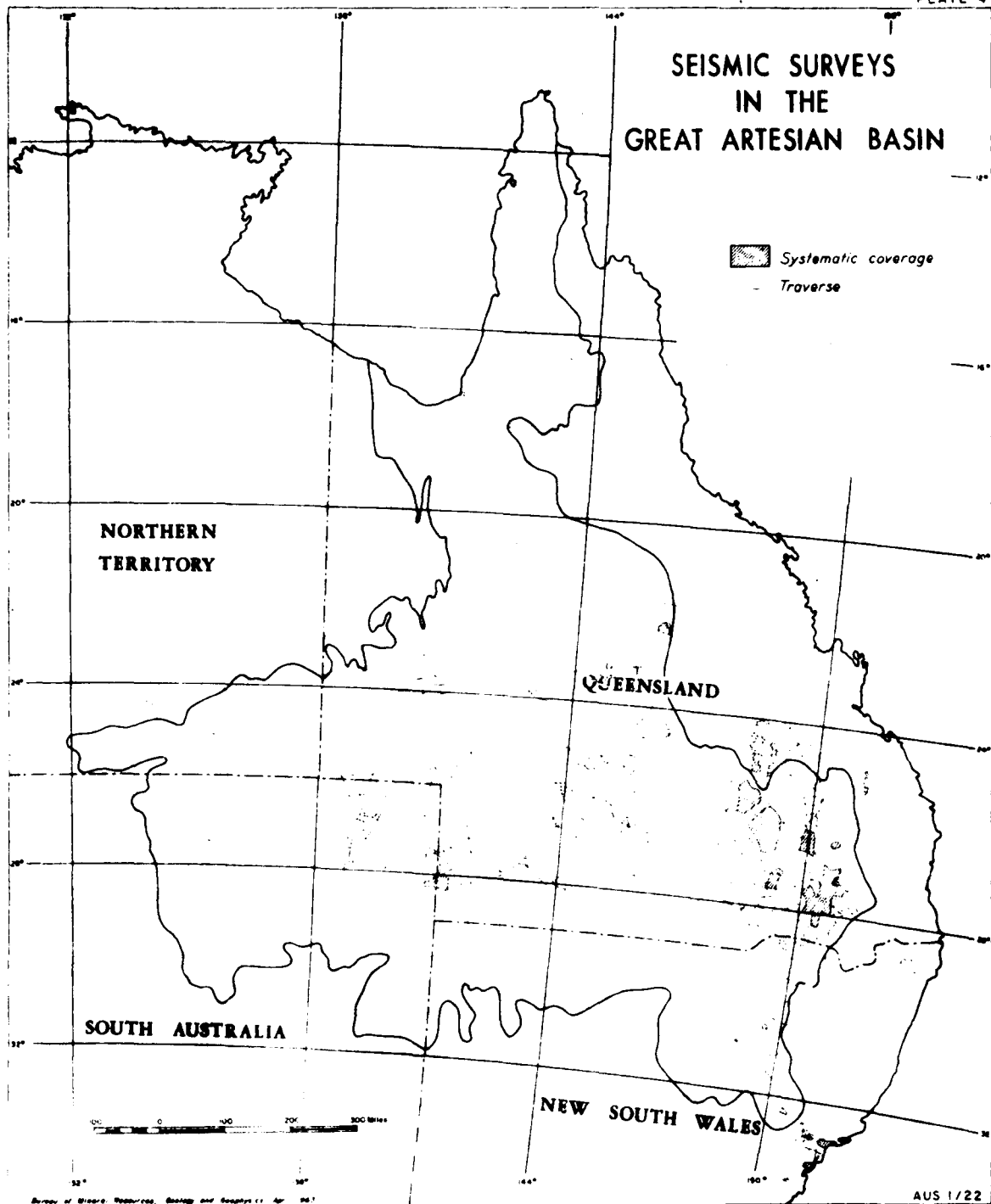
Colour maps published

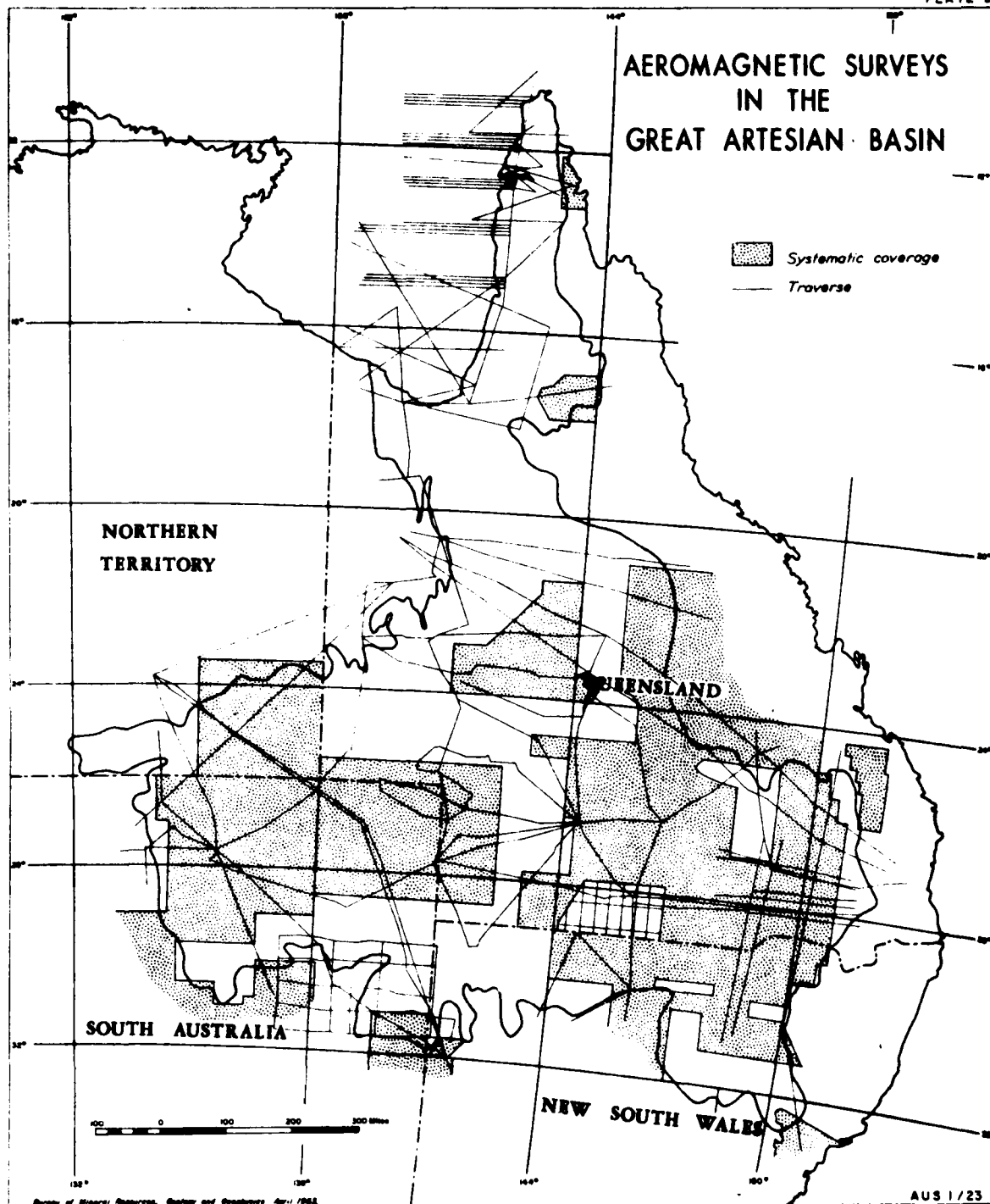




GRAVITY SURVEYS IN THE GREAT ARTESIAN BASIN







REFERENCE TO REPORTS IN THE GREAT ARTESIAN BASIN

30 } Area or locality described
in reports listed in table I
•21

