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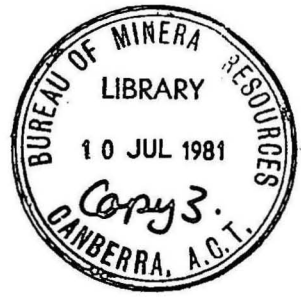

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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

RECORD 1981/30

MURRAY BASIN HYDROGEOLOGICAL PROJECT

PROGRESS REPORT 5

for half year ending 31st March 1981

compiled by W.J. Perry

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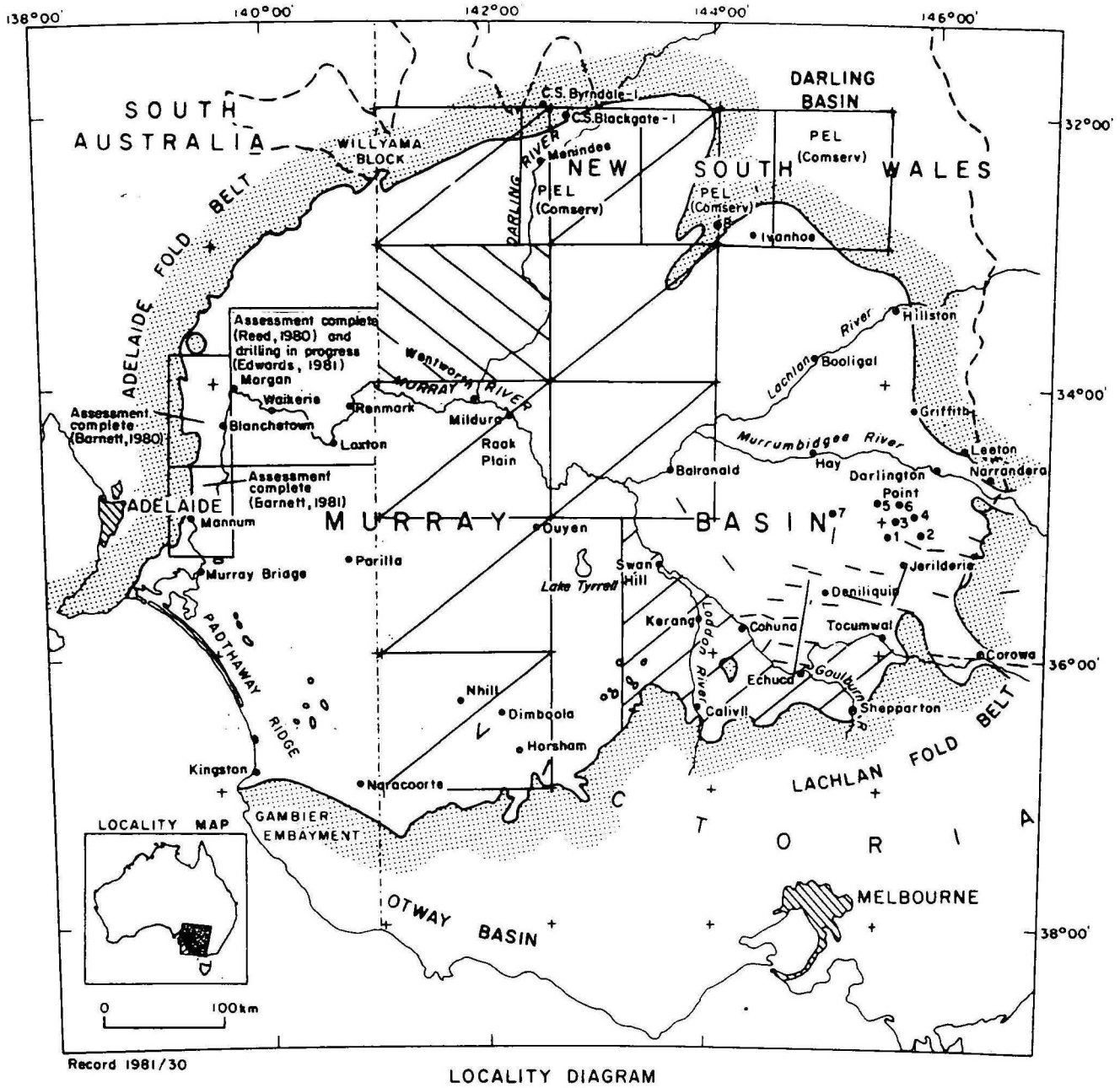
Figure 1



Record 1981/30

LOCALITY DIAGRAM

MURRAY BASIN HYDROGEOLOGICAL PROJECT

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Seismic line, Water Resources Commission of N.S.W.

Drill hole, Geological Survey of N.S.W.

1 - DM Wood-1
2 - DM Bundure-1
3 - DM Yanko South-1
4 - DM Cadell-1
5 - DM Morton-1
6 - DM Waloona-1
7 - DM Wargan-1
8 - DM Umalee-1

In progress
Completed during period
Previously completed

Plotting of borehole localities and tabulation of downhole stratigraphic information, BMR.

AUS 1/998-1

MURRAY BASIN HYDROGEOLOGICAL PROJECT

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INTRODUCTION

The groundwater modelling sub-committee set up by the Steering Committee in June 1980, met in October and recommended that a preliminary model of the Basin should be attempted; it should contain 3 layers, with a 10 x 10 grid (300 nodes) and have the aim of increasing the accuracy of solutions at later stages by decreasing the grid size. The sub-committee proposed that a whole basin model be attempted by the South Australian Department of Mines & Energy using a finite element method, and by the Water Resources Commission of New South Wales using a finite difference approach; the methods could then be compared before a more elaborate model was tried.

A meeting of the Steering Committee scheduled for 7th November 1980 could not be held as planned because of an industrial dispute which grounded domestic aircraft, thus preventing the attendance of Dr C.R. Lawrence (Geological Survey of Victoria), D.H. Probert (Geological Survey of New South Wales), and W.J. Perry (Bureau of Mineral Resources). However an informal meeting attended by J. Selby (SADME), J. Forth (Engineering & Water Supply Department of S.A.), D.R. Woolley (WRCNSW) and Dr M.A. Habermehl (BMR) supported the recommendations of the groundwater modelling sub-committee, and work was begun on the preliminary model during the period.

PROGRESS REPORTS

DEPARTMENT OF MINES & ENERGY, SOUTH AUSTRALIA

by

J. Selby

A total of 65 exploratory wells, drilled into the Murray Group aquifer system, have now been completed. This work is being carried out as part of the S.A. salinity mitigation program. Assessment of existing drillhole data along the River Murray has been completed as far south as Tailem Bend.

An assessment of BMR aeromagnetic data has been carried out to compute revised depth to magnetic basement for the S.A. section of the Murray Basin. This will be incorporated in the revised aeromagnetic 1:1 million scale map to be published in a few months. A synthesis of all available gravity data is also being carried out for the Southern Murray Basin. So far the Naracoorte 1:250 000 scale sheet has been completed and the Penola Sheet is next.

There is still a high level of coal exploration activity and renewed interest in petroleum prospects with the granting of PEL's 17 and 18 which cover nearly all of the Basin.

GEOLOGICAL SURVEY OF NEW SOUTH WALES

by

D.H. Probert

Coal Exploration

1. Murray Infrabasin Drilling Program

This drilling program has now been completed.

(a) Six cored drill holes totalling 1856 m were drilled on the northern extensions of the "Oven's Valley Graben" between Yanco and Coleambally Creeks to the following depths:-

DM Wood No. 1	346.2 m	DM Cadell No. 1	277 m
DM Bundure No. 1	277.3 m	DM Morton No. 1	233 m
DM Yanko South No. 1	395.5 m	DM Waloona No. 1	337 m

All bores encountered Tertiary sediments of the Wunghnu and Renmark Groups underlain by Triassic sediments of the Jerilderie Formation, Late Permian (Coorabin) Coal Measures and Early Permian marine sediments.

All bores were electrically logged and palynologically sampled. No specific water testing was carried out. Prominent coarse gravelly horizons were encountered in the Tertiary sequence of DM Morton No. 1 between 75 and 114 m.

Reports on these bores will shortly be available.

(b) DM Wargan No. 1 was drilled and cored to a depth of 158.3 m near Boorooban between Deniliquin and Hay. This bore encountered Tertiary sediments for its full depth.

(c) DM Umalee No. 1, located 20 km west-northwest of Ivanhoe was drilled and cored to a depth of 176 m. The hole encountered Quaternary/ Tertiary sediments overlying Early Cretaceous and Early Permian Marine sediments.

The bore was left "open" at the landholder's request to test groundwater potential.

2. An assessment has also commenced of brown coal occurrences in the Murray Basin.

3. Authorisations

(a) Kembla Coal and Coke (Pacific Coal) Pty Ltd

Exploration drilling to prove coal reserves continued on this authorisation. Much of the already proven coal occurs at potential open cut depth. Groundwater consultants have been retained to undertake a comprehensive study of the authorisation area to recommend a plan of future water management for a future mining operation.

(b) Mitsubishi Pty Ltd

Final reports including groundwater assessment and monitoring studies are awaited.

Petroleum Exploration Activity, Murray Basin

Comserv (779) Pty Ltd are currently conducting aerial surveys over their licence areas in the Murray Basin and Darling Depression. Landsat studies and recontouring of existing gravity data and a 1 milligal contour interval are also underway. Copies of the recontoured gravity maps have been supplied to the Department.

Meekatharra Minerals N.L. are currently undertaking field studies and a data appraisal with the intention of defining areas for follow up geophysical activities.

No drilling is programmed for the forthcoming six months, but we expect seismic work to begin in at least one area held by Comserv (779) within this period.

BUREAU OF MINERAL RESOURCES

by

C.M. Brown

Plotting of borehole locality maps and tabulation of down-hole stratigraphic information continued, and work commenced on the compilation of structure contour maps depicting the subsurface geology and geometry of aquifer systems. Copies of the 1:1 000 000 scale Landsat mosaic and printouts of the Murray Basin bibliographic data base were distributed to participating organisations in November. Coal data were extracted from borehole information, and maps and diagrams prepared to accompany a talk on Tertiary coal of the Murray Basin, given at the CECSEA conference in late November. Compilation of the geology of Permian infrabasins underlying the Cainozoic Murray Basin was completed and a draft record prepared. The first draft of a paper on the hydrocarbon source rock potential of Devonian rocks of the Darling Basin, beneath the northern Murray Basin, was completed and a talk based on it was given in BMR in early March. During the period the project received further contributions on the hydrogeology of the northern and western margins of the basin in South Australia by Edwards (1981) and Barnett (1981).

Work has not yet commenced on the hydrogeological phase of the project although M.A. Habermehl in collaboration with E. Anderson of the ADP Group worked on the design of a data base system for handling hydrogeological data on the BMR Hewlett-Packard computer.

Phase 1 - Geological Synthesis

(1) Bore Locations and borehole data sheets - Further work was done on revision of the stratigraphy of boreholes in several 1:250 000 sheet areas in western New South Wales as part of a joint BMR/NSW Water Resources Commission compilation of subsurface data. Aquifer boundaries are not necessarily coincident with formation boundaries and hence the aquifer systems were tabulated separately.

(2) Structure Contour and Isopach Maps - Preliminary work was done on compilation of base Tertiary and top Renmark Beds/Olney Formation structure contour maps, and compilation of several other maps commenced, using published maps from several sources. In accordance with the recommendations of the modelling sub-committee, some work was done in preparing maps depicting aquifer geometry. However, it was found that major data gaps occur and that rapid compilation of the maps, at other than a very cursory level, was not possible. Compilation of subsurface maps depicting aquifer systems of the basin began during the period.

(3) Geophysical compilations - Contour values at 5 milligal contour intervals were plotted on a 1:1 000 000 scale Bouguer gravity anomaly map. Hand coloured versions with a contour interval of 10 milligals were prepared to illustrate infra-basin and basement trends underlying the Murray Basin. The Metalliferous and Airborne section within the Geophysical Branch of BMR plans to complete aeromagnetic coverage of western New South Wales and northwest Victoria during 1981.

(4) Murray Basin bibliography - In November editing of the Murray Basin bibliographic data base was completed and print-outs distributed to participating organisations for addition/amendment. Additional references were received from the Geological Survey of New South Wales.

(5) Economic Mineral Deposits and Occurrences - C.M. Brown presented a talk on Tertiary brown coal deposits in the Murray Basin, at the Coal Workshop session of the CECSEA Conference dated in Canberra in late November. The talk mainly concerned the distribution of brown coal in New South Wales and Victoria, and discussed the inter-relationship between the accumulation of coal-bearing sediments of the Murray Basin and global cycles of relative rise in sea-level.

The coals occur as discontinuous lenses intercalated within paralic and fluvio-lacustrine sediments of the Late Eocene to early Oligocene Upper Renmark Beds (South Australia) and their equivalents, the late Eocene to mid-Miocene Olney Formation of the Renmark Group (Victoria and New South Wales). In the east the coals occur beneath an overburden of between 80 and 130 m, whereas to the west they occur at depth of up to 300 m. They are of low rank, having undergone varying degrees of coalification, and range from peat through soft brown coal to dull black lignite. They mainly show the characteristics of peaty coals deposited

in swamp and marsh environments, and grade laterally and vertically into carbonaceous clays and sands, although many samples have been logged as wood, presumably from fringing forest environments and are intercalated with channel conglomerates and sands. Limited analyses indicate that they have a low calorific value, high moisture, and variable ash and sulphur contents. With the aid of subsurface maps and cross-sections the stratigraphy of the Cainozoic sequence of the Murray Basin was discussed in detail and various events correlated with global cycles of relative change in sea-level which resulted in regional disconformities and laterally extensive and complex migrations of facies boundaries. Enhanced peat accumulation can occur only when rates of rise in sea-level, crustal subsidence and sediment composition are favourably balanced against rate of sediment deposition. Peat accumulation in the Murray Basin was mainly confined to the period late Eocene to mid-Miocene and increased during periods of relative rise in sea-level. With the aid of a Bouguer gravity anomaly map it was shown that differential subsidence also appears to have resulted in thicker accumulation of peat in the fault-bounded depressions around the basin margins, and possibly elsewhere. Palaeoclimates, and the correlation between deep-weathering events and periods of maximum rise in relative sea-level were also discussed.

(6) Pre-Tertiary infra-basins by P.E. O'Brien

P.E. O'Brien completed a study of the Permian sediments underlying the Murray Basin (O'Brien, in prep.). Permian rocks are known in 10 infrabasins beneath the Murray Basin, reaching a maximum thickness of 960 m in the Ovens Graben. Two stratigraphic units have been recognised. The lower is mostly Early Permian glacio-marine sediments, correlated with the Cape Jervis Beds because their lithologies and faunas are similar to rocks cropping out on the Fleurieu Peninsula, whereas the upper consists of the Late Permian Coorabin Coal Measures which are known from the Ovens Graben beneath the southeastern corner of the Murray Basin.

The study concentrated on the Cape Jervis Beds equivalents because material was available within BMR. Eleven sedimentary facies may be recognised. Of these, three diamictite facies clearly indicate the presence of glacial ice during deposition. Petrographic and limited porosity and permeability data suggest rocks suitable for trapping hydrocarbons are present, but published source rock studies reveal low

source potential. Information on groundwater is very limited. Some fresh water was found in the Ovens Graben, but formation waters are generally thought to be brackish to saline.

The Coorabin Coal Measures are of Late Permian to Mid-Triassic age and overlie the Cape Jervis Beds unconformably. They are quartzose sandstones, conglomerates, and mudstones of fluvial origin, and contain a coal seam ranging in thickness from 3.5 m to 19 m. This coal is presently being investigated by Government and private companies with a view to its exploitation. Ground water in the Coorabin Coal Measures is variable in quality, with fresh water being reported from some holes.

O'BRIEN, P.E., in prep. - The Permian beneath the Murray Basin, Bureau of Mineral Resources Record.

Associated activities: Darling Basin Source Rock Study

A draft of a paper reporting the results of the study has been completed (Lockwood, Brown, Jackson & Passmore, in prep.). Evans (1977) suggested that hydrocarbons may be present in regressive Lower Devonian sand bodies of shallow marine or deltaic facies, and may have originated in and been sealed by possible marine Lower Devonian shale preserved in grabens of the western Darling Basin beneath the northern Murray Basin. The objectives of the study were to assess the hydrocarbon source potential, and maturation history of Lower Devonian rocks, based on samples from petroleum exploration wells and shallow BMR drilling. The main conclusions reached are that the very low total organic carbon content suggests that the Lower Devonian rocks were a poor source, and probably gas prone. Maturation indicators suggest that the source rocks are well advanced into maturity in the gas zone, and similar indicators from overlying Permian/Cretaceous rocks suggest that the Lower Devonian reached maturity before deposition of the Permian or Cretaceous rocks; samples from the latter have low organic content with marginal maturity.

C.M. Brown, V.L. Passmore and K. Lockwood presented the results of the study in a talk in the BMR lecture series in March.

LOCKWOOD, K.L., BROWN, C.M., JACKSON, K., PASSMORE, V.L., in prep. - The Petroleum Potential of the Darling Basin.

EVANS, P.R., 1977 - Petroleum geology of western New South Wales. The APEA Journal, 17(1), 42-49.

WATER RESOURCES COMMISSION OF NEW SOUTH WALES

by

D.R. Woolley

No drilling associated with the project was completed during the period because all available rigs were involved in town or farm water supply drilling as a result of the current drought. For the same reason there was very little data compilation undertaken.

Geophysical investigation work continued in the Murray River area, as indicated on the map.

Reports based on earlier work in the lower Lachlan & Murrumbidgee valleys were compiled for presentation to the 9th Annual Convention of AWWA (Australian Waste Water Association) (Woolley & Kalf, 1981), and for background notes for the delegates to the first meeting of the AWRC (Australian Water Resources Council) Groundwater Committee meeting at Griffith (Water Resources Commission of NSW, 1981).

GEOLOGICAL SURVEY OF VICTORIA

by

C.R. Lawrence

Work undertaken by the State Rivers and Water Supply Commission has concentrated on monitoring the water table, and on a number of schemes for controlling the rise or lateral movement of shallow groundwater which causes salt problems for soil or streams. Completed are the interceptor works at Mildura, and under progressive expansion is a system of de-watering bores in the Goulburn valley.

Specific areas for which close investigation has been carried out are Nangiloc-Coligan (some 40 km upstream from Mildura) and Lake Tyrrell; these are known as Mineral Reserve Basins.

Increasing use is being made of remote sensing techniques to complement current investigations.

The Department of Mines and Energy is working in three main areas: 1) Groundwater modelling; a steady state model has been developed for the Murray Basin; the model will use data supplied by each of the States, including cell dimensions, horizontal and vertical conductivities, recharge/discharge rates, rainfall, evaporation and the elevation of the ground surface.

2) Riverine Plain; several reports have been written on the hydrochemistry of shallow aquifers. Four drilling rigs are allocated to groundwater-salinity investigations of the Riverine Plain, i.e. the eastern part of the Murray Basin in Victoria.

3) A comprehensive report is being prepared on the hydrogeology of groundwater discharge zones in northwestern Victoria. These include Lake Tyrrell and the Raak Plain, where a complex model for the genesis of saline groundwater has been developed. The model incorporates such phenomena as salt water interfaces analogous to those known from coastal regions, and re-solution of evaporites.

RECENTLY PUBLISHED AND UNPUBLISHED REPORTS ON THE GEOLOGY AND HYDROGEOLOGY OF THE MURRAY BASIN

BARNETT, S.R., 1981. Murray Basin Hydrogeological Investigation, Data Assessment, Western Margin (South). S. Aust. Dept Mines Rept No. 81/21 (unpublished).

BROWN, C.M., 1980 - Tertiary coal in the Murray Basin. In TRUSWELL, E.M., and ABELL, R.S. (Compilers), 1980 - The Cainozoic Evolution of Continental Southeast Australia, Abstracts, Bureau of Mineral Resources, Australia, Record 1980/67, 12-13 (unpublished).

EDWARDS, D., 1981. Murray Basin Hydrogeological Investigation, Drilling Programme, Upper Murray and Northern Region, Progress Report No. 1. S. Aust. Dept Mines Rept No. 81/31 (unpublished).

LAWRENCE, C.R., 1980 - Salt lakes as groundwater discharge zones in northwestern Victoria and northern Chile. In COOK, P.J. (Editor), 1980 - Australasian Sedimentologists Group Conference, Canberra, A.C.T. December 1980. Geological Society of Australia, Abstracts Volume, 2, 29 (unpublished).

MACUMBER, P.G., 1980 - Hydrochemical and hydrodynamical processes in the salt lake basins of northwestern Victoria. In COOK, P.J. (Editor), 1980 - Australasian Sedimentologists Group Conference, Canberra, A.C.T., 1980. Geological Society of Australia, Abstracts Volume, 2, 33-34 (unpublished).

O'BRIEN, P.E., in prep. - The Permian beneath the Murray Basin. Bureau of Mineral Resources, Geology and Geophysics, Record (unpublished).

WATER RESOURCES COMMISSION NSW, 1981 - Notes on groundwater resources of the eastern part of the Murray Basin, Prepared for AWRC Groundwater Committee meeting, Griffith, NSW, April 1981.

WILLIAMS, R.M., DRURY, L.W., 1980 - Cainozoic sedimentation of the eastern Murray Basin. In TRUSWELL, E.M. and ABELL, R.S. (Compilors), 1980 - The Cainozoic Evolution of Continental Southeast Australia, Abstracts, Bureau of Mineral Resources, Australia, Record, 1980/67, 77-78 (unpublished).

WOOLLEY, D.R., 1980 - Geology of the eastern Murray Basin in N.S.W. In TRUSWELL, E.M., and ABELL, R.S. (Compilers), 1980 - The Cainozoic Evolution of Continental Southeast Australia, Abstracts, Bureau of Mineral Resources, Australia, Record, 1980/67, 79-80 (unpublished).

WOOLLEY, D.R., & KALF, F.R.P., 1981 - Groundwater resources of the Lower Lachlan and Murrumbidgee Valleys, Paper presented at 9th Convention AWWA, Perth, 6-10 April, 1981.

APPENDIX

General Statement - Murray Basin Hydrogeological Project

This project is a long-term study which is being undertaken jointly by South Australian, Victorian, and New South Wales geological surveys and water authorities, and by the Commonwealth Bureau of Mineral Resources, Geology and Geophysics. It will be co-ordinated by a steering committee comprising members of those organisations.

The Murray Basin is a geological structure with an area of 300 000 km^2. In each of the three States the basin sediments contain very large groundwater reserves. Where the groundwater has a low salinity it is increasingly being used for irrigation and/or town water supply. In much of the basin, the groundwater is suitable only for stock use, and is extensively used for this purpose. In other parts of the basin the groundwater is too saline for any use. There is a complex interaction between groundwater and surface water which may be beneficial, as in recharge areas in some parts of the basin, or harmful, as in areas of saline groundwater discharge to rivers. In recent years, the States involved have stepped up the rate of assessment of the groundwater regime in the basin.

The primary aim of the project is to improve the understanding of the groundwater regime of the basin by examining it as a single entity, unencumbered by State boundaries. Since a knowledge of the geology of an area is basic to the understanding of groundwater occurrence, a geological study of the basin is an essential part of the project, and as a consequence it will also be possible to make an assessment of other mineral resources.

The project is planned initially to last five years and will be organised in five phases:

(1) Geological synthesis, using all available geological and geophysical data.

(2) Hydrogeological assessment from available data.

(3) Documentation of deficiencies in geological and hydrogeological information, and formulation of proposals for appropriate work programs.

(4) Additional work as approved, which might include stratigraphic drilling, aquifer testing, biostratigraphic analysis, and isotope hydrology studies.

(5) Development of numerical model(s), if found to be appropriate in the light of the data then available.

Investigations currently being undertaken by State authorities will continue, and data generated by them will be used for the joint project. Collection, collation, and compilation of data during the first phase, and interpretation and documentation of the second and third phases, will be undertaken by officers of BMR with assistance from officers of the State authorities. Additional work required in phase 4 (e.g., stratigraphic drilling, geophysical investigations) may be conducted by BMR or by appropriate State authorities. The development of a numerical model (phase 5), if found to be feasible, may be undertaken by BMR. The project will depend on the close co-operation of staff from all organisations involved, and some movement of staff between organisations for short periods will be necessary. Throughout the study, individuals and organisations will be encouraged to publish results of various aspects of the work. Results of the overall project will be incorporated into joint publications.