DEPARTMENT OF MINES
SOUTH AUSTRALIA

RIVER MURRAY PLANNING STUDY
GEOLOGICAL FEATURES AND MINERAL RESOURCES
(Client - State Planning Office)

by

M.N. HIERN
SUPERVISING GEOLOGIST
ENVIRONMENT AND RESOURCE DIVISION

Rept. Bk. No. 74/161
G.S. No. 5479
D.M. No. 888/70

5th August, 1974

CONTENTS

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept.Bk.No. 74/161
G.S. No. 5479
D.M. No. 888/70

RIVER MURRAY PLANNING STUDY
GEOLOGICAL FEATURES AND MINERAL RESOURCES

(Client - State Planning Office)

ABSTRACT

The River Murray valley contains the principal exposures of the Tertiary and Quaternary sequence of the Murray Basin and access to the whole of the riverine tract is essential for continuing scientific study and teaching purposes. Man made excavations provide the main exposures suitable for detailed study.

Present demand for construction sand and aggregates is centred on the river towns. Future expansion in the area is also likely to be along the river because of dependence on water supplies. Workable deposits of construction materials, particularly concrete sand, are mainly confined to the study area. Future community development will be severely retarded unless positive action is taken to identify and secure environmentally acceptable source areas.

Large areas of the State depend on the river for potable water. Geological conditions are such that pollution of the river can occur from incorrectly sited disposal areas and drainage bores. All development proposals where disposal of solid or liquid waste is necessary should be referred to the Mines Department for comment.

Gypsum deposits north of Renmark are used for agricultural purposes and sand deposits on Lake Alexandrina are an alternative source of glass sand. Extensive flats around Lakes Alexandrina and Albert have potential for salt making and may be an alternative to the environmentally sensitive coastal mangrove swamp association.

INTRODUCTION

The State Planning Office requested information on development proposals of regional significance or major local importance lying within 2 km of the 1956 flood level of the River Murray to assist in a study of the Murray Valley.

The study area covers the entire length of the river in South Australia, including all lakes and rivers, but excluding the Coorong. The aim of the study is to determine policies for future land use, orderly development and conservation of the river valley, and to make proposals for the allocation of land for various purposes such as recreation, housing development, and wildlife habitats.

GEOLOGICAL SETTING

The Murray Basin, through which the river flows, is a shallow tectonic basin infilled principally with Tertiary sediments which are overlain by a veneer of Quaternary accumulations of varying lithology.

As the sequence is flat lying and relief in the basin is low, the river cliffs provide the principal exposures of the geology and stratigraphy. The riverine tract also displays many classical geomorphological features.

The river valley may be divided into three sections:-

Lower lacustrine Section extending from the Murray Mouth to Wellington.

Gorge section extending from Wellington to Overland Corner. Here the river flows through a relatively narrow steep sided gorge which is generally less than 2 km wide.

Upper lacustrine section extending from Overland Corner through Loxton to the Victorian Border. Here the valley widens considerably, being 5 km wide at its narrowest point and up to 13 km wide elsewhere. In this section there is generally only one well developed cliff which alternates from side to side.

These physiographic features of the river are controlled by basin tectonics and coincide with major differences in the stratigraphy of the cliff rocks.

The most recent systematic studies of the geology and stratigraphy of the Murray Basin are by Ludbrook (1961, 1969), Firman (1972, 1973) and Lindsay and Giles (1973). In the gorge section of the river, the cliffs are comprised mainly of Tertiary fossiliferous limestones while upstream from Overland Corner, Loxton Sands, Parilla Sand and younger units form the cliffs.

SIGNIFICANT GEOLOGICAL FEATURES

Bio-stratigraphic study of the river cliffs, particularly the limestones of the gorge section, began in the late 1870's and a large bibliographical list of scientific reports and papers exists. Many type sections of vital importance to stratigraphers and palaeontologists, where particular sections of the sequence are clearly exposed, have been established (see Appendix 1). In the interest of continuing scientific study and teaching it is essential that these be preserved and that free access to them is available.

In addition to these type sections, the entire river, particularly the cliffs, contains exposures of interest to scientists and the public where geological and other features can be

observed and studied. It is considered impractical to give the whole of the river valley the status of a National Park in terms of the present National Parks and Wildlife Act, but all development proposals should be examined by the appropriate authorities, including the Geological Survey, to ensure that they do not impinge on the continued availability of the riverine tract for scientific study and public purposes.

Man made excavations such as the pumping stations, the sand pits around Loxton and road access cuttings to the flats have improved the natural exposures and permitted detailed studies which would otherwise not have been possible. Future excavations will likewise provide new exposures which will add to scientifiic knowledge. As a general policy, these exposures should not be covered over except in the interests of safety.

The provision of signs explaining the geological features at major points of interest would increase the understanding of these areas by tourists and the public.

Construction materials and other minerals are used in roads, buildings and services for the benefit of the community. Transport is a major element in the cost of providing these materials and the availability of deposits as close as possible to the place of use permits maximum utilisation of public funds. Provision of adequate deposits near to existing and future growth centres, consistent with amenity and environmental standards, must be regarded as being in the public interest.

Mineral commodities are non renewable resources and new deposits are required for future community needs. Geological formations containing useful deposits are irregularly distributed

and often restricted in occurrence. Many coincide with sites of environmental and historical significance. Deposits free of such constraints can be lost to the community for all time by the premature establishment of land uses such as housing. Supplies have then to be obtained from more distant sources and the consequent increase in costs either delays or defers the provision of essential community services.

Deposits set aside for long term community needs provide open space until demand requires their development. After extraction and rehabilitation, the land can revert to open space or other use.

Because of the dependence on the river for water supplies, most of the settlement and intensive horticulture in the Murray Basin is located adjacent to the river. As a consequence, the greatest demand for construction materials is also in the vicinity of the river.

The absence of clays suitable for brickmaking creates greater dependence on concrete as a building and constructional material. Concrete is also used extensively in irrigation channels and drainage works.

As discussed in the following section, most of the accessible deposits of these materials lie in the study area.

Building stones have been used locally and in Adelaide from several quarries along the river. Continued access to these should be assured to provide matching stone for restoration of historic and other buildings of significance.

Policy proposals arising from the study should include provision for ensuring adequate supplies of concrete and other

materials in accordance with the principles discussed above. It is necessary to define adequate source areas, consistent with competing land uses and acceptable environmental standards, and to take appropriate action to reserve these sites specifically for extractive industry as required in the future.

Contamination of river water by solid and liquid waste from irrigation drainage works, industrial plants, animal feed lots and refuse pits is of critical importance because of the dependence of large areas of the State on the river for potable water.

Disposal through boreholes can raise the water table to the point where saline effluent enters the river. It is expected that in the near future the whole of the State will be proclaimed under the Underground Waters Act. A permit will then be required to drill a bore for any purpose. Until this control is established all development which may involve disposal of solid or liquid waste through bore holes should be referred to the Department of Mines for comment.

Contamination of river water is also possible from areas adjacent to the river valley as the sand and limestone sediments in the cliffs are porous and cavernous. Thus all proposals for industrial development, establishment of animal feed lots or refuse pits within the study area should be referred to the Department for comment.

MINERAL RESOURCES

Mineral resources of the Upper Murray Planning Area are described by Blissett (1970) and by Hiern (1974) for the Murray Mallee Planning Area.

The significant deposits along the River Murray are extractive and industrial minerals as discussed below.

Extractive Minerals

Concrete Sand

Most of the present demand is in the Loxton-Barmera-Berri-Renmark area and is provided either from Loxton Sands in the river cliffs or from reworked deposits in the river bed.

Recorded production from this area in 1972 amounted to 20,000 tonnes. Current mining tenements are listed in Appendix 2.

Although sand is the dominant sediment in the upper lacustrine section of the river, only the Loxton Sands in the cliffs and reworked derivatives in the river have gradings which approximate to building sand specifications. Loxton Sands are generally overlain by an excessive thickness of younger sediments and workable deposits occur only where this overburden has been removed by erosion.

Reserves of sand within existing tenements are not known. A detailed evaluation of all deposits is required to provide a basis for securing sufficient reserves for the future.

In the gorge section, the Loxton Sands are generally finer grained and unsuitable for construction purposes.

Large quantities of concrete sand will be required for Monarto and mineral leases in Sections 597, 602, 603, 604 and 718 Hundred Finniss have been pegged for this purpose over good quality sand exposed in channels of Reedy Creek. Reserves in these leases are expected to be small because useful sand is restricted to the present channels. Alternative sources are being

investigated outside of the study area.

Major water storage dams such as those proposed at Chowilla and Teal Flat require large quantities of sand and aggregates of specified grading. Policies emanating from the study should provide for the necessary materials to be available.

Coarse aggregate

The Murray Basin rock sequence comprises mainly unconsolidated sediments and hard rocks suitable for concrete aggregates and road building occur only as relatively thin indurated cappings to certain units (Hiern 1963).

Most of these formations contain only poor quality material and sources of concrete aggregate and bitumen surface chippings are restricted to a few deposits. Siliceous limestone is worked at Jones' Quarry near Barmera and Schlein's Quarry in Section 622, 623 Hd. Gordon near Loxton. These provide most of the concrete aggregate requirements of the Upper Murray area. Only Jones' Quarry lies in the study area. Similar deposits may exist around the eastern side of Lake Bonney.

Calcrete (formerly referred to as travertine limestone or kunkar) is used extensively for roadworks. Where well developed, such as at the Renmark Irrigation Trust Quarry near Calperum, calcrete produces low quality concrete aggregate and chippings. The distribution of this material, shown on the published RENMARK, ADELAIDE AND BARKER 1: 250 000 geological map sheets, is such that quarry sites can generally be opened inland from the river cliffs outside of the study area.

In the upper lacustrine section, a ferruginous capping developed on the top of the Loxton and Parilla Sands often forms a

system of low cliffs within the main valley. This rock is of variable hardness but has found some use as a building stone and as a facing stone around the locks. At a few localities, such as Coombe's Quarry in Section 20, Hd. Paringa and on the left bank of the river at Lyrup, a locally thicker development of ferruginous quartzite may be required for future river works. These deposits should be secured for extractive industry purposes.

A reported aboriginal flint quarry on the northern side of the river near Lyrup is in an intensely silicified phase of this formation.

A small deposit of indurated sponge spicules in Sections 7B and 45, Hd. Murtho, 3 km upstream from Paringa, has been used locally as a building stone. Provision should be made for this quarry to be re-opened as required.

In the gorge section, a hard recrystallised cap developed on the Morgan Limestone has been worked extensively around Murray Bridge for road stone, railway ballast, concrete aggregate and building stone (Nichol 1974). No quarries are working at present. Large quantities of this material are likely to be required for construction of Monarto. This unit will also provide construction material for future public works elsewhere along the gorge section of the river. Thick overburden of younger sediments reduces the availability of sites for quarrying and in some cases extraction of stone from river frontages will have undesirable visual impact. The incised valleys of tributary streams such as Bryant Creek, Marne River, Sanders Creek, Milendella Creek, Long Gully, Preamimma Creek and Reedy Creek will provide quarry sites out of view of the river.

Soft limestone at Overland Corner has been worked on a small scale for building stone.

"Waikerie Freestone" from Section 110 Hd. Markaranka and "Ramco Freestone" from Section 451, Hd. Waikerie have been used locally and in Adelaide. Building stone has also been won from Section 131 Hd. Cadell. Continued availability of these sites for restoration and other uses should be ensured.

Isolated granite masses on the river flats south of Murray Bridge have produced the red Swanport Granite which has been used extensively in Adelaide. A source should remain available.

Industrial Minerals

Gypsum is quarried on a small scale from lunette type dunes associated with lagoons such as Rotten Lake north of Renmark. The deposits are a potential raw material for any industries in the area fabricating plaster based building materials. These lunettes are not unique landforms and should remain available as a source of gypsum in the future.

Gypsum workings southeast of Blanchetown are outside of the study area. Similar deposits may be found nearer the river valley in this area and west of Waikerie.

Extensive gypsum deposits occur at Cookes Plains and these should remain available for working.

Salt is produced from a small lake in Sections 208, 209 Hd. Brinkley. This deposit is conveniently located near the Adelaide- Melbourne railway and continued operation should be permitted. South Australia provides a significant proportion of salt to the Australian chemical industries. Commercial salt fields in the State are located mainly on low lying coastal

mangrove and samphire swamp associations which are also important fish breeding grounds. Should it become necessary in the future to place new salt making facilities away from coastal locations, areas such as the extensive swamps and flats on the northern and eastern side of Lake Alexandrina and the eastern side of Lake Albert might be considered as alternatives. Detailed technical feasibility study and rigorous environmental investigation may show these areas to be unsuitable. However at this stage, the current study should not propose policies which would preclude the investigation and establishment of salt making operations in the area.

Recent sampling of quartz sand dunes flanking the northern shore of Lake Alexandrina showed them to be a potential source of glass and foundry sands. These deposits may provide an alternative to the deposit at Normanville being worked at the present from coastal dunes.

SUMMARY AND CONCLUSIONS

The Murray River valley provides the principal exposures of the sedimentary sequence and palaeontological record of the Murray Basin and the whole of the riverine tract, particularly the cliffs, are of major importance for scientific study, teaching purposes and public observation of geological and other features.

Man made excavations provide the best, and in places the only, exposures suitable for detailed study.

Construction materials are essential for public works and the provision of local community services. Availability of deposits within short trucking distance maximises the use of public-

funds. Provision of sufficient reserves for future use in close proximity to growth centres is in the public interest. Present and future demand for these materials will be mainly along the river.

Banning of mining from the riverine tract presupposes that alternative sources exist within reasonable haulage distance. Most of the present sources of sand, aggregate and building stone lie within the study area. The availability of resources is limited by geological distribution, overburden thickness and environmental features. The community can be permanently deprived of deposits free of such constraints by the inadvertent or premature establishment of housing and other land uses. Controlled extraction in preselected and reserved areas has little impact on the amenity of the total area.

No restrictive policy on mining should be proposed until an overall resource -demand study has been completed. Adequate supplies should then be reserved in defined extractive industry areas.

Building stones in the study area have been used locally and in Adelaide. Faithful restoration of buildings of national or historic importance depends on the continued availability of stone from these deposits.

Gypsum is the principal industrial mineral in the study area, most of current production being for local use.

Dune sands on the northern shore of Lake Alexandrina and swamp areas bordering Lakes Alexdrina and Albert are potential alternative sources of industrial sand and salt respectively which are presently supplied from environmentally and ecologically sensitive areas elsewhere in the State.

Pollution of potable waters is possible from disposal of solid and liquid wastes in boreholes and pits both on the river flats and the adjacent plains.

RECOMMENDATIONS

In respect to geological features and mineral resources, policy proposals emanating from the River Murray Study should include:-

1. Provision for continued access to the whole of the riverine tract for scientific study, teaching purposes and public observation. Development proposals within the study area should be referred to the Geological Survey for comment. Significant exposures, such as type sections, must be preserved and it may be necessary to restrict access to these. Explanatory signs, demonstrating the features visible, could be erected at points of general interest.
2. A recommendation for a detailed analysis of future demand for construction materials and agricultural gypsum and an evaluation of resources in terms of physical and environmental constraints. On the basis of this study, sufficient reserves for the long term future should be set aside in defined extractive industry areas.
3. Until statutory controls are introduced, all proposals for disposal of solid and liquid waste along and adjacent to the river valley should be referred to the Department of Mines for comment. This should include refuse pits and wastes from animal feed lots.

Policy proposals for the Lakes Alexandrina and Albert area should not be so stringent as to preclude the consideration and

investigation of the area for alternative sources of industrial sand and salt.

13th August 1974.
MNH:SC.

M.N. HIERN
SUPERVISING GEOLOGIST
ENVIRONMENT & RESOURCE DIVISION

REFERENCES

BLISSET, A.H., 1970. Mineral resources of the Upper Murray Planning area. Dept. Mines unpublished report RB70/146.

FIRMAN, J.B., 1972. RENMARK Explanatory Notes 1: 250 000 Geological Series Sheet S1/54-10 International Index. Geol. Surv. S. Aust.

_____, 1973. Regional Stratigraphy of Surficial deposits in the Murray Basin and Gambier Embayment. Geol. Surv. S. Aust. Rept. Investigations 39.

HIERN, M.N., 1963. Chowilla dam site - geological investigation - materials of construction. Min.Rev. Adelaide 115 : 117-129.

_____,1974. Mineral resources of the Murray Mallee Planning area. Dept. Mines report in preparation.

LINDSAY, J.M. & GILLES, S.D., 1973. Notes on the Lepidocyclina Zone in the Morgan Limestone along the Murray River, South Australia. Geol. Surv. S.Aust. Quart. Geol. Note 45.

LUDBROOK, N.H., 1961. Stratigraphy of the Murray Basin in South Australia. Geol. Surv. S. Aust. Bull. 36.

LUDBROOK, N.H., 1969. Tertiary Period in L.W. Parkin (Ed.) Handbook of South Australian Geology. Geol. Surv. S. Aust.

NICHOL, D., 1974. Construction materials resources - Monarto area. Dept. Mines unpublished report RB74/84.

APPENDIX 1

Recorded significant exposures in the Murray River Cliffs.

APPENDIX 1

RIVER MURRAY STUDY

RECORDED SIGNIFICANT GEOLOGICAL EXPOSURES IN MURRAY RIVER CLIFFS

LOCATION	HUNDRED	SECTION	FEATURE
TAILEM BEND - WELLINGTON	SEYMOUR		Ferry cutting - Blanchetown Clay, Norwest Bend Formation, Mannum Formation. Top of Ettrick Formation at pool level south of Tailem Bend.
CALOOTE	FINNISS	594	Morgan Limestone, Loxton Sands.
MANNUM PUMPING STATION	FINNISS	519	Mannum Formation type section, Finniss clay type section, Loxton Sands, Morgan Limestone.
BLANCHETOWN	PAISLEY	16	Blanchetown clay type section 5 km below Blanchetown
"	SKURRAY	CAR PARK WEST SIDE OF BRIDGE.	Morgan Limestone, Finniss clay Equivalent, Mannum Formation, Norwest Bend Formation.
GLENFORSLAN	MURBKO	1	Morgan Limestone, Loxton Sands, Norwest Bend Formation.
	MURBKO	28	Morgan Limestone.
MORGAN	CADELL	[illegible]	Morgan Limestone and Cadell Marl Lens type sections.
MORGAN 1B PUMP STATION	EBA	445	Morgan Limestone, Cadell Marl Lens.
NORWEST BEND	STUART	250	Norwest Bend Formation type section.
CADELL	STUART	BW	Morgan Limestone, Norwest Bend Formation.
QUALCO	WAIKERIE	BNW	Morgan Limestone, Cadell Marl Lens equivalent, ? Loxton Sands, Norwest Bend Formation.
WAIKERIE PUMP STATION	WAIKERIE		Morgan Limestone, Cadell Marl equivalent, Norwest Bend Formation.
HOLDER RESERVE	HOLDER		Morgan Limestone, Cadell Marl equivalent, Norwest Bend Formation.
LOWBANK	HOLDER		Morgan Limestone, Finniss clay equivalent, Mannum Formation.
BLIGHTS	HOLDER		Morgan Limestone, Finniss clay equivalent, Cadell Marl Lens equivalent, Mannum Formation.
WOOLPUNDA PUMP STATION	MOOROOK		Morgan Limestone, Finniss clay equivalent, Mannum Formation.
'ARIVERRON'	PARCOOLA	44	Morgan Limestone, Mannum Formation, Finniss clay equivalent.
OVERLAND CORNER RESERVE	PARCOOLA		Morgan Limestone, Finniss clay equivalent, Cadell Marl equivalent, Mannum Formation.

LOCATION	HUNDRED	SECTION	FEATURE
KINGSTON BRIDGE - WEST BANK	MOOROOK	8C	Loxton Sands.
KINGSTON - MOOROOK ROAD	MOOROOK	-	Loxton Sands
GREAT PYAP BEND	PYAP	11	Bookpurnong Beds type section, Loxton Sands.
LOXTON PUMPING STATION	GORDON	118	Loxton Sands type section
LAKE BONNEY	STONEY RIDGE	-	Blanchetown clay, siliceous limestone, Loxton Sands.
JONES QUARRY	SUGARLOAF HILL	-	Blanchetown clay, siliceous limestone, Loxton Sands.
BUNYIP REACH	MURTHO	21	Bunyip Sand type section.
CHOWILLA DAM SITE	MURTHO	19	Monoman Formation (in bores) Parilla Sand, Karoonda Surface.
BORDER GATE	MURTHO	24	Chowilla Sand type section.
LOCK 4	GORDON	109	Loxton Sands, Parilla Sand.

APPENDIX 2

Mining tenements as at 30 June 1974.

APPENDIX 2

RIVER MURRAY STUDY

MINING TENEMENTS WITHIN 2 KM OF 1956 FLOOD LEVEL - SUMMARY TABLE, JUNE, 1974

NUMBER	LOCATION		REGISTERED NAME	MATERIAL	
M.C. 442	Co. Hamley	Block 1003	R. & F. Quarry Supplies, Renmark	Limestone	M.L. applied for DM 1211/73
M.C. 5536	Co. Hamley	Block 988	Santos Ready Mixed Concrete	Limestone	M.L. applied for DM 456/73
M.L. 3153	Co. Hamley	River Murray	Scherer Contractors Pty.Ltd.	Sand	
M.L. 3173	Hd. Gordon	River Murray opp. 115,150	V.R. Migga, Berri	Sand	
M.L. 3178	Co. Hamley	River Murray	Scherer Contractors Pty.Ltd.	Sand	
M.L. 3207	Co. Alfred	River Murray	Santos Ready Mixed Concrete	Sand	
M.L. 3234	Hd. Cadell	River Murray adj. 275	L.C. Heppner & J.C.Ziegler	Sand	
M.L. 3255	Hd. Gordon	River Murray adj. 115	V.R. Migga, Berri	Sand	
EML 3374	Co. Hamley	Block 988	Santos Ready Mixed Concrete	Sand	
EML 4003	Hd. Paringa	291	Scherer Contractors Pty.Ltd.	Limestone	
EML 4004	Hd. Paringa	291	Scherer Contractors Pty.Ltd.	Limestone	
EML 4005	Hd. Gordon	River Murray adj. 182	Scherer Contractors Pty.Ltd.	Sand	
EML 4006	Hd. Gordon	River Murray	Scherer Contractors Pty.Ltd.	Sand	
EML 4095	Hd. Finniss	718, 603	R.M.C. Minerals	Sand	
EML 4096	Hd. Finniss	597, 602	R.M.C. Minerals	Sand	
EML 4097	Hd. Finniss	597	R.M.C. Minerals	Sand	
EML 4144	Hd. Finniss	603, 604	L.C. Guerin	Sand	
EML 4145	Hd. Finniss	603, 718, 597	L.C. Guerin	Sand	
EML 4352	Hd. Seymour	12, 13	Keough Sand Depot Pty.Ltd.		
P.M. 38	Hd. Brinkley	207, 208,209,	Aust. Paper Manufacturers	Salt	
- -	Co. Hamley		Jones' Quarry, Barmera	Aggregate	This operation is not on a mining tenement.