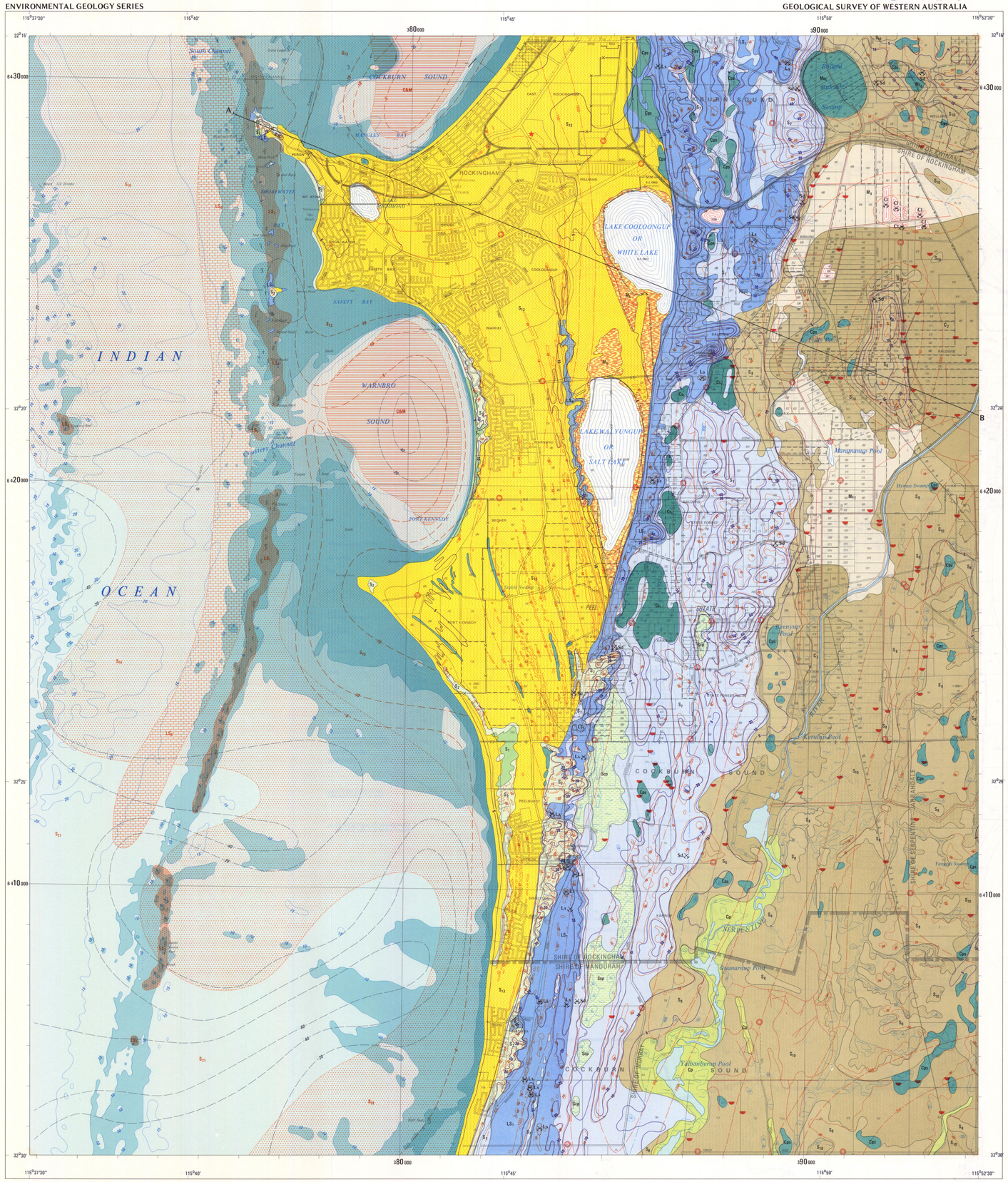
ENVIRONMENTAL GEOLOGY SERIES

ROCKINGHAM

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

PART OF SHEETS 2033 II AND 2033 III



OFFSHORE GEOLOGY

- Submarine reef — limestone, as LS_1 (in main reference)
- BECHER/ROCKINGHAM BANK UNIT : sand — moderately sorted carbonate lithoskals and lithoclasts with minor skeletal fragments of molluscs and algae
- SHEET UNIT : sand — well sorted, medium-grained carbonate lithoskals and lithoclasts with minor skeletal fragments of molluscs and algae
- BASIN UNIT — muds and silts — homogenous, calcareous muds and silts predominantly of calcite with a minor proportion of granite, occasional large skeletal fragments of echinoids and pelecypods
- Zone of submerged beach rock : limestone (as LS_1), north trending ridges 3–4 m high, 100–200 m apart, flanked and linked by tabular masses of seaward-sloping beach rocks
- INNER SHELF UNIT : sand — rocky surface of limestone with veneer (2-3m) of well sorted mixed quartz (10-40%) and carbonate sands, generally filling hollows, local variations in clast/skeletal debris can be expected

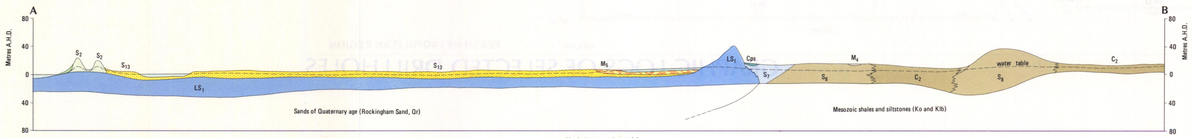
Searle J.D., 1984. Quantitative modelling, sediment transport system, Perth Sector, Rottnest Shelf. Final report for Project 80/2039, Marine Science and Technologies Grant Scheme, Department of Geology, University of Western Australia.

—20— Distribution of detrital quartz grains in the superficial sediments (percentage)

—10— Holocene sediment isopachs (metres)

SCALE 1 : 50 000

0 1 2 3 4 5 6 KILOMETRES



Vertical exaggeration x 12.5

SCHEMATIC CROSS–SECTION TO SHOW THE RELATIONSHIP OF THE UNITS

CAINOZOIC

QUATERNARY — HOLOCENE

Map Unit: Unconsolidated Material	Map Unit: Rock	Description	Equivalent unit on geological maps	Relief; slope	Rock–mineral resources	Permeability	Corrosion potential	Slope stability	Ease of excavation	Shrink–swell potential	Bearing capacity	SMEC	Current processes	Suitability for specified land uses: Solid waste disposal	Liquid waste disposal	Septic tanks	Construction of roads	Urban development	Excavation (mining, quarrying)	Notes
Cb_1		SANDY CLAY — dark grey to black, firm, variable quartz sand content, occasionally some silt in matrix, of lacustrine origin	Swamp deposits (Qhw)	5 m; F	Diatomite, sand	L	M	L	H	M–H	L	CI–CH	Flooding	✕	✕	✕	○	✕	●	High water table, prone to flooding, clayey soils of low bearing capacity
Cps		PEATY CLAY — dark grey and black, soft, variable organic content, some quartz sand in places, of lacustrine origin		5–15 m; F	Peat, diatomite	L	M–H	L	H	M–H	L	OH–CH	Flooding	✕	✕	✕	○	✕	●	High water table, prone to flooding, low bearing capacity, differential settlement may occur, most materials are compressible
Mh_1		SANDY SILT — dark brownish grey silt, with disseminated fine-grained quartz sand, firm, variable clay content, of lacustrine origin		6 m; F	Sand, diatomite	L	L–M	L	H	L	L–M	ML	Flooding	✕	✕	✕	○	✕	●	High water table, prone to flooding, differential settlement may occur
Scp		CLAYEY SAND — black, fine to medium-grained quartz sand with clay matrix, variable organic matter, of lacustrine origin		3 m; F	Sand	M	L–M	L	H	L	L–M	SW	Flooding	✕	✕	✕	○	✕	●	High water table, prone to flooding, differential settlement of foundations may occur
S_1		CALCAREOUS SAND — white, fine to medium-grained, sub-rounded quartz and shell debris, of eolian origin	Safety Bay Sand (mobile dunes) (Qhsm)	0–15 m; M	Limesand	H	L–M	L	H	N/A	L	SP–SW	Wind transportation	✕	●	◆	✕	✕	●	Active blowouts and sand sheets, unvegetated, high lime content gives it considerable potential for fixing certain kinds of waste, like dissolved heavy metals, and neutralising acids, low bearing capacity, settlement is common and can be uneven
S_2		CALCAREOUS SAND — as S_1		5–40 m; M–S	Limesand	H	L–M	L	H	N/A	L	SP–SW	Wind transportation	◆	●	◆	⊗	✕	✕	Moderate to steep slopes, very susceptible to remobilisation where the sparse vegetation is removed, high lime content gives it considerable potential for fixing certain kinds of waste, like dissolved heavy metals, and neutralising acids, low bearing capacity, settlement is common and can be uneven
	LS_4	LIMESTONE — pale yellowish brown, weakly cemented, friable, medium-grained, sub-rounded quartz and shell debris, of eolian origin	Safety Bay Sand (Qhs)	5–20 m; M–S	Limesand	H	L–M	M	H	N/A	L–M	SP–SW	Wind transportation	✕	●	◆	⊗	✕	✕	Generally linear features with moderate to steep slopes, susceptible to remobilisation, low bearing capacity generally
S_{13}		CALCAREOUS SAND — white, medium-grained, rounded quartz and shell debris, well sorted, of eolian origin		0–10 m; F	Limesand	H	L–M	M	H	N/A	L–M	SP	Marine erosion	✕	✕	◆	◆	◆	●	Low undulating relic foredune topography, variably thick sands overlying LS_1 type limestone at relatively shallow depth, generally high water table, variable bearing capacity dependent on degree of consolidation of sands
Cp		PEATY CLAY — mid to dark grey, soft, water saturated clay with variable organic content, of alluvial origin	Alluvium (Qha)	0–2 m; F	Clay for brick, pipe and tile manufacture	L	L–M	L	H	L–M	L	CI	Flooding, stream flow, sediment transport	✕	✕	✕	○	✕	●	Confined to the lower reaches of the Serpentine River and a small valley in the southeast of the area, high water table, prone to flooding, low bearing capacity
Sh_2		CALCAREOUS SILT — dark greyish brown silts and minor clays, shells and shell fragments and limestone are locally common, a recemented limestone is common on some low ridges	Lagoonal deposits (Qhg)	5 m; F	Marl, limestone	L	M	L	H	L	L	ML	Flooding	✕	✕	✕	○	✕	●	High water table, prone to flooding, differential settlement may occur

QUATERNARY — PLEISTOCENE

Map Unit: Unconsolidated Material	Map Unit: Rock	Description	Equivalent unit on geological maps	Relief; slope	Rock–mineral resources	Permeability	Corrosion potential	Slope stability	Ease of excavation	Shrink–swell potential	Bearing capacity	SMEC	Current processes	Suitability for specified land uses: Solid waste disposal	Liquid waste disposal	Septic tanks	Construction of roads	Urban development	Excavation (mining, quarrying)	Notes
S_7		SAND — pale yellowish brown, medium- to coarse-grained, sub-angular quartz, trace of feldspar, moderately sorted, of residual origin	Sand derived from Tamala Limestone (Qts)	10–60 m; G	Specification sand	M	L	L–M	H	N/A	L–M	SP–SW	Groundwater recharge	●	●	●	◆	◆	◆	Few limitations, some settlement under foundations can be expected, some ability to attenuate pollutants due to small clay content, usually considerable depth to water table due to topography
	LS_1	LIMESTONE — pale yellowish brown, fine to coarse-grained, sub-angular to well rounded quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin	Tamala Limestone (Qtl) and Safety Bay Sand (Qhs) in part	5–75 m; G–M	Dimension stone, metallurgical, agricultural and construction grade limestone	H	L	M–H	M–H	N/A	V	SP–SW	Groundwater recharge	✕	✕	●	◆	◆	◆	Variable bearing capacity depending on degree of cementation, common solution cavities and fissures could lead to severe settlement under load and also offer an easy path for pollutants down to the water table. High water table on beach ridge plain
S_8		SAND — very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of eolian origin	Bassendean Sand (Qpb)	5–45 m; G	Construction and glass sand	H	L	L	H	N/A	M–H	SP–SW	Groundwater recharge, some wind transportation	●	✕	●	◆	◆	◆	Well drained, when dry and vegetation free it could be remobilised, drainage disposal is only a problem in areas of high water table
S_{10}		SAND — as S_8 as relatively thin veneer over C_2, M_4 and Mc_2	Thin Bassendean Sand over Guildford Formation (Qpb/Qpa)	5–20 m; F	Construction and glass sand	H	L	L	H	N/A	M–H	SP–SW	Groundwater recharge, some wind transportation	✕	✕	✕	◆	◆	◆	Of variable thickness, the sand's physical properties are modified by the underlying material, generally high water table, prone to flooding in part
C_2		CLAY — strong brown and dark grey clay, plastic in places, soft when wet, variable silt content in matrix, of alluvial origin	Guildford Formation (Qpa)	2–10 m; F	Clays for brick, pipe and tile manufacture	L	L	L–M	H	L–M	L–M	CI	Flooding, stream flow, sediment transport	✕	✕	✕	◆	⊗	◆	High water table, prone to flooding in part, cohesion and shrinkage very, alternate wetting and drying may cause swelling and shrinkage, dispersive in places
M_4		SILT — very pale brown silt, soft when moist, firm when dry, low clay content, of alluvial origin		5–8 m; F	Clays for brick, pipe and tile manufacture	L	L	L–M	H	L–M	L–M	ML–MI	Some flooding	✕	✕	✕	◆	⊗	◆	High water table, prone to flooding in part, potential in part for swelling and shrinkage
Mc_2		CLAYEY SILT — dark greyish brown, mottled in part, soft when wet, plastic in part, blocky, variable clay content, of alluvial origin		2–5 m; F	Clays for brick, pipe and tile manufacture	L	L	L	H	L	L–M	ML	Some flooding	✕	✕	✕	◆	✕	◆	High water table, prone to flooding in part, some settlement of foundations may occur

REFERENCES

1 See Lithological Classification

2 The terms unconsolidated material and rock are used in the sense of the engineering terms "soil" and "rock".

3 Colours were derived from Standard Soil Colour Charts, notation omitted

4 Maximum and minimum elevation of the unit with respect to Australian Height Datum

5 Slopes expressed qualitatively
F–flat . . . . . <3°
G–gentle . . . . . 3°–10°
M–moderate . . . . . 10°–20°
S–steep . . . . . >20°
The dominant slope of each unit is given

6 H . . . . . high
M . . . . . moderate
L . . . . . low
V . . . . . variable
N/A . . . . . not applicable
Properties vary with degree of weathering

7 Snowy Mountains Engineering Corporation Soil Classification which describes soils in terms of grain size, grading characteristics and compressibility
For rocks the symbols refer to the weathered products

8 ✕ activity undesirable for the environment
● possible problems for the environment
⊗ possible problems for the activity
◆ activity compatible with unit

The data contained on this sheet are provided for preliminary studies and are not intended as a substitute for detailed on-site investigation

This map should not be used for navigation purposes

LITHOLOGICAL CLASSIFICATION

UNCONSOLIDATED MATERIAL

A single capital letter denotes the main lithology of the soil unit followed, if required, by lower case letters denoting qualifying lithologies in decreasing order of importance – left to right.

C . . . . . clay
M . . . . . silt
S . . . . . sand
P . . . . . organic material

ROCK

Double capital letters denote lithological symbols of rocks

LS . . . . . limestone

Different mappable units of similar lithologies are shown by the lithological symbol followed by an Arabic number.

SYMBOLS

GEOLOGY
- geological boundary

HYDROGRAPHY
- perennial stream with direction of flow
- seasonal stream with direction of flow
- marsh
- lake
- 950 isohyet (mm), figure on high side of line
- 15 depth to groundwater, metres
- 500 isohaline (mg/l T.D.S.)
- area inundated during floods
- 20 bathymetric contour in metres

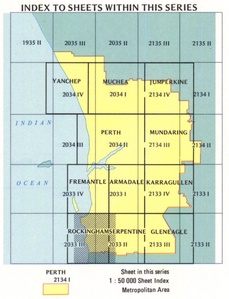
BOREHOLES, WELLS AND OTHER WORKS
- observation borehole, Metropolitan Water Authority
- storage reservoir, dam or tank
- solid waste disposal site, active
- drain
- tailing pond, water-filled excavation

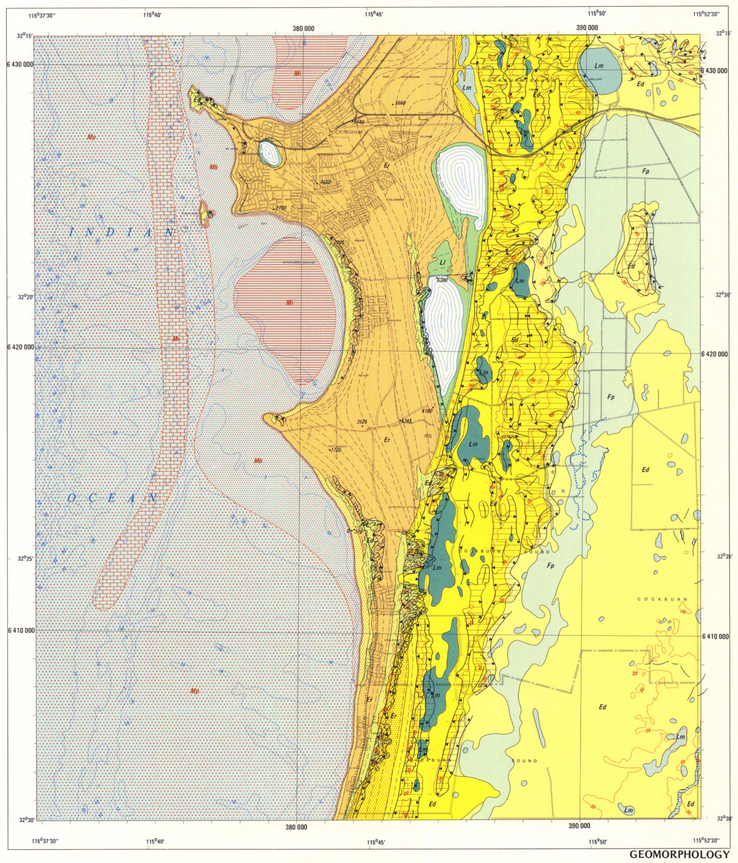
MINERAL RESOURCES
- quarry or pit, active
- quarry or pit, inactive
- mineral occurrence
- Cl clay
- Sd sand
- Ls limestone

TOPOCADASTRAL INFORMATION
- road, classification as shown
- railway
- Metropolitan Regional Scheme boundary
- townsite boundary
- local authority boundary
- state forest boundary
- agricultural area boundary
- power line
- 20 contour in metres

The Australian Map Grid covers Australia and the Territories administered by Australia. Zones are 6° wide plus ½° overlap. A.M.G. zones are numbered from zone 47 with central meridian 99°E to zone 58 with central meridian 165°E. The origin of each zone is the intersection of the central meridian with the equator. On this map ticks on the sheet edge represent 1000 metre intervals on the superimposed A.M.G. Zone 50.

INDEX TO SHEETS WITHIN THIS SERIES





GEOMORPHOLOGY

SCALE 1 : 100 000

0 1 2 3 4 5 6 KILOMETRES

GEOMORPHOLOGICAL CLASSIFICATION

- Ed Parabolic and nested parabolic dunes, Quindalup Dunes
- Er Relic foredune plain, high level, Holocene
- Er Relic foredune plain, low level, Holocene
- Er Relic foredune plain, Pleistocene/Holocene
- Ed Degraded surface of eolian origin, Spearwood Dunes
- Ed Degraded surface of eolian origin, Bassendean Dunes
- Lm Marsh in interbarrier depression, high level
- Lm Marsh in interbarrier depression, low level
- Lm Marsh in interdunal swale
- Lm Marsh on alluvial plain
- Ll Lagoon
- Fp Alluvial plain
- Fp Flood plain
- Ms Submarine bank
- Mp Submarine shelf
- Mt Submarine basin
- Zone of submerged beach rock
- Lake

The geomorphological classification comprises a single capital letter which denotes the origin of the material and a lower case letter which represents the morphology.

ORIGIN
E . . . . . eolian
L . . . . . lacustrine
F . . . . . fluvial
M . . . . . marine
e.g. Er . . . . . eolian ridge

MORPHOLOGY
d . . . . . dune
r . . . . . ridge
m . . . . . marsh
l . . . . . lagoon
p . . . . . plain
i . . . . . interbarrier depression
b . . . . . bank
Ll . . . . . lagoon

SLOPES
- 0°–3°
- 3°–10°
- 10°–20°
- 20°–30°

FEATURES
- Prominent ridge
- Sharp convex break of slope
- Sharp concave break of slope
- Oxbow or cutoff channel
- Relic foredune trend lines
- Erosional scarp
- 5660 Sample site with reported age in years (Woods, Searle, 1983)

Rocky coast with hard cliffs and small sandy beaches. The impact of medium scale dynamic changes and storm patterns is unlikely to alter the shoreline position by any great extent.

Sandy coast. Storm and erosion cycles have the greatest impact on these coasts. Without protection, large scale erosion during stormy years is likely to occur. Once erosion does start there is little to stop it. Preservation of the dunes and their vegetation is important in facilitating recovery following storm onset and beach erosion.

Published by and available from Geological Survey of Western Australia, 66 Adelaide Terrace, Perth. Cartography by the Mapping Branch, Surveys and Mapping Division, Department of Mines. Topographic base from compilations by the Department of Lands and Surveys. Cadastral base from Town Planning Department, Metropolitan Region Scheme Map, 1981. Bathymetry from Public Works Department Hydrographic Series. Printed by Government Printing Office, Perth, 1985.

Bibliographic Reference : Gozzard J.R. 1983 Rockingham part Sheets 2033 III and 2033 II. Perth Metropolitan Region, Environmental Geology Series, Geological Survey of Western Australia.

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PERTH METROPOLITAN REGION
1 : 50 000 ENVIRONMENTAL GEOLOGY SERIES

ROCKINGHAM
PART OF SHEETS 2033 II AND 2033 III

1 : 50 000 ENVIRONMENTAL GEOLOGY SERIES

ROCKINGHAM

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

PART OF SHEETS 2033 II AND 2033 III

NE 99 ..... drillhole registration number

..... drillhole site

..... sand

..... clay

..... limestone

..... standing water level

..... sandy clay

..... sandy limestone

..... gravel

..... shale

Qr ..... Rockingham Sand

Ko ..... Osborne Formation

..... symbol denotes full thickness of borehole not shown graphically

Kb ..... Leederville Formation

100.7 ..... base of drillhole

..... approximate extent of clayey facies of Guildford Formation

Abbreviations for the superficial deposits are the same as those on the face of the map

SCALE 1 : 50 000

KILOMETRES 0 1 2 3 4 5 6

PERTH METROPOLITAN REGION

GRAPHIC LOGS OF SELECTED DRILLHOLES