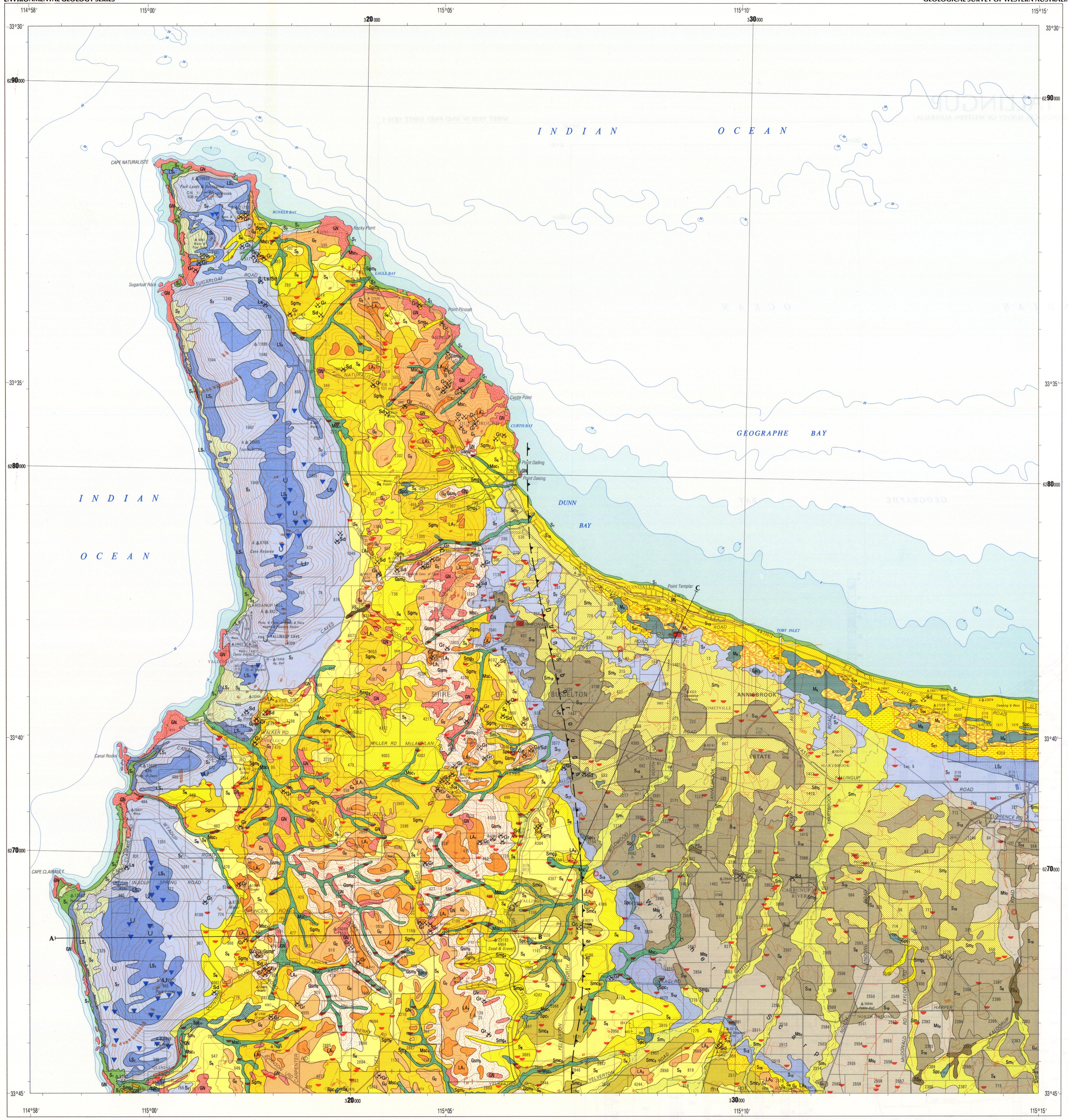
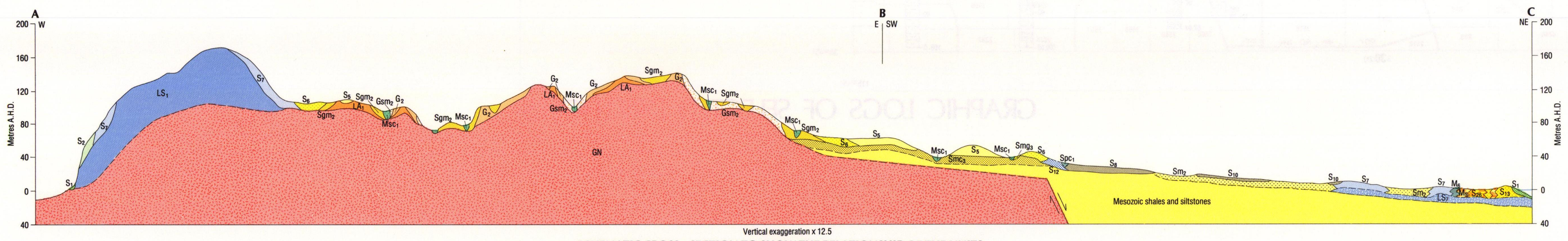
YALLINGUP

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA



SCALE 1:50 000 KILOMETRES



SCHEMATIC CROSS–SECTION TO SHOW THE RELATIONSHIP OF THE UNITS

Age	Map unit[1]: Unconsolidated material[2]	Map unit[1]: Rock[2]	GENERAL FEATURES: Description	Equivalent unit on geological maps	Relief[3]; slope[4]	Rock-mineral resources	PHYSICAL PROPERTIES[5]: Permea-bility	Slope stability	Ease of excavation	Shrink-swell potential	Bearing capacity	USC[6]	CURRENT PROCESSES	SUITABILITY FOR SPECIFIED LAND USES[7]: Sanitary land-fill	Septic tanks	Urban-isation	Exca-vation	NOTES
CAINOZOIC – QUATERNARY – HOLOCENE	Spc_1		CLAYEY PEATY SAND — grey to black quartz sand with variable organic content; minor clays	Swamp deposits (Qhw)	3—110 m; F	Peat	L	L	H	L—M	L	SC	Annual flooding	✕	✕	✕	●	High water table, seasonal flooding; variable bearing capacity depending on peat and clay content
	S_1		CALCAREOUS SAND — white, fine- to coarse-grained, sub-rounded quartz and shell debris; also sub-rounded lithic pebbles	Safety Bay Sand mobile dunes (Qhsm)	0—25 m; F	Limesands, heavy minerals	H	L	H	N/A	L	SP—SW	Wind transportation, marine erosion	✕	◆	✕	✕	Active blowouts and sand sheets, unvegetated; high lime content gives it considerable potential for fixing certain types of waste and neutralizing acids; settlement common
	S_2		CALCAREOUS SAND — white, fine- to medium-grained, sub-rounded quartz and shell debris	Safety Bay Sand (Qhs)	3—140 m; G—M	Limesands, heavy minerals	H	L	H	N/A	L	SP—SW	Wind transportation	◆	◆	○	●	Moderate slopes, very susceptible to mobilization when sparse vegetation is removed
	S_{13}		CALCAREOUS SAND — white, medium-grained, rounded quartz and shell debris; well sorted		0—3 m; F	Limesands	H	L	H	N/A	L	SP—SW	Wind transportation, marine erosion	◆	◆	◆	●	Low undulating relict foredune topography; variably thick sands sometimes over limestone (LS_7)
	S_{26}		CALCAREOUS SAND — as S_{13}, modified by estuarine and marine processes		1—3 m; F	Limesands	H	L	H	N/A	L	SP—SW	Flooding, marine erosion	◆	◆	◆	●	Variable thickness, dependent upon degree of estuarine and marine modification; sometimes occurring over limestone (LS_7)
	S_{27}		SAND — as S_{26} as a relatively thin layer of quartz and calcareous sand over variably thick estuarine silts and gley clays	Estuarine deposits (Qhg)	0.5—3 m; F		M—H	L	H	L	L	SP—SW	Flooding	✕	✕	✕	●	High water table; thin sands have physical properties modified by silts and clays beneath them
	M_6		SILT — brownish grey, calcareous in part, soft; some fine sand and shell debris in places, minor clay content		0.5—2 m; F		L	L	H	L	V	MH	Flooding	✕	✕	✕	●	High water table, prone to flooding; differential settlement may occur with compaction
	M_5		CALCAREOUS SILT — dark greyish brown silts and minor clays; some organic matter, shells and shell fragments and limestone are locally common		0.2—1 m; F		L	L	H	L	L	MH	Seasonal inundation	✕	✕	✕	●	High water table, inundated most of the year; variably thick, unconsolidated layers of clays, organic oozes, gleys and silts overlying LS_7 type limestone
	Sm_1		SILTY SAND — strong brown to reddish brown, fine- to medium-grained quartz; variable silt content	Alluvium (Qha)	3—130 m; F—G		M	L—M	H	L	M	SM	Stream flow	○	✕	✕	◆	Variable thickness dependent on position in channel; sometimes over ironstone – coffee rock (FS_3)
	Msc_1		CLAYEY SANDY SILT — pale brown, angular to rounded sand; low cohesion; of alluvial origin		22—75 m; F—G		L	M	H	L	M	ML	Stream flow	○	✕	✕	◆	High water table, streams leading to coastal plain; sand from eolian and alluvial sources
	Smg_3		GRAVELLY SILTY SAND — very pale yellow to yellowish grey, mottled, fine- to medium-grained, quartz; locally high concentrations of pisoliths, variable silt content		35—95 m; F		L—M	L—M	H	L	M	SM	Stream flow	✕	✕	○	◆	Highly variable alluvial deposit draining gneissic terrane of Leeuwin Complex
	G_1		GRAVEL — red-brown gravels set in silty matrix overlying ironstones, cemented limonitic gravels, and coarse sands		16—25 m; F	Gravel	L—M	M	M—H	L	L—M	GM	Stream flow	✕	●	✕	◆	Incipient formation of pisolithic limonitic deposits, poorly drained
		FS_3	IRONSTONE — red-brown limonitic gravel cemented in a limonite quartz-sand matrix		20—40 m; F		V	H	V	L	H	N/A	Water table leaching, deposition	✕	●	✕	●	Bog-iron or cemented pisolithic limonite deposited along palaeo-watertables, dune swales or rivers; deposition occurring currently; poor internal drainage
	Sm_{12}		SILTY SAND — yellowish brown to reddish brown, fine- to medium-grained quartz; some pisolithic gravels, variable silt content		1.5—16 m; F		L—M	L	M	L	M	SM	Stream flow	✕	✕	◆	◆	Alluvial deposit derived from material of the Leeuwin Complex; generally homogeneous composition
	Smg_4		GRAVELLY SILTY SAND — moderate brown to dark yellowish brown, fine- to coarse-grained, poorly sorted quartz variable silt content		10—45 m; F		L—M	L	H	L	L—M	SM	Stream flow	○	✕	✕	◆	Restricted occurrence, appearing as a coastal alluvial deposit draining gneissic terrane of Leeuwin Complex; highly variable composition
PLEISTOCENE	S_7		SAND — white to pale and olive-yellow, medium- to coarse-grained, sub-angular quartz; moderately sorted	Sand derived from Tamala Limestone (Qts)	2—150 m; F—M	Specification sand	M	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
		LS_7	LIMESTONE — light yellowish brown, fine- to coarse-grained, sub-angular to well-rounded quartz with shell, coral and, less commonly, crinoid debris; often overlain by S_7	Tamala Limestone (Qtl)	0—2 m; G—S		H	M—H	M—H	N/A	V	SP—SW	Groundwater recharge	✕	●	◆	◆	Variable bearing capacity depending on degree of cementation, solution cavities and fissures could lead to severe settlement under load and also offer an easy path for pollutants down to the water table
		LS_1	LIMESTONE — light yellowish brown, fine- to coarse-grained, sub-angular to well-rounded quartz, with shell debris and a trace of feldspar; kankar at surface common		0—214 m; F	Limestone	H	M—H	M—H	L	V	SP—SW	Groundwater recharge	✕	●	◆	◆	As for LS_7; cave systems and other large-scale karstic phenomena (e.g. swallows, dolines) present
	S_8		SAND — very light grey at surface, yellow at depth, fine- to medium-grained, sub-rounded quartz; moderately well sorted; local concentrations of heavy minerals, local development of coffee rock	Bassendean Sand (Qpb)	10—55 m; F	Sand fill, construction sand, heavy minerals	H	L	H	L	M—H	SP—SW	Groundwater recharge	◆	◆	◆	◆	Depth to water table variable; becomes remobilized if devegetated, permanent cuts unstable: may have coffee rock (FS_3) zones at palaeo-watertable ranging from red discolouration to unrippable massive limonite
	S_{10}		SAND over SILT and SANDY SILT — sand as S_8 overlying Ms_2		5—38 m; F	Sand fill, construction sand	H	L	H	L	M—H	SP—SW	Groundwater recharge	●	●	◆	◆	Of variable thickness; the sands physical properties are modified by the underlying units; high water table
	Ms_2		SANDY SILT — strong brown to mid-grey, mottled, blocky, disseminated fine sand, hard when dry	Guildford Formation (Qpa)	5—20 m; F		L	M—L	H	L	M—H	ML	Flooding	✕	✕	○	◆	High water table, prone to flooding; can be developed as small-holding ponds when excavated in clayey horizons
	Sm_2		SILTY SAND — brown to yellow-grey, fine- to medium-grained quartz sand with variable silt content		2—30 m; F		L—M	L—M	H	L	M—H	SM	Flooding	○	○	○	◆	High water table, prone to flooding; can be developed as small-holding ponds when excavated in clayey horizons
	S_{12}		SAND — white, medium- to very coarse-grained, sub-rounded to rounded quartz; well sorted; local concentrations of heavy minerals	Yoganup Formation (Qpr)	35—95 m; F—G	Sand fill, coarse grits, heavy minerals	M—H	L—M	H	L	L—M	SW	Eolian and fluvial erosion	◆	◆	◆	◆	Marine beach and dune deposits; has silty and, more rarely, clayey bands; boulder deposit common at base of unit
	S_5		SAND — very pale brown, medium- to coarse-grained, well sorted, sub-angular to rounded quartz and feldspar	Colluvium (Qc)	25—110 m; F—G	Potential construction sand	H	L—M	H	N/A	L—M	SP	Sheet wash	◆	◆	◆	◆	Good foundations when compacted, permanent cuts unstable
	S_6		SAND — light grey, fine- to coarse-grained, angular to sub-rounded quartz with some feldspar; moderately sorted, loose		55—136 m; F—G	Potential construction sand	H	M—H	H	N/A	M—H	SP—SW	Sheet wash	◆	◆	◆	◆	Good foundations when compacted
	S_{28}		SAND — white, coarse- to very coarse-grained, rounded quartz, occasional pebble and cobble beds		105—133 m: F—G	Coarse grits, sand fill	M—H	L—M	H	L	L—M	SW	Fluvial erosion	◆	◆	◆	◆	Eluvial sand portion of lateritized Mesozoic beach deposit
	Sgm_2		SILTY GRAVELLY SANDS — moderate brown to reddish brown, mottled, fine- to coarse-grained quartz; trace feldspar, pisolithic gravels, variable silt content		10—134 m; F—G	Gravel	M—H	L—M	H	L	M—H	SM	Sheet wash, solufluction	●	✕	○	◆	Variable value as foundation
	Gsm_2		SILTY SANDY GRAVELS — moderate brown, mottled, pisolithic gravels and quartz; variable silt content, often thinly overlying gneiss (GN)		35—121 m; F—G	Gravel	H	M	M	L	M—H	GM	Sheet wash	●	✕	○	◆	Variable value as foundation
	Smg_5		GRAVELLY SILTY SAND — dark reddish brown, mottled fine- to coarse-grained, quartz and feldspar and gneiss gravels; thinly developed over gneiss (GN)		20—75 m; G		L	L	H	L	M	SM	Sheet wash	✕	✕	◆	◆	Restricted occurrence on Leeuwin Complex
TERTIARY	G_2		GRAVEL — brown to reddish brown, ferruginous, pisolithic; occasionally cemented in a clay-silt matrix, moderately sorted	Laterite (Czl)	5—149 m; F—G	Gravel	H	M	H	L	H	GP	Stream flow, sheet wash	✕	◆	◆	◆	When compacted can stand heavy loads
		LA_1	LATERITE — massive and cemented, occasionally vesicular, up to 4m in thickness; overlies mottled and/or pallid clays, sometimes overlain by a ferruginous gravel set in a clay-sand matrix		45—140 m; F—G	Gravel, building stone	V	H	L(V)	L	H	N/A	Stream flow, sheet wash	✕	●	◆	●	Strong foundations but subsurface drainage is a problem; requires blasting to excavate
		LA_3	LATERITE — massive, indurated, nodular and vesicular, iron-cemented, contains abundant fine- to medium-grained sub-angular quartz; developed over Leederville Formation		50—70 m; F—G	Gravel, building stone	V	H	L(V)	L	H	N/A	Sheet wash	✕	●	◆	◆	May require blasting to excavate, variable value as a foundation
MESOZOIC – CRETACEOUS	Cms_1		SANDY SILTY CLAY — pale yellow to red, mottled; grades into weathered gneissic rock (GN) at depth, often overlain by pisolithic gravels		55—110 m; M—S		L	LV	M	L—M	L—M	CL	Sheet wash, soil moisture changes	◆	○	○	◆	Completely weathered gneissic material over gneiss (GN); foundation conditions variable, stability problems may occur on moderate to steep slopes
	Smc_3		CLAYEY SILTY SAND — off-white to brown, mottled, fine- to coarse-grained, sub-rounded sand with local concentrations of clay; variable silt content	Leederville Formation (Klb)	40—70 m; M—G		L	LV	M	L—M	L—M	SM	Sheet wash, stream flow, soil moisture changes	◆	○	○	◆	Highly weathered to completely weathered Leederville Formation; variable kaolinite content; foundation conditions variable, possible stability problems on steep slopes
ARCHAEAN		GN	GNEISS — medium-grained mesocratic gneiss	Gneiss (An)	0—130 m; F—S	Armour stone, crushed rock aggregate	V(L)	H	L	N/A	H	N/A	Stream flow	●	✕	◆	◆	Competent foundations when fresh; slope stability dependent on orientation of joints; gneissic foliation and occurrence of dolerite dykes; weathering produces planar weakness parallel to gneissocity

REFERENCES

1 See Lithological Classification

2 These terms are used in the engineering sense.
The term "soil" denotes an aggregate of mineral grains which can be separated by gentle mechanical means.
The term "rock" denotes an aggregate of minerals connected by strong and permanent forces.

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

4 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

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

6 Unified Soil Classification System which describes soils in terms of grain size, grading characteristics, and compressibility. Rock units are not applicable (N/A).
Refer to GSWA Record 1989/10 for classification table.

7 ✕ land use undesirable for the environment
● possible problems for the environment
○ possible problems for the land use
◆ land use compatible with the unit

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

The seaward part of 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
G .... gravel
M .... silt
P .... organic material
S .... sand

ROCK

Double capital letters denote lithological symbols of rock

FS .... ironstone
GN .... gneiss
LA .... laterite
LS .... limestone

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

SYMBOLS

GEOLOGY
.... geological boundary, inferred
.... concealed trace of Dunsborough Fault System

HYDROGRAPHY
.... seasonal stream with direction of flow
.... marsh
.... lake
1000 .... isohyet (mm), figure on high side of line
5 .... depth to groundwater, metres
500 .... isohaline (mg/L TDS)
20 .... bathymetric contour in metres

KARST FEATURES
.... doline
.... cave without known groundwater flow

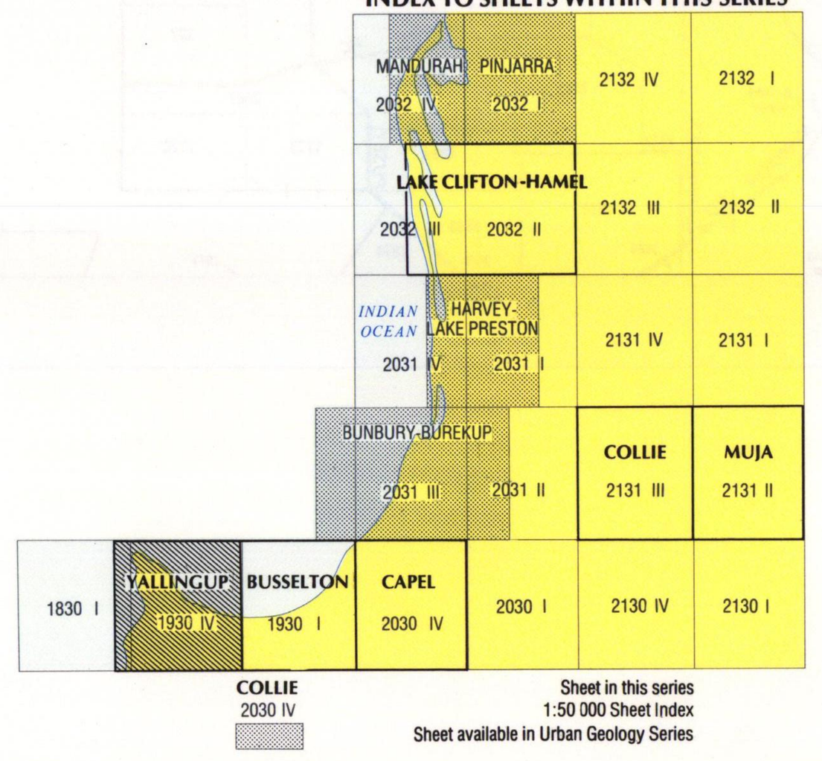
BOREHOLES, WELLS AND OTHER WORKS
.... observation borehole, Geological Survey of Western Australia
.... groundwater treatment plant
.... storage reservoir, dam or tank
.... solid waste disposal site, active
.... drain

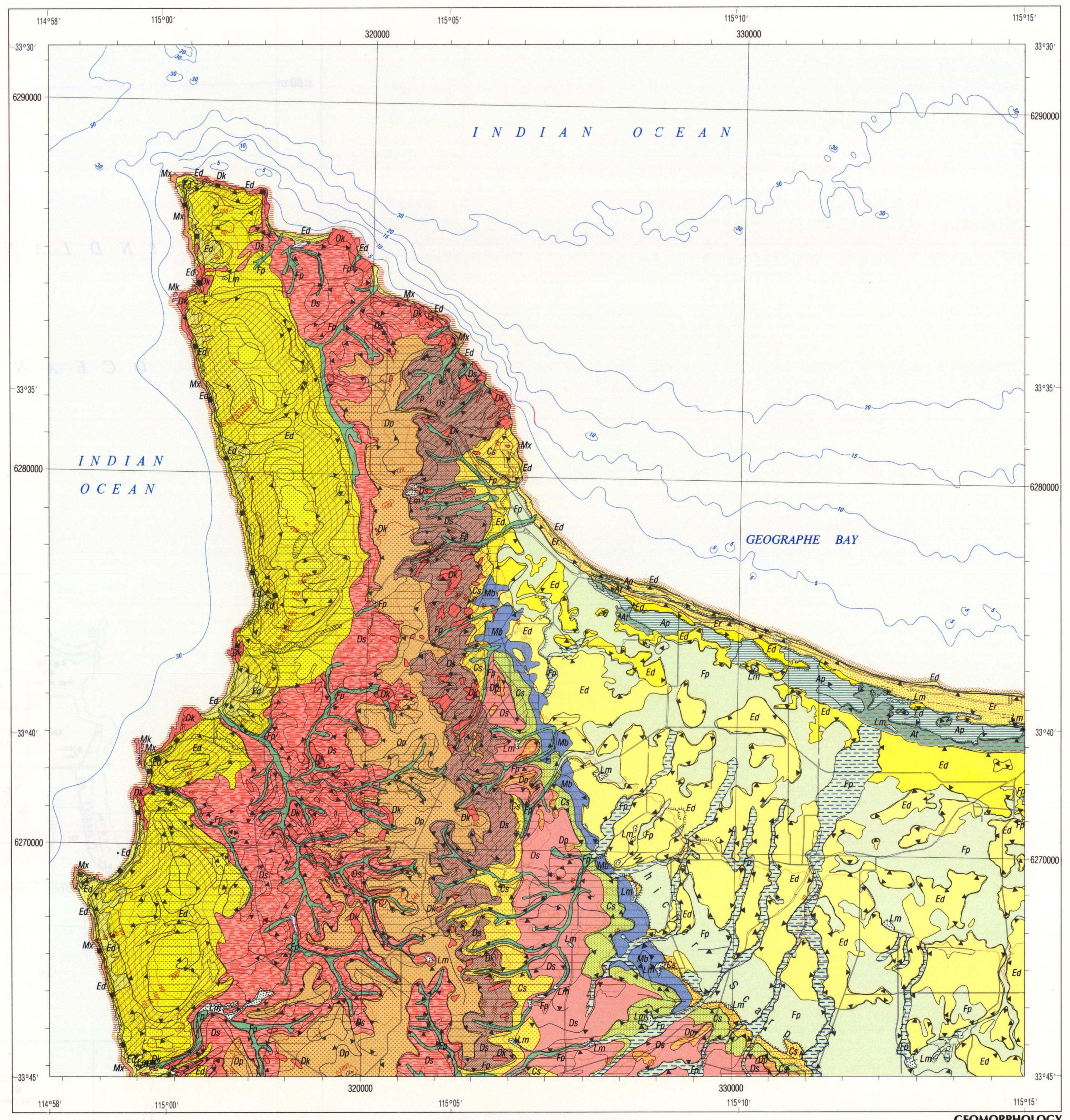
MINERAL RESOURCES
.... quarry or pit, active
.... quarry or pit, inactive
mineral occurrence
Gr .... gravel
Ls .... limestone
Sd .... sand

TOPOCADASTRAL INFORMATION
HIGHWAY .... road, classification as shown
.... townsite boundary
.... State Forest boundary
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 KILOMETRES
0 1 2 3 4 5 6

GEOMORPHOLOGICAL CLASSIFICATION

Symbol	Description
Ap	Estuarine (saline) flat, Vasse Coastal Land System, Holocene
At	Estuarine terrace, Vasse Coastal Land System, Holocene
Ed	Eolian dunes, mobile, Quindalup Dunes, Holocene
Ed	Eolian dunes fixed, Quindalup Dunes, Holocene
Ed	Degraded surface of eolian origin, Quindalup Dunes, Holocene
Er	Relict foredune plain, Quindalup Dunes, Holocene
Lm	Marsh, Holocene
Lm	Marsh in interdunal swale, Vasse Coastal Land System, Holocene
Fp	Flood plain, Holocene
Fp	Narrow fluvial valley floor, Holocene
Ed	Degraded surface of eolian origin, Spearwood Dunes on coastal plain, Pleistocene
Ed	Degraded surface of eolian origin, Bassendean Dunes, Pleistocene
Ed	Degraded surface of eolian origin, Spearwood Dunes on Leeuwin Ridge, Pleistocene
Fp	Alluvial plain, Pleistocene
Cs	Colluvial slope of the Yoganup Formation, Pleistocene
Mb	Raised marine surface, Yoganup shoreline, Pleistocene
Cs	Colluvial slope of the Whicher Scarp, Pleistocene
Ds	Degraded surface of planation and denudational slopes of the Blackwood Plateau, Pleistocene
Dp	Surface of planation of the Blackwood Plateau, Pleistocene
Cs	Colluvial slopes at the foot of the Dunsborough Fault scarp, Pleistocene
Ds	Gently to steeply inclined scarp face of the Dunsborough Fault, Pleistocene
Ds	Degraded surface of planation and denudational slopes of Leeuwin Complex, Pleistocene
Dp	Surface of planation of the Leeuwin Complex, Pleistocene
Mk	Gneissic offshore islands, Archaean
Mx	Gneissic rock shore-platform, Archaean
Dk	Gneissic knolls, inselbergs and bornhardts, Archaean
	Lake

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

ORIGIN
A .... estuarine
C .... colluvial
D .... denudational
E .... eolian
F .... fluvial
L .... lacustrine
M .... marine

LANDFORM
b .... beach
d .... dune
k .... knoll, inselberg
m .... marsh
p .... plain
r .... ridge
s .... slope
t .... terrace
x .... rock platform

eg. *Cs* .... colluvial slope
Fp .... floodplain

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.

SLOPES
0°—3°
3°—10°
10°—20°
>20°

FEATURES
Prominent ridge
Sharp convex break of slope
Sharp concave break of slope
Sharp convex and concave breaks of slope too close to be shown individually
Relic dune trend lines
Cliff

Cartography by the Surveys and Mapping Division, Department of Mines, Western Australia.
Topographic base from compilations by the Department of Land Administration.
Cadastral base from the Department of Conservation and Land Management.
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HON. GORDON HILL, J.P., M.L.A.
MINISTER FOR MINES
D.R. KELLY, DIRECTOR GENERAL OF MINES

P.E. PLAYFORD
DIRECTOR, GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

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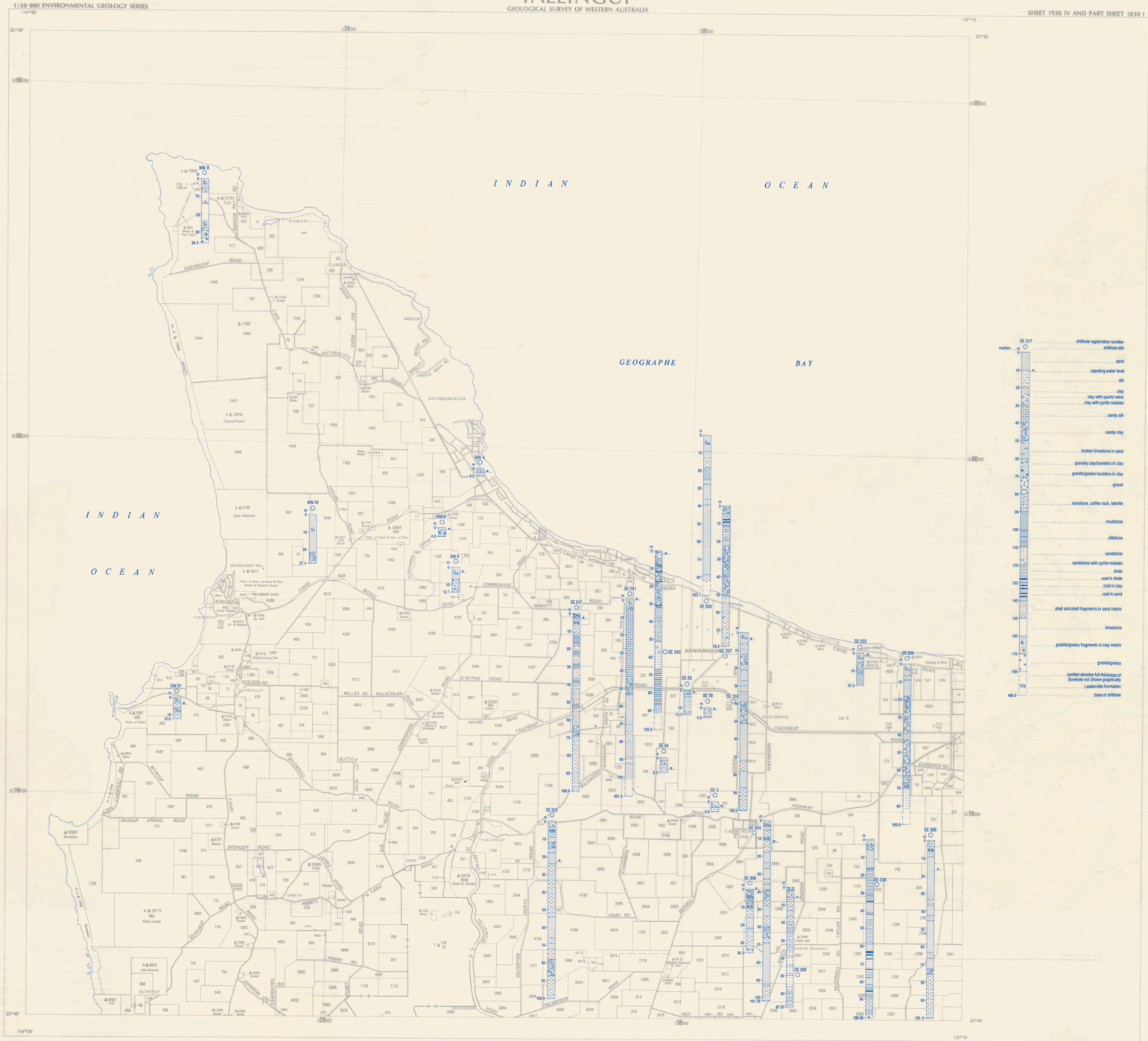
GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

SHEET 1930 IV AND PART SHEET 1830 I



SCALE 1 : 50 000

0 1 2 3 4 5 6 KILOMETRES

GRAPHIC LOGS OF SELECTED DRILLHOLES