BAYNTON

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

SHEET 2256 III

URBAN GEOLOGY OF THE BAYNTON SHEET

The aim of this Urban Geology series is to provide information for those concerned with aspects of raw material and water supply, rural, urban, industrial or transport development. The intention is to point out geological factors which may affect planning on a broad, rather than specific basis. Detailed site investigations will still be required but it is hoped that this information will provide a useful framework for such further work.

Land-use in the Baynton area is predominantly pastoral (on Karratha and Mount Welcome stations) with a minor segment of the evaporation ponds serving a salt extraction process to the northeast. The North West Coastal Highway crosses the mapped area from west to northeast. Part of the Indian Ocean occupies approximately 5 km^2 of the northwest corner of the area, flanked by mud flats, most of which are inundated only during exceptionally high tides.

The geology of the Dampier 1:250 000 sheet was mapped previously by Kriewaldt, Horwitz, Ryan and Bock of the Geological Survey of Western Australia and the results published in 1964. The Baynton 1:50 000 sheet was remapped in 1976, using a 1:50 000 base map and 1971 and 1972 air photographs. With minor modification, the work of the earlier mappers was utilized for the Precambrian units. The Quaternary units are essentially the work of the present mapper from moderately-spaced traverses and photointerpretation.

PHYSIOGRAPHY

Physiographically, the Baynton area is dominated by the broad, flat alluvial plain of the Maitland and Yanyare Rivers and their tributaries. These form part of the extensive coastal plain depicted on the inset map. Fringing the ocean are young calcareous sand dunes on the wide mud flats of the coastal flat zone. From Mount Regal westwards, a chain of volcanic hills and ridges rises some 60 to 180 m above the plains. In the southwest, rugged lava hills near Mount Leopold are a small part of the dissected uplands which occur mainly to the south of this area.

STRATIGRAPHY

An Archaean granite is assumed to form an irregular basement above which are Archaean volcanic rocks and metasediments. In the south-west, the granite surface is seen to be unconformably overlain by Proterozoic lavas and associated clastic sediments. Quaternary sediments mantle most of the granite and Archaean volcanics but are very thin over Proterozoic rocks.

ARCHAEAN

Granite and granite-gneiss is assumed to underlie a large proportion of the mapped area. Small, heavily weathered outcrops are seen in the beds of many watercourses, especially in an arc from Cajuput Well through Lawn Well and to the northwest. Scattered rounded hills and hillocks of granite are common near, south and east of Karratha homestead. In the hills west from Mount Leopold, granite forms the smooth, lower slopes, widely free from rock debris. The granite is leucocratic, pink and grey, coarse-grained and commonly includes quartz-feldspar veining. At several localities, but particularly in the southeast, the granite is distinctly foliated and tends towards granite gneiss. Elsewhere it is evengrained to porphyritic, composed of equal amounts of grey quartz and pink and white feldspar with subordinate ferromagnesians, usually dark brown biotite. Phenocrysts are pink feldspar crystals up to 50 mm long.

Schistose and some massive **amphibolites** have been mapped north and south of Mount Regal. The northern occurrence is close to a localised fault zone, the southern is astride the supposed position of the Sholl Shear Zone, so it is possible that this is a locally sheared sub-unit of the volcanics described below. Lithologies include blue-green hornblende schist and amphibolite; blue-grey foliated or sheared amphibolite; and medium- to coarse-grained dark green talcose amphibolite on the line of the Sholl Shear. A few interbedded saccharoidal quartzites are seen and malachite forms rare films on some amphibolite.

Chert and clastic sediments crop out as distinct ridges easterly from Normie Well. The sediments include very minor metavolcanics and are much thicker than the chert horizons. However, the cherts appear to predominate because they are resistant to weathering and form sharp ridges of bare white, grey, brown, blue or black rock. The clastic sediments include mottled purple and brown, siliceous tuffs and pale blue-grey ashes; white, greenish and honey-coloured quartzites; and soft, black and dark green carbonaceous ? ash. Accessory minerals are common iron pyrites and rare chalcopyrite. Manganese staining is widespread on the cherts and minor calcrete has developed over all strata in this unit.

The **basic and intermediate volcanics** include a wide range of unaltered or metamorphosed volcanic rocks, pyroclastics and other minor sedimentary rocks. They form high, rolling hills between Mount Regal and Miaree Pool. Predominant rocks are fine- to coarse-grained, greenish or bluish-grey metabasalts, metagabbros and spilites exhibiting pillow structures in places. Some relict structures may represent flow-banding of lavas. Epidotization of the rocks is widespread and calcite veining is common. Calcrete and mammiform quartz are seen on many weathering surfaces. Local developments of hornblende rhyodacite and fine-grained quartz diorite have been recognized in this unit.

Several of the igneous strata have undergone metamorphism and are now represented by greenish amphibolites, some cleaved, others massive, schistose or knotted. Random radiating and parallel arrangements of amphibole are seen. Minor but important ultramafic horizons, chiefly pyroxenite, occur throughout the sequence. Pyrite is a common accessory mineral and rare malachite is dispersed through all horizons. Probable former ash beds now occur as quartzofeldspathic bands and there are several interbedded horizons of shale, chert, siltstone and dolomite. One chert horizon forms a conspicuous ridge parallel to the main road south of Five Mile Well.

The **ferruginous chert** unit is a marine sedimentary sequence correlated with the Gorge Creek Group near Marble Bar. Black, brown and red ferruginous cherts distinguish this from the lower sedimentary sequence. In this sheet area however, most of the ferruginous horizons have been weathered and are presumably mantled by Quaternary sediments, so the assignment of other sediments to this unit is somewhat conjectural. Within this unit, non-ferruginous cherts occur in shades of green, blue, grey and white, alternating with fawn shales. Other minor sediments seen are pale, weathered volcanoclastics and pale brown or green, sericitic, saccharoidal quartzite. The hematite and chert horizons are thinly laminated except where iron has been removed by leaching and silica redeposited to form a massive chert, commonly manganese-stained.

PROTEROZOIC

A white **quartz dyke** crops out conspicuously on two islands at White Ridge in Pond Zero, the westernmost salt evaporator pond. The dyke is vertical, up to 20 m wide and flanked by thick quartz scree. The quartz is white, opaque and massive, with rare crystal development in vughs. Apart from some iron staining, the dyke appears barren of other minerals. Although no evidence is seen on the age of this quartz dyke, it is correlated with similar dykes to the east which have been dated as Proterozoic.

Near the mouth of Maitland River are four small outcrops of **gabbro**. They are completely surrounded by Quaternary sediments and their precise relationship with other Precambrian rocks therefore cannot be determined. One possibility is that they are equivalent to the dolerite dykes described below but from their geographical position, it may be surmised that they are equivalent to the lower, gabbroic member of the Gidley Granophyre seen in the Dampier Archipelago. The rocks are medium- to coarse-grained, blue-grey metamorphosed dolerite to gabbro with a dark brown rubbly weathering surface. The contained pyroxene is locally altered to uralite and biotite and may be cut by a network of veins filled with sericite.

In the southwest, **Mount Roe Basalt** rests unconformably on Archaean granite. In places, the lavas lie directly on the granite, in others, a basal conglomerate separates the two rock-types. The Basalt is composed chiefly of basaltic and andesitic, amygdaloidal, vesicular and columnar jointed lava flows. The lenticular basal units are polymictic conglomerates and sandstones and may have economic significance (see below under "Economic Geology"). Agglomerate and tuff of dacitic to andesitic composition form thick lenticular units within the formation. A distinctive feature of the Mount Roe Basalt is the glomeroporphyritic texture commonly exhibited by its lava. Phenocrysts of plagioclase, generally sericitised, up to 10 mm long form clusters within a fine-grained, variably carbonatized groundmass.

Dolerite dykes cut all Precambrian rock types except the gabbro at May Rock. The dolerite is medium to coarse grained, melanocratic blue to grey and has dark brown, spheroidal weathering surfaces. Most dykes contain abundant disseminated iron pyrites. Many in the southwest are probably feeders to the Mount Roe Basalt.

CAINOZOIC

Calcrete is common throughout the coastal plain as nodules and discontinuous beds of impure calcium carbonate, typically one to two metres below surface. Where the Yanyare River and its major tributary cut through Mount Roe Basalt, calcrete occurs in continuous horizons flanking alluvium. This concentration reflects the higher percentage of calcium carbonate weathering from the basalts when contrasted with other rocks in the area. Impurities in the carbonate are iron oxides, quartz and varied amounts of clay.

Red-brown **silty sand** covers a large proportion of the area mapped. It is mainly eluvial but includes deposits transitional between colluvium and alluvium, generally in a broad flood-plain environment. The unit shows rapid lateral variation within an overall uniformity, consisting mainly of subangular to subrounded, fine to coarse quartz grains with varied proportions of fine, reddish-brown silt. In places, silt is the dominant grain-size. As mentioned above, calcrete nodules and lenses are commonly encountered one to two metres below surface. Pebbles of limonite or rock are ubiquitous, particularly where low outcrops of bedrock pierce the sands. Near granite outcrops the sand is very coarse, emphasizing the eluvial nature of part of this unit.

Areas of **clayey silt** have formed, as a subdivision of the "Qps" unit, where poor drainage has enabled finer material to settle out from mud-laden floodwaters. The sand fractions of the preceding unit are subordinate or absent and swelling clays comprise a significant proportion of the sediment, giving rise to numerous small sinkholes often known as "crabhole country". The boundaries between this unit and the silty sand or alluvium are generally transitional and in places drawn arbitrarily. The clays tend to have a higher organic content than the silty sands and, in consequence, are darker brown.

Eolian Sand is possibly another subdivision of the main silty sand unit but its formation has extended into more recent times. It comprises very fine- to medium-grained reddish-brown quartz sand with varied but considerable amounts of clay. The prevailing easterly winds have winnowed this fine sand into low, sub-parallel ridges or seif dunes and some areas of random dunes, none exceeding about two metres in height. Concentrated to the north of the Mount Regal line of hills, this unit also occurs in a few areas south of Karratha homestead. One striking area of closely-parallel dunes is seen due north of Stone Well. The eolian sand unit is generally pebble-free and may exhibit some crabhole characteristics where the clay content is high.

As a marked contrast, the **outwash gravel** contains no fine material. It occurs as a thin veneer on the parent silty sand and is thought to have been formed when gentle sheet-flooding removed all the finer sand and clay fractions. It is possible that wind action has contributed to the formation of the veneer, as many of the pebbles are glazed with "desert varnish". Rarely more than 50 mm thick, the veneer consists of closely-packed pebbles, usually flattened and lying horizontally. Where well-developed, all the pebbles interlock and exclude vegetation. Many occurrences of the gravel are too small to depict at this map scale so their extent is somewhat greater than shown here. Also included are some areas of secondary chalcedony pebbles forming a pavement near Cajuput Well.

Similarly, **colluvium** has only been mapped where it forms a significant topographic feature. Occurrences flanking cherts and Proterozoic volcanics fall in this category, but thin colluvium is also common on slopes of all Precambrian rocks. The material is unsorted and is moved principally by gravity but with some water lubrication on flatter slopes. It ranges from fine clays through sands to angular pebbles and boulders of the parent rock. Water transportation and deposition become increasingly important towards the lower margins of the unit where it grades into the silty sand plains.

Sand ridges have been formed sub-parallel to a former coastline near what is now the Spring-tide line. The ridges are one to two metres high and represent the inland silty sand unit reworked by shoreline processes. The fawn sand is only slightly silty and is composed of medium to coarse, subangular to subrounded, frosted quartz grains. Fragments and pebbles of granite, limonite and feldspar are common, suggesting little movement of material from its source rocks. West of White Ridge, this sand unit forms a raised rim to the sandy plain. No fossils have been found in this sand which is assumed to be late Pleistocene to Holocene from its field relationships.

Alluvium occurs in all present-day drainage channels and is still being deposited. Some distributaries, such as the one through Horseflat Well, contain flowing water only during high floods and the alluvium appears very similar to the "Qpc" unit silty clays. In other water channels, alluvium varies from fine silt especially in the lower reaches and in banks, through fine and coarse sand to lenses of coarse gravel and boulders. Individual grains are angular to rounded, depending on distance of transport, but the majority are subangular to subrounded. Sands are predominantly quartz but include rock fragments, feldspar and limonite and rarer zircon, garnet and other heavy minerals. There are two distinct ages of alluvium in the Maitland valley, the younger sediments in the present watercourse, the older represented by abandoned meander channels and banks. The older deposits have undergone a certain amount of reworking.

The Holocene **silty sand** is in most respects identical with the Pleistocene unit but is distinguished by the presence of shells of the bivalve *Anadara granosa*. Shells of this and other molluscs are distributed throughout the sand and are widely scattered on the surface after erosion. The unit is probably derived by reworking of Pleistocene silty sand.

The two **shelly sand** units comprise fine to coarse quartz sand and between 30 and 70 per cent shell fragments. Rounded pebbles and boulders are common and the silt content increases near mangrove thickets. Mollusc shells and massive corals are widespread on storm beaches. The units represent beach and foredune deposits; the younger unit is still being formed and has had at least two phases of deposition; the older has a partial development of soil, marked weathering of fossils, fewer corals, and a base level some two to three metres higher than the younger unit.

Mud and silt represent the most recent sedimentation and are being deposited inland and between the mangroves fringing the ocean. The sediments of this unit range from brown gelatinous muds through grey-brown silts to brown silty sands, all heavily salt-impregnated. Covered only by high Spring tides, the sediments may have a patchy surface veneer of salt crystals, rock fragments and modern shells.

STRUCTURE

The Archaean rocks of the Mount Regal hills strike eastnortheasterly and form the northern limb of an extensive anticline. A major dislocation, the Sholl Shear Zone (mainly evident on the adjacent Karratha sheet) can be traced for some two kilometres westward to Mornong Well and almost certainly continues further westwards, truncating the outcrops of metasediments and metavolcanics.

Granite underlies the area north of the Highway but its structure is unknown. There is no evidence that it forms part of a domal structure as do granites to the east and it is interpreted as either intrusive into or faulted against the Archaean sequence. South of Karratha homestead, granitic rocks form part of the Cherratta Batholith, on the irregular surface of which Proterozoic volcanics were deposited.

ECONOMIC GEOLOGY

CONSTRUCTION MATERIAL

Building stone is available between Mount Regal and Miaree Pool (metabasalt) and near Karratha homestead and northeast of Gregory Well (granite).

Clay used in the construction of levees for the solar salt evaporation system was obtained from shallow pits in the finer portions of the silty sand unit, west and southeast of White Ridge.

Gravel and sand used in local building projects has been intermittently obtained from alluvium in the Maitland River. Slightly clayey material in colluvium between Gimriki Pool and Stone Well was extracted from shallow pits and used for realignment and upgrading of the North West Coastal Highway.

METALS

The mafic to ultramafic rocks of the Mount Regal-Miaree Pool area have been prospected for nickel-copper mineralization. No occurrences of economic importance have been found.

Possibly prospective areas include the belt of chert units between Mount Regal and Normie Well (possibly copper-gold mineralization) and sandstone-conglomerate units at the base of the Mount Roe Basalt (possible gold or uranium mineralization). The units of ferruginous cherts and banded iron formation which extend from Stone Well to Gimriki Pool do not appear to contain any deposits of iron oxide approaching economic grade.

SALT

The northeastern section of the area includes part of a solar salt evaporation project which extends northeastwards on the Dampier and Nickol Bay sheet areas. Total annual production exceeds 1 000 000 tonnes of salt.

WATER

The annual rainfall in the area averages about 300 mm. It is unreliable and cyclonic, mainly falling between the beginning of December and the end of April. Creeks and rivers flow briefly after heavy rain. Along the main courses of the Maitland and Yanyare Rivers there are a few semi-permanent fresh to slightly brackish pools, fed by river underflow or groundwater from fractured bedrock.

Groundwater of good stock and domestic quality is readily available throughout most of the area, from alluvium and from the foot of colluvial slopes. The water table ranges from 3 to 10 m below ground level, depending on relative elevation within each valley. Supplies from individual boreholes or wells are generally less than 50 m^3/day, but larger supplies, up to 250 m^3/day or more, may be obtainable where layers of calcrete (impure limestone) are developed within the alluvium. Small supplies of fresh water are sometimes obtainable from fractured Archaean or Proterozoic bedrock.

South of the North West Coastal Highway the salinity of the groundwater ranges from 1 000 mg/l to 7 000 mg/l total dissolved solids along the main river-courses, elsewhere the salinity is generally less than 1 000 mg/l. About 2 km north of the Highway, below the coastal plain, the groundwater becomes rapidly brackish and then salty towards the ocean.

ENGINEERING GEOLOGY

The engineering properties of rocks, which include such features as strength, suitability for foundations, stability on slopes and in excavations, and suitability as construction materials, depend on geological features such as mode of origin, composition, susceptibility to processes of change such as metamorphism, weathering and erosion, and their present mode of occurrence. The generalized engineering properties of the rocks that occur in the area are described with this in mind.

ARCHAEAN

A variable group of rocks with a wide range of engineering properties. The granitic rocks of Archaean age are strong and stable when fresh, but near the surface are generally weakened and less stable due to weathering of either the rock substance or along joints. Schistose phases and sheared zones within these rocks are particularly susceptible to weathering.

Although the igneous parts of the basic and intermediate volcanic unit are resistant to erosion and crop out to form hills, a detailed examination shows many defects and complex variations in composition and structure. In addition to jointing the rocks are foliated in part, contain lenses of weak material and are cut by quartz veins and minor dykes of varied composition. These features may, but do not necessarily, make them unstable on slopes or in excavations or reduce their suitability as foundations but do detract from their value as a source of aggregate. Of the chert and clastic sediments, the more abundant clastic sediments are generally weak. They would not stand well in excavations but would be satisfactory as foundations for structures of moderate loading. Their properties differ widely from those of the interbedded chert which more commonly crops out and is hard and resistant to weathering. Engineering problems could arise with the rock unit as a whole because of the differing properties of the two closely associated rock types. For example, slopes and excavations could be unstable and differential settlement could occur beneath foundations. They are unsuitable as a source of aggregate.

The ferruginous chert unit is generally strong and forms low ridges but contains well-developed bedding and joint surfaces which aid the production of abundant rock fragments in the colluvium that forms on the slopes. This contributes to the suitability of adjacent superficial deposits as a construction material. Because of thin interbedded shales the rock unit as a whole has some of the engineering defects of the previous group, such as instability on slopes and in excavations, but the predominantly chert sections would make satisfactory foundations in flat areas even for high load structures.

PROTEROZOIC

The Proterozoic igneous rocks are generally more uniform and less deformed than the Archaean rocks and present fewer engineering problems. They are generally competent and unless extensively jointed or weathered are expected to have satisfactory engineering properties. In some cases these rocks produce scree slopes in the areas below prominent outcrops, for example, the quartz dyke at White Ridge and the Mount Roe Basalt in the southwest of the area. Such scree material is unstable if close to its natural angle of rest, but could be a source of fill material for construction.

CAINOZOIC

The Cainozoic includes a wide variety of superficial units with complex field relationships and differing engineering properties. For example, the behaviour of a unit is modified by such factors as the properties of an underlying unit, level and salinity of the local groundwater and the pH of the unit. Because this material occurs in the flatter parts of the area where future development could be expected, its varying properties and their complex distribution are significant. It is stressed that detailed investigation at the actual site of proposed development is necessary and the information given here can only serve as a guide.

One of the major engineering problems with the silty sand unit is the presence of expansive clays in the clayey silt sub-unit. The expansive clays contain a high percentage of montmorillonite thought to be derived from the weathering of ferromagnesian minerals in the mafic and ultramafic volcanic and intrusive rocks of the region. If the material containing expansive clays is not avoided in the siting of engineering works, it should either be removed or allowed for in the design of foundations. This allowance can be made by placing a foundation pad of stable material over it or by taking foundations below the surface zone of fluctuating moisture content. Both methods have been used in an adjacent area to the east, but so far development in this area has been minor.

Low permeabilities occur in the clayey parts of the silty sand, and in the colluvium and outwash soils with high pH values. In these latter soils the clays disperse when wet, further reducing permeability. These types of soils should be avoided for housing development, or precautions taken, such as provision of adequate drainage. In these areas, the construction of foundation pads aids the solution of both drainage and foundation problems.

These types of soils also pose problems for road and railway construction both as foundations and when used for construction. They should therefore be avoided where possible or allowances made in design. Inadequate culverts behind embankments made of these materials allow ponding and consequent wetting which can lead to failure. It may be necessary to take steps to prevent erosion from surface runoff on embankments and where culverts discharge in areas of susceptible soils.

The less clayey parts of the superficial units such as outwash gravel, colluvium and alluvium make suitable foundations for structures of moderate loading provided the normal precautions are taken. Piles or piers are needed for bridges where the major roads cross rivers filled with alluvium. At the Maitland River crossing the alluvial material is up to 8 m thick. Sandy clay, sand, shingle and conglomerate were recorded during the investigation for the bridge.

The less clayey superficial units provide suitable fill material for the construction of foundations. The coarser alluvial gravels are suitable, after treatment, for concrete aggregate. Such deposits from the Maitland River have been used for this purpose.

The various beach and dune deposits are generally friable and when loose may be unstable in excavations and on slopes. They are liable to erosion if cleared of vegetation. Except for older, leached deposits, they are of limited use in construction because of their salt content.

The mud and silt of tidal areas is a weak material and poses foundation problems for roads, railways and levees. The problem has been solved by the provision of properly compacted, stable embankments of suitable material. The possibility of using lime stabilization for road embankments is being studied. Suitable materials for embankments include the less clayey parts of the Cainozoic deposits in conjunction with rock fill obtained from the stronger parts of the older rock units. For levee construction silty sand containing clay has been used, but it requires thorough compaction. Weak, unconsolidated mud and silt is displaced from beneath the fill during construction. For bridges on this material elsewhere, piles up to 18 m have been driven without reaching basement rocks.

In many cases the superficial deposits are thin or of too limited extent to have any engineering significance.

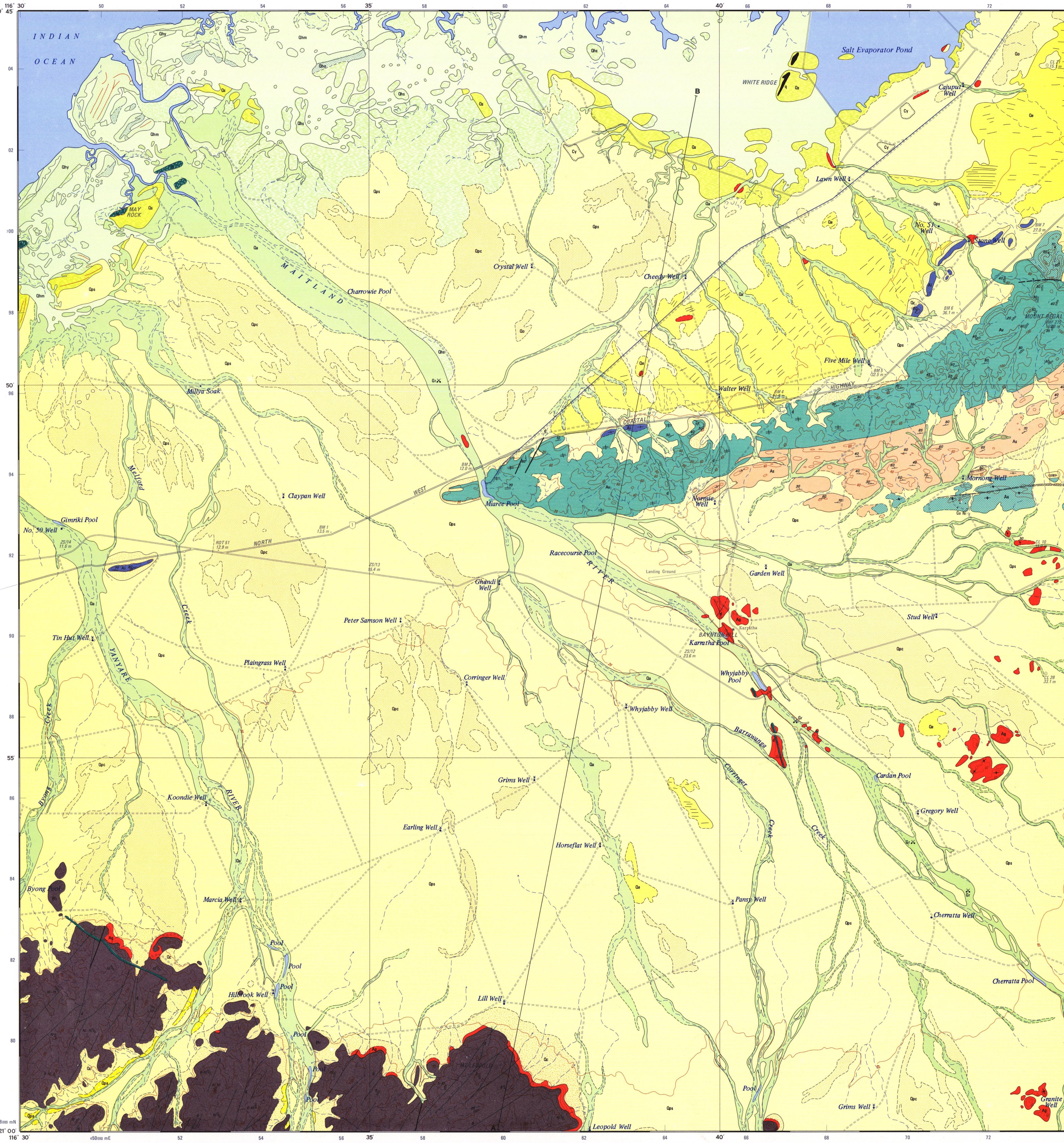
ENVIRONMENTAL GEOLOGY

Waste disposal is probably inadvisable in many areas north of the Highway where the clay and fine silt content of the sediments is high. Drainage is likely to be very poor in these areas, with consequent retention of leach liquors. Elsewhere on the coastal plain, sites for disposal of domestic rubbish should be readily available if away from points of water supply or clear of the water table. Wells in the Maitland valley are dug to eight to twelve metres and indicate a water table six to seven metres deep.

Sites for toxic waste disposal may be located in the volcanic hills west of Mount Regal. The rocks are locally faulted but generally appear free from fractures which would enable leachate to escape. Mount Roe Basalt is considered too porous and faulted for safe waste disposal sites.

Active gully erosion near Whyjabby Well indicates the instability of the silty sand where vegetation has been removed and run-off therefore increased. The moderate slopes in the Maitland valley tend to reduce this possible danger.

Further information may be obtained from the Geological Survey of Western Australia, Mineral House, Perth.



Geology : E.R. Biggs, 1976

REFERENCE

	Symbol	Probable maximum thickness (m)	
CAINOZOIC – QUATERNARY – HOLOCENE	Qhm	5	Mangrove flats (tidal); Mud and silt
	Qhy	16	Younger shelly sand, beach and dune
	Qho	4	Older shelly sand, beach and dune
	Qhs	10	Silty sand, red-brown, containing Anadara Granosa
? PLEISTOCENE TO HOLOCENE	Qa	8	Alluvium; gravel, sand or silt
	Qs	10	Sand ridges along fossil coastline
	Qc	7	Colluvium, mainly quartzose scree
	Qo	0.1	Outwash gravel; veneer on Qps
	Qe	4	Eolian sand
PLEISTOCENE	Qpc	3	Clayey silt
	Qps	16	Silty sand, red-brown
	Qpa	3	Calcrete
PROTEROZOIC	d	50	Dolerite dyke
	Pr	400	MOUNT ROE BASALT
		650	Gabbro
	q	20	Quartz dyke
ARCHAEAN	Ai	200	Ferruginous cherts and related sediments
	Av	1200	Basic and intermediate volcanics, some metasediments
	As	1100	Chert and clastic sediments
	Aa	600	Amphibolites, mainly schistose
	Ag	?	Granite and granite-gneiss

Anadara Granosa: Internal and external lateral views of right valve

SYMBOLS

Geological boundary
- Accurate
- Transitional or inferred

Fault
- Accurate
- Inferred

Sholl Shear Zone
- Inferred

Bedding
- Strike and dip
- Strike of vertical beds
- Strike and dip of lava
- Strike of vertical lava

Foliation
- Strike and dip of foliation
- Strike of vertical foliation

Dune crest (July 1972)

Dune trend

Quarry or pit

Alluvial working

Mineral occurrence
- Copper — Cu
- "Clay" (for levee construction) — Cy
- Gravel (and some sand) — Gr
- Nickel — Ni

Contour in metres

Watercourse

Pipeline

Windpump on well or borehole

Highway

Road

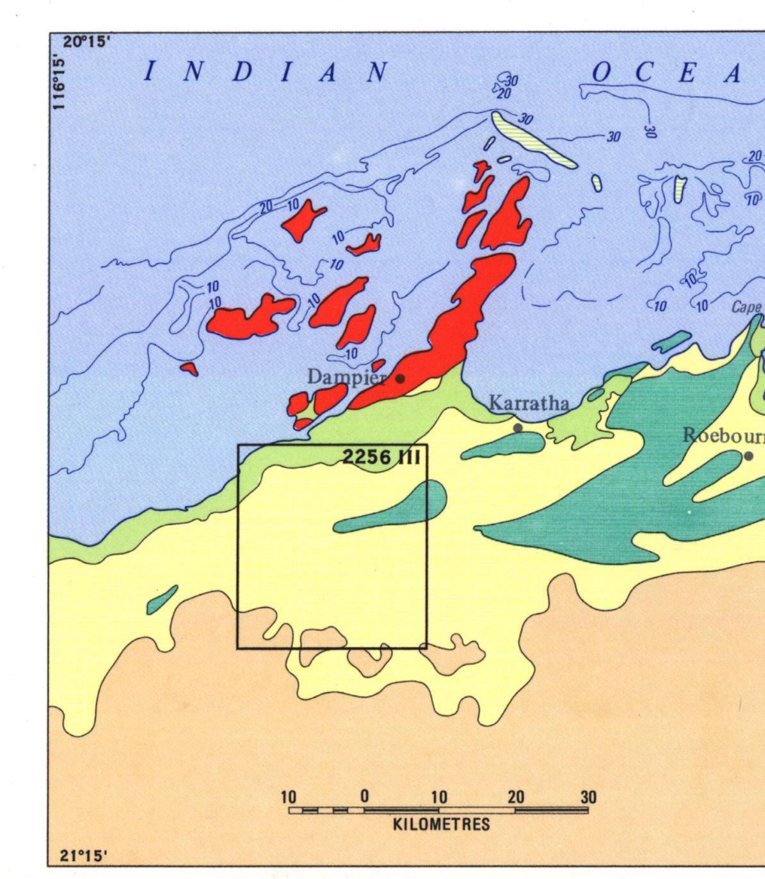
Track

Horizontal control; minor — CL 28

Bench mark, height accurate — ZS/11 29.2 m

Homestead

The representation on this map of a track does not necessarily imply right of way



PHYSIOGRAPHIC DIAGRAM

Limestone Islands; Dampier Archipelago; Coastal Flats; Coastal Plain; Isolated Hills; Dissected Upland

Compiled and published by Geological Survey of Western Australia. Cartography by Geological Mapping Section, Department of Mines. Topographic base from compilations by Department of Lands and Surveys. Printed by Government Printing Office, Perth, 1980

Copies of this map may be obtained from the Geological Survey of Western Australia, in Perth.

HON. A. MENSAROS, M.L.A.
MINISTER FOR MINES
J. H. LORD DIRECTOR, GEOLOGICAL SURVEY

SCALE 1:50 000

KILOMETRES

CONTOUR INTERVAL 0–100 m : 20 m; Over 100 m : 50 m

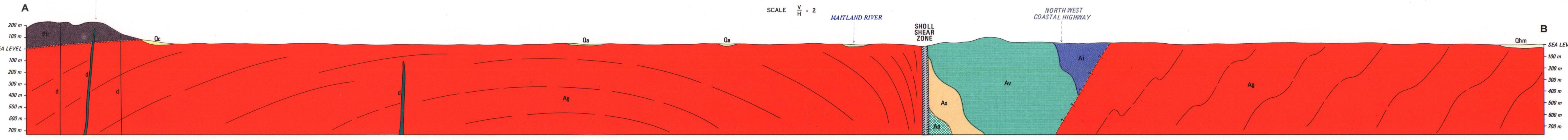
Ticks inside the sheet edge represent 2000 metre intervals of the superimposed Australian Map Grid, Zone 50 AUSTRALIAN NATIONAL SPHEROID

INDEX TO ADJOINING SHEETS

EAGLEHAWK ISLAND 2156 I	DAMPIER 2256 IV	NICKOL BAY 2256 I
MOUNT WILKIE 2156 II	BAYNTON 2256 III	KARRATHA 2256 II
VIRCHOW 2155 I	MOONDLE 2255 IV	PINDERI HILLS 2255 I

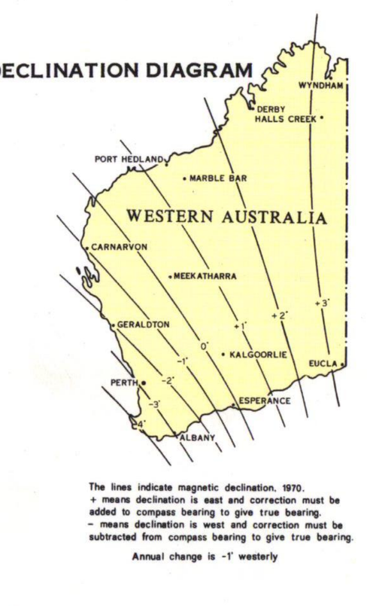
DIAGRAMMATIC SECTION A-B

SCALE V/H = 2



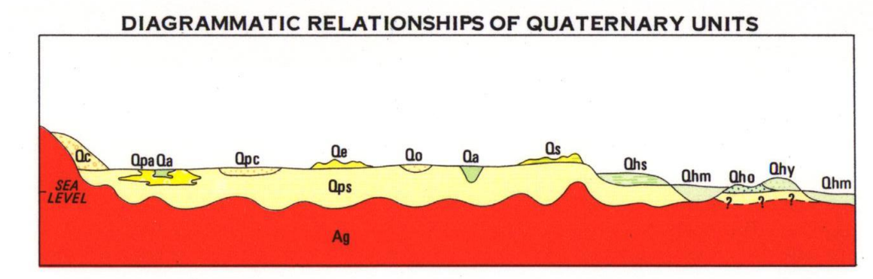
Unconformity

DECLINATION DIAGRAM



The lines indicate magnetic declination, 1970. + means declination is east and correction must be added to compass bearing to give true bearing. − means declination is west and correction must be subtracted from compass bearing to give true bearing. Annual change is −1′ westerly

DIAGRAMMATIC RELATIONSHIPS OF QUATERNARY UNITS



BAYNTON
URBAN GEOLOGY
2256 III

FIRST EDITION 1980