RECORD
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# THE GEOLOGY AND MINERAL RESOURCES OF THE PROPOSED DAMPIER ARCHIPELAGO NATIONAL PARK

by C.J. KOJAN

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

DEPARTMENT OF MINERALS AND ENERGY

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

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by

C. J. Kojan

Perth 1994

**MINISTER FOR MINES**
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***L. C. Ranford***

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# The geology and mineral resources of the proposed Dampier Archipelago National Park

by

**C. J. Kojan**

# Abstract

This report describes the geology and mineral resources of the proposed Dampier Archipelago National Park and surrounding area and assesses the mineral and petroleum potential of the proposed park. The proposed park comprises 24 islands or island groups together with part of Malus Island. These island areas, which are currently listed as nature reserves, total 13 866 ha. The remaining 15 islands together with the remaining part of Malus Island are excluded from the park proposal and will retain their current status.

The majority of the islands nominated for the proposed park consist of Precambrian (late Archaean) basalt and sandstone of the Fortescue Group and intrusive igneous rocks comprising dolerite, gabbro and granophyre. The granophyre contains rafts of partially assimilated Archaean granite. The Precambrian rocks of the archipelago and adjacent mainland are locally mantled by Cainozoic deposits of clay, gravel, limesand, mud and silt. Limestone outcrops are confined to the outer islands of the archipelago. Six of the islands of the proposed park consist almost entirely of limestone. Results from Woodside Offshore Petroleum's sea-floor sampling and drilling indicate that extensive deposits of limestone and limesand underlie the archipelago sea floor.

The larger limesand and limestone deposits represent important lime resources for the existing and future industries of the rapidly developing Karratha–Dampier region. Resources totalling 166.5 Mt of limesand and 32.2 Mt of limestone within the proposed park and 22.4 Mt of limesand and 264.0 Mt of limestone from other areas have been reported. Management of the onshore and offshore lime resources of the Dampier Archipelago should occur in the context of the Government's economic objectives for the region. A significant proportion of the onshore limesand resources will be sterilized if the current national park proposal is implemented. There is a strong case for reserving the offshore potential lime resources for future industry requirements.

There is some potential for metalliferous mineralization in the gabbro and larger dolerite bodies, and for gold within the Fortescue Group basal sandstone. There is no potential for petroleum or salt production.

**KEYWORDS:** national parks, geology, limestone, calcareous sands, islands, conservation, marine sediments, mineral resources

# Introduction

## General

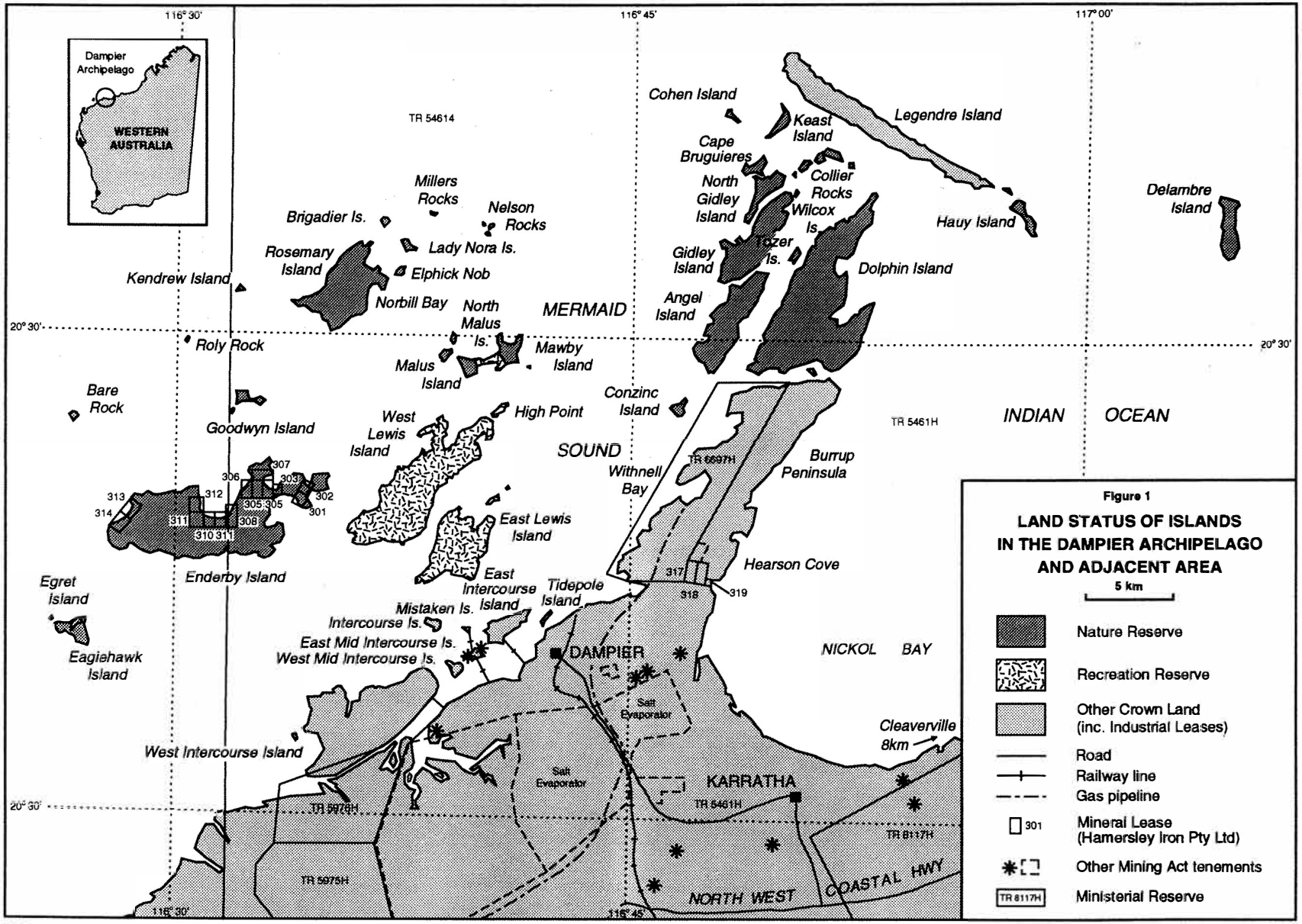
The main purpose of this report is to describe the geology and mineral petroleum resources of the proposed Dampier Archipelago National Park. The mineral and petroleum potential of the proposed national park is also assessed.

The proposed national park is described in the Dampier Archipelago Nature Reserves Management Plan (Chevis et al., 1990). The 40 islands, islets and rock groupings constituting the Dampier Archipelago are shown in Figure 1. The national park proposal applies only to those islands which are currently nature reserves. Other islands and adjacent areas of the mainland are considered unsuitable or unavailable for incorporation into the proposed park. Islands not the subject of the proposed park include part of Malus and both East and West Lewis Islands. These islands are used extensively for recreation and contain a large number of shacks.

The salt, iron ore, and liquified natural gas (LNG) shipping facilities, salt evaporators and associated industrial plant centred on Mermaid Sound and the lower Burrup Peninsula are of major strategic and economic importance. The nearby town of Karratha is developing into an important regional and industrial centre. Several types of government reserve and land tenure have been established to control this development. These include special-purpose leases on Burrup Peninsula and the adjacent islands (port facilities and shipping channels); a Mining Act Section 19 restriction over Legendre Island (future port facilities and industrial development); ministerial reserves 5975H and 5976H (future salt production); and Ministerial Reserves 5461H, 6697H and 8117H (orderly industrial development).

The Department of Minerals and Energy is seeking cancellation of Ministerial Reserves 5461H, 6697H and 8117H in order to encourage mineral exploration. The Department of Resources Development, which manages these reserves, wishes to maintain them, at least for the present.

Mining Act tenements in the Dampier Archipelago area comprise the Hamersley Iron mineral leases on Enderby Island and at Hearson Cove (limesand); the Specified Services mineral leases at Cleaverville, east of Karratha (limesand); the Mineralogy Pty mining lease application at Hearson Cove and exploration licence application over West Intercourse Island (limesand); the Dampier Salt mineral leases located over the


116° 30'
116° 45'
117° 00'
Dampier Archipelago
WESTERN AUSTRALIA
TR 54614
Cohen Island
Keast Island
Legendre Island
Cape Bruguieres
Collier Rocks
North Gidley Island
Wilcox Is.
Hauy Island
Delambre Island
Millers Rocks
Nelson Rocks
Brigadier Is.
Lady Nora Is.
Rosemary Island
Elphick Nob
Gidley Island
Tozer Is.
Dolphin Island
Kendrew Island
Norbill Bay
North Malus Is.
MERMAID
Angel Island
20° 30'
Roly Rock
Malus Island
Mawby Island
Conzinc Island
Bare Rock
Goodwyn Island
West Lewis Island
High Point
SOUND
TR 5461H
INDIAN
OCEAN
Withnell Bay
TR 6697H
Burrup Peninsula
East Lewis Island
Hearson Cove
Enderby Island
East Intercourse Island
Tidepole Island
Egret Island
Mistaken Is.
Intercourse Is.
East Mid Intercourse Is.
West Mid Intercourse Is.
DAMPIER
NICKOL BAY
Eaglehawk Island
Salt Evaporator
Cleaverville 8km
West Intercourse Island
KARRATHA
TR 5976H
TR 5975H
TR 8117H
NORTH WEST COASTAL HWY
Figure 1
LAND STATUS OF ISLANDS IN THE DAMPIER ARCHIPELAGO AND ADJACENT AREA
5 km
Nature Reserve
Recreation Reserve
Other Crown Land (inc. Industrial Leases)
Road
Railway line
Gas pipeline
Mineral Lease (Hamersley Iron Pty Ltd)
Other Mining Act tenements
Ministerial Reserve
CJK3

tidal mud flats between Karratha and Dampier (salt evaporators), and exploration licence applications covering Nickol Bay (alluvial gold). There are several mining leases for construction materials situated adjacent to the main transport routes in the southern Burrup peninsula and adjacent East Mid Intercourse island. The mineral leases on Enderby Island are the only Mining Act tenements affected by the national park proposal.

## Location and access

The proposed national park lies within the Shire of Roebourne between latitudes 20° 20'S – 20° 40'S and longitudes 116° 25'E – 117° 05'E. The islands, islets and rocks constituting the archipelago are situated within a 45 km radius of the town of Dampier on the northwest coast of Western Australia (Fig. 1). The archipelago, including the proposed park, is covered by the PRESTON*, LEGENDRE, DAMPIER and DELAMBRE 1:100 000 map sheet areas, and parts of the DAMPIER (Kriewaldt, 1964) and ROEBOURNE (Ryan, 1966) 1:250 000 sheets.

## Current status of the islands and adjacent mainland

The Management Plan recommends that those islands which have nature reserve status, i.e. are reserved for the purpose of conservation of flora and fauna, are incorporated into the proposed national park. Details of the 24 island groups, islands, islets and rocks proposed for incorporation in the park are set out in Table 1. Details of the 16 islands excluded from the proposed park are given in Table 2. The location and current status of the islands and adjacent mainland areas are shown on Figure 1.

Details concerning the location of special leases, ministerial reserves and Mining Act tenements are shown on the 1:100 000 public plans (LEGENDRE and PRESTON) and the 1:50 000 public plans (DAMPIER and NICKOL BAY).

## Climate

The Dampier Archipelago has a semi-desert tropical climate. The mean annual rainfall is about 300 mm. Potential annual evaporation is about 2500 mm. Mean daily

---

* Capitalized names refer to standard map sheets.

## Table 1. Details of islands proposed for inclusion in the national park

| *Reserve class* | *Island* | *Vested authority* | *Purpose* | *Area (hectares)* |
|---|---|---|---|---|
| A36915 | Enderby Island and Rosemary Island | NPNCA | Conservation of Flora & Fauna | 4 436 |
| | | | **Total Class A** | **4 436** |
| B34944 | Dolphin Island | NPNCA | Conservation of Flora & Fauna | 3 203 |
| C39202 | Cohen Island | NPNCA | Conservation of Flora & Fauna | 11 |
| C36913 | Angel Island | NPNCA | Conservation of Flora & Fauna | 880 |
| C36913 | Bare Rock | NPNCA | Conservation of Flora & Fauna | 3 |
| C36913 | Brigadier Island | NPNCA | Conservation of Flora & Fauna | 6 |
| C36913 | Collier Rocks including North Gidley Island and Cape Brugieres | NPNCA | Conservation of Flora & Fauna | 408 |
| C36913 | Conzinc Island | NPNCA | Conservation of Flora & Fauna | 11 |
| C36913 | Delambre Island | NPNCA | Conservation of Flora & Fauna | 320 |
| C36913 | Eaglehawk Island | NPNCA | Conservation of Flora & Fauna | 140 |
| C36913 | Elphick Nob | NPNCA | Conservation of Flora & Fauna | 22 |
| C36913 | Egret Island | NPNCA | Conservation of Flora & Fauna | 1 |
| C36913 | Gidley Island | NPNCA | Conservation of Flora & Fauna | 845 |
| C36913 | Goodwyn Island | NPNCA | Conservation of Flora & Fauna | 65 |
| C36913 | Hauy Island | NPNCA | Conservation of Flora & Fauna | 105 |
| C36913 | Keast Island | NPNCA | Conservation of Flora & Fauna | 51 |
| C36913 | Kendrew Island | NPNCA | Conservation of Flora & Fauna | 6 |
| C36913 | Lady Nora Island | NPNCA | Conservation of Flora & Fauna | 27 |
| C36913 | Malus Island (part) | NPNCA | Conservation of Flora & Fauna | 170 |
| C36913 | Mawby Island | NPNCA | Conservation of Flora & Fauna | 3 |
| C36913 | Millers Rocks | NPNCA | Conservation of Flora & Fauna | 1 |
| C36913 | Nelson Rocks | NPNCA | Conservation of Flora & Fauna | 1 |
| C36913 | Tozer Island | NPNCA | Conservation of Flora & Fauna | 1 |
| C36913 | Wilcox Island | NPNCA | Conservation of Flora & Fauna | 20 |
| | | | **Total Class B + C** | **6 300** |
| | | | **Total area of proposed national park** | **10 736** |

Explanation of abbreviations:

| | |
|---|---|
| Reserve Class A | Tenure can only be changed by agreement of both houses of the W.A. Parliament<br>Mining also requires the consent of both Houses of Parliament |
| Reserve Class B | Tenure can be changed by the Governor of W.A. Reasons for changes must be reported to Parliament.<br>Mining requires the recommendation of the Minister for the Environment |
| Reserve Class C | Tenure can be changed by the Governor of W.A.<br>Mining requires the recommendation of the Minister for the Environment |
| NPNCA | National Parks and Nature Conservation Authority |

maximum and minimum temperatures range from 26 to 35° in January and from 19 to 26° in July. There are two peaks of rainfall, a first peak from January to March and a second from May to June.

**Table 2. Details of islands proposed for exclusion from the national park**

| *Reserve class* | *Land status* | *Island* | *Vested authority* | *Purpose* | *Area (hectares)* |
|---|---|---|---|---|---|
| C36907 | Recreation | East Lewis Island | NPNCA | Cons & Rec | 1 018 |
| C36909 | Recreation | West Lewis Island | NPNCA | Cons & Rec | 2 082 |
| C36910 | Recreation | Malus Island (part) | NPNCA | Cons & Rec | 76 |
| | | **Total area for recreation** | | | **3 176** |
| S.L.3116 3469 | Crown Land | East Intercourse Island | Not vested | Mining (H.I.) | 300 |
| S.L.3116 3469 | Crown Land | Tidepole Island | Not vested | | 10 |
| S.L.3116 4976 | Crown Land | Mistaken Island | Not vested | Mining (D.S.) | 20 |
| | | **Total area for mineral resource development** | | | **330** |
| None | Crown Land | Legendre Island | Min. Ind. Dev. | Industrial | 1 300 |
| None | Crown Land | Dixon Island | Not vested | None | 500 |
| None | Crown Land | East Mid Intercourse Island | Not vested | None | 2 |
| None | Crown Land | Haycock Island | Not vested | None | 5 |
| None | Crown Land | Intercourse Island | Not vested | None | 20 |
| None | Crown Land | Pemberton Island | Not vested | None | 2 |
| None | Crown Land | Roly Rocks | Not vested | None | 1 |
| None | Crown Land | Walcott Island | Not vested | None | 10 |
| None | Crown Land | West Intercourse Island | Not vested | None | 2 300 |
| None | Crown Land | West Mid Intercourse Island | Not vested | None | 2 |
| | | **Total area of Crown Land** | | | **4 142** |
| | | **Total area of islands excluded from the proposed DANP** | | | **7 648** |

Explanation of abbreviations:

| | |
|---|---|
| Reserve Class C | Tenure can be changed by the Governor of W.A. Mining requires the recommendation of the Minister for the Environment |
| NPNCA | National Parks and Nature Conservation Authority |
| Cons & Rec | Conservation and Recreation |
| Min Ind Dev | Minister for Industrial Development |
| H.I. | Hamersley Iron Pty Ltd |
| D.S. | Dampier Salt Pty Ltd |
| S.L. | Special Lease |
| DANP | Dampier Archipelago National Park |

## Geomorphology

The Dampier Archipelago was formed 6000–8000 years ago when rising sea levels, caused by the melting of polar ice caps, flooded coastal plains leaving hills and ridges exposed as islands. The islands range in size from rock islets of less than one hectare to large islands of up to 3290 ha (Enderby Island). Dolphin Island is the highest island in the Archipelago rising to 120 m above sea level.

Topographically many of the islands resemble the adjacent mainland, and are steep and rugged with coastal cliffs and large rock piles formed of volcanic and other igneous rocks separated by valleys, beaches and coastal sand plains. The beaches are often backed by sparsely vegetated sand dunes rising to three metres. Other islands situated in the northern part of the archipelago are low and flat and the beaches are often backed by low limestone cliffs. These limestone islands represent remnants of an ancient coastal dune system at a time when the igneous islands were rocky hills on a coastal plain.

# Geology

## Regional setting

The islands of the Dampier Archipelago, many of which are included in the proposed national park, consist predominantly of Precambrian (late Archaean) basalt and intrusive igneous rocks including dolerite, gabbro and granophyre (Fig. 2). These rocks, which are assigned to the Fortescue Group, give rise to the rugged topography of the Burrup Peninsula and the major islands, and unconformably overlie older Precambrian (early Archaean) granite and gneiss, which outcrop in the Dampier–Karratha area on the western margin of the Pilbara Craton. Several islands in the northern part of the archipelago consist predominantly of Cainozoic limestone. Scattered deposits of unconsolidated limesand occur throughout the islands of the archipelago and are also found in coastal areas on the adjacent mainland.

The unconformity between the Fortescue Group and the underlying early Archaean granite and gneiss is exposed on the mainland at Cape Preston at 20° 50'S, 116° 12'E, and at Mount Wilkie at 20° 57'S, 116° 25'E. Within the archipelago granophyre and gabbro are intruded at the unconformity. The granophyre contains rafts and blocks of partially assimilated Archaean granite. At the top of the granophyre are small lenses of metasomatized arkose, which represent the basal unit of the Fortescue Group Mount Roe Basalt. The Mount Roe Basalt, which dips gently northwest, is in turn overlain by the Hardey Sandstone, which outcrops on Rosemary Island. Dolerite sills are intruded into the Mount Roe Basalt and Hardey Sandstone on West Lewis, Enderby and Rosemary Islands: these sills are in turn intruded by a set of extensive, narrow, dolerite dykes.

The early Archaean rocks are largely confined to the mainland. In the Dampier–Karratha area, the granite and gneiss form major domal structures that are separated by tightly folded synclines of Archaean basalt and iron-formation.

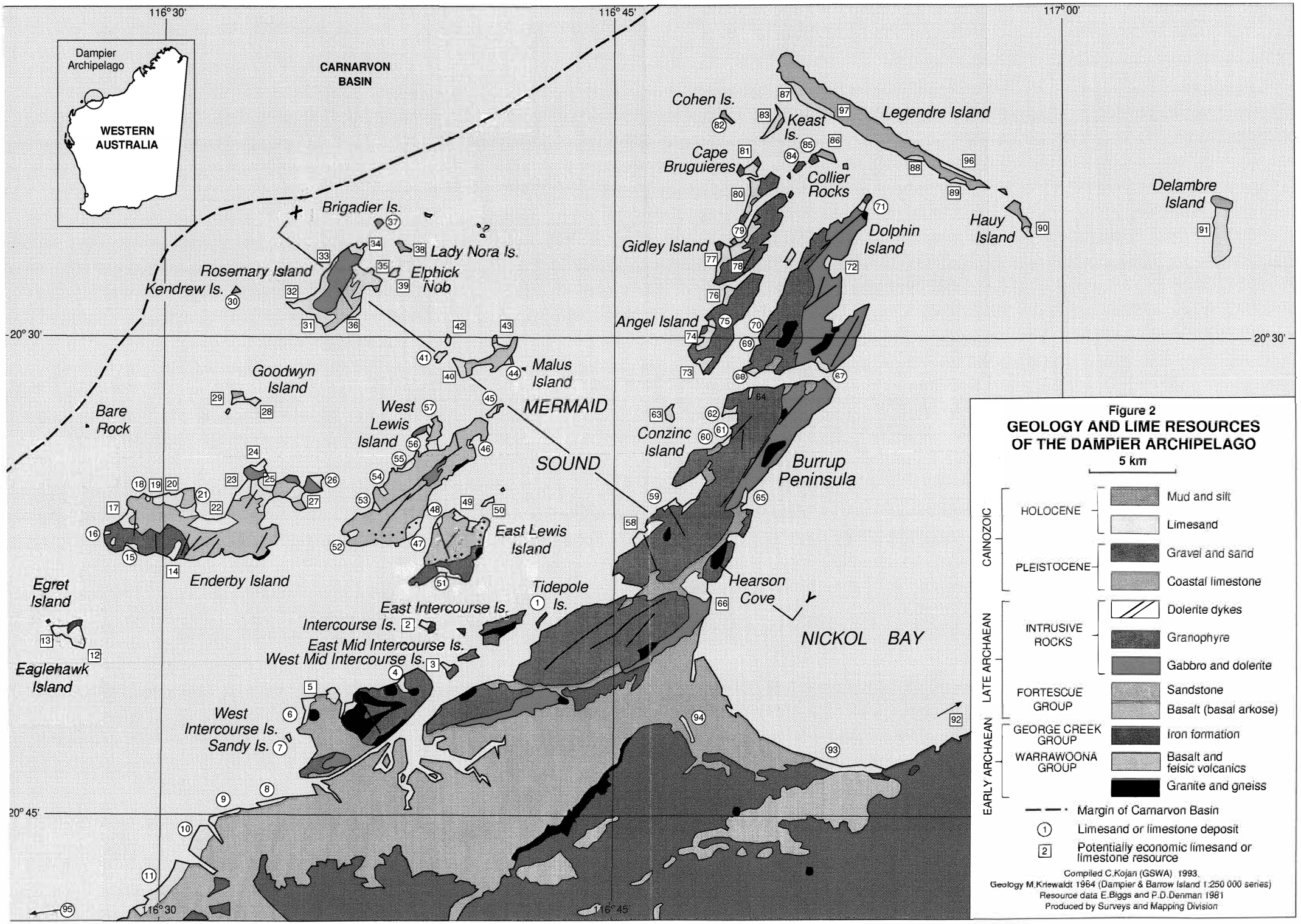
The Precambrian rocks of the archipelago and adjacent mainland are locally overlain by Cainozoic formations that include the products of weathering and erosion of the older rocks. The older Pleistocene formations include the clay, red-brown silty sand and minor gravel deposits that overlie areas of poorly exposed Archaean rocks on the mainland, and coastal limestone which outcrops on the outer islands of the archipelago and underlies most of the surrounding sea floor. The younger Holocene formations include limestone, gravel and conglomerate, and overlying calcareous sand also known as limesand. These younger formations mostly occur offshore; however limesand also forms as beach and foredune deposits within bays located on the islands of the archipelago and adjacent mainland. Mud and silt occur within the intertidal zone.

## Stratigraphy and geochronology

The stratigraphy of the Dampier Archipelago and adjacent mainland area is shown in Figures 2 and 3. Recent geochronological information suggests that the Archaean stratigraphic succession of the Pilbara Craton was deposited between 3.6 and 2.8 Ga. This succession includes the Warrawoona and Gorge Creek Groups. Rocks assigned to these groups outcrop on the mainland near Karratha.

The surrounding granite and gneiss (Karratha Granite and Dampier Granitoid Complex) outcrop south and west of Karratha. The Dampier Granitoid Complex underlies much of the southern archipelago and adjacent mainland. The granitoid bodies developed as domes as a result of multiple intrusion during the period in which Archaean sedimentary and volcanic rocks (Warrawoona Group) were accumulating.

Basalt and sandstone of the late Archaean Fortescue Group date from about 2.8 to 2.7 Ga. The Gidley Granophyre and associated gabbro and dolerite intrude the Fortescue Group formations. A probable age range for these intrusions is 2.7 to 2.4 Ga.


116° 30'
116° 45'
117° 00'
20° 30'
20° 45'
Dampier Archipelago
WESTERN AUSTRALIA
CARNARVON BASIN
Brigadier Is.
Lady Nora Is.
Rosemary Island
Elphick Nob
Kendrew Is.
Goodwyn Island
Malus Island
Bare Rock
West Lewis Island
MERMAID SOUND
East Lewis Island
Enderby Island
Egret Island
Eaglehawk Island
East Intercourse Is.
Intercourse Is.
East Mid Intercourse Is.
West Mid Intercourse Is.
West Intercourse Is.
Sandy Is.
Tidepole Is.
Hearson Cove
NICKOL BAY
Burrup Peninsula
Conzinc Island
Cohen Is.
Keast Is.
Legendre Island
Cape Bruguieres
Collier Rocks
Gidley Island
Dolphin Island
Angel Island
Hauy Island
Delambre Island
Figure 2
GEOLOGY AND LIME RESOURCES OF THE DAMPIER ARCHIPELAGO
5 km
CAINOZOIC
HOLOCENE
Mud and silt
Limesand
PLEISTOCENE
Gravel and sand
Coastal limestone
LATE ARCHAEAN
INTRUSIVE ROCKS
Dolerite dykes
Granophyre
Gabbro and dolerite
FORTESCUE GROUP
Sandstone
Basalt (basal arkose)
EARLY ARCHAEAN
GEORGE CREEK GROUP
Iron formation
WARRAWOONA GROUP
Basalt and felsic volcanics
Granite and gneiss
Margin of Carnarvon Basin
1 Limesand or limestone deposit
2 Potentially economic limesand or limestone resource
Compiled C.Kojan (GSWA) 1993.
Geology M.Kriewaldt 1964 (Dampier & Barrow Island 1:250 000 series)
Resource data E.Biggs and P.D.Denman 1981
Produced by Surveys and Mapping Division

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The Pleistocene gravel deposits and limestone date from approximately 2 Ma, and the Holocene limesand deposits and mud and silt from about 0.01 Ma (10 000 years BP).

## Early Archaean granitoids and greenstones

The Archaean granitoid bodies comprising the Dampier Granitoid Complex and Karratha Granite are poorly exposed. Hickman (1990) has described the granitoids of the West Pilbara as consisting of foliated monzogranite, granodiorite, and migmatite with some minor porphyritic phases. Greenstone xenoliths occur. Hickman (1983, p. 27) cites the Karratha Granite as an example of a sheared adamellite.

Biggs (1980) reports that granite and gneissic granite (Dampier Granitoid Complex) probably underlie much of Roo Cove (the site of the salt evaporators). The granite is coarse grained and leucocratic, usually pink-grey. It is even grained to porphyritic and pink feldspar phenocrysts are set in equal amounts of grey quartz and white feldspar with subordinate ferromagnesians, usually dark-brown biotite. The gneissic granite is sheared, presumably by local faulting, and is widely penetrated by quartz stringers. According to Kriewaldt (1964) granite and gneissic granite are usually restricted to the bottom of the Archaean succession although they intrude all but the highest unit (the iron-formation of the Gorge Creek Group).

The Dampier Granitoid Complex, at its northern margin, has been intruded and partially assimilated by late Archaean gabbro and granophyre collectively referred to as the Gidley Granophyre. The Gidley Granophyre contains numerous large granite bodies which are believed to represent rafts of granite transported by the host gabbro and granophyre from the underlying granitoid basement. The larger granite rafts outcrop on the Burrup Peninsula and on Dolphin and West Intercourse Islands.

Hickman (1983, p. 52) reports that granite samples collected close to the granite contact near Dampier show marked effects of partial remelting. Coarse, enlarged quartz grains are separated from very coarse-grained potash feldspar by broad areas of granophyre. Contact metamorphism imposed on the granite has recrystallized the rock, or at least produced new textures such as erratic perthitic exsolution lamellae.

Archaean volcanic and sedimentary rocks are not found in the archipelago. However, basalt, chert and minor felsic volcanics of the Warrawoona Group outcrop

near Karratha and iron-formation of the Gorge Creek Group outcrops along the coast to the northeast of that town. These formations constitute the Regal Greenstone Belt, which separates the Dampier Granitoid Complex and Karratha Granite. At Nickol River, 11 km east of Karratha, quartz-veined felsic volcanic rocks host small gold deposits.

## Late Archaean Fortescue Group

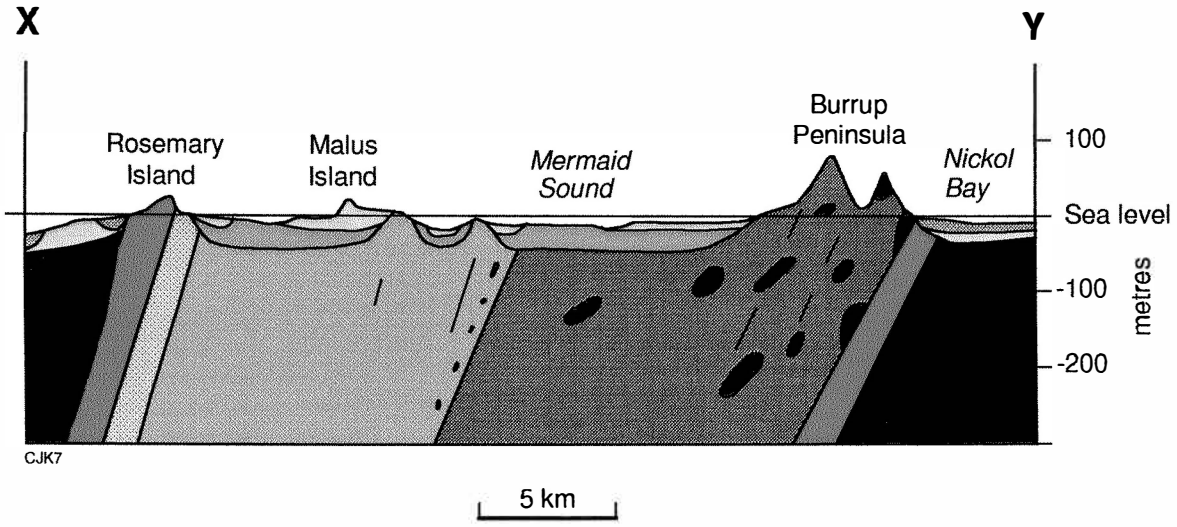
Late Archaean rocks of the Fortescue Group outcrop on the islands of the western archipelago. Two formations have been mapped. The lower formation, the Mount Roe Basalt, which makes up most of the sequence, consists of basaltic lavas with some agglomerate. Arkose locally occurs as lenses at the base of the sequence. The upper formation, the Hardey Sandstone, includes bedded and cross-bedded, pale-green, fine-grained tuffaceous rocks, white quartz sandstone, and purple and green shales. Outcrops of this formation are confined to Rosemary Island.

Biggs (1980) reports that the Fortescue Group sequence observed in the archipelago dips from 10 to 30° in a northerly direction and has an estimated thickness of 1300 m.

On the mainland, south of the archipelago, the sequence unconformably overlies granite and gneiss of the Dampier Granitoid Complex. Within the archipelago, granophyre and gabbro (Gidley Granophyre) have been intruded at the unconformity and the granophyre is in contact with the Mount Roe Basalt. The basal arkose lenses have been partly metasomatized and small dykes, apparently offshoots of the granophyre, intrude the overlying basalt.

Late Archaean intrusive rocks comprise the Gidley Granophyre (granophyre and gabbro), dolerite sills, and dolerite dykes. The Gidley Granophyre is a massive, differentiated and hybridized suite of rocks which intrudes the Archaean granitic basement along the unconformity with the overlying Fortescue Group (Mount Roe Basalt).

A coarse-grained gabbro forms the base of the intrusion and outcrops along the eastern shores of Burrup Peninsula and Dolphin Island. The gabbro contains distinctive hornblende phenocrysts up to 10 cm long, which often occur in radiating

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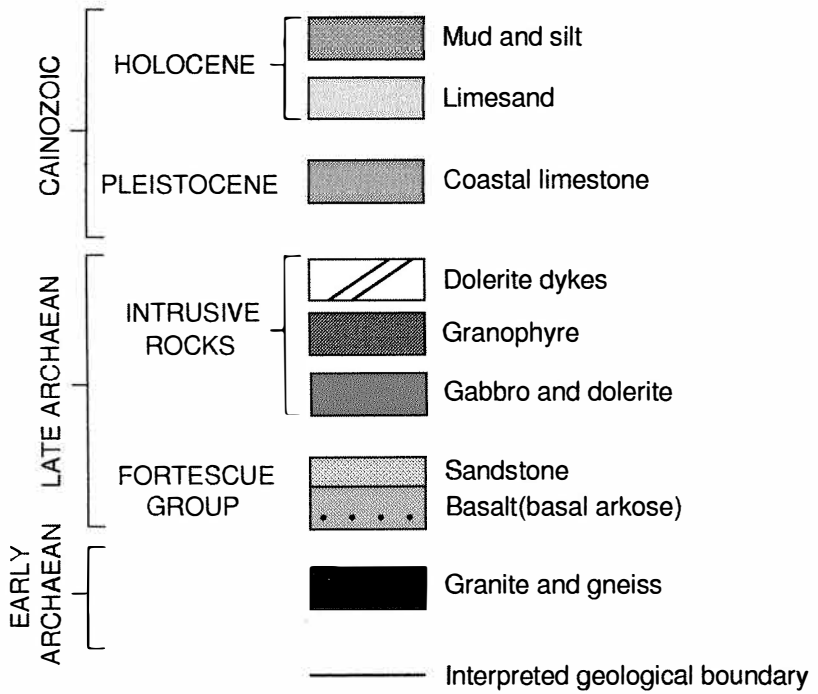


**Figure 3. Geological cross section, Dampier Archipelago.**

groups. Gradations to feldspathic diorite are common and partial remelting and assimilation of early Archaean granite has resulted in some hybridization.

Above the gabbro the main component of the intrusion is a fine- to medium-grained porphyritic, dark-green to purple granophyre, which forms the major part of Burrup Peninsula. It also forms significant portions of Dolphin, Angel, Gidley, East Lewis, and Enderby Islands. Large rafts and xenoliths of early Archaean granite occur and assimilation of granite, arkose and basic rocks has produced localized hybrid rocks. Basal arkosic sandstone of the Mount Roe Basalt has been metasomatized by the granophyre and small granophyric dykes intrude the overlying basalt on Enderby Island.

Estimates for the thickness of the Gidley Granophyre intrusion (including the basal gabbro) range from 870 m (Trendall, 1990, p. 174) to 3000 m (Hickman, 1983, p. 133). Assuming an outcrop width of 15 km, as measured on section A–B through Rosemary Island (Kriewaldt, 1964), and a constant dip of 5°, the calculated thickness for the Gidley Granophyre is 1307 m. A very similar thickness estimate of 1369 m is obtained by calculation using the dips and outcrop width shown on section A–B through Dampier (Biggs, 1980).

The dolerite sills that intrude the Fortescue Group formations on Enderby, East Lewis, and Rosemary Islands have not been described in detail. Kriewaldt (1964) considers the sill on Rosemary Island to be analagous to the large sill which occurs south of Roebourne (Cooya Pooya Dolerite).

The youngest igneous rocks encountered in the archipelago are blue-grey, fine- to medium-grained dolerite dykes. Accessory pyrite is disseminated or aggregated and rare to common in different dykes. Weathering surfaces are dusky brown. The dykes form negative, trench-like features within granophyre and generally positive features within other rocks. The predominant trend is northeasterly.

## Cainozoic

Small areas of Tertiary laterite have been mapped in the Karratha area on the mainland. Quaternary formations and unlithified deposits cover extensive areas of the mainland and adjacent offshore areas and are represented on some of the islands.

The older Quaternary rocks include the dune limestone which forms the outer islands of the archipelago. This limestone, which is correlated with the Tamala Limestone (formerly Coastal Limestone) of the Perth and Carnarvon Basins and the Bossut Formation of the Canning Basin, consists of sandy calcarenite which represents lithified dunes and beach and offshore bar deposits. Test-drilling and sampling results from Mermaid Sound indicate that most of the submerged area of the archipelago is underlain by limestone. The limestone in the offshore areas generally overlies Precambrian basement. In the southern archipelago area, the limestone passes laterally into clay. These relationships are illustrated in Figures 4 to 6.

Other older Quaternary deposits include a diverse group of alluvial and colluvial deposits which consist predominantly of gravel and sand. They range in age from Pleistocene to Holocene and include reworked Tertiary deposits consisting of lateritized Archaean bedrock. These deposits are largely confined to the mainland areas as shown in Figure 2. Offshore, possibly contemporaneous deposits comprising gravel and limestone conglomerate are widely distributed on the archipelago sea floor and overlie the dune limestone from which they are largely derived.

The younger Quaternary deposits include the limesand deposits which are scattered throughout the islands of the archipelago and along the coastline of the adjacent mainland. Limesand deposits ranging up to five metres in thickness have been intersected in the course of test drilling in Mermaid Sound. These deposits represent beaches and sand plains formed of shelly sands which have formed in offshore areas during the Holocene (less than 0.01 Ma.).

Results of Woodside Offshore Petroleum's sea-floor sampling and drilling are summarized in the Appendix. These data have been used to construct a plan and four sections (Figs 4 to 6).

# Mineral and petroleum resources

## Metalliferous mineral resources

By analogy with areas of similar geology in the Pilbara and elsewhere, the gabbro (Gidley Granophyre) has some potential for metalliferous mineralization (gold, nickel, copper, and platinum group elements). Likewise the basal arkosic lenses of the Mount

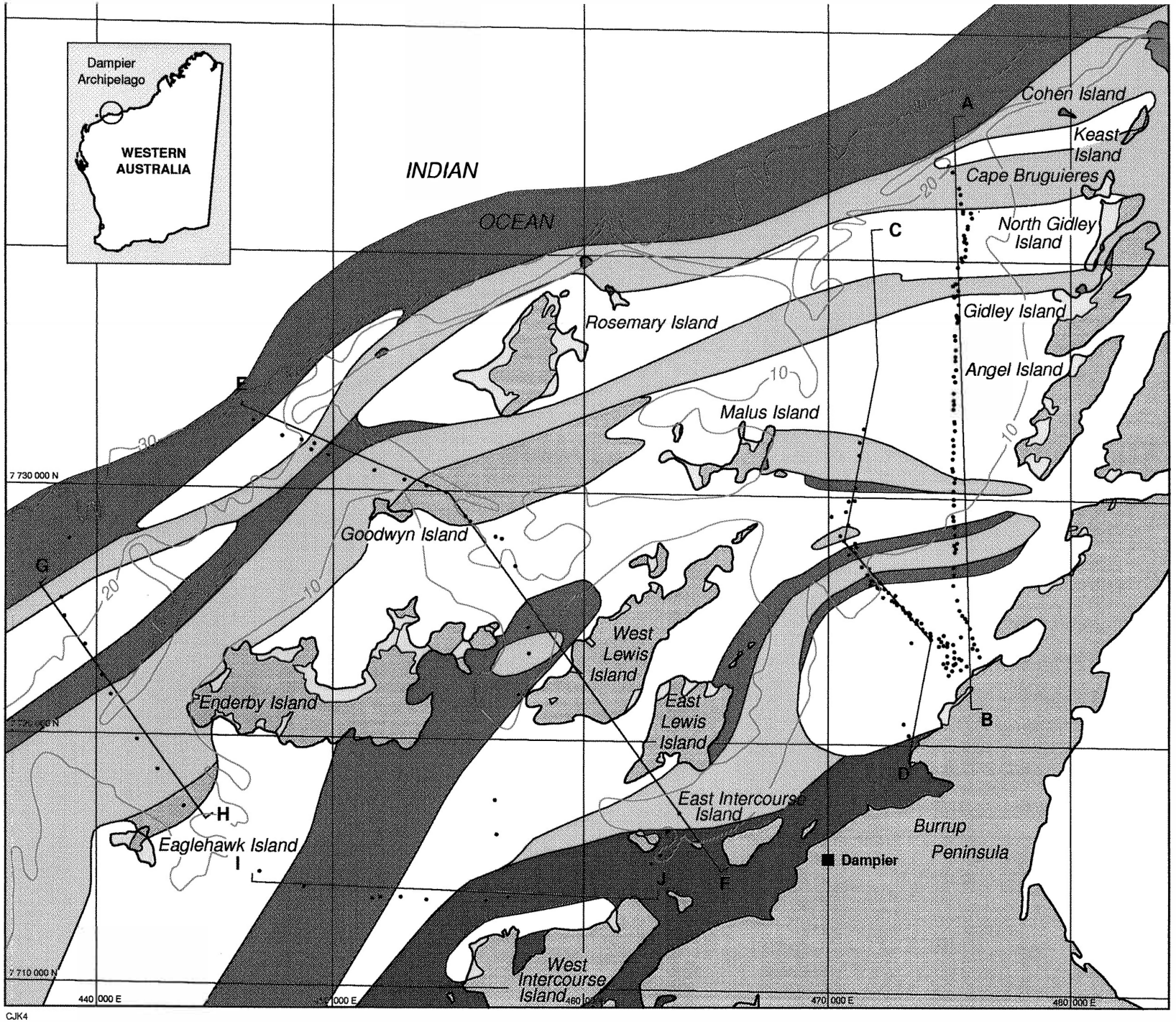


**Figure 4**

# PRELIMINARY GEOLOGICAL INTERPRETATION CAINOZOIC GEOLOGY DAMPIER ARCHIPELAGO

5 km

- Limesand
- Gravel
- Limestone
- Clay (borehole geology at/near surface)
- Basement rocks
- Seafloor, geology unknown
- Coastline
- Terrestrial limesand or limestone
- Geological section (refer Figs 5 and 6)
- Seafloor sample location or drillhole
- 10 Seafloor depth in metres below low tide

Compiled : C.Kojan (GSWA) 1993
Geology: E. Biggs (1979, 1980) and Woodside Petroleum (1972, 1978, 1981)
Resource data: E. Biggs and P.H. Denman 1981
Produced by: Surveys and Mapping Division

CJK4

Roe Basalt (Fortescue Group) have some potential for gold and uranium mineralization (Hickman, 1983, p. 118).

## Lime resources

The islands of the archipelago, surrounding offshore areas, and coastal areas of the adjacent mainland contain extensive deposits of limesand and limestone. The larger limesand deposits and larger onshore limestone deposits represent potential lime resources suitable for a variety of industrial uses, notably iron-ore processing, steel making and cement manufacture. Limesand has been quarried at Hearson Cove on the Burrup Peninsula, and from the mainland at Cleaverville (Figs 1 and 2). Current production is confined to the Cleaverville area. Limestone deposits have been investigated but there has been no limestone mining within the archipelago or adjacent area.

### Limesand

Limesand in the form of shell beds and dunes occurs in scattered deposits within island bays. In addition it covers large tracts of the sea floor and occurs at several sites on the coast of the adjacent mainland. The distribution of limesand occurrences is shown in Figures 2 and 4.

The deposits were investigated by Hamersley Iron Pty Ltd. This company applied for 74 mineral leases in order to secure all deposits of limesand and limestone within the archipelago. Three mineral leases (MLs 317–319) were granted at Hearson Cove on the eastern coastline of the Burrup Peninsula as shown in Figure 1. The reference number for these deposits is '66' (Fig. 2 and Table 4). Mining of limesand commenced in 1968 to supply an iron-ore pelletizing plant, which was located at Dampier. The pellet plant ceased operating in 1980. Total production amounted to 379 000 tonnes at an average grade of approximately 80% $CaCO_3$.

The limesand deposit at Cleaverville on the mainland northeast of Karratha was pegged by Specified Services Pty Ltd, a subsidiary of Pioneer Concrete. Ten mineral leases (MLs 511–520) were granted. The reference number for this deposit is '92' (Fig. 2 and Table 4). Limesand mining at the deposit is reported by Biggs and Denman (1981, p. 28–29). Mining commenced in 1974 from the eastern end of the deposit.

Production for the period 1974–76 was used in the Cliffs International Cape Lambert iron-ore pellet plant. Production (1974–76) amounted to 94 000 tonnes at 75% $CaCO_3$; however, the grade was only marginally suitable and was discontinued in favour of Japanese limestone. Production since 1976 has been directed at cement manufacture. Total production to date amounts to 172 000 tonnes.

The Geological Survey of Western Australia (GSWA) investigated 97 separate onshore occurrences of limesand/limestone (Biggs and Denman, 1981). Possible economic resources of limesand were identified at 47 locations. The locations are shown in Figure 2 and results of the resource assessments are summarized in Tables 3 and 4. A total of 166.5 Mt of limesand with a weighted mean grade of 89.58% $CaCO_3$ was reported from 36 locations within the proposed national park (Table 3). A total of 22.4 Mt of limesand with a weighted mean grade of 83.51% $CaCO_3$ was reported from 11 locations outside the proposed national park (Table 4).

The review of sea-floor drilling and sampling data acquired from Woodside Offshore Petroleum Pty Ltd shows that extensive deposits of limesand underlie the archipelago sea floor. There is no information available concerning the grade of these deposits and very limited information concerning their thickness. These offshore limesand deposits represent important potential lime resources: most are located within Ministerial Reserve 5461H. The distribution of these offshore deposits and the western boundary of this reserve are shown in Figure 4.

## Limestone

Dune limestone (calcarenite) underlies most of the archipelago sea floor, but its onshore outcrop is largely confined to Legendre, Hauy and Delambre Islands and the adjacent Collier Rocks. The distribution of these onshore limestone deposits is shown in Figure 2. The interpreted subsurface extent of the limestone is shown in Figure 4. The onshore limestone deposits were originally pegged by Hamersley Iron Pty Ltd but the mineral lease applications were subsequently withdrawn. Legendre Island is currently intended for industrial development, and the other limestone islands are proposed for incorporation into the national park.

Biggs and Denman (1981) investigated the onshore limestone deposits and the results of their resource assessment are summarized in Tables 5 and 6. A total of

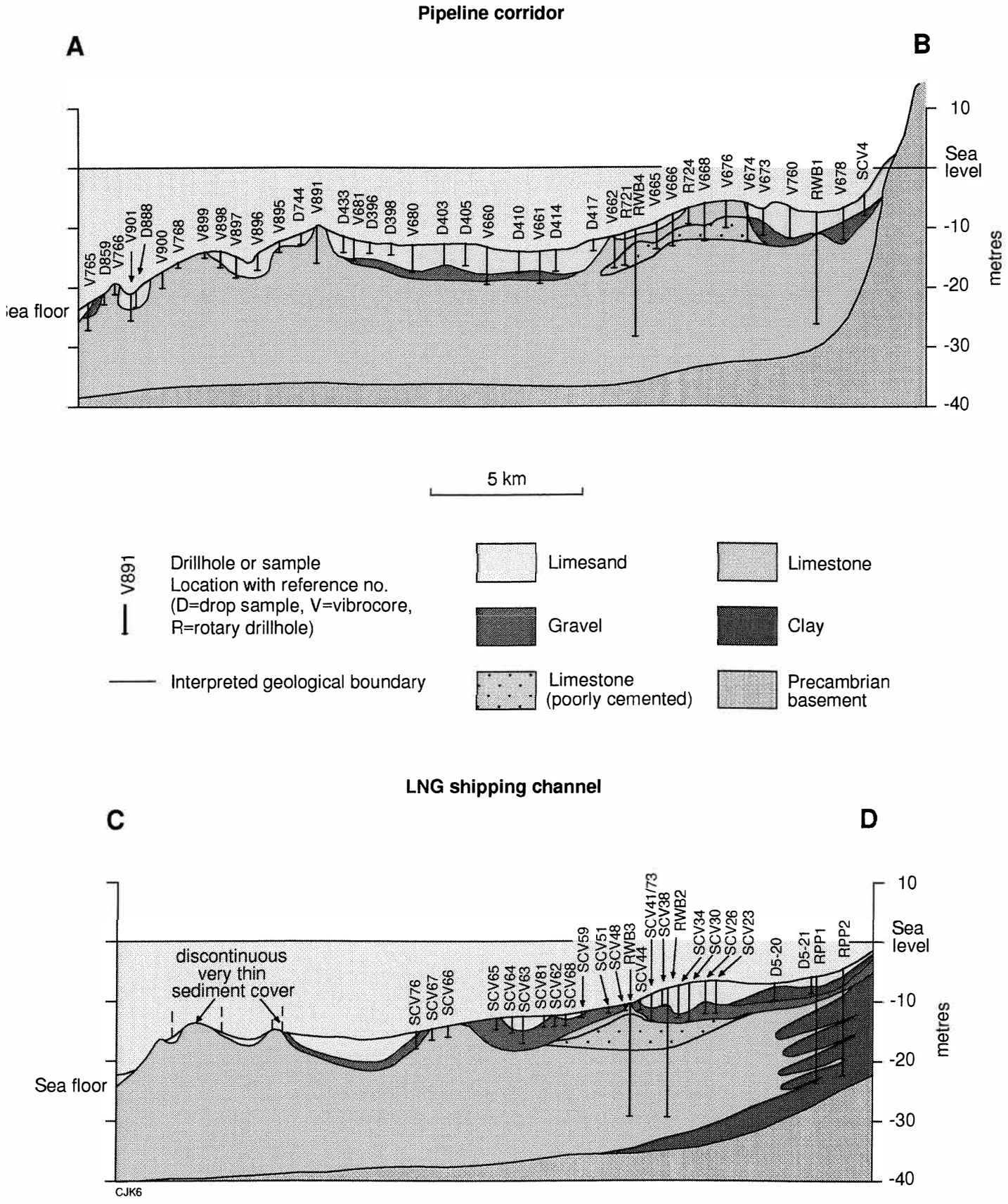


**Figure 5. Geological cross sections A–B and C–D Cainozoic geology Mermaid Sound**

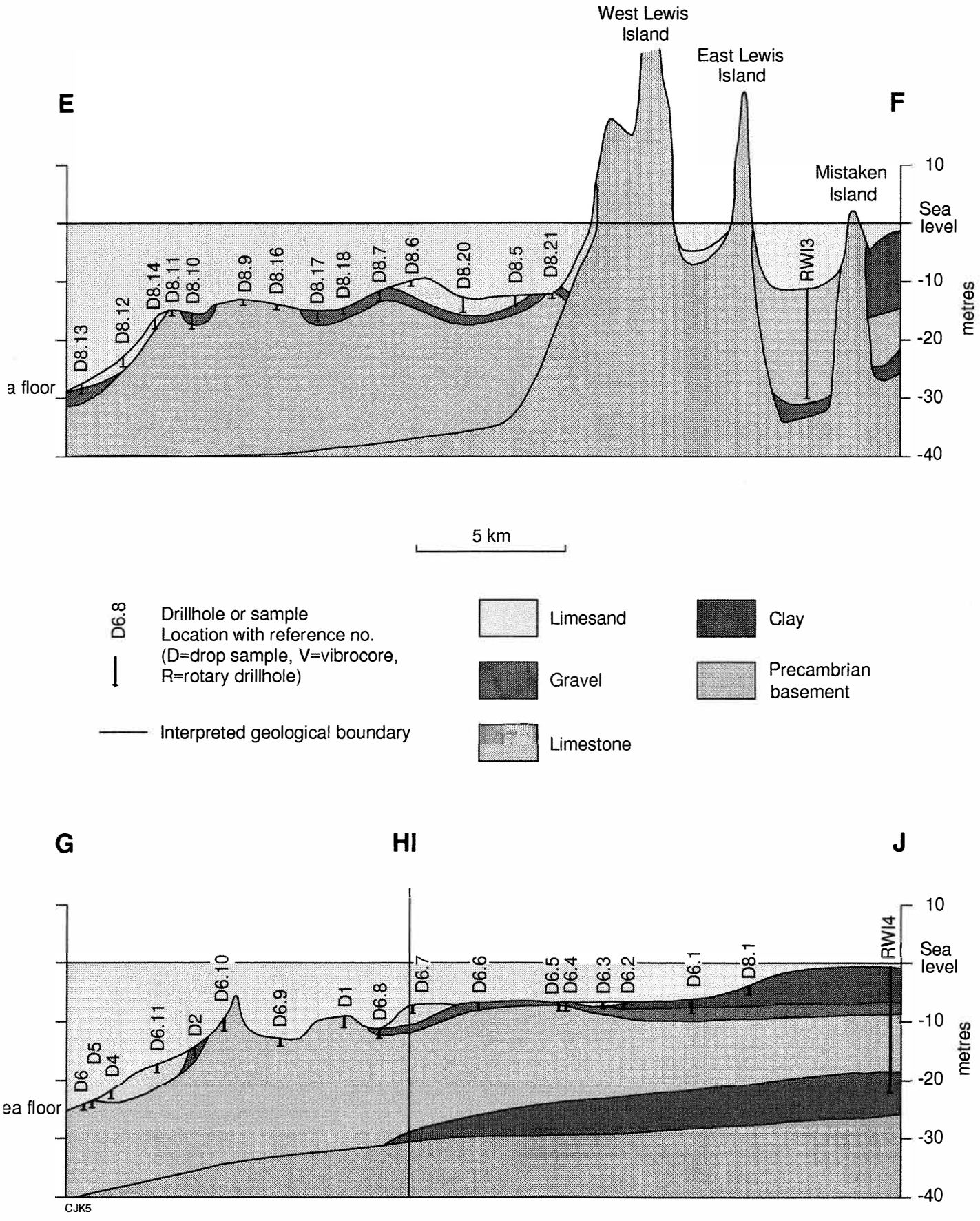


**Figure 6. Geological cross sections E–F, G–H and I–J Cainozoic geology western archipelago**

## Table 3. Limesand resources of islands for inclusion in the national park

| *Island* | *Current purpose* | *Map locality* | *Limesand ($10^6m^3$)* | *Mass (Mt)* | *Grade $CaCO_3$ (%)* |
|---|---|---|---|---|---|
| Enderby Island | A Nature Reserve | 14 | 1.60 | 2.4 | 89.00 |
| | | 17 | 0.90 | 1.4 | 90.20 |
| | | 19/20 | 2.15 | 3.2 | 93.60 |
| | | 22 | 6.10 | 9.2 | 90.70 |
| | | 23 | 1.55 | 2.3 | 93.90 |
| | | 24 | 1.98 | 3.0 | 93.40 |
| | | 25 | 3.15 | 4.7 | 89.50 |
| | | 27 | 1.55 | 2.3 | 92.30 |
| | | | **Subtotal** | **28.5** | **WM 91.34** |
| Rosemary Island | A Nature Reserve | 31 | 3.80 | 5.7 | 89.70 |
| | | 32 | 9.60 | 14.4 | 90.40 |
| | | 33 | 2.00 | 3.0 | 90.20 |
| | | 34 | 1.40 | 2.1 | 89.50 |
| | | 35 | 5.60 | 8.4 | 90.00 |
| | | 36 | 3.00 | 4.5 | 92.30 |
| | | | **Subtotal** | **38.1** | **WM 90.37** |
| Eaglehawk Island | C Nature Reserve | 12 | 4.90 | 7.4 | 81.40 |
| | | 13 | 2.60 | 3.9 | 84.10 |
| | | | **Subtotal** | **11.3** | **WM 82.34** |
| Goodwyn Island | C Nature Reserve | 28 | 1.65 | 2.5 | 89.10 |
| | | 29 | 1.30 | 2.0 | 87.60 |
| | | | **Subtotal** | **4.4** | **WM 88.44** |
| Malus Island | C Nature Reserve | 40 | 3.25 | 4.9 | 92.50 |
| | | 42 | 0.70 | 1.1 | 94.50 |
| | | 43 | 1.00 | 1.5 | 92.50 |
| | | | **Subtotal** | **7.4** | **WM 92.78** |
| Angel Island | C Nature Reserve | 73 | 1.40 | 2.1 | 88.20 |
| | | 74 | 2.65 | 4.0 | 88.80 |
| | | 76 | 1.75 | 2.6 | 94.50 |
| | | | **Subtotal** | **8.7** | **WM 90.38** |
| Gidley Island | C Nature Reserve | 77 | 5.15 | 7.7 | 89.80 |
| | | 78 | 0.90 | 1.4 | 88.80 |
| | | | **Subtotal** | **9.1** | **WM 89.65** |
| Dolphin Island | B Nature Reserve | 72 | 1.00 | 1.5 | 87.10 |
| Lady Nora Island | C Nature Reserve | 38 | 1.35 | 2.0 | 90.20 |
| Elphick Nob | C Nature Reserve | 39 | 0.95 | 1.4 | 90.20 |
| Conzinc Island | C Nature Reserve | 63 | 0.70 | 1.1 | 88.00 |
| North Gidley Island | C Nature Reserve | 80 | 6.00 | 9.0 | 88.20 |
| Cape Bruguieres | C Nature Reserve | 81 | 2.50 | 3.8 | 86.10 |
| Keast Island | C Nature Reserve | 83 | 1.10 | 1.7 | 88.90 |
| Hauy Island | C Nature Reserve | 90 | 1.45 | 2.2 | 91.80 |
| Delambre Island | C Nature Reserve | 91 | 24.35 | 36.5 | 89.60 |
| | | | **Subtotal** | **59.1** | **WM 89.17** |
| | | | **Grand total limesand** | **166.5** | **WM 89.58** |

Note: WM = weighted mean

**Table 4. Limesand resources of islands or areas excluded from the national park**

| *Island or adjacent area* | *Current purpose* | *Map locality* | *Limesand ($10^6m^3$)* | *Mass (Mt)* | *Grade $CaCO_3$ (%)* |
|---|---|---|---|---|---|
| East Lewis Island | C Recreation Res. | 49 | 0.95 | 1.4 | 90.50 |
| | | 50 | 0.85 | 1.3 | 88.80 |
| | | | **Subtotal** | **2.7** | **WM 89.70** |
| Legendre Island | Industrial Devel. | 87 | 0.90 | 1.4 | 83.00 |
| | | 88 | 0.55 | 0.8 | 89.10 |
| | | 89 | 0.90 | 1.4 | 88.20 |
| | | 96 | 2.10 | 3.2 | 90.80 |
| | | | **Subtotal** | **6.7** | **WM 88.49** |
| Hearson Cove | Crown Land | 66 | 3.00 | 4.5 | 78.20 |
| Dampier Promontory | Crown Land | 58 | 0.75 | 1.1 | 84.60 |
| Cleaverville | Crown Land | 92 | 2.75 | 4.1 | 75.60 |
| Intercourse Island | Crown Land | 2 | 0.40 | 0.6 | 87.30 |
| West Mid Intercourse | Crown Land | 3 | 0.60 | 0.9 | 85.40 |
| West Intercourse | Crown Land | 5 | 1.20 | 1.8 | 84.30 |
| | | | **Subtotal** | **13.1** | **WM 79.69** |
| | | **Grand total limesand** | | **22.4** | **WM 83.51** |

Note: WM = weighted mean

32.2 Mt of limestone with a weighted mean grade of 85.20% $CaCO_3$ was reported from the three islands proposed for incorporation into the national park (Table 5). A total of 264.0 Mt of limestone with a mean grade of 84.80% $CaCO_3$ was reported from Legendre Island (Table 6).

## Salt

Salt is obtained by evaporation of seawater from specially constructed ponds which occupy the low-lying ground known as Roo Cove, which separates the Burrup Peninsula from the mainland. Production is continuing at a rate in excess of one million tonnes annually. There are no large, sheltered, intertidal areas from which salt could be produced within the archipelago.

## Construction materials

The granophyre and gabbro, which form much of Burrup Peninsula and the adjacent islands, represent a useful resource of ballast and aggregate for engineering and

**Table 5. Limestone resources of islands for inclusion in the national park**

| *Island* | *Current purpose* | *Map locality* | *Limestone ($10^6 m^3$)* | *Mass (Mt)* | *Grade $CaCO_3$ (%)* |
|---|---|---|---|---|---|
| Collier Rocks | C Nature Reserve | 86 | 3.20 | 7.7 | 88.00 |
| Hauy Island | C Nature Reserve | 90 | 6.50 | 15.6 | 82.00 |
| Delambre Island | C Nature Reserve | 91 | 3.70 | 8.9 | 88.40 |
| | | **Grand total limestone** | | **32.2** | **WM 85.20** |

Note: WM = weighted mean

construction purposes. Production is largely confined to a group of quarries located east of Dampier, on the north side of the evaporator ponds. Sand for construction purposes is quarried from mining leases in the Karratha area.

## Water

There are no significant water resources within the islands nominated for the proposed park. Limited surface-water resources are available from rock holes in valleys, following rain. Most of the islands of the proposed park consist of Archaean basalt and granophyre, which have been intruded by narrow dolerite dykes. Some groundwater may be available within fracture zones adjacent to the dolerite dykes but is likely to be brackish to saline.

## Petroleum resources

The islands of the archipelago are located on the northwest margin of the Precambrian Pilbara craton and are unprospective for petroleum owing to their predominantly igneous nature and lack of structures capable of hosting petroleum resources. The archipelago sea floor is covered by thin, very recent (Quaternary) deposits of limestone and limesand and accordingly is also unprospective.

The boundary separating the Precambrian igneous rocks of the Pilbara craton and the thick Mesozoic sedimentary sequence of the Carnarvon Basin is shown in Figure 2. The boundary has been interpreted from marine seismic data recorded by oil-exploration companies (McClure et al., *in* Purcell, 1988). There are no known petroleum occurrences within the portion of the basin shown in Figure 2. However,

**Table 6. Limestone resources of islands for exclusion from the national park**

| *Island* | *Current purpose* | *Map locality* | *Limestone ($10^6 m^3$)* | *Mass (Mt)* | *Grade $CaCO_3$ (%)* |
|---|---|---|---|---|---|
| Legendre Island | Industrial Devel. | 97 | 110.00 | 264.0 | 88.80 |
| | | | | | 84.80 |
| | | | | | 80.80 |
| | | **Grand total limestone** | | **264.0** | **mean 84.80** |

the area has not been tested by drilling and it is possible that petroleum accumulations do occur in this area, parts of which are located within 10 km of the outer islands of the archipelago.

# Conclusions

The review of the geology and mineral resources of the Dampier Archipelago shows that the islands of the archipelago, surrounding offshore areas, and coastal areas of the adjacent mainland contain extensive deposits of limesand and limestone.

The larger limesand deposits (onshore and offshore) and the larger onshore limestone deposits represent important lime resources for the existing and proposed iron-ore processing, steel-making and cement-manufacturing industries of the rapidly developing Dampier–Karratha region.

Most of the onshore limesand resources of the archipelago and surrounding area (166.5 out of a total of 188.9 Mt) are located within the proposed Dampier Archipelago National Park. In contrast, most of the known limestone resources (264.4 out of a total of 296.6 Mt) are located outside the proposed park.

The review of sea-floor drilling and sampling data acquired from Woodside Offshore Petroleum Pty Ltd shows that extensive deposits of limestone and limesand underlie the archipelago sea floor. There is no information available concerning the grade of these deposits and very limited information concerning their thickness. These offshore limesand deposits represent important potential lime resources. High-grade

limesand is currently being dredged from the sea floor in Cockburn Sound. Most of the limesand is used in the production of lime for the gold and alumina industries.

Management of the onshore and offshore lime resources of the Dampier Archipelago should occur in the context of the Government's economic objectives for the region. A significant proportion of the onshore limesand resources of the archipelago will be sterilized if the current national park proposal is implemented.

Review of the geology of the islands proposed for inclusion in the new park indicates some potential for metalliferous mineralization, including gold, nickel, copper and platinum group elements, within the gabbro and larger dolerite bodies. There is also some potential for alluvial gold within the basal sandstone of the Fortescue Group. However, there is no record of metalliferous mineral exploration within the islands of the archipelago.

Review of the geology of the archipelago also indicates low potential for groundwater and no potential for salt production. There is no potential for petroleum within the islands of the archipelago or the archipelago sea floor. There is some potential for petroleum in the offshore area northwest of the archipelago, which corresponds to the margin of the Carnarvon Basin. This area has not been test drilled and parts of the area are located within 10 km of the outer islands of the archipelago.

## Sources

Much of the introductory section of this report is based on information contained in the Dampier Archipelago Nature Reserves Management Plan (Chevis et al., 1990). The principal sources for the onshore geology are GSWA Bulletin 127 (Geology of the Pilbara Block and its environs) by Hickman (1983), the 1:250 000 map sheet and explanatory notes, DAMPIER AND BARROW ISLAND (Kriewaldt et al., 1964) and the two 1:50 000 map sheets and notes, NICKOL BAY–LEGENDRE (Biggs, 1979)

and DAMPIER – EAGLEHAWK ISLAND – ROSEMARY, (Biggs, 1980). The principal source for the offshore geology is Woodside Offshore Petroleum's data relating to the test sampling and drilling of the archipelago sea floor. These sea-floor investigations were designed to determine the most appropriate routes for the gas pipeline and the LNG shipping channel. Woodside Offshore Petroleum's cooperation in making these data available is acknowledged.

The principal source for the mineral resources section is GSWA Record 1978/6 (Dampier Archipelago limesand and limestone) by Biggs and Denman (1981).

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## Appendix

# Sea-floor sampling details (Woodside Offshore Petroleum Pty Ltd)

Table A-1. Sea-floor drilling and sampling details — pipeline corridor
Table A-2. Sea-floor drilling and sampling details — LNG shipping channel
Table A-3. Sea-floor sampling details — pipeline corridor reconnaissance surveys
Table A-4. Sea-floor rotary drilling details — proposed harbour sites

Sources:
Associated Surveys (1978), Associated Osiris (1981), Decca (1973).

## Table A-1. Sea-floor drilling and sampling details — pipeline corridor

| *Ref. no.* | *Easting* | *Northing* | *Section* | *PBSF (a) (m)* | *Geology* |
|---|---|---|---|---|---|
| V677 (b) | 476225 | 7723660 | None | 1.3 | Silty carbonate sand |
| | | | | 1.9 | Calcarenite, gravel |
| V678 | 476110 | 7723925 | A–B | 2.4 | Silty carbonate sand |
| | | | | 3.2 | Calcarenite, gravel |
| D30 | 475985 | 7724075 | None | 2.6 | Silty carbonate sand |
| D432 | 476030 | 7724230 | None | 1.1 | Silty carbonate sand |
| V679 | 475880 | 7724480 | None | 3.1 | Silty carbonate sand |
| | | | | 2.0 | Limestone |
| | | | | 0.7 | No recovery |
| D430 | 475740 | 7724790 | None | 3.0 | Silty carbonate sand |
| D429 | 475670 | 7725075 | None | 2.2 | Silty carbonate sand |
| V760 | 475550 | 7725300 | A–B | 5.3 | Silty carbonate sand |
| | | | | 0.3 | Limestone and gravel |
| D428 | 475525 | 7725340 | None | 1.9 | Silty carbonate sand |
| V759 | 475400 | 7725565 | None | 3.9 | Silty carbonate sand |
| | | | | 1.1 | Gravel |
| D427 | 475395 | 7725635 | None | 1.9 | Silty carbonate sand |
| V758 | 475300 | 7725870 | None | 2.6 | Silty carbonate sand |
| | | | | 1.9 | Gravel |
| | | | | 0.2 | Silty carbonate sand |
| V673 | 475180 | 7726130 | A–B | 1.0 | Silty carbonate sand |
| | | | | 2.8 | Coarse sand |
| | | | | 4.7 | Gravel |
| V674 | 475170 | 7726530 | A–B | 1.2 | Coarse sand |
| | | | | 1.5 | Silty sand |
| | | | | 2.5 | Limestone |
| | | | | 5.8 | No recovery |
| V675 | 475155 | 7726830 | None | 0.4 | Silty sand |
| | | | | 2.5 | Calcarenite |
| | | | | 5.8 | No recovery |
| V676 | 475155 | 7727135 | A–B | 0.3 | Coarse sand |
| | | | | 0.5 | Gravel |
| | | | | 2.7 | Calcarenite |
| | | | | 5.8 | No recovery |
| V668 | 475150 | 7727650 | A–B | 0.2 | Silty sand |
| | | | | 4.0 | Calcarenite |
| | | | | 5.8 | No recovery |
| V667 | 475170 | 7728080 | None | 0.30 | Silty sand |
| R724 | 475160 | 7728140 | None | 0.2 | Silty sand |
| | | | | 1.1 | Calcarenite |
| | | | | 1.9 | No recovery |
| | | | | 2.5 | Limestone with gravel |
| V1058 | 475230 | 7728300 | None | 0.2 | Calcarenite |
| | | | | 2.0 | Coarse sand |
| | | | | 2.3 | Calcarenite |
| V666 | 475160 | 7728620 | A–B | 0.5 | Calcarenite |
| | | | | 1.7 | Gravel |
| | | | | 2.7 | Calcarenite |
| | | | | 4.8 | No recovery |
| | | | | 5.8 | Limestone |
| | | | | 5.8 | No recovery |
| D421 | 475215 | 7729100 | None | 2.0 | Coarse sand |

**Table A-1. (*continued*)**

| *Ref. no.* | *Easting* | *Northing* | *Section* | *PBSF (m)* | *Geology* |
|---|---|---|---|---|---|
| D420 | 475160 | 7729740 | None | 1.3 | Silty sand |
| | | | | 1.8 | Coarse sand |
| V664 | 475150 | 7729980 | None | 0.6 | Silty sand |
| | | | | 0.7 | Calcarenite |
| R721 | 475180 | 7730040 | A–B | 1.1 | Silty sand |
| | | | | 2.1 | Limestone |
| | | | | 2.6 | No recovery |
| | | | | 3.2 | Limestone |
| | | | | 5.8 | No recovery |
| V663 | 475165 | 7730430 | None | 0.8 | Silty sand |
| | | | | 1.4 | Calcarenite |
| | | | | 2.3 | No recovery |
| | | | | 2.7 | Calcarenite |
| | | | | 5.8 | No recovery |
| V662 | 475170 | 7730825 | A–B | 0.3 | Silty sand |
| | | | | 0.5 | Coarse sand |
| | | | | 0.7 | Calcarenite |
| | | | | 2.5 | No recovery |
| | | | | 3.2 | Calcarenite |
| | | | | 3.6 | No recovery |
| | | | | 5.0 | Calcarenite |
| | | | | 5.8 | No recovery |
| D417 | 475190 | 7730880 | A–B | 1.7 | Silty sand |
| | | | | 1.8 | Calcarenite |
| D416 | 475190 | 7731085 | None | 1.5 | Silty sand |
| | | | | 1.7 | Calcarenite |
| D415 | 475160 | 7731475 | None | 3.2 | Silty sand |
| D414 | 475200 | 7731760 | A–B | 4.1 | Silty sand |
| D413 | 475185 | 7732020 | None | 3.3 | Silty sand |
| V661 | 475190 | 7732350 | A–B | 3.1 | Silty sand |
| | | | | 3.4 | Gravel |
| | | | | 4.8 | No recovery |
| | | | | 5.8 | Limestone |
| D411 | 475215 | 7732670 | None | 3.2 | Silty sand |
| D410 | 475240 | 7733000 | A–B | 3.3 | Silty sand |
| D409 | 475240 | 7733285 | None | 3.5 | Silty sand |
| D408 | 475195 | 7733450 | None | 3.1 | Silty sand |
| | | | | 3.3 | Gravel |
| V660 | 475200 | 7733830 | A–B | 4.5 | Silty sand |
| | | | | 5.7 | Gravel |
| D405 | 475210 | 7734470 | A–B | 3.8 | Silty sand |
| D404 | 475210 | 7734725 | None | 4.0 | Silty sand |
| D403 | 475240 | 7735050 | A–B | 3.7 | Silty sand |
| V680 | 475270 | 7735935 | A–B | 4.6 | Silty sand |
| D399 | 475240 | 7736275 | None | 1.9 | Silty sand |
| D398 | 475250 | 7736560 | A–B | 1.0 | Silty sand |
| | | | | 2.2 | Coarse sand |
| D397 | 475250 | 7736875 | None | 2.5 | Coarse sand |
| D396 | 475230 | 7737190 | A–B | 2.5 | Coarse sand |
| D395 | 475260 | 7737560 | None | 1.8 | Coarse sand |
| D394 | 475300 | 7737705 | None | 1.3 | Coarse sand |
| V681 | 475250 | 7737760 | A–B | 3.4 | Coarse sand |
| | | | | 3.7 | Gravel |

**Table A-1. (*continued*)**

| *Ref. no.* | *Easting* | *Northing* | *Section* | *PBSF (m)* | *Geology* |
|---|---|---|---|---|---|
| D433 | 475260 | 7738080 | A–B | 2.5 | Coarse sand |
| D911 | 475355 | 7738350 | None | 0.2 | Coarse sand |
| D713 | 475160 | 7738625 | None | 1.7 | Silty sand |
| V891 | 475210 | 7738670 | A–B | 0.8 | Calcarenite |
| | | | | 3.8 | No recovery |
| | | | | 5.8 | Calcarenite |
| D714 | 475155 | 7738705 | None | 1.4 | Coarse sand |
| D913 | 475290 | 7738850 | None | 0.2 | Coarse sand |
| D712 | 475215 | 7738960 | None | 0.3 | Coarse sand |
| D744 | 475310 | 7739140 | A–B | 1.9 | Coarse sand |
| D745 | 475450 | 7739415 | None | 1.6 | Coarse sand |
| V895 | 475320 | 7739760 | A–B | 0.9 | Coarse sand |
| | | | | 1.1 | Calcarenite |
| D747 | 475520 | 7740090 | None | 1.5 | Coarse sand |
| D748 | 475585 | 7740295 | None | 0.5 | Coarse sand |
| V896 | 475430 | 7740350 | A–B | 2.0 | Coarse sand |
| | | | | 2.3 | Calcarenite |
| | | | | 3.1 | Coarse sand |
| D749 | 475665 | 7740580 | None | 0.9 | Coarse sand |
| D750 | 475690 | 7740845 | None | 0.6 | Silty sand |
| V897 | 475535 | 7740930 | A–B | 0.8 | Coarse sand |
| | | | | 3.2 | Silty sand |
| | | | | 3.7 | Calcarenite |
| D873 | 475645 | 7741045 | None | 1.2 | Coarse sand |
| D875 | 475530 | 7741245 | None | 1.6 | Coarse sand |
| D118 | 475700 | 7741475 | None | 2.4 | Coarse sand |
| V898 | 475670 | 7741510 | A–B | 1.6 | Coarse sand |
| | | | | 2.0 | Gravel |
| | | | | 2.1 | Calcarenite |
| D753 | 475905 | 7741805 | None | 0.6 | Silty sand |
| | | | | 1.3 | Coarse sand |
| | | | | 1.7 | Gravel |
| V769 | 475540 | 7742260 | None | 0.2 | Coarse sand |
| | | | | 0.8 | Calcarenite |
| V768 | 475450 | 7742550 | A–B | 0.9 | Calcarenite |
| V901 | 475000 | 7744080 | A–B | 1.0 | Silty sand |
| | | | | 2.5 | Coarse sand |
| | | | | 3.5 | Calcarenite |
| | | | | 4.1 | Coarse sand |
| | | | | 4.6 | Gravel |
| D858 | 475030 | 7744185 | None | 0.3 | Silty sand |
| | | | | 0.8 | Coarse sand |
| V766 | 474920 | 7744400 | A–B | 1.8 | Calcarenite |
| D859 | 474700 | 7744670 | A–B | 1.6 | Gravel |
| D860 | 474510 | 7744970 | None | 2.2 | Silty sand |
| | | | | 3.3 | Coarse sand |
| V765 | 474350 | 7745200 | A–B | 4.2 | Coarse sand |
| | | | | 4.6 | Gravel |

Notes: (a) PBSF = penetration below sea floor
(b) D = drop sample, R = rotary drillhole, V = vibrocore

## Table A-2. Sea-floor drilling and sampling details — LNG shipping channel

| *Ref. no.* | *Easting* | *Northing* | *Section* | *PBSF (a) (m)* | *Geology* |
|---|---|---|---|---|---|
| SCV1 (b) | 474969 | 7722943 | None | 1.9 | Silty sand |
| | | | | 2.3 | Gravel |
| SCV2 | 475136 | 7723042 | None | 1.5 | Silty sand |
| | | | | 1.8 | Gravel |
| SCV3 | 475408 | 7723199 | None | 1.6 | Silty sand to gravel |
| SCV4 | 475670 | 7723346 | A–B | 2.6 | Silty sand |
| | | | | 2.7 | Gravel |
| SCV5 | 474937 | 7723215 | None | 1.3 | Silty sand |
| | | | | 1.4 | Gravel |
| SCV6 | 475191 | 7723357 | None | 1.7 | Silty sand |
| | | | | 2.0 | Gravel |
| SCV7 | 475191 | 7723357 | None | 2.5 | Silty sand to gravel |
| | | | | 3.0 | Gravel |
| SCV8 | 474761 | 7723395 | None | 0.7 | Silty sand |
| | | | | 1.4 | Gravel |
| SCV9 | 474867 | 7723455 | None | 0.8 | Silty sand |
| | | | | 1.5 | Gravel |
| SCV10 | 475175 | 7723635 | None | 2.0 | Silty sand to gravel |
| | | | | 2.3 | Gravel |
| SCV11 | 475378 | 7723748 | None | 2.0 | Silty sand |
| | | | | 2.5 | Gravel |
| SCV13 | 474898 | 7723763 | None | 1.5 | Silty sand |
| | | | | 1.6 | Gravel |
| SCV14 | 475173 | 7723924 | None | 2.3 | Silty sand |
| | | | | 3.3 | Clay over gravel |
| SCV16 | 474925 | 7724006 | None | 1.8 | Silty sand |
| | | | | 2.3 | Gravel |
| SCV17 | 474644 | 7724068 | None | 2.0 | Silty sand |
| | | | | 2.3 | Gravel |
| SCV18 | 474798 | 7724250 | None | 1.5 | Silty sand |
| | | | | 3.0 | Coarse sand |
| | | | | 3.6 | Gravel |
| SCV19 | 474393 | 7724174 | None | 3.3 | Silty sand tending coarse |
| | | | | 4.3 | Gravel |
| SCV20 | 474534 | 7724322 | None | 2.4 | Silty sand |
| | | | | 5.1 | Gravel |
| SCV21 | 474279 | 7724431 | None | 3.8 | Silty sand tending coarse |
| | | | | 5.1 | Gravel |
| SCV22 | 474230 | 7724541 | None | 2.2 | Coarse silty sand |
| | | | | 2.4 | Coarse sand |
| | | | | 2.7 | Gravel |
| SCV23 | 474206 | 7724701 | C–D | 4.3 | Silty sand tending coarse from 3m |
| | | | | 4.8 | Gravel |
| SCV24 | 474043 | 7724707 | None | 2.2 | Silty sand tending coarse |
| | | | | 2.8 | Gravel |
| SCV25 | 473888 | 7724726 | None | 2.8 | Coarse silty sand |
| | | | | 5.3 | Gravel |
| SCV26 | 473856 | 7724873 | C–D | 3.5 | Coarse silty sand |
| | | | | 4.8 | Gravel |
| SCV27 | 473791 | 7724987 | None | 0.4 | Medium sand |
| | | | | 5.0 | Coarse silty sand |
| | | | | 5.2 | Gravel |

**Table A-2.** ***(continued)***

| *Ref. no.* | *Easting* | *Northing* | *Section* | *PBSF (m)* | *Geology* |
|---|---|---|---|---|---|
| SCV28 | 473669 | 7725039 | None | 4.2 | Coarse silty sand |
| | | | | 4.9 | Gravel |
| SCV29 | 473520 | 7725048 | None | 1.2 | Gravel |
| | | | | 4.2 | Coarse silty sand |
| | | | | 5.6 | Gravel |
| SCV30 | 473482 | 7725205 | C–D | 4.3 | Coarse sand |
| | | | | 5.1 | Gravel |
| SCV31 | 473427 | 7735329 | None | 0.2 | Medium sand |
| | | | | 4.0 | Silty sand tending coarse |
| | | | | 5.0 | Gravel |
| SCV32 | 473295 | 7725371 | None | 0.5 | Coarse sand (yellow) |
| | | | | 4.1 | Coarse sand |
| | | | | 4.5 | Gravel |
| SCV33 | 473148 | 7725392 | None | 0.9 | Medium to coarse sand (yellow) |
| | | | | 4.2 | Coarse sand |
| | | | | 5.0 | Gravel |
| SCV34 | 473108 | 7725537 | C–D | 1.5 | Medium to coarse sand (yellow) |
| | | | | 5.3 | Medium to coarse silty sand |
| | | | | 5.6 | Gravel |
| SCV35 | 473062 | 7725676 | None | 1.8 | Medium to coarse sand (yellow) |
| | | | | 4.2 | Silty sand |
| | | | | 4.5 | Gravel |
| SCV36 | 472921 | 7725702 | None | | No recovery |
| SCV36A | 472921 | 7725702 | None | 0.8 | Medium sand (yellow) |
| | | | | 1.5 | Silty sand (grey) |
| | | | | 1.7 | Gravel |
| | | | | 4.5 | Fine to medium silty sand |
| | | | | 4.7 | Gravel, sand and cobbles |
| SCV37 | 472805 | 7725762 | None | 1.2 | Medium to coarse sand (yellow) |
| | | | | 3.3 | Fine to coarse silty sand |
| SCV38 | 472734 | 7725868 | C–D | 0.8 | Medium to coarse sand (yellow) |
| | | | | 1.5 | Medium to coarse silty sand (grey) |
| | | | | 2.1 | Gravel |
| | | | | 3.2 | Fine to medium silty sand |
| | | | | 3.5 | Gravel and sand |
| SCV39 | 472716 | 7726029 | None | 0.8 | Medium to coarse sand (brown) |
| | | | | 1.5 | Medium to coarse sand (grey) |
| | | | | 2.0 | Gravel |
| | | | | 3.3 | Fine to medium silty sand |
| SCV40 | 472547 | 7726034 | None | 0.8 | Medium to coarse sand (grey) |
| | | | | 2.0 | Gravel |
| | | | | 3.2 | Fine to medium silty sand to gravel |
| SCV42 | 472360 | 7726200 | None | 0.4 | Medium to coarse sand (yellow) |
| | | | | 1.0 | Sand and gravel |
| | | | | 1.8 | Medium to coarse sand |
| | | | | 2.0 | Sand, gravel and cobbles |
| SCV43 | 472296 | 7726318 | None | 1.0 | Medium to coarse sand (yellow) |
| | | | | 1.2 | Medium to coarse sand and gravel |
| SCV44 | 472173 | 7726366 | C–D | 0.4 | Silty medium sand |
| | | | | 1.7 | Sand, gravel and cobbles |
| SCV45 | 472022 | 7726396 | None | 0.9 | Gravely medium sand (yellow) |
| | | | | 1.6 | Sand, gravel and cobbles (yellowish) |

**Table A-2.** ***(continued)***

| *Ref. no.* | *Easting* | *Northing* | *Section* | *PBSF (m)* | *Geology* |
|---|---|---|---|---|---|
| SCV46 | 471985 | 7726532 | None | 1.0 | Medium to coarse sand |
| | | | | 1.9 | Sand and gravel |
| SCV47 | 471814 | 7726536 | None | 1.5 | Medium to coarse sand |
| | | | | 2.0 | Sand and gravel (of calcarenite) |
| SCV48 | 471798 | 7726698 | C–D | 0.2 | Medium to coarse silty sand |
| | | | | 0.6 | Sand and gravel |
| SCV50 | 471624 | 7726876 | None | 0.3 | Gravel |
| SCV51 | 471572 | 7727007 | C–D | 0.0 | Bedrock |
| SCV53 | 471321 | 7727119 | None | | No recovery |
| SCV59 | 470984 | 7727758 | C–D | 0.1 | Silty medium sand |
| | | | | 0.6 | Sand, gravel and some clay |
| SCV60 | 474848 | 7724300 | None | 3.2 | Fine to medium silty sand |
| | | | | 3.9 | Gravel, sand and clay (brown) |
| SCV61 | 471024 | 7728031 | None | 0.7 | Medium sand, gravel and cobbles |
| SCV62 | 470568 | 7728437 | C–D | 0.8 | Calcarenite and cemented coral |
| SCV63 | 470855 | 7729370 | C–D | 2.7 | Fine to coarse sand |
| | | | | 3.3 | Sand and gravel |
| | | | | 4.2 | Calcarenite (cobbles and core) |
| SCV64 | 470933 | 7729864 | C–D | 2.4 | Medium to coarse sand with clay |
| | | | | 2.6 | Gravel and cobbles |
| SCV65 | 471012 | 7730358 | C–D | 1.5 | Gravel with silt and clay to calcarenite |
| SCV66 | 471242 | 7731840 | C–D | | No recovery — shoe damaged |
| SCV67 | 471320 | 7732334 | C–D | | Calcarenite core recovered in shoe |
| SCV68 | 470695 | 7728051 | C–D | 1.4 | Medium silty sand |
| | | | | 1.8 | Sand and gravel with cobbles at base |
| SCV69 | 475487 | 7723531 | None | 2.0 | Fine to coarse silty sand |
| | | | | 2.6 | Gravel, sand and clay (brown) |
| SCV70 | 475490 | 7723160 | None | 1.4 | Fine to coarse silty sand |
| | | | | 1.7 | Gravel, sand and clay |
| SCV71 | 472082 | 7726530 | None | 2.3 | Gravel with sand and calcarenite cobbles |
| SCV72 | 472195 | 7726449 | None | 0.9 | Medium to coarse sand and gravel |
| SCV73 | 472400 | 7726069 | C–D | | Medium to coarse sand (yellowish) |
| | | | | 4.5 | Medium sand to gravel (greyish) |
| | | | | 4.8 | Calcarenite |
| SCV74 | 471024 | 7727886 | None | 0.7 | Silty gravel to cobbles |
| SCV75 | 470091 | 7729084 | None | 2.0 | Medium to coarse sand |
| | | | | 3.0 | Gravel |
| | | | | 3.2 | Calcarenite (core) |
| SCV76 | 471494 | 7732905 | C–D | 1.1 | Silty medium sand |
| | | | | 1.9 | Sand and gravel |
| | | | | 2.2 | Calcarenite |
| SCV77 | 471025 | 7729988 | None | 1.5 | Medium to coarse sand with clay |
| | | | | 2.6 | Calcarenite gravel with clay |
| | | | | 2.8 | Calcarenite |
| SCV78 | 474811 | 7724558 | None | 3.6 | Fine to medium silty sand |
| | | | | 4.7 | Gravel |
| SCV79 | 470866 | 7727738 | None | 0.3 | Silty sand and gravel |
| SCV80 | 475100 | 7724205 | None | 2.4 | Fine to coarse silty sand |
| | | | | 3.5 | Clayey calcarenite gravel (yellowish) |
| | | | | 4.5 | Clayey gravel and sand |

**Table A-2.** ***(continued)***

| *Ref. no.* | *Easting* | *Northing* | *Section* | *PBSF (m)* | *Geology* |
|---|---|---|---|---|---|
| SCV81 | 470851 | 7728855 | C–D | 1.5 | Silty medium to coarse sand |
| | | | | 2.1 | Calcarenite gravel |
| | | | | 2.2 | Calcarenite core |
| SCV82 | 473713 | 7724900 | None | 4.2 | Medium to coarse sand (yellow and grey) |
| | | | | 4.6 | Gravely clay |
| | | | | 5.0 | Calcarenite gravel |
| SCV84 | 473334 | 7725221 | None | 0.5 | Fine to coarse sand (yellow) |
| | | | | 4.1 | Medium to coarse sand |
| | | | | 4.2 | Fine sand to gravel (yellow) |

Notes: (a) PBSF = penetration below sea floor
(b) SCV = vibrocore

## Table A-3. Sea-floor sampling details — pipeline corridor reconnaissance surveys

| *Ref. no.* | *Easting* | *Northing* | *Section* | *PBSF(a) (m)* | *Rec.(b) (m)* | *Rec.(b) (%)* | *Geology* |
|---|---|---|---|---|---|---|---|
| D5.1(c) | 467923 | 7755488 | None | 0.66 | 0.22 | 33 | Silty clayey sand |
| D5.2 | 469523 | 7752051 | None | – | 0.02 | – | Grey sand and shells |
| D5.3 | 470702 | 7750381 | None | – | 0.22 | – | Shells and gravel |
| D5.4 | 471723 | 7748924 | None | 0.96 | 0.87 | 91 | Grey silty sand and shells |
| D5.5 | 472793 | 7747389 | None | 1.8 | 1.09 | 61 | Grey sandy clay |
| D5.6 | 473893 | 7745816 | None | 1.97 | 1.64 | 83 | Grey clayey sand/sandy clay |
| D5.7 | 474922 | 7744341 | None | 0.08 | 0.08 | 100 | Grey sandy limestone |
| D5.8 | 475838 | 7742648 | None | – | 0.10 | – | Shells and gravel |
| D5.9 | 476327 | 7740816 | None | – | 0.02 | – | Shelly sand |
| D5.10 | 476362 | 7738979 | None | 0.02 | 0.02 | 100 | Limestone |
| D5.11 | 476052 | 7737036 | None | 0.05 | 0.05 | 100 | Sand |
| D5.12 | 475638 | 7735227 | None | 2.95 | 2.07 | 70 | Silty fine to medium sand |
| D5.13 | 475199 | 7733395 | None | 2.24 | 1.80 | 80 | Grey clayey coarse sand |
| D5.14 | 474969 | 7731608 | None | 2.32 | 1.23 | 53 | Grey clayey coarse sand/ weathered ironstone, clay |
| D5.15 | 474754 | 7729914 | None | 0.05 | 0.02 | 40 | Limestone |
| D5.16 | 474527 | 7728012 | None | 0.05 | 0.02 | 40 | Limestone |
| D5.18 | 474298 | 7726165 | None | – | 0.07 | – | Shells and gravel |
| D5.19 | 474068 | 7724357 | None | – | 0.25 | – | Grey fine sand |
| D5.20 | 473825 | 7722493 | C–D | 2.03 | 1.09 | 54 | Grey silty sandy clay/stiff red-brown clay and gravel |
| D5.21 | 473831 | 7721410 | C–D | 2.62 | 1.91 | 73 | Grey sandy clay and shells/ brown clay and basalt |
| D6.1 | 456092 | 7713556 | I–J | 2.49 | 1.58 | 63 | Grey and brown sandy clay |
| D6.2 | 453767 | 7713510 | I–J | 1.17 | 0.87 | 74 | Grey sand, red sandy clay |
| D6.3 | 453105 | 7713570 | I–J | 1.07 | 0.66 | 62 | Grey sand, red clay and gravel |
| D6.4 | 451990 | 7713574 | I–J | 0.76 | 0.52 | 68 | Grey sand/red clay and weathered limestone |
| D6.5 | 451577 | 7713604 | I–J | 0.52 | 0.24 | 46 | Shells, gravel/weathered limestone |
| D6.6 | 448883 | 7713933 | I–J | – | 0.02 | – | Shells and gravel |
| D6.7 | 446813 | 7714569 | I–J | – | 0.05 | – | Shells and sand |
| D6.8 | 443752 | 7716947 | G–H | – | 0.05 | – | Shells, gravel/limestone |
| D6.9 | 441704 | 7719564 | G–H | – | 0.02 | – | Limestone rock |
| D6.10 | 439639 | 7721155 | G–H | – | 0.02 | – | Shelly limestone |
| D6.11 | 442911 | 7723115 | G–H | – | 0.05 | – | Limestone rock |
| D1 | 442911 | 7717920 | G-H | – | 0.05 | – | Limestone |
| D2 | 440244 | 7722033 | G–H | – | 0.05 | – | Shell, gravel/sandstone |
| D4 | 438697 | 7724536 | G–H | – | 0.10 | – | Silt |
| D5 | 438693 | 7725029 | G–H | – | 0.10 | – | Shell, gravel/rock |
| D6 | 438552 | 7725292 | G–H | 0.05 | 0.05 | 100 | Limestone rock |
| D8.1 | 457975 | 7713664 | I–J | – | 0.10 | – | Brown sand and clay |
| D8.2 | 456467 | 7715810 | None | – | 0.13 | – | Brown sand |
| D8.3 | 456344 | 7718320 | None | 1.14 | 0.88 | 77 | Sandy clay, shells/limestone |
| D8.4 | 461715 | 7716452 | None | 0.37 | 0.10 | 27 | Gravel and shells |
| D8.5 | 457823 | 7724736 | E–F | 0.64 | 0.50 | 78 | Gravel, shells/grey sandy clay |
| D8.6 | 456389 | 7727973 | E–F | 0.64 | 0.24 | 38 | Shelly sand and clay |
| D8.7 | 455386 | 7728743 | E–F | – | 0.16 | | Shells, gravel/limestone |
| D8.9 | 451431 | 7730783 | E–F | – | 0.05 | – | Limestone rock |

**Table A-3. (*continued*)**

| *Ref. no.* | *Easting* | *Northing* | *Section* | *PBSF(a) (m)* | *Rec.(b) (m)* | *Rec.(b) (%)* | *Geology* |
|---|---|---|---|---|---|---|---|
| D8.10 | 449834 | 7731307 | E–F | 0.16 | 0.13 | 81 | Shells, gravel/sandy limestone |
| D8.11 | 449034 | 7731588 | E–F | 0.05 | 0.02 | 40 | Limestone rock |
| D8.12 | 447626 | 7732002 | E–F | – | 0.02 | – | Shells and sand |
| D8.13 | 446480 | 7732812 | E–F | 0.27 | 0.18 | 67 | Shells, gravel/clay and limestone |
| D8.14 | 448720 | 7731979 | E–F | – | 0.05 | – | Shells and sand |
| D8.15 | 449144 | 7731855 | None | 0.05 | 0.05 | 100 | Limestone rock |
| D8.16 | 452454 | 7730739 | E–F | 0.07 | 0.07 | 100 | Shelly limestone |
| D8.17 | 453712 | 7730169 | E–F | – | 0.05 | – | Shells, gravel/limestone |
| D8.18 | 454538 | 7729796 | E–F | 0.37 | 0.13 | 35 | Shells and gravel |
| D8.19 | 456636 | 7728159 | None | – | 0.05 | – | Fine sand |
| D8.20 | 457391 | 7726934 | E–F | 2.82 | 1.86 | 66 | Grey sand/clayey sandy silt |
| D8.21 | 457863 | 7723410 | E–F | – | 0.02 | – | Sand and limestone rock |
| D8.22 | 457479 | 7721835 | None | – | 0.02 | – | Shells and gravel |

Notes: (a) PBSF = penetration below sea floor, (b) Rec. = sample recovery, (c) D = drop sample

## Table A-4. Sea-floor rotary drilling details — proposed harbour sites

| *Ref. no.* | *Easting* | *Northing* | *Section* | *PBD (a) (m)* | *Geology* |
|---|---|---|---|---|---|
| RPP1 (b) | 472966 | 7721188 | C–D | 10.31 | Sea |
| | | | | 12.60 | Grey silty sand |
| | | | | 13.21 | Soft brown gravely clay |
| | | | | 14.88 | Rock fragments, clay, shells, coral and sand |
| | | | | 15.95 | Soft, brown sandy limestone |
| | | | | 19.15 | Red, brown and grey clay — some rock fragments |
| | | | | 28.60 | Red and grey clay, shells, limestone, coral, sand and fine gravel |
| RPP2 | 473369 | 7720364 | C–D | 8.93 | Sea |
| | | | | 9.84 | Grey silty medium sand, shell fragments |
| | | | | 10.91 | Soft grey sandy silt |
| | | | | 11.06 | Soft brown clay |
| | | | | 13.04 | Grey limestone with clay and shells |
| | | | | 13.50 | Hard limestone fragments |
| | | | | 27.22 | Brown clay, shells, limestone and sand — some gravel, coral and layers of red clay |
| RWI1 | 463553 | 7716373 | None | 8.56 | Sea |
| | | | | 16.48 | Red and red-brown sandy clay with bands of shelly limestone |
| | | | | 18.47 | Hard conglomerate of limestone and basalt |
| | | | | 25.17 | Light-grey and brown limestone conglomerate |
| | | | | 26.85 | Shattered and broken granite |
| RWI2 | 463249 | 7716548 | None | 8.77 | Sea |
| | | | | 10.29 | Coarse sand, medium gravel and blue-grey silt |
| | | | | 11.36 | Brown sand with fine gravel |
| | | | | 12.58 | Red-brown sandy clay with some gravel |
| | | | | 14.77 | Fine to medium gravel, coarse sand and red clay |
| | | | | 15.93 | Basalt boulders |
| | | | | 17.08 | Hard grey (limestone) conglomerate |
| RWI3 | 463899 | 7717135 | E–F | 13.06 | Sea |
| | | | | 15.73 | Soft grey shelly limestone |
| | | | | 18.14 | Weathered grey limestone with some clay |
| | | | | 18.47 | Soft brown coarse sandstone |
| | | | | 25.57 | Shattered and weathered red and grey limestone |
| | | | | 28.30 | White chalky limestone, weathered and broken |
| | | | | 31.96 | Shattered and weathered grey limestone |

Notes: (a) PBD = Penetration below datum, (b) R = Rotary drillhole