Technical Appendix C8

Marine Benthic Habitats

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GORGON DEVELOPMENT ON BARROW ISLAND

TECHNICAL REPORT

MARINE BENTHIC HABITATS

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Report No: R03207

April 2005

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1 Introduction

ChevronTexaco Australia Pty Ltd (ChevronTexaco), on behalf of the Gorgon Venture participants, proposes to develop a gas processing facility on Barrow Island. Marine infrastructure for the proposed development would have elements on both the east and west coast of Barrow Island, comprising:

- a feed gas pipeline or pipelines from the offshore Gorgon gas field to the west coast of Barrow Island with a shore crossing at North White's Beach or Flacourt Bay
- a causeway and materials offloading facility (MOF) at Town Point with associated dredged channel for barge access on the east coast
- an open-pile jetty from the MOF to an offshore product loading (tanker) facility with dredged shipping channel and turning basin
- a domestic gas pipeline and fibre optic cable from the east coast of Barrow Island to the mainland.

Impacts to marine biodiversity are extremely difficult to assess in the absence of regional baseline studies of faunal or flora diversity. In light of the paucity of information on the distribution and abundance of much of the state's marine biodiversity (predominantly invertebrates), the twin goals of maintaining biodiversity and maintaining ecosystem function can be achieved through protection of the benthic habitats on which the ecosystems depend. Marine managers generally assess the conservation significance of areas such as marine conservation reserves on the basis of benthic habitats according to their significance to important fauna, their contribution to ecosystem productivity (benthic primary producers) or their assumed role in maintaining biodiversity, for example IMCRA (1998), CALM (2004), EPA (2003).

ChevronTexaco, on behalf of the Gorgon Venture participants, engaged RPS Bowman Bishaw Gorham to survey marine benthic habitats in the proposed development areas to assist in the formal assessment of the environmental implications of the proposal. This report describes the results of current and previous surveys in the area, in a regional context, to facilitate assessment of potential impacts associated with the proposed development.

Intertidal habitats, including mangroves and marine protected species are covered in separate technical appendices (Appendices C6 and C9). Impacts on benthic primary producers are covered in Chapter 11 of the main report.

Dredging of the access channels to the offshore product offloading facility and MOF would require disposal of dredged material to a designated spoil ground. Seabed surveys are underway to examine potential dredge spoil grounds off the east coast of Barrow Island. The dredge spoil ground would be sited and assessed within the procedures of a dredging licence application under the *Environment Protection (Sea Dumping) Act 1981* and will be reported separately.

2 Methods

The survey comprised a review of the available information describing the marine environment of the area and field surveys at the locations of proposed infrastructure. Assessment of potential impacts from the proposed development was based on the results of field observations, general knowledge of the area from previous surveys and literature on the area.

2.1 Field Surveys

Field surveys were undertaken during August 2002, January 2003 and January 2004 to identify any areas of high conservation significance within the areas of potential impact from the proposed Development. The survey team examined subtidal benthic habitats in the following areas:

- near the existing and proposed offshore wells
- along the feed gas pipeline route to the west coast of Barrow Island
- in the areas associated with the nearshore facilities on the east coast
- along the domestic gas pipeline to the mainland.

Subtidal, benthic marine habitats were surveyed using a combination of video transects and snorkel diver surveys.

Video transect surveys involved towing an underwater video camera behind the survey vessel to assess benthic habitats in the possible development and nearby reference areas. Marine biologists assessed the videography as it was captured to characterise benthic habitats and assemblages. Positional accuracy along the survey routes was monitored using GPS receivers linked to real time GIS and navigation software.

Snorkel diver surveys involved marine biologists 'bounce' diving to examine and photograph benthic habitats that were identified from existing aerial photography of the area or from the video surveys.

2.2 Habitat Distribution and Mapping

Broad-scale habitat maps for the east and west coast development areas were created from aerial photography flown in October 2001. Ground-truth data collected during the August 2002, January 2003 and January 2004 surveys were used to confirm habitat descriptions in potential impact areas and to assist in characterising the broader distribution of benthic habitats apparent in other areas from the aerial photography. The extent of the ground-truthing surveys is shown in Figure 2-1 and Figure 2-2.

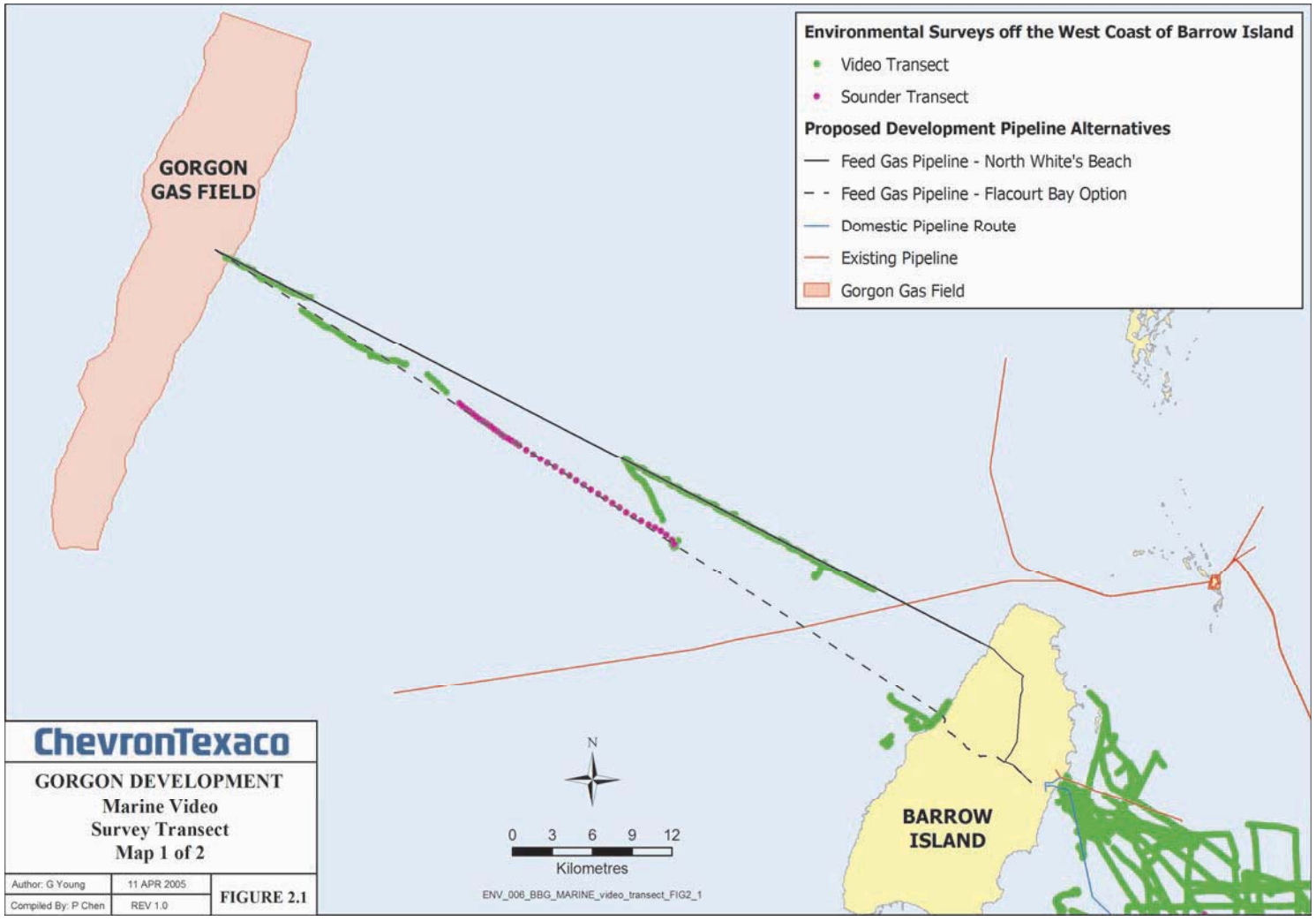

Figure 2-1 - Environmental Surveys off the West Coast of Barrow Island

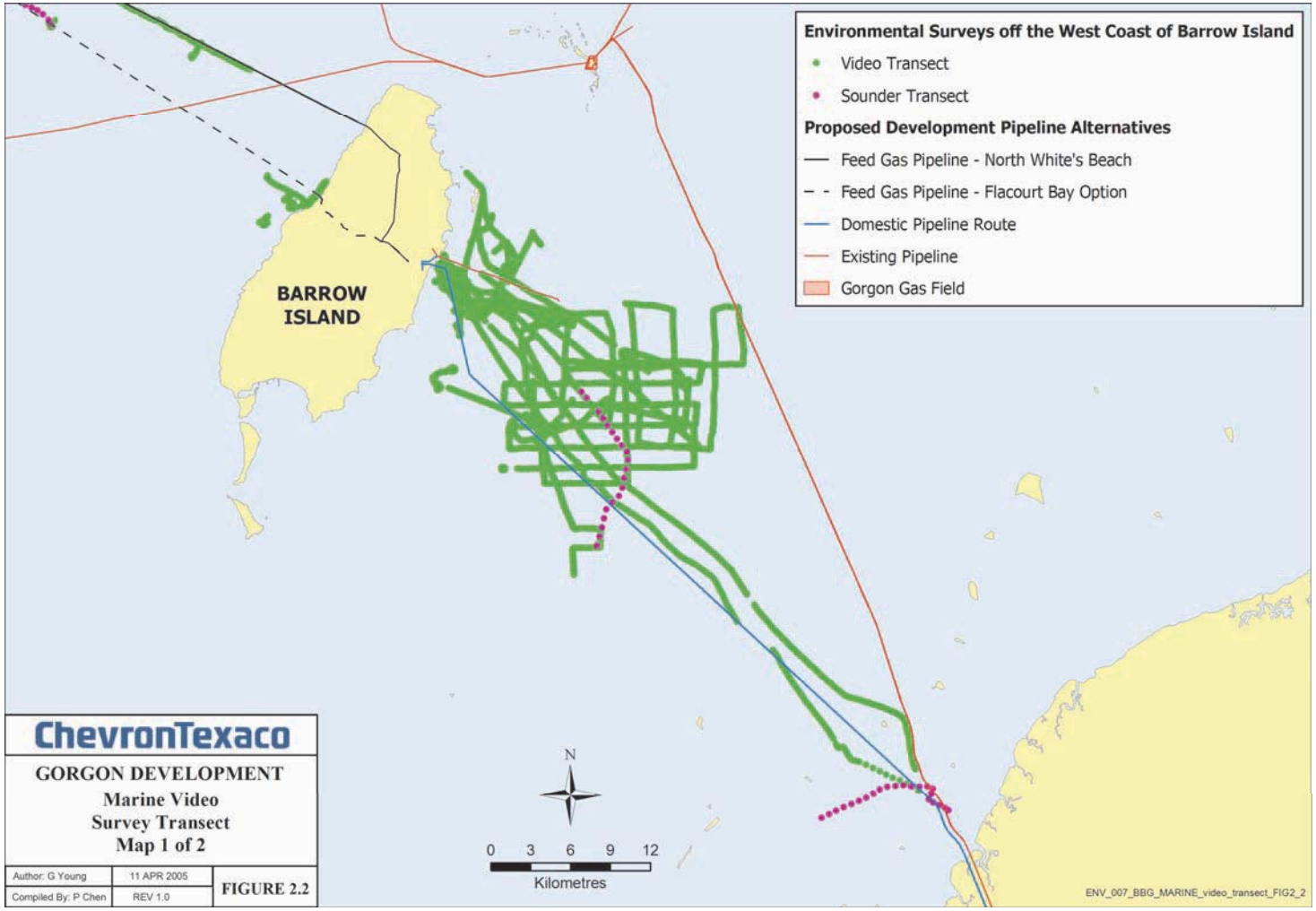

Figure 2-2 - Environmental Surveys off the East Coast of Barrow Island and Along the Proposed Domestic Gas Pipeline Route to the Mainland

Mapping of habitats from the aerial photography in areas beyond the ground-truthed survey area also incorporated field data from previous surveys and an existing regional habitat map (Bancroft and Sheridan 2000; CALM 2004). The proposed development area has been mapped at finer resolution and is better ground-truthed than the regional benthic habitat map (CALM 2004). The habitat data for the east coast of Barrow Island has been submitted for incorporation into the revision of the Draft Management Plan for the Montebello/Barrow Islands (CALM 2004) and in revision of CALM's regional marine GIS database.

The extent of high-profile seabed features was further distinguished from the survey vessel's sounder trace and from bathymetry data produced during side-scan sonar surveys by Fugro Survey.

3 Regional Marine Environment

3.1 Introduction

The Rowley Shelf is a large, shallow (less than 20 m) submarine limestone shelf extending up to 80 km from the West Pilbara coast. The shelf is composed mainly of Pleistocene limestone overlain in places by sediments of various thickness and particle size. The geomorphology of the shelf is characterised by chains of islands running roughly parallel to the mainland coast.

Barrow Island, the Montebello Islands and the Lowendal Islands are the furthest offshore islands on the Rowley Shelf. These islands are separated from the inner part of the Rowley Shelf by the Flinders Fault and collectively form the Barrow-Montebello Complex (Wilson et al. 1994).

The proximity of Barrow Island to the western edge of the Rowley Shelf results in a wide range of oceanographic conditions around the Island. The west coast is highly energetic, being subject to persistent southerly winds and strong influence of deep ocean swell and large-scale, along-shelf currents. The east coast is far less energetic and is more strongly influenced by tidal currents.

3.2 Regional Benthic Habitats

The large variety of oceanographic and physical conditions occurring in the region, notably water depth, substrate type, turbidity, tidal regime and energetics, create a large variety of marine benthic habitats and associated assemblages of flora and fauna. This section describes the following five main subtidal habitats that dominate the region:

- coral reefs and bombora
- seagrass and macroalgae meadows
- invertebrate filter feeder assemblages on pavement
- deeper high profile reefs
- soft sediments.

3.2.1 Coral Communities

Coral assemblages and reefs provide a structurally-complex habitat for a diverse array of fish and invertebrates. The habitat value of a coral area is dependent on its structural complexity, age, stability and proximity to other coral habitats. Corals spawn annually or

bi-annually and the constant cycle of death and recruitment is vital in maintaining the ecological function of the habitat.

The broad, shallow Rowley Shelf contains a vast variety of coral habitats and communities. The principal coral habitats include turbid inshore pavements, raised limestone shoals, fringing coral reefs around sand cays and offshore reefs in clear water. The small islands along the mainland coast are also generally fringed by reef platforms supporting diverse coral assemblages in relatively turbid water.

The diversity of coral communities in the region was illustrated by a Western Australian Museum survey in 1993, where 150 species of corals representing 54 genera were identified from the Montebello Islands (Marsh 1993).

A number of coral communities within the Barrow-Montebello Complex have been recognised as regionally significant and have been afforded special protection within the sanctuary zones of the Montebello Islands Marine Park and the Barrow Island Marine Park (CALM 2004). These coral communities include:

- Fringing reef communities to the west of the Montebello Islands.
- Patch reefs and bomboras stretching along the south eastern Montebello Islands.
- Biggada Reef on the west coast of Barrow Island.

Although the distribution of corals within the Montebello/Barrow Islands Marine Conservation Reserves is not well known, other extensive coral communities within the Barrow-Montebello Complex which have high species diversity or their known distribution within the region is restricted, may likewise be considered to be of regional significance. These coral communities include:

- An extensive coral reef on the eastern side of the Lowendal Shelf.
- Coral patch reef and bombora fields on the southern end of the Lowendal Shelf.
- Dugong Reef
- Batman Reef
- Barrow Island Shoals.

Locally significant coral communities in the waters surrounding Barrow and the Lowendal Islands include:

- Coral assemblages that fringe parts of the north-east and east coasts of Barrow Island.
- Coral assemblages on the eastern side of Double Island.
- A series of bomboras along a raised limestone ridge offshore of Shark Point on the eastern side of the Barrow Island.

3.2.2 Coral Communities Surrounding Barrow Island

Biggada Reef (Figure 3-1) is an extensive, largely intertidal coral reef on the west coast of Barrow Island that extends into the subtidal zone. It is the basis of the Barrow Island Marine Park (CALM 2004) and is the best developed seaward coral reef on the west side of the Island. Subtidal coral habitats are well developed in the lagoon of Turtle Bay and on the south western side of the fringing reef (Plate 3-1).

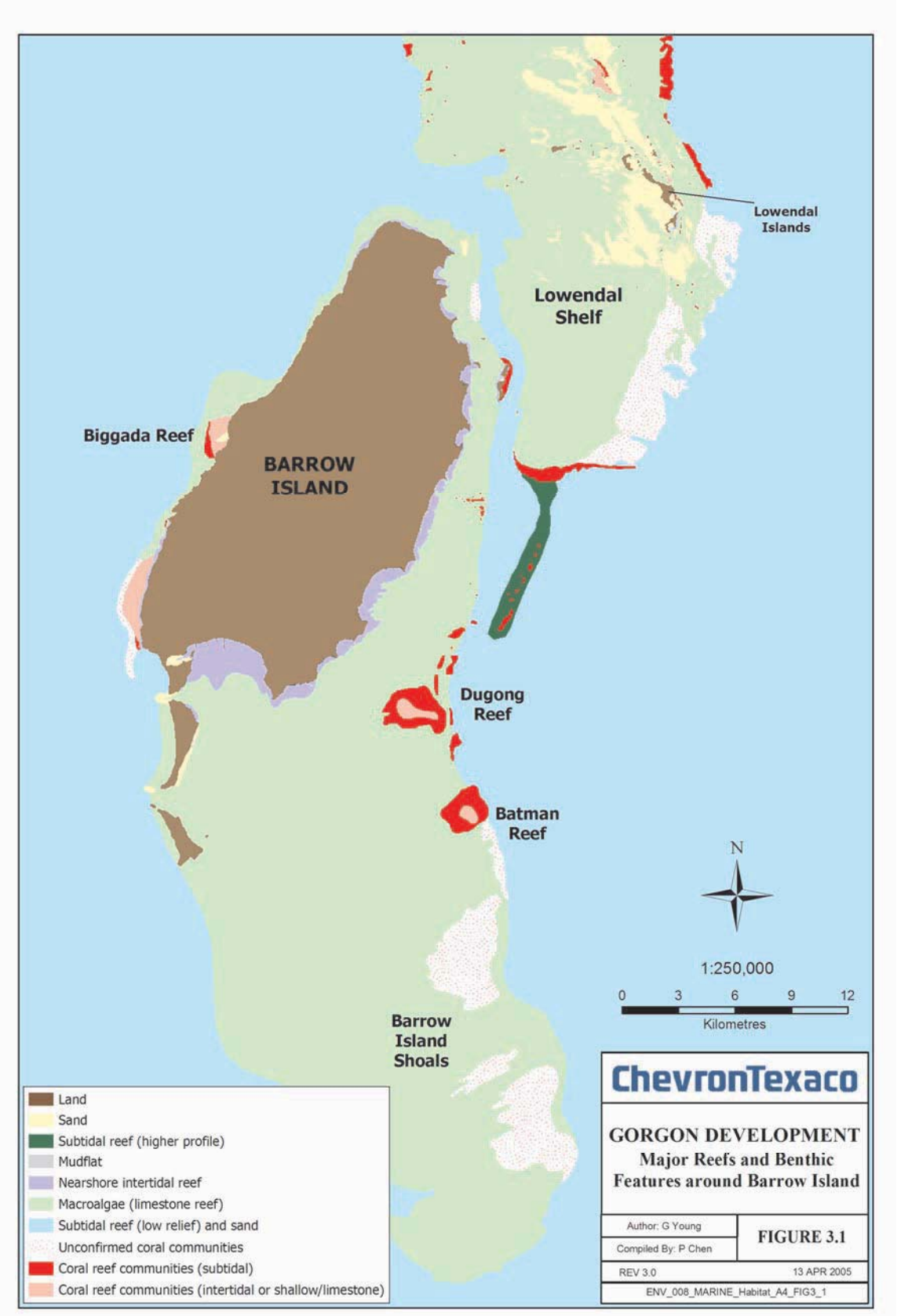

Figure 3-1 - Major Reefs and Benthic Features Around Barrow Island

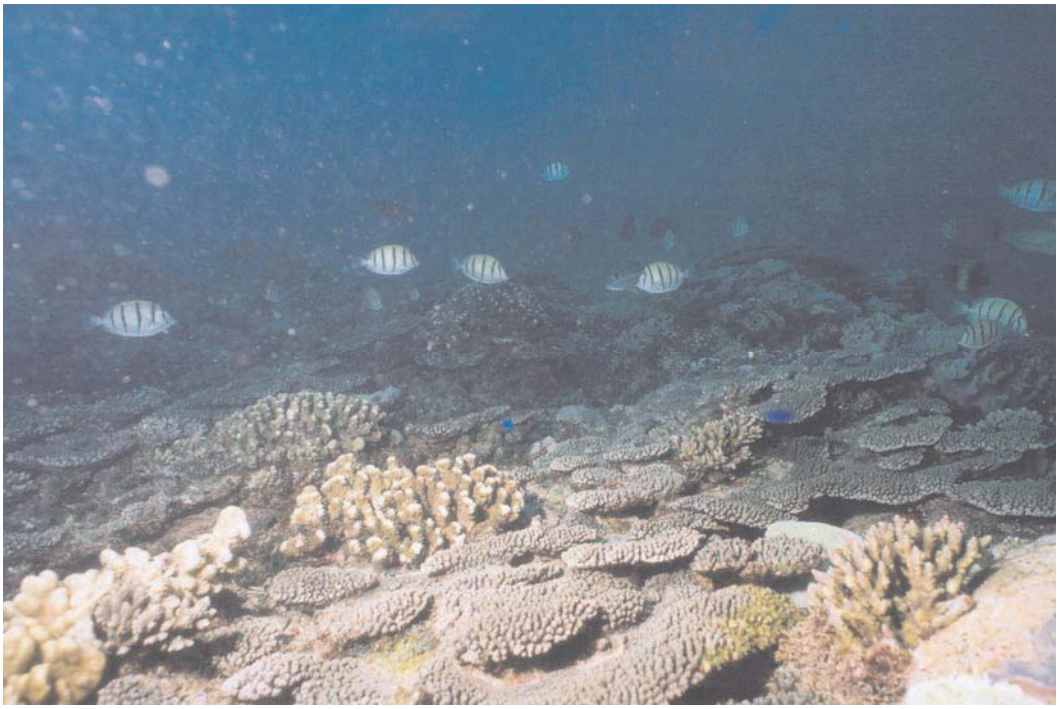

Plate 3-1 - Corals on the Southern End of Biggada Reef

A large *Acropora* thicket on the southern end of the Lowendal Shelf is partly dead, but structurally intact (Plate 3-2). The size of this relatively-fragile habitat indicates the area is little affected by cyclonic swells. Large coral bombora fringe the south-western edge of the shelf. These bombora are predominantly *Porites* colonies with numerous other associated corals (Plate 3-3).

Plate 3-2 - *Acropora* Coral Reef on the South-Western Edge of the Lowendal Shelf

Plate 3-3 - Coral Bomboras Along the South-Western Edge of the Lowendal Shelf

Large coral patch reefs have developed along the edge of Barrow Island Shoals, on the south east side of Barrow Island (Figure 3-1). The largest of these, Dugong Reef, was severely degraded, possibly due to an anoxic event associated with coral spawning in 1991. Surveys conducted on the reef in 1994 (Bowman Bishaw Gorham 1994) identified at least 4.2 km^2 of dead coral. Another highly diverse live coral community on Barrow Island Shoals was less affected.

Narrow coral assemblages fringe parts of the north-east and east coasts of Barrow Island. The extent and species composition of the north eastern coral community are unknown. It lies approximately 1.5 km from the shore and extends at least three kilometres along the edge of the shallow subtidal platform between Square Bay and Ant Point. The eastern coral community, offshore from Shark Point, comprises isolated patches of coral that extend for up to 1.3 km and run roughly parallel to the coast of Barrow Island. Preliminary observations indicate a series of large *Porites* bomboras and mixed coral species bomboras, rising out of approximately 5–8 m water depth at both locations.

The reef platform fringing the east coast of Barrow Island also supports scattered small coral bombora (up to 1.5 m high). There are also many bombora covered with macroalgae that appear to be overgrown dead corals.

3.2.3 Seagrass and Macroalgae

Seagrasses and macroalgae are important components of shallow tropical marine environments. They are important primary producers and significant contributors to the productivity of the region. In addition to providing energy and nutrients for detrital and grazing food webs, they provide food for protected animals such as dugong (*Dugong dugon*) and green turtles (*Chelonia mydas*). Dense seagrass and macroalgal meadows

enhance the habitat value of abiotic benthic habitats by increasing structural diversity and by stabilising soft substrates. Seagrass and macroalgae habitats vary seasonally in response to water temperature, day length, reproductive cycles, physical disturbance and regrowth.

Seagrasses occur within the photic zone throughout the Montebello/Barrow Island region and although widespread, they generally form sparse communities in the Barrow Island region (CALM 2004). The most common species are *Halophila ovalis* and *Syringodium isoetifolium*. Less common species include *Cymodocea angustatus*, *Halodule uninervis*, *Thalassia hemprichii* and *Thalassodendron ciliatum.*

Halophila spp. are the most common seagrasses on shallow soft substrates and sand veneers throughout the area. They extend from the intertidal zone to approximately 15 m water depth. Sparse seagrass meadows are also widespread along the mainland coast on the shallow subtidal sediments, although these meadows probably have a narrower depth range due to the high turbidity of nearshore mainland waters.

Macroalgae are very common components of marine environments in the shallow waters of the Pilbara. CALM (2004) estimate that macroalgae meadows make up 40 per cent of the benthic habitats of the Montebello/Barrow Islands Marine Conservation Reserve. Abundant macroalgae in the region include Phaeophytes (brown macroalgae) such as *Sargassum*, *Dictyopterus*, *Dictyota, Cystoseira* and *Padina*, Chlorophytes (green macroalgae) such as *Halimeda*, *Codium* and *Caulerpa* and Rhodophytes (red macroalgae) such as *Hydrolithon* and *Laurencia.*

Large brown macroalgae, especially *Sargassum*, dominate the extensive shallow limestone pavement reef around Barrow Island (Plate 3-4). They have the largest thalli and contribute most to the biomass on shallow pavement reefs. *Sargassum* spp. undergo large seasonal variations in biomass, having a summer growth and reproductive stage, followed by winter senescence. During summer, the extremely foliose thalli of this species may exceed one metre in height. In winter, when the reproductive thalli are shed, the senescent stipes are generally less than 20 cm high.

The biomass of macroalgae and seagrass meadows is also controlled by physical stressors such as wave energy, sedimentation and insolation. On the high-energy west coast platforms of Barrow Island, the macroalgae form short dense 'turfs'. On the calmer subtidal platforms on the east coast and in deeper areas beyond the wave zone on both coasts, the meadows are more luxuriant.

Plate 3-4 - *Sargassum*-dominated Macroalgae Bed on Pavement Reef off the East Coast of Barrow Island

3.2.4 Filter Feeding Communities

Deeper limestone pavements on the southern Rowley Shelf sometimes support a diverse community dominated by attached filter-feeding invertebrates. These communities typically contain diverse assemblages of tubular, digitate, laminar, branching, globose and encrusting sponge species in association with gorgonians, including sea fans (Subergorgiidae and Plexauridae) and sea whips (Leptogorgiidae), colonial and solitary ascidians, bryozoans, algae and small scleractinian corals (e.g. *Turbinaria*). These assemblages of sessile, filter-feeding invertebrates are attached to the pavement reef and provide a habitat for fish and mobile invertebrates.

Filter-feeder dominated pavement habitats are widespread between Barrow Island and the mainland and in areas of exposed pavement on the west coast of the Island. It is likely that any area of exposed pavement reef, in water too deep for macroalgae to become established, will support a filter-feeding assemblage. The habitat value of these areas is dependent on how well developed the assemblages are. Areas that are regularly smothered by sand sheets are unlikely to support more than a sparse, transient assemblage.

3.2.5 High Profile Reefs

Deeper, high-profile reefs off both coasts of Barrow Island support filter-feeding assemblages, however, their value as habitat for larger organisms, such as fish, is in their structural complexity. Shallow, high-profile reefs support macroalgae and also provide shelter for fish. Reefs standing up to 5–8 m above the surrounding seabed generally have undercut caves and ledges and are important refugia for larger vertebrate fauna.

Extensive high-profile rocky reefs are generally linear features, either adjacent to a high energy shoreline or remnants of historical shorelines. There are high-profile reefs on both sides of Barrow Island and probably throughout the Montebello/Barrow Islands region.

A large reef ridge runs parallel to the east coast of Barrow Island from the south end of the Lowendal Shelf. There are numerous high-profile rocky lumps (possibly dead corals) on the platform adjacent the east coast of Barrow Island. These are relatively isolated and presumably of lower habitat value than extensive reef areas.

On the west coast of Barrow Island there are high-profile reefs adjacent to the shore and there are two rocky ridges of variable height in 40–50 m water depth offshore. The nearshore reefs are covered with dense *Sargassum* and other algae and provide habitat for fish and turtles. The offshore ridges run in a north-south orientation and are of variable height above the seabed. They support invertebrates and an abundant fish fauna.

3.2.6 Soft Sediments

Soft sediment habitats generally support a diverse assemblage of burrowing and crawling infauna, but are generally too unstable for larger attached organisms. These habitats offer little structural diversity and are dominated by detrital-based faunal food webs. Their habitat value is generally dependent on oxygenation levels through the sediment profile, particle size, wave energy and the amount of allochthonous organic matter in the sediments. Finer sediments and detritus generally accumulate in low energy areas and support richer infaunal assemblages.

Soft sediment habitats are widespread in deeper offshore areas off the west coast of Barrow Island and throughout the region. These fine sands, silts and clays are expected to support diverse infaunal assemblages, as is evident at East Spar (Kinhill 1999). Sediments in the shallower area off the east coast of Barrow Island are less stable and generally comprise coarser particles. These sediments are affected by wave energy and currents and tend to be relatively mobile. Pavement habitats between Barrow Island and the mainland are covered by a sediment veneer that appears to periodically move, exposing areas of pavement reef. Sessile benthic organisms that require hard substrates for attachment, such as gorgonians, are frequently seen emerging through a shallow veneer of sand (Plate 3-5). These mobile sand sheets are generally of lower habitat value to infauna and are less likely to support diverse infaunal assemblages.

Plate 3-5 - Scattered Soft Corals and Seagrass on Sand in Deeper Waters off the East Coast of Barrow Island

3.3 Conservation Reserves and Protected Fauna

A number of areas within the Montebello/Barrow Islands region are currently protected under state or Commonwealth legislation. Some of the faunal species in the area are also specifically protected. See Appendix C6 for coverage of marine protected fauna.

3.3.1 Conservation Areas

Within the Montebello/Barrow Islands region, there are two conservation parks and four nature reserves vested in the Nature Conservation Commission (Osborne et al. 2000):

- Montebello Islands Conservation Park (2 sections).
- Barrow Island Nature Reserve.
- Boodie and Double Islands Nature Reserve.
- Lowendal Islands Nature Reserve.
- Great Sandy Island Nature Reserve.

The Montebello Islands Conservation Park (Reserve Nos. 42196 and 42197) comprises more than 100 islands, islets and rocks. The islands are reserved as a Class A conservation park to the high water mark and as a Class C park down to low water.

The Lowendal Islands Nature Reserve comprises the land above the high water mark on 40 islands, islets and rocks including Varanus Island. It is a Class C Nature Reserve (Reserve No. 33502). Class C Nature Reserves are now referred to as reserves with conservation orders.

Barrow Island is a Class A Nature Reserve down to the low water mark (Reserve No. 11648). Barrow Island was given reserve status in 1908. Middle, Boodie, Pascoe, Boomerang and Double Islands, immediately south and east of Barrow Island, make up a Class C Nature Reserve (Reserve No. 38728) that extends down to the low water mark on these islands.

CALM (2004) has established system of marine conservation reserves to encompass the Montebello/Barrow Islands region. Within the Barrow Island Marine Management Area there are two areas of special protection, one a marine park and the other a marine conservation management area. The Barrow Island Marine Park covers Biggada Reef and surrounds on the west coast of Barrow Island, while the Bandicoot Bay Conservation Area (benthic fauna/seabird protection) covers the waters of Bandicoot Bay on the southern end of the island (CALM 2004).

The Great Sandy Island Nature Reserve is a Class B Nature Reserve (No. 33831) extending down to low water. The reserve includes one of the sand cays known as the Barrow Island Shoals to the south of Barrow Island and 25 islands between Barrow Island and the mainland coast.

4 Local Marine Environment

4.1 West Coast Development Areas

4.1.1 Gorgon Gas Field and Outer Feed Gas Pipeline route

The Gorgon gas field lies in approximately 200 m of water, 70 km off the west coast of Barrow Island. Video transects along the offshore end of the proposed feed gas pipeline route indicate that the seabed is primarily characterised by soft sediments. The survey followed the proposed pipeline route out to 180 m water depth. Rough weather precluded survey of the actual well-sites, however, the homogeneity of the seabed over the previous ten kilometres suggest the seabed at these sites is similarly soft sediment habitat.

The sediments are heavily bioturbated indicating a well-developed infaunal assemblage. These habitats are very widespread in the region and are of low conservation significance.

4.1.2 Feed Gas Pipeline Corridor

The benthic habitats along the proposed pipeline corridor are predominantly soft sediments of varying grain size, with isolated rocky reefs and patches of exposed pavement reef. The proposed pipeline route crosses the existing East Spar pipeline approximately ten kilometres from shore.

Sediment grain sizes tend to be smaller in the deeper offshore areas and larger in the surge affected nearshore areas. The nearshore sediments are rippled in many areas, indicating that they are continually reworked by swells. While the fine offshore sediments are heavily bioturbated, the coarser inshore sediments appear to support less infauna.

Scattered areas of exposed pavement reef support sparse filter-feeding assemblages, dominated by seawhips, gorgonians and sponges. There are rock piles associated with

the East Spar pipeline and areas of exposed pavement reef near the point where the two pipelines would cross.

These habitat types are very widespread in the region and are of low conservation significance.

There is a high profile reef in 40–45 m water depth approximately 14 km off the west coast of the Island that rises several metres above the surrounding seabed. The reef is characterised by areas of exposed rocky platform reef and areas of upstanding reef. The platform reef supports scattered black corals (*Cirripathes*, *Antipathes*), sponges, seawhips (*Junceella*) and branching gorgonians. The upstanding reef with large ledges supports encrusting or lithophagic sponges and abundant fish. The reef appears to be part of a linear series of reefs that run north-south. Side scan data revealed features of a similar profile approximately five kilometres south of the pipeline corridor.

A second high-profile reef area was encountered in approximately 40 m water depth and 24 km offshore. This reef supported encrusting sponges, scattered deepwater coral (*Pachyseris*) and rubble around the reef. This reef was also evident in the side scan data.

The rocky reefs are large features that provide structural diversity to an otherwise planar seabed. They are of higher conservation significance as they are less widespread than the soft sediment habitats.

4.1.3 Shore Crossing at North White's Beach or Flacourt Bay

Benthic habitats in the nearshore areas off North White's Beach and Flacourt Bay are both characterised by bare sand habitats interspersed with areas of exposed limestone pavement and high profile rocky reef near the beach with no significant coral communities (Figure 4-1).

The high-profile reefs extend offshore from the rocky headlands to five to ten metres water depth. They stand up to three metres above the surrounding seabed, are undercut with small caves and ledges and are dissected by channels. They support well-developed macroalgae meadows dominated by *Sargassum*, *Dictyopterus* and *Halimeda* and scattered small corals such as *Acropora* and *Turbinaria* (Plate 4-1).

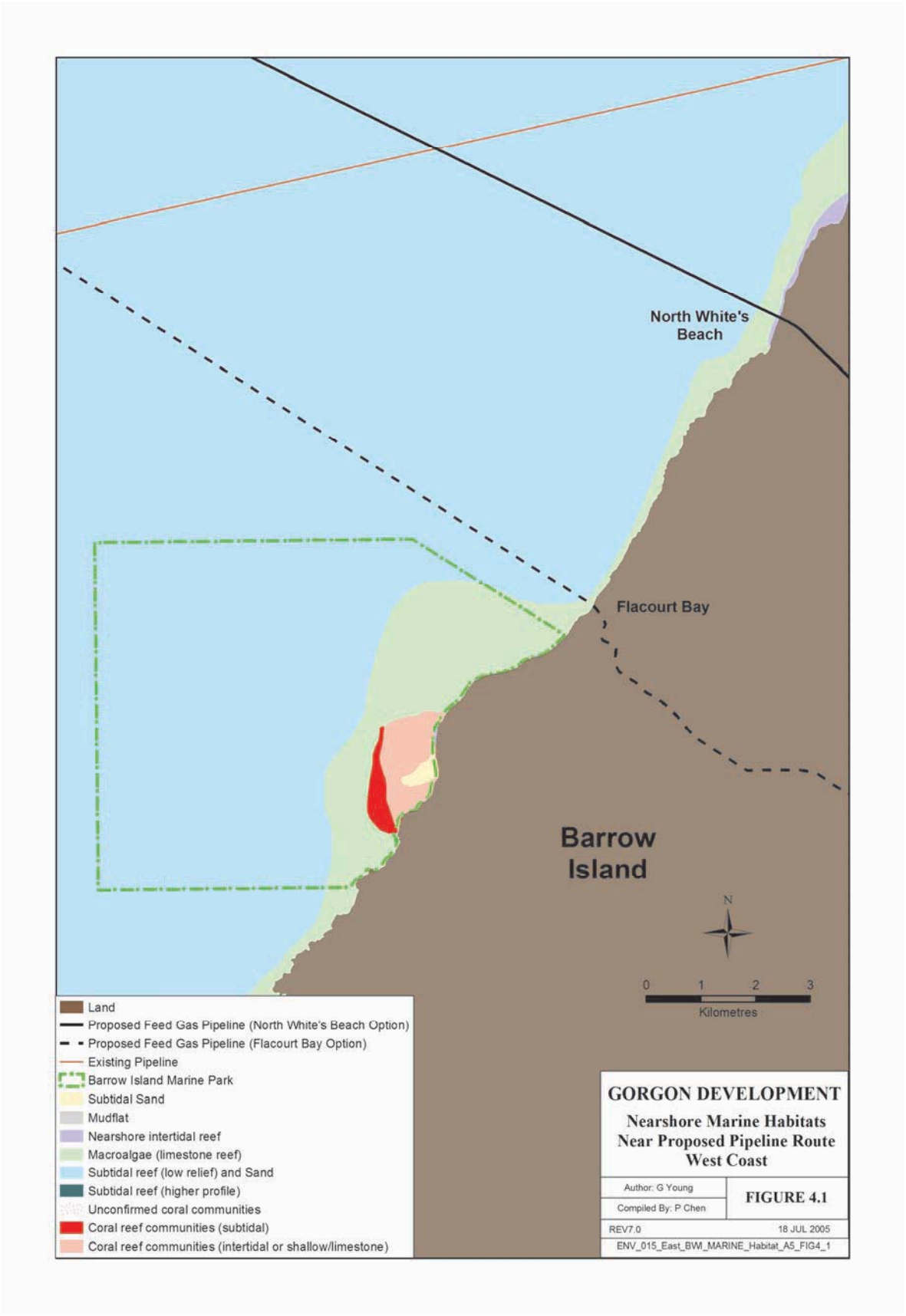

Figure 4-1 - Nearshore Marine Habitats near the Proposed Pipeline Route on the West Coast of Barrow Island

Plate 4-1 - *Sargassum*-dominated Reef in Nearshore Waters at Flacourt Bay

The seabed adjacent to the sandy beaches is characterised by rippled coarse sand in mobile sheets over pavement reef that is exposed in places. The sediments support a very sparse assemblage of epibiota. Many areas of sand are completely bare and the lack of obvious bioturbation suggests that large infaunal species are not abundant in the area. The absence of seagrass and stoloniferous macroalgae is consistent with the instability of the sandy sediments due to the high wave energy regime on this coast.

The exposed pavement habitat in the high-energy zone near the beach supports a dense cover of turfing brown and red macroalgae and small corals. The macroalgal turf on the shallow subtidal/intertidal pavement at Flacourt Bay is short and dense and obviously subject to extreme wave energy. It is also likely that this pavement reef is buried periodically. The macroalgae in the dissected pavement reef at North White's Beach tend to have longer thalli and probably higher biomass.

The proposed alternative Flacourt Bay shore crossing and nearshore section of the pipeline are approximately 1.3 km north of Biggada Reef. At the northern end, Biggada Reef is characterised by rocky pavement reef with macroalgae and scattered small corals. The significant corals that are proposed to be protected in the Barrow Island Marine Park are located approximately 3–4 km south of the proposed alternative pipeline route.

This coral assemblage extends into the intertidal zone and is best developed at the southern end of the reef. The south-western end of the reef front is dominated by rugged morphology scleractinian corals, such as *Pavona* and soft corals that are resistant to the high wave energy of this area. Corals are scattered throughout the lagoon inside Biggada Reef at Turtle Bay.

4.2 East Coast Development Areas

The locations of areas surveyed by towed underwater video transects or snorkel diving on the east coast are shown in Figure 2-2. The benthic habitats in the proposed Development area are shown in Figure 4-2 and are described below.

4.2.1 Causeway, MOF and MOF Access Channel

The proposed causeway and MOF-access channel would cross the intertidal and shallow subtidal platform reef adjacent to Town Point. Benthic habitats in this area are typical of the nearshore seabed along the east coast of Barrow Island. The subtidal pavement reef along the edge of the Island is overlain by a thin veneer of sediment and dominated by *Sargassum,* with other macroalgae such as *Dictyopterus*, scattered small hard corals (*Acropora*, *Turbinaria*), soft corals (*Rumphella*) and occasional coral bomboras of *Porites* and other coral genera up to one metre high. The biomass of *Sargassum* varies seasonally, peaking in spring and summer.

Sargassum-dominated benthic primary producer habitats within the proposed Development area are of minor conservation significance because the habitat is very widespread and the causeway is likely to provide hard substrate suitable for macroalgae that is not inundated by sand.

Approximately 42 ha of *Sargassum*-dominated pavement habitat would be removed or buried by the proposed marine facilities.

4.2.2 Jetty, Tanker Loading Facility and Access Channel

The proposed jetty would run south-east from the MOF across the macroalgal dominated limestone reef close to the island and the low relief subtidal platform reef further offshore before terminating in the deeper soft sediments off the edge of the limestone platform (Figure 4-2).

On top of the platform reef adjacent to the Island, the open-piled jetty would run across *Sargassum*-dominated limestone pavement reef and two areas of coral. The *Sargassum*-dominated pavement is very widespread and of low conservation significance. The coral reef area comprises scattered bombora and isolated patch reefs (*Porites*, *Merulina*, *Pectinia*). The coral communities are of local significance, but have not been identified as regionally significant in CALM's assessment of the conservation values of the region (CALM 2004). The benthic primary producers in this area that would be affected during the construction of the jetty comprise a small area of coral habitat and *Sargassum*-dominated pavement habitat. Effects would be highly localised, limited to those areas directly impacted during pile driving or drilling for pile setting. Significant recolonisation of the jetty piles is expected.

To the east of the coastal platform reef, the channel between the Lowendal shelf and Barrow Island experiences tidal currents of up to several knots. The scoured seabed in the channel is characterised by pavement and rubble with patchy thin veneers of sand. The pavement reef supports macroalgae and a sparse assemblage of invertebrates, such as gorgonians, sea whips, scleractinian corals and sponges. Towards the southern end of the channel where the proposed jetty would cross, the tidal stream is weaker and deeper sand veneers overlay the pavement reef in this area.

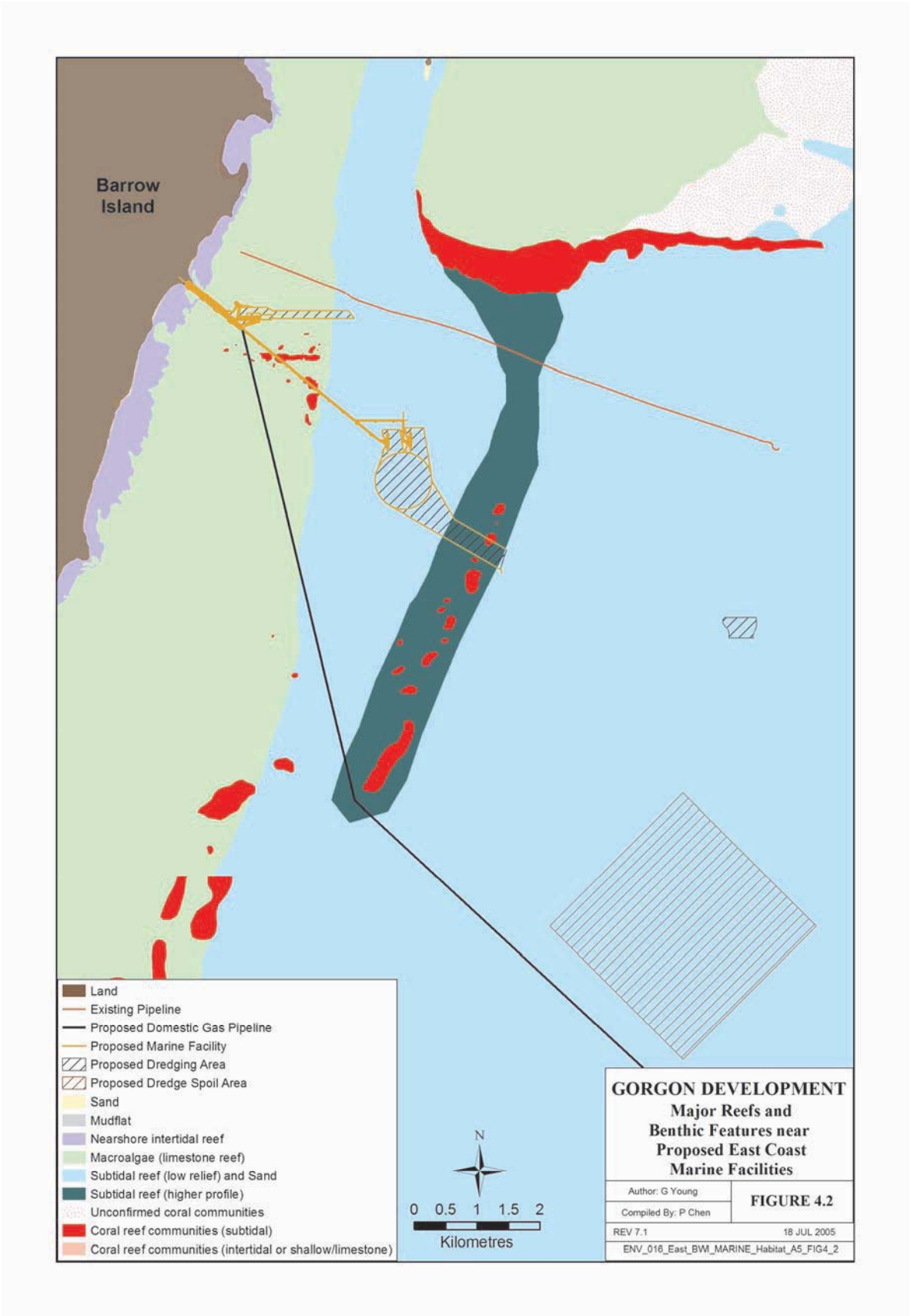

Figure 4-2 - Nearshore Marine Habitats near the Proposed Pipeline Route, Jetty and Shipping Channel on the East Coast of Barrow Island

The benthic habitats in the area to be dredged for the proposed tanker loading facility and turning basin comprise pavement reefs with sand veneer in ten metres water depth. The sand supports relatively-dense stands of seapens in some places (Plate 4-2), but is generally bare and of little conservation significance.

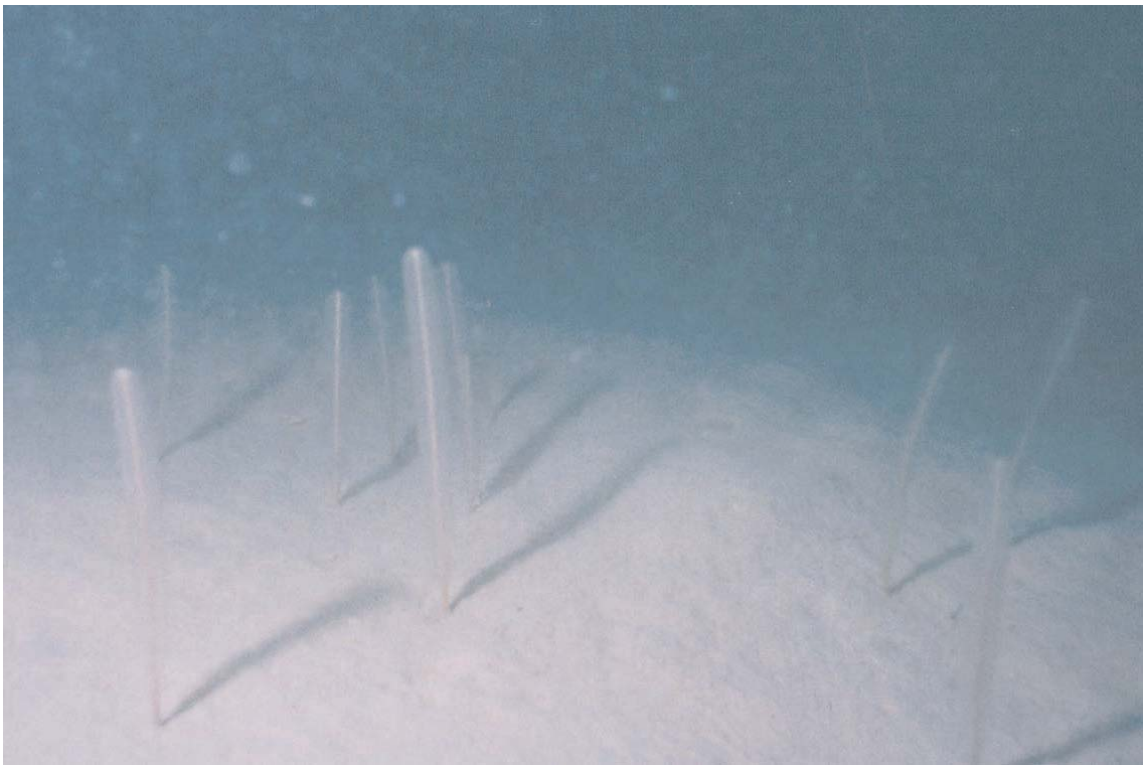

Plate 4-2 - Seapens on Sand off the East Coast of Barrow Island

The proposed dredged access channel for the tankers would cross the ridge of exposed limestone that extends southwards from the south-western end of the Lowendal shelf. This ridge stands about 2–4 m above the seabed and is characterised by rocky boulders, macroalgae and a sparse filter-feeding assemblage. In the deeper (12–14 m) areas of the dredged channel, the benthic habitats comprise sandy sediments and areas of exposed pavement reef. The exposed pavement reef supports scattered soft corals (*Rumphella*) and gorgonians (Plate 4-3). The sediments support sparse seagrass (*Halophila*), sea stars, heart urchins and holothurians.

A small volume of sand (~100,000 m^3) is proposed to be dredged from an area within the LNG access channel, approximately 3 km east of the limestone ridge. This area, which covers approximately 15 ha, is comprised predominantly of sandy sediments overlying limestone pavement and is generally bare and of little conservation significance.

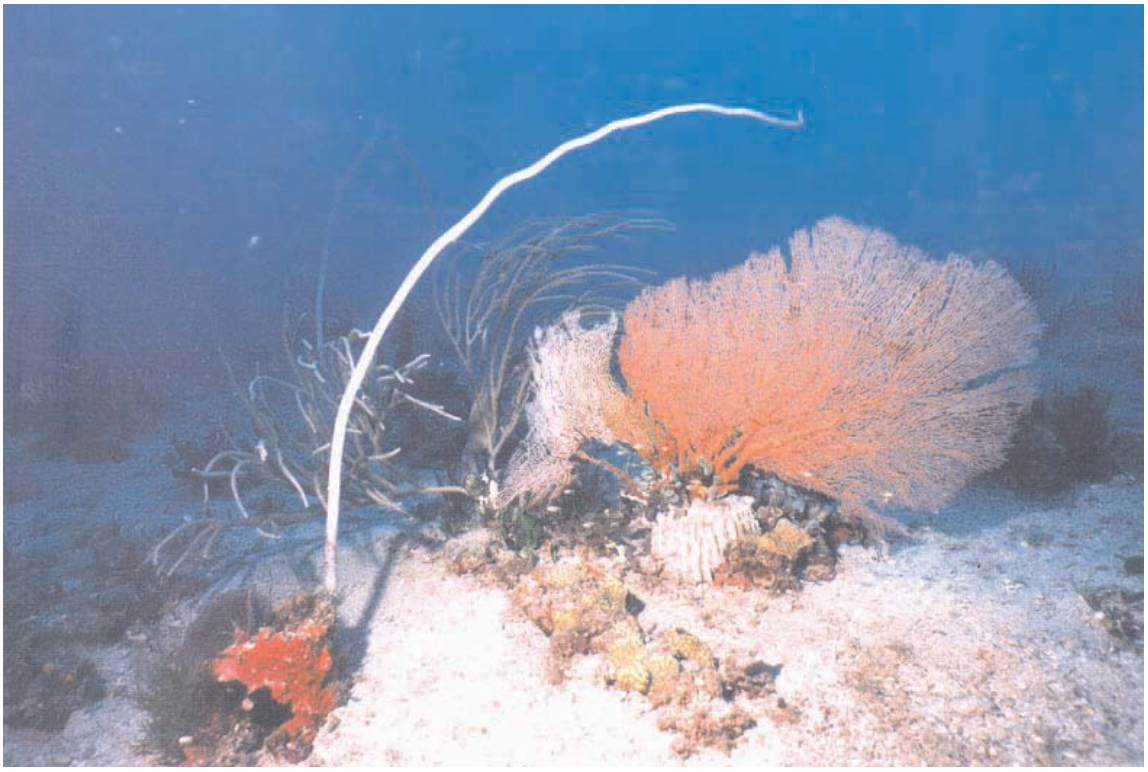

Plate 4-3 - Sparse Filter Feeding Assemblage on Hard Substrate off the Southern Edge of the Lowendal Shelf

4.2.3 Domestic Gas Pipeline Route to the Mainland

The proposed domestic gas pipeline corridor runs approximately 60 km across the seabed from Town Point to the mainland coast (Figure 4-2). Benthic habitats along the route are dominated by sand veneers over pavement reef, with scattered seagrass on the sediments and filter-feeding assemblages on exposed pavement. Video transect routes are shown in Figure 2-2.

The exposed pavement habitats and occasional coral bomboras (*Porites, Montipora)*, support hydroids, seawhips, gorgonians and scattered small corals (*Turbinaria*). These areas appear to be inundated irregularly by sand and the associated benthic assemblages are expected to be spatially and temporally variable.

Sediment habitats include bare, rippled sand in higher energy areas, fine bioturbated sediments, sandy sediments with stoloniferous macroalgae and seagrass and silty sediments in turbid water near the mainland coast. Epibenthic assemblages are generally very sparse with the exception of medium densities of crinoids and soft corals on sediments in the shallow (less than seven metres) waters near the mainland coast. Seagrass meadows are expected to be widespread, but temporally variable in shallow water habitats along the mainland Pilbara coast.

Localised patches of very high bivalve density were encountered in 6.5 m water depth approximately 13 km from the mainland coast. These mussel beds appear to comprise mainly dead bivalves and the structural habitat diversity they provide is likely to be locally significant for small invertebrates.

5 Sensitivity and Conservation Significance

The major environmental sensitivities within the proposed Development area relate to coral habitats. Protected mammals and reptiles that may be affected by impacts on these habitats are covered in Appendix C6**.**

The coral assemblages on the south-western corner of the Lowendal Shelf are of regional conservation significance. The extensive patch of *Acropora* in this location is one of the few extensive patches of fragile acroporid corals in the region. Some of the *Porites* coral bombora in the area are three to four metres high and are estimated to be several hundred years old. These corals support diverse assemblages of fish and invertebrates.

The coral reef areas on the subtidal pavement adjacent to Barrow Island are locally significant because they represent a benthic habitat with restricted distribution around the Island. The individual coral bomboras are of low conservation significance as they are very widely distributed along the east coast of the island.

The seagrasses in the proposed Development area mainly comprise species such as *Halophila* and *Halodule*. The plants are small and the meadows are too sparse to provide habitat for the fauna usually associated with high-density seagrass meadows. These seagrasses are unlikely to be of high importance to local dugong or sea turtle populations.

Halophila, *Syringodium* and *Halodule* recover rapidly from disturbance and recolonise disturbed areas from sediment seed banks. These genera are widespread throughout the area and the low-density seagrass in the development area has low conservation significance.

The *Sargassum*-dominated macroalgae beds on both the east and west coasts of Barrow Island are of low conservation significance as they are widely distributed and recover rapidly from disturbance. These beds undergo large seasonal biomass fluctuations each year and are adapted to an environment that is periodically buried with sand and thus undergo cycles of loss and recolonisation on the reefs around Barrow Island.

The significance of the effects of the proposed Development on benthic primary producer habitats is discussed in Chapter 11 of the ERMP report.

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